



**FLIPPING VIRTUAL CLASSROOM THROUGH GAMIFICATION: ITS EFFECT ON STUDENTS'
AUTONOMOUS MOTIVATION, LEARNING ACHIEVEMENTS, AND COMPLETION RATE OF PRE-
SESSION ACTIVITIES IN SAUDI HIGHER EDUCATION**

BY

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Abstract

The growing use of online learning and learner-centred models in the last few years has been triggered by several factors, including an increasing emphasis on learner autonomy within educational sectors, rapid advancement of learning technology, and developments due to the Covid-19 pandemic. One key adaptation of educational technology that has attracted much attention from instructors and educational institutions alike has been the adoption of flipped learning strategies in fully online learning modes. However, their implementation, particularly in computer science (CS) higher education, has not been without challenges, and the literature reveals a lack of consensus as to the exact format of flipped classes linked to effective learning. For example, many studies have revealed students' lack of motivation for completing pre-class activities, yet do not suggest ways in which such behaviour may be mitigated. Since the success of the flipped learning pedagogical approach relies on students' pre-session preparation, research that critically examines student motivation within pre-class tasks is much needed.

The purpose of the current study, therefore, is mainly to investigate the issue of student motivation during preparation for flipped learning classes and determine whether integrating gamification into a flipped virtual classroom (FVC), based on self-determination theory (SDT) as a theoretical framework, may act to effectively prepare students. Specifically, this research seeks to examine students' autonomous learning motivation, learning achievement, and their completion rates of pre-session tasks and critically explore the efficacy of the online flipped learning approach when the SDT-based gamification is integrated. The study sample consisted of 66 first-year university students recruited in two groups: an experimental group (n=34) employed a gamified FVC, and a control group (n=32) applied a non-gamified FVC. It employed a mixed-method design, adopting pre-post tests, formative assessments, pre-post questionnaires, VLE statistical reports, and semi-structured interviews (using deductive and inductive thematic analysis) to assess any possible changes in CS students' autonomous learning motivation, learning achievement, and completion rates of the pre-class activities in the context of Saudi higher education.

The findings indicate that the computed gain score (gain score= post-pre) means of the achievement tests in the gamified FVC group was significantly higher than in the control group,

revealing positive changes in students' autonomous motivation, which might be attributed to using the gamified FVC in the intervention group compared to the other group. Students in the gamified FVC group also recorded a significantly higher overall completion rate of pre-session activities than their non-gamified FVC counterparts. The study found a moderate correlation between the students' autonomous motivation and the task completion rate variables; the more motivated students were, the more pre-class tasks they completed. The study's analysis showed that the intersection between STD-based gamification and online flipped learning strategies might contribute to motivating university CS students autonomously to learn because of supporting their three basic psychological needs for autonomy, competence, and social relatedness. This study has theoretical and practical implications for various levels of learning, particularly in higher education, where motivation is a key antecedent of engaged learning, but strategies for increasing motivation might need to be explored and introduced more systematically. Furthermore, since autonomy is regarded as an essential element of learning development and where, in parallel, blended learning is based explicitly upon, or adapting, flipped learning principles, such approaches might need to be more actively explored in terms of academic learning development. Thus, future research is recommended to examine the effectiveness of using the gamified FVC method in different educational stages and disciplines.

Dedication

To overcome life's challenges and reach our goals, we must put in effort and get support from those closest to us. I dedicate my humble effort to:

My Father: Atyah Albshry

My Mother: Nafiah Albshry

My Wife: Amal Albishri

My Children: Larin, Ghazi, Retaan, Faris and Eleena

Soul of My Brother, Raid

My Brothers: Waleed, Ayad and Adel

My Sisters: Nora, Eman and Atheer

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Author's Declaration

I declare that this thesis is entirely my own work, except for any quotes or citations that have been properly acknowledged and cited. No part of this thesis has previously been included in a thesis, dissertation or report submitted to Newcastle University or any other institution for the award or qualification of any other degrees.

Mohammad Albshry

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Chapter One – Introduction

This first chapter serves as an introduction to the study, presenting its background, an overview of the research problem, relevant literature gaps, the research context, and the motivation behind this research work. In addition, the significance of the study, its purposes and aims, and the research questions are briefly discussed. Finally, the study's structure is presented at the end of this chapter, together with the definitions of the main terms used in this thesis.

1.1 Background of the Study

The growing use of online learning and learner-centred models in the last few years has been triggered by several factors, including an increasing emphasis on learner autonomy within educational sectors, the rapid advancement of learning technology, and developments due to the Covid-19 pandemic (Marshall & Kostka, 2020; Piyatamrong *et al.*, 2021). These have significantly reshaped teaching and learning strategies within educational settings on a global level, from traditional classroom styles to more self-directed pedagogical approaches (Stöhr *et al.*, 2020; Zainuddin *et al.*, 2021). Such pedagogies can be adapted into everyday instructional situations based on students' needs and demands, thus driving the learning process closer to the supposed characteristics of the digital society of the 21st century (Lopes *et al.*, 2024). This has resulted in the emergence of new didactic methods from innovative perspectives, in which learners are required to play a greater role in their learning process (Murillo-Zamorano *et al.*, 2019). Among the more pervasive of these methodologies, online and blended learning approaches have contributed to upgrading both traditional and distance learning (Rasheed *et al.*, 2020). These have increasingly been developed as an essential part of numerous educational systems due to their potential to complement or, in many cases, replace conventional face-to-face instruction in various educational contexts (Stöhr *et al.*, 2020; Lo & Hew, 2022). Blended learning may be characterised by the integration of online learning modes with the traditional classroom format, aiming to benefit from the flexibility, source accessibility, and continuous learning that online learning often offers (Rasheed *et al.*, 2020).

Moreover, one of the blended learning offspring strategies utilised in higher education is the ‘flipping’ of courses (Gilboy *et al.*, 2015; Knapp, 2018). In such a techno-pedagogical approach, students are expected and required to understand the instructional contents outside of the usual class time, often delivered through a learning management system (LMS), to be completed as pre-class activities (Bergmann & Sams, 2012). Subsequently, they use the acquired information to construct new knowledge during in-class collaborative learning sessions in which scaffolding and feedback are provided by the teacher and peers (Zainuddin *et al.*, 2018). Such a learning method can be effective in many instructional situations in comparison to conventional lecture formats (Al-Zahrani, 2015; Karabulut-Ilgu *et al.*, 2018). According to several research studies, a well-designed flipped learning strategy tends to encourage students to participate and share their acquired knowledge in a cooperative learning environment (Chen & Hwang, 2018; Murillo-Zamorano *et al.*, 2019). However, there are many conceptual and practical gaps remaining in this body of research, as well as questions concerning the precise contextual and cultural nature of the findings, and these will be discussed later in this study.

The utilisation of online learning and, indeed, blended learning is well underway in most educational sectors and has been growing as numerous world-leading universities have created departments aiming to provide fully online and blended learning courses (Ramírez-Donoso *et al.*, 2021; Lane, 2024); a hallmark characteristic of education that has accelerated, as a consequence of the Covid-19 pandemic (Tang *et al.*, 2020). Many university courses have been delivered remotely via MOOCs and other online learning platforms such as Canvas, Coursera, and edX. To illustrate this, the number of learners enrolled on Coursera in 2020 increased by 353% compared to the same period in 2019 (Coursera, 2020). However, in many cases, online learning platforms have merely become content deliverers and depositories for learning materials, whether synchronously or asynchronously, without adequate consideration for online collaborative discussions and engaging instructional design (Knapp, 2018; Klemke *et al.*, 2018). This situation in the online learning context has exacerbated the difficulties of engaging students (Raju *et al.*, 2021), creating a sense of dissonance between them and the instructional course. Indeed, keeping students motivated and engaged is a considerable challenge that instructors often face, particularly when applying full online learning models (Panigrahi *et al.*, 2018). Pure teacher-centred learning approaches that often rely on one-way interaction, such as unilateral lecturing,

may reduce the instructor's ability to provide students with sufficient assistance based on their individual differences when encountering learning difficulties. Therefore, many educators and educational institutions have striven to accelerate their efforts to innovate active online learning environments (Zainuddin *et al.*, 2019; Tang *et al.*, 2020), where motivating students to engage in meaningful learning has become a central focus (Raju *et al.*, 2021).

Unlike conventional online learning or the traditional classroom, the flipped learning strategy tends to promote the quality of students' learning by explicitly dedicating a portion of class time to problem-solving activities, in-depth discussions, application-based tasks, and feedback through collaborative and self-directed learning settings (Zainuddin & Perera, 2018). This scenario, it is argued, may yield an increase in peer interaction and constant feedback, which, in numerous cases, can enhance students' achievement, satisfaction, and engagement (Thai *et al.*, 2017; Wang, 2017; Kazanidis *et al.*, 2018). Employing such pedagogical approaches in higher education is likely to modify the students' role from being principally passive recipients of information into more active constructors of their own knowledge, supporting them in assimilating, at least, the key concepts at their own pace, before the class time where they are enabled to participate collaboratively in learning activities and achieve high levels of Bloom's taxonomy (Gilboy *et al.*, 2015; O'Flaherty & Phillips, 2015; Kim *et al.*, 2017). Such a learning process is underpinned by the theory of social constructivism, which postulates that in order to achieve active learning, students need to construct their understanding through social interactions (Crotty, 1998; Lindeiner-Stráský *et al.*, 2020).

A recent initiative within the field has been to adopt the flipped classroom approach into fully online learning contexts, aiming to innovate efficient remote learning models (Stöhr *et al.*, 2020; Akram *et al.*, 2021; Lo & Hew, 2022). The potential of employing this approach in fully online learning methods is supported by research evidence which suggests that such mixed models, when carefully designed, might influence students' learning and engagement at least as much as conventional classrooms (Phillips & O'Flaherty, 2019; Stöhr *et al.*, 2020; Candel *et al.*, 2023). This incorporation model argues that online learning environments may be enriched with the active practices of flipped classrooms, which can bolster interaction and collaboration among students through harnessing new-generation synchronous communication systems to create effective

virtual spaces (Marshall & Kostka, 2020; Tang *et al.*, 2020). However, it has been claimed that the absence of a physical classroom, as the most prominent characteristic of online learning, may diminish the interaction between students and learning materials due to experiencing a sense of isolation, as mentioned in several studies as being among the possible reasons for the failure of such learning environments (Srivastava, 2018; Stöhr *et al.*, 2020; Piyatamrong *et al.*, 2021). In fact, being merely an attendant in a learning environment, whether physically or virtually, does not mean that learning occurs (Bandura, 1986; Greener, 2020). Moreover, fostering interactions, interpersonal discussions, and scaffolding through learning activities using active online teaching and learning methodologies is likely to generate a sense of social connectedness among students (Nortvig *et al.*, 2018); thus alleviating feelings of isolation. This may contribute to stimulating students' learning motivation (Ryan & Deci, 2000a) and engagement (Dicheva & Dichev, 2016), compared to the individual impact of conventional online learning or traditional classroom methods. Given the need today for active online learning, it is imperative to explore how to develop supportive, motivating, and engaging online flipped-class models that can maximise the effectiveness of online learning courses (Koretsky, 2020; Tang *et al.*, 2020; Xiao & Hew, 2023). Nevertheless, there is a lack of robust research that examines the efficacy of utilising flipped learning in a fully online learning setting based on theoretical frameworks (Phillips & O'Flaherty, 2019; Stöhr *et al.*, 2020; Candel *et al.*, 2023).

Besides the flexibility and autonomy that the flipped-class approach may add to online learning courses through the provision of out-of-class activities, as students can opt when and how to engage, virtual in-class sessions provide them with the opportunities to apply what has been learnt collaboratively (Phillips & O'Flaherty, 2019; Ng & Lo, 2022). This approach has been employed as a new online learning style called *Flipped Virtual Classroom* – (FVC) (Phillips & O'Flaherty, 2019). Inspired by the conventional flipped classroom, in this innovative method learners are required to watch video lectures, which often include pre-session activities, independently, in preparation for online meetings, rather than physical in-class sessions. The FVC approach mimics the main foundations of face-to-face in-class settings, as students and instructors can meet virtually via real-time videoconferencing systems such as Zoom, Adobe Connect, Skype (Stöhr *et al.*, 2020), and Microsoft Teams.

However, opponents have claimed that such distance education approaches may expand the communication gaps between students and their teachers due to inadequate face-to-face interactions and the lack of socialisation opportunities, resulting in dissatisfaction (Piyatamrong *et al.*, 2021). In fact, the transactional distance can be associated with the ability of an instructional activity to engage students successfully in their learning. This is demonstrated by the transactional distance theory (TDT), which posits that in distance learning strategies, the salient distance between instructors and learners is transactional more than spatial, and is attributed to the “psychological and communication space to be crossed, a space for potential misunderstanding between the inputs of instructor and those of the learner” (Moore, 1993, p. 22). Bearing this in mind, whether using online or conventional learning methods, providing students with active learning and an optimal level of challenge through team-based tasks is likely to give them a sense of excitement, connectedness, and relatedness. This in turn may shrink the transactional gap in learning environments and the feelings of remoteness among students (Moore, 1993). As a result, they may frequently feel as though they are motivated and have a sense of urgency to continue studying, although this may not translate into measurable motivation and actual engagement in conceptual psychological terms.

Applying these aforementioned pedagogies does not simply mean recording video lectures and asking learners to watch them as individual pre-class activities; these tasks need to be attractive to students (Zainuddin *et al.*, 2018). Although FVCs revolve around proffering learner-centred and flexible learning methods (Zainuddin *et al.*, 2021), numerous studies have implied that the heavy reliance on individual asynchronous activities without adequate consideration of the collaboration and meaningful feedback aspects might engender a sense of boredom, isolation, and disengagement among students (Aşıksoy, 2017; Zainuddin, 2018; Lo & Hew, 2020; Stöhr *et al.*, 2020). Research findings suggest that integrating possible motivational elements (e.g., gamification) in the flipped learning approach, based on theoretical frameworks, requires further exploration (Lo & Hew, 2020; Gündüz & Akkoyunlu, 2020; Ekici, 2021).

1.2 Overview of the Research Problem and the Literature Gap

At the core of flipped learning approaches is the enhancement of the time students spend in class, interacting with their peers and teachers. The objective is to deepen their understanding

based on the acquired knowledge and experience (El Miedany, 2019; Låg & Sæle, 2019). However, students' unpreparedness and disengagement in pre-session activities is one of the most commonly reported problems in such models; some studies have found that learners can easily miss the pre-class instructional videos and attend class without preparation, impacting their completion of in-class tasks (Karabulut-Ilgü *et al.*, 2018; Zainuddin *et al.*, 2019). For instance, Stöhr *et al.* (2020) reported that some students might prioritise the assigned online learning activities by meeting only the minimum requirements of pre-class activities and neglecting the extra challenging tasks and wrap-up sessions. Another example is Palmer's (2015) study, which revealed that more than 70% of the students had missed the assigned individual pre-class activities, which negatively affected their performance during the in-class sessions. These findings are also consistent with the research results of Kim *et al.* (2014), who observed that about 25% of the students in a flipped class did not watch the assigned pre-recorded video lectures, resulting in less participation in the group tasks. In fact, the success of such a learning approach is often associated with a student's completion rate of pre-class tasks (Jovanovic *et al.*, 2019; Lee & Choi, 2019). Several studies have concluded that students might encounter difficulties in terms of maintaining their attention and concentration when they find pre-class activities less engaging (Burke & Fedorek, 2017). These activities, such as video lectures, reading tasks, and quizzes, might be challenging and overwhelming for some students who feel demotivated or isolated (Rasheed *et al.*, 2020). Moreover, since such student-centred approaches often rely on extra work (e.g., formative activities) that requires self-study (Muñoz-Merino *et al.*, 2017), several factors can influence the success of utilising the flipped learning strategy, and one of these might be associated with the motivation factor (Rasheed *et al.*, 2020; Zainuddin *et al.*, 2020). It has been reported that this may significantly impact the effort and time spent by students on their learning and that when they are highly motivated, they tend to go that extra mile to achieve more in flipped learning environments (Yang, 2017; Chuang *et al.*, 2018). Therefore, multiple studies have been conducted with the aim of stimulating students' self-motivation in various educational contexts (Parra-González *et al.*, 2020; Ekici, 2021; Lin *et al.*, 2021). Ryan and Deci (2000a), for instance, in their self-determination theory (SDT), emphasise that students are autonomously motivated when their three innate psychological needs are supported and satisfied. These three proactive human tendencies, namely autonomy (i.e., a sense of choice, freedom, and volition to

act); social relatedness (i.e., the feeling of being connected with and related to others); and competence (i.e., a sense of mastery and capability), are crucial motivational resources (Ryan & Deci, 2020), that can be fulfilled or neglected in the learning environment (Vansteenkiste & Ryan, 2013). After assessing the three innate psychological needs and the well-being of Chinese students at two different times, Tian *et al.* (2014) obtained findings which revealed significant positive relationships between the satisfaction of the three elements and the student's well-being. According to Froiland and Worrell (2016), the level of students' inherent motivation can be used to predict learners' engagement and achievement.

Several studies have explored the effectiveness of various modifications made to learning environments, aiming to enhance the didactic outcomes. One of the instructional interventions that has been integrated into various learning contexts in a bid to support students' motivation in online learning is the motivational appeal of game elements, used for purposes beyond gaming (Saputro *et al.*, 2019). Game mechanisms have been used as a fundamental axis of learning environment development to promote students' motivation and performance, utilising activities based on so-called 'gamification' (Sánchez *et al.*, 2020; Ekici, 2021). Such mechanisms are often employed in education to support learning through playful, interesting, and enjoyable situations; these can exemplify autonomous motivation behaviours (Ryan & Deci, 2020). Gamification in education refers to the provision of game elements, such as points, badges, stars, and leaderboards, in non-gaming contexts to motivate desired behaviours (Deterding, 2012). The learning activities can arguably be designed by utilising such elements to support students' interests in a way that can maximise their autonomous motivation to engage in their learning. Gamification is a dynamic strategy that can be designed to meet some special needs of modern individuals (Volkova, 2013) and as a motivating process, to facilitate learning content in parallel with rewarding efforts, progression, and achievement (Deterding *et al.*, 2011; Parra-González *et al.*, 2020).

However, Tan and Hew (2016) argued that some gamified learning activities may be counter-productive for those who have less desire to compete with others. When presented as an individual reward-based system, in which students concentrate merely on beating each other rather than working collaboratively to achieve shared goals, gamification may lead to a

reduction in their self-determined motivation (Hanus & Fox, 2015) as they may experience feelings of pressure, rejection, and inadequacy (Krijgsman *et al.*, 2017). Furthermore, research indicates that even when the utilisation of gamification results in a positive impact on student learning, this may be received, in many cases, as a short-term effect which may be attributed to its novelty value; once this has worn off, students' activity would potentially drop during the course period (Tsay *et al.*, 2020). Such a short-term impact can be associated with students' external motivation that may appear from reward-based gamification design (Ryan & Deci, 2000a; Tan & Hew, 2016). This scenario might undermine learners' autonomous motivation, which is essential to overcome the novelty value of gamification and potentially produce long-term learning effects (Nicholson, 2015). Students may maintain engagement in instructional activities when they are autonomously motivated to learn (Ekici, 2021).

Although most gamified systems focus merely on motivating students with external rewards for completing learning tasks, gamification can also be designed to engender long-term effects, by providing constructive competition and meaningful experiences in which the three factors of autonomous motivation are supported (Fülöp, 2009; Ryan & Deci, 2020). This design can be incorporated into various active learning environments, such as flipped learning, and at different educational levels (Su & Cheng, 2015; Gómez-Carrasco *et al.*, 2020). Gamification and flipped learning are innovative methods that have often been adapted separately in different teaching and learning contexts, despite the various potentialities of each element reported in previous literature (Sánchez *et al.*, 2020; Segura-Robles *et al.*, 2020; Parra-González *et al.*, 2021). Based on the SDT framework, it is hypothesised that gamification and flipped learning can promote students' motivation autonomously by satisfying their needs for autonomy, social relatedness, and competence (Rigby & Ryan, 2011; Sohrabi & Iraj, 2016; Sailer *et al.*, 2017; Zainuddin, 2018); in turn, such a combination is expected to boost students' engagement (Raju *et al.*, 2021) and learning achievement (Zainuddin *et al.*, 2020). Although those motivational principles of SDT have been widely investigated and applied in gamification research (e.g., Sailer *et al.*, 2017; Ofosu-Ampong, 2020) and conventional flipped-learning studies (e.g., Sergis *et al.*, 2017; Zainuddin *et al.*, 2019), to date, there has been very little research investigating how to integrate SDT-based gamification into flipped-class environments in higher education (Sailer & Sailer, 2020; Sánchez *et al.*, 2020; Gündüz & Akkoyunlu, 2020; Candel *et al.*, 2023). According to

Saputro *et al.* (2019), the principles of autonomous motivation, mentioned in SDT, can be used as a reference to identify the appropriate gamification elements that may foster learners' motivation when engaging in online courses. Their study exposes an important element of gamification research concerning the salience and congruence of the 'gaming' strategies adopted for specific student groups. This point aside, the findings of previous research show promising results regarding the integration of the motivational features of game mechanisms into pure flipped classroom settings. Huang and Hew (2018), for instance, implemented a theory-driven gamification approach through two quasi-experimental studies of postgraduate flipped courses. Their results reveal that the completion rate of pre-class activities in the gamified flipped classroom was higher than that for such activities in the non-gamified flipped class. Therefore, it has been suggested that gamification can be employed as an effective means of reinforcing students' motivation and engagement (Zainuddin *et al.*, 2020).

Based on the above reasoning, an innovative strategy that merges gamification in theoretical terms with the FVC approach as a possible motivational intervention is arguably needed urgently, with the aim of motivating students autonomously to complete pre-session instructional activities used as a form of preparation. Nevertheless, there is a considerable paucity of empirical research which builds on the theoretical frameworks in the existing literature and which aims to explore the impact of gamifying the flipped-class strategy on educational outcomes in the context of fully online electronic delivery (Sailer & Sailer, 2020; Khaldi *et al.*, 2023; Xiao & Hew, 2023). In the current study, this combination is referred to as the *Gamified Flipped Virtual Classroom* – (Gamified FVC). This study, as well as filling the significant research gaps and making a substantial contribution to developing the thresholds of gamification applications, will also benefit the higher education sector by providing a preliminary framework for promising online flipped learning practices and practical guidelines for autonomously motivating learning environments.

1.3 Context of the Study and Motivation

The current study was carried out at a state university in Saudi Arabia, in the Computer Science and Information Technology Faculty. At the time of conducting this study, many undergraduate Master's courses were offered by this university in various disciplines. In addition,

several online courses were provided, and the number of these distance-learning modules has notably increased since the Covid-19 pandemic. To illustrate, in late 2020, the Ministry of Education in Saudi Arabia announced that online learning would continue to be applied as a fundamental part of the educational system, whether during Covid-19 or after this period (Abueish, 2020; Al-Shargabi *et al.*, 2021). The majority of Saudi universities have started implementing distance education and shifting the teaching mode of many courses in various academic disciplines to be delivered entirely remotely, by harnessing advanced educational technologies in accordance with the Saudi 2030 Vision (Abdullateef *et al.*, 2023).

Moreover, the study was conducted on a computer science (CS) course since this field has recently gained greater attention from most Saudi universities due to a notable increase in demand for this domain in today's job market (Misk Academy, 2020). Another reason for choosing this discipline was due to its inclusion of a variety of conceptual and practical knowledge, such as foundational computer skills, computer networks, software, and hardware, which could enable the researcher to examine the application of the study's intervention in a diversity of topics. Although online flipped learning has been used in many instructional courses in Saudi universities (e.g., Akram *et al.*, 2021), including CS modules, particularly after the pandemic restrictions, there was no clear guidance or instructional design for applying such an approach, at least in this context.

Despite the urgent need for innovating effective online flipped learning methods, to the best of the author's knowledge, no research has yet investigated the impact of the gamified FVC on students' autonomous motivation, completion rate of pre-session activities, and achievement in higher education, particularly in Arab and Saudi university contexts. This dearth of studies could make it difficult to understand the effect of SDT-based gamification on students' autonomous motivation when integrated into this context. Therefore, the author has been motivated to investigate how to apply an effective gamified FVC through the lens of the SDT as a theoretical framework, aiming at examining its impact on students' autonomous learning motivation and achievement in an online computer science course. Educational systems in Saudi universities seek to improve teaching and learning methods by harnessing effective digital tools to produce sustainable learning, in which collaborative work and engagement in online instructional activities

are supported (Abdullateef *et al.*, 2023). Indeed, the way that online courses are implemented plays a vital role in students' learning experiences. Online pre-class activities such as completing quizzes and watching instructional videos can be challenging when students feel isolated and are demotivated to engage or progress in their learning (Rasheed *et al.*, 2020). Supporting the autonomous motivation factor among students may contribute to maximising the effectiveness of such learning environments (Zainuddin *et al.*, 2020; Xiao & Hew, 2023).

1.4 Significance of the Study

This study will enhance the understanding of how gamification and the flipped-class approach can be incorporated into a fully online learning format and will make a valuable contribution to the expansion of both the flipped virtual classroom pedagogical approach and gamification literature. It seeks to transfer the concept of the gamified conventional flipped-class method to a fully online learning setting. The aim is to develop an effective online flipped learning environment that can support students' autonomous learning and achievement, particularly for those in the Saudi higher education CS context. Additionally, the research aims to shed light on the advantages and challenges of using this combined approach and will suggest innovative ways to employ practical online learning strategies, which are increasingly in demand nowadays. It is widely acknowledged that pre-session activities in FVCs can support students' preparedness and facilitate their learning during virtual in-class sessions, if they perform these learning activities efficiently before the class. However, students' lack of preparation is a significant problem in such student-centred approaches, as reported frequently in several studies mentioned previously in this chapter and discussed further in Chapter Two. Gamifying FVC activities, therefore, is hypothesised in this study to promote students' autonomous motivation and preparedness by engendering a sense of collaboration and constructive competition among them, as well as providing meaningful feedback.

There has been very little attention in the relevant research towards designing gamified pre- and in-class activities delivered entirely online, with the aim of fostering motivation and achievement factors among students in the higher education context (Gündüz & Akkoyunlu, 2020; Candel *et al.*, 2023). This study contributes to the understanding of how the utilisation of FVC methods in general, and gamified models in particular, can potentially enhance these

learning outcomes. Moreover, the central focus of the study is on understanding how gamifying the FVC approach can influence the levels of autonomous motivation by providing supportive practices that may improve students' preparation before attending their online sessions, compared to the conventional online flipped learning format. The importance of this study stems from the current necessity for innovating effective online learning models that can motivate students and reduce the transactional distance between them and their teacher and peers, in the absence of face-to-face physical interaction. There is already a proliferation of studies which have investigated the relationship between student motivation and the implementation of the conventional flipped classroom, with or without the integration of gamification; nevertheless, these studies have obtained mixed results (Ekici, 2021; Parra-González *et al.*, 2021). Furthermore, this study is different, particularly in terms of delivering and gamifying online flipped-class activities for autonomous learning. It was also applied in a different cultural context, focusing on Saudi learners' perspectives of the gamified FVC approach in higher education. The author hypothesises that a well-designed online learning environment, in which gamification is employed based on SDT theory and integrated with the utilisation of flipped pedagogical learning strategies, can increase students' motivational outcomes and academic results. By reflecting on the results derived from the current study, policymakers at universities globally, and particularly in Arab and Saudi Arabia, can benefit from the suggested gamified FVC practices to produce effective online courses.

1.5 Purposes of the Study

The present research investigates the development of the FVC as a new direction in distance education, and the extent to which gamification can be utilised for effective learning experiences in online courses in Saudi universities. Previous research shows that, in many cases, integrating gamification into flipped classrooms may enhance students' learning (e.g., Gündüz & Akkoyunlu, 2020; Ekici, 2021; Tarhan & Öztürk, 2022). However, the integration of gamification into fully online flipped learning has not yet been investigated adequately (e.g., Kalogiannakis *et al.*, 2021; Khaldi *et al.*, 2023; Xiao & Hew, 2023). In addition, students' unpreparedness and disengagement in pre-class activities have been among the most reported problems when

applying such student-centred approaches (Huang *et al.*, 2019; Lai & Foon, 2019; Stöhr *et al.*, 2020).

Therefore, this study aims to investigate in more detail the impact of incorporating gamification into the FVC on students' learning achievement, autonomous motivation, and completion rate of pre-session activities. It also aims to deeply understand the gamified FVC experience from students' perspectives for effective implementations. Based on this, the study provides suggestions and considerations on how this approach can effectively be adopted and implemented for autonomously motivating learning. Considering the context of Saudi higher education, it will also be possible to provide practical recommendations to develop the online flipped learning approach in Saudi universities and inform future studies. The purposes of this research are therefore:

- 1) To examine the effect of integrating gamification into the FVC on students' achievements in Saudi higher education CS.
- 2) To investigate the effect of incorporating gamification into the FVC on students' autonomous motivation in Saudi higher education CS.
- 3) To investigate the effect of incorporating gamification into the FVC on students' completion rate of pre-session tasks in Saudi higher education CS.
- 4) To identify the correlation between students' autonomous motivation and their completion rate of pre-session tasks during the gamification integration.
- 5) To develop an in-depth understanding of the utilisation of the gamified FVC in the context of Saudi higher education CS.

1.6 Research Questions

Considering the above literature gaps, study motivation, and its purposes, the main research question leading this study is:

What is the effect of integrating gamification into the FVC on Saudi higher education students' achievement, autonomous motivation, and completion rate of pre-session activities?

This main research question gives rise to the following sub-questions and relevant hypotheses:

- 1) To what extent did the integration of gamification into FVC affect students' learning achievement in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores.

- 2) To what extent did the integration of gamification into FVC affect students' autonomous motivation in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation.

- 3) To what extent did the integration of gamification into FVC affect students' completion rate of pre-session tasks in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks.

- 4) To what extent did the students' autonomous motivation correlate with their pre-session task completion rate when gamification was integrated into FVC?

H₀: No linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC.

H₁: There is a linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC.

- 5) How did the Saudi university students perceive their gamified FVC experiences?

- 6) What are the key adoption and design considerations that need to be addressed when implementing the gamified FVC method for autonomously motivating learning?

To achieve the study's objectives and address these research questions, the key appropriate methodological approaches were considered. The study utilised a mixed-method research approach underpinned by the pragmatic paradigm. A mix of quasi-experimental with a pre-post control group and explanatory sequential mixed-methods research design was applied to investigate the potential effect of integrating SDT-based gamification into the FVC on students' autonomous motivation, achievement, and completion rate. In addition, students' perceptions and experiences were explored in the current study. This involved two study groups for the analysis process: the experimental (gamified flipped virtual classroom—gamified FVC) and the control group (non-gamified flipped virtual classroom – non-gamified FVC). The main research instruments employed were a pre- and post- test, formative assessments, a pre- and post- questionnaire, and semi-structured interviews. In this mixed-methods research, the quantitative data phase was aimed at assessing any possible changes in learning achievement, autonomous motivation, and completion rate variables before and after the gamification intervention, when comparing the two groups. In addition, the qualitative data phase helped the researcher to understand the possible reasons behind these changes and to provide suggestions and recommendations for effective implementations of gamified FVCs, based on students' perceptions in Saudi universities.

1.7 Definitions of the Key Terms Used in this Study

Flipped Learning:

This term can be defined as a pedagogical learning approach in which “what has been traditionally done during class time, i.e., class presentations is shifted to home activities and what has been traditionally done at home, i.e., homework and projects are transferred to class activities” (Sohrabi & Iraj, 2016). Students are required to complete pre-class activities, such as watching videos and completing quizzes, as a form of preparation for in-class sessions which are often dedicated to applications, discussions, and questions (Huang & Hew, 2018).

Throughout the current study, the flipped-class approach was applied to a fully online learning environment called the flipped virtual classroom (FVC). This approach can be described as an online learning strategy that utilises synchronous and asynchronous learning environments in which students are advised to watch instructional videos as pre-class activities before joining

online meetings as a form of virtual in-class sessions (Phillips & O’Flaherty, 2019). In addition, the term can be hereafter referred to as “Online Flipped Learning” or a “Virtual Flipped Classroom” (Stöhr *et al.*, 2020).

Gamification:

This term is defined as a method that utilises game mechanisms and elements such as points, leaderboards, progress bars and badges in non-game settings to foster the desired change in learners’ behaviour (Hitchens & Tulloch, 2018). It can be described as a “successful integration of the gamification framework into the curriculum in order to improve students’ motivation, academic achievement, and attitudes toward lessons” (Yildirim, 2017).

Autonomous Motivation:

The term autonomous motivation can be defined as a crucial type of motivation, referred to as enacting a behaviour or doing an activity by individuals because they find it inherently meaningful, enjoyable, interesting, or satisfying (Ryan & Deci, 2000a). In this study, this type of motivation is associated with the self-determination theory (SDT), which states that satisfying students’ psychological needs for autonomy, social relatedness, and competence can promote students’ autonomous motivation (Ryan & Deci, 2020).

1.8 Structure of the Thesis

This thesis is structured in six chapters. The first chapter summarises the study background, provides an overview of the research problem and the literature gaps, and discusses the study context, motivation, significance, aims and questions, and, eventually, the thesis structure. Chapter Two presents a literature review related to the flipped-class approach, gamification, motivation, and gamified flipped learning, highlighting the current limitations in the relevant literature. Chapter Three shows the research methodology, design, and data analysis procedures. While Chapter Four presents the quantitative and qualitative data findings. The fifth chapter critically discusses the study’s findings in parallel with considering and comparing different previous studies. The final chapter highlights the implications of this research, concludes the main findings, explains the contributions and limitations, and offers suggestions and recommendations for future studies and practical implementations.

Chapter Two – Literature Review

2.1 Introduction

The purpose of this chapter is to critically review the literature on the concept of flipped learning and the construction of knowledge in such a pedagogical approach and to explore and elucidate research gaps relating to these conceptual areas. In doing so, this chapter will also shed light on the effectiveness of flipped learning in the context of higher education and the possible challenges frequently mentioned in the relevant literature when applying such a student-centred strategy. In addition, the term "gamification" will be defined while explaining its relationship with similar terms and highlighting some commonly utilised gamification elements and designs. Therefore, a synthesis of research currently available and relevant to the employment of gamification in online higher education and flipped learning will be reviewed, along with an exploration of appropriate motivation theories that have laid the foundations of gamification research, before justifying and explaining the reasons behind choosing the self-determination theory (SDT) as a theoretical framework for the current study. This will also include criticisms and acknowledgement of strengths as well as any perceived weaknesses associated with the applications of this theory and other alternative motivation theories. The practicality of integrating gamification into online flipped learning based on SDT will be discussed, and various relevant design and application frameworks in such online learning environments will be highlighted. The chapter will also provide insights into the possible relationship between motivation and autonomous learning in a gamified flipped virtual classroom (gamified FVC) context, as well as the potential impact of integrating SDT-based gamification mechanisms into online flipped learning on students' autonomous learning motivation, learning achievement, and completion rate of pre-class activities. Eventually, the practical research and conceptual and theoretical gaps that inspired this study will be outlined.

In the search for flipped learning and gamification literature, the literature review model developed by Machi and McEvoy (2016) was adopted in this study. Several digital bibliographic databases were used, including Web of Science (WOS), Google Scholar, Education Resources Information Centre (ERIC), Newcastle University Library, ScienceDirect, ProQuest, EBSCO Host, and Scopus. These databases provide extensive coverage of peer-reviewed research papers as

well as additional resources such as books, book chapters, research reports, and conference contributions, covering both empirical research studies and systematic reviews. The literature search was conducted using a broad-to-narrow strategy, starting with several general relevant keywords. The results were narrowed down to the flipped learning domain and online learning based on gamification in higher education contexts. The search terms used in this review encompass: "flipped learning" OR "flipped class*" "gamification" OR "gamif*" AND "online learning" AND "higher education" OR "high education". The strings of this search also included the key factors "motivation" OR "achievement" OR "performance". Several key considerations were identified in the selection phase of the research papers for this literature review. The main concern of these considerations was the extent to which they are related to the research topic. This means that the inclusion of the literature had to be relevant to flipped learning and/or gamification, particularly in online learning and education contexts. In addition, the importance of the studies included was also considered and gauged based on the publication source and their frequent citations in other studies.

2.2 Flipped Learning

2.2.1 Basic Concept of Flipped Learning

Educationalists and educators have always strived to research and ultimately develop innovative teaching methods that will motivate students to take the initiative in their learning and will culminate in them being autonomous learners. Blended learning is arguably seen as a promising instructional technique that can enhance and elevate traditional teaching styles so that students' motivation is stimulated and learning opportunities maximised (Leszczyński *et al.*, 2018). It can be characterised by the integration of online learning modes with a conventional classroom setting, aiming to harness the flexibility, information accessibility, and continuous learning potentials of online learning platforms (Rasheed *et al.*, 2020). Multiple studies have indicated that such an approach is likely to promote students' engagement, interaction, and self-directed learning skills due to the employment of various new-generation synchronous and asynchronous digital tools (Al-Zahrani, 2015; Turan & Gökteş 2018; Zainuddin, Haruna, *et al.*, 2019). Indeed, recent educational technology development has paved the way for approaches such as blended learning, especially flipped learning (Chen & Hwang, 2018). Flipped learning can

be described as "a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is changed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter." (Flipped Learning Network, 2014, p. 1). This approach has been utilised in higher education since the late 1990s, with the aim of providing what has been termed active learning, where such learning revolves around the learner (Sailer & Sailer, 2020). Such orientation in learning is what John Dewey called for in the early twentieth century, emphasising that learning should be centred around the learners, not the teacher, and they should take part in their own learning to reveal their proficiency (Zainuddin *et al.*, 2021). In fact, this also parallels the general notion of flipped learning pedagogy, in which students are encouraged to learn and master basic knowledge via learning materials at their own pace before attending the class (He *et al.*, 2016). The literature reveals that even though flipped learning cannot be represented by a single model (Strelan *et al.*, 2020), it generally consists of two sequential phases: individual asynchronous online learning activities that students are required to perform outside the classroom, followed by collaborative learning in-class sessions that may include higher-order thinking and hands-on practices (Zou, 2020; Sailer & Sailer, 2020).

2.2.2 Flipped Learning and Knowledge Construction

Flipped learning is a student-centred learning approach often founded on social constructivist pedagogy (Bishop & Verleger, 2013); it consists of pre-sessional activities that mainly focus on preparing students for in-class sessions that often include peer interactions and discussions in which prior and new knowledge is scaffolded and put into practice (Romero-García *et al.*, 2019). The flipped learning approach is also in line with the notion of the Zone of Proximal Development (ZPD), which concerns the gap between what students can perform independently, for example, in pre-class activities, and what they can achieve with supportive feedback and guidance from the instructor and/or a more knowledgeable peer (MKP) (e.g., in-class collaborative activities) (Vygotsky & Cole, 1978). Scaffolding is another concept that has been applied in many flipped learning models, which describes the process of providing guidance for students to acquire essential knowledge required before attending the class through watching pre-class videos, then performing scaffolding in-class tasks and application-based situations

facilitated by the instructor and peers' feedback (Roehling *et al.*, 2017; Xiu & Thompson, 2020; Lin *et al.*, 2021). In other words, students are expected to become familiar with the basic concepts and instructional activities assigned by the instructor before the class, often via online learning resources, such as pre-recorded lecture presentations, assignments, and reading tasks. Hence, the learner often undertakes lower-level learning related to understanding and remembering cognitive levels in accordance with Bloom's taxonomy (Kim *et al.*, 2017). Consequently, this should prepare them for higher-level learning, such as applying new knowledge, analysing, evaluating, and creating their own work, represented by group discussions, problem-solving tasks, case studies, and project presentations, as in-class activities (Zainuddin *et al.*, 2018).

As indicated in Figure 2.1, in flipped learning, each topic or lesson should have a set of learning objectives categorised on different cognitive levels of Bloom's taxonomy (Krathwohl, 2002). These learning objectives should guide creating and designing pre- and in-session activities to target different learning levels (see Table 2.1). Pre-session tasks often aim to ensure students have the essential knowledge required to facilitate their in-session engagement in more advanced learning processes and deepen their understanding of the instructional content (Mohamed & Lamia, 2018; Ekici, 2021).

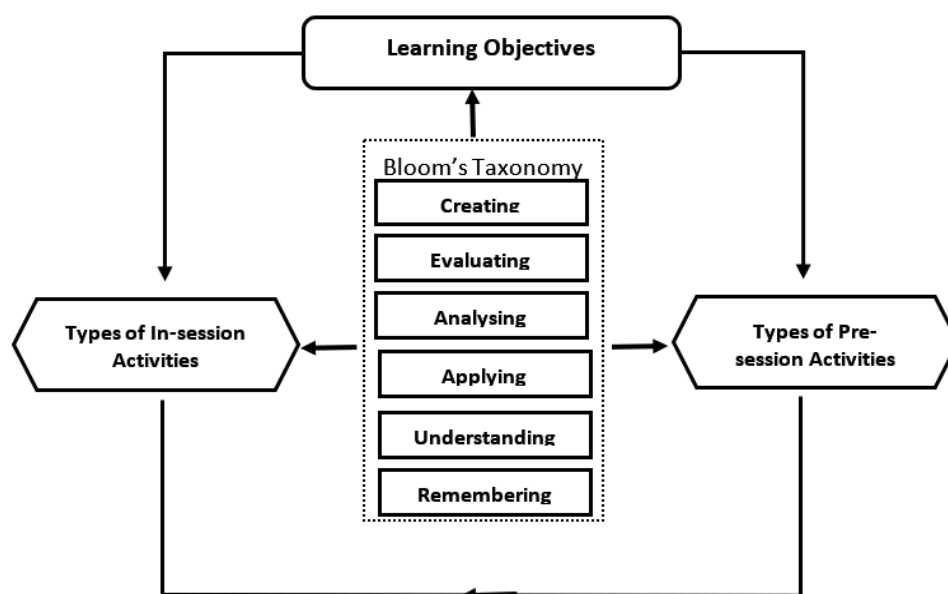


Figure 2.1: Basic Utilisation of Flipped Learning Based on Bloom's Taxonomy Adapted from Khalil and Elkhider (2016)

In the computer science course-disciplinary context, learning is typically constructed sequentially through concepts and practical information/skills, which requires students to acquire

prior knowledge associated with the lower-level learning skills, including terminologies, definitions, and functions of the hardware and software, as well as programming language codes and orders (Chis *et al.*, 2018). This prior knowledge is often provided through online pre-class activities aiming to prepare students for practical situations associated with higher-level learning skills. For example, students may need to remember and understand the definitions and functions of the codes and orders before putting this prior information into practice to produce or create programmes or digital projects using computer software. Hence, it is crucial to ensure that the pre-session task has led the students to achieve the learning objectives; otherwise, their engagement in the in-session tasks can be negatively affected.

Table 2.1: Example of a Set of Learning Objectives Based on Bloom’s Taxonomy (Krathwohl, 2002)

Activity type \ Objective level	<i>Remember</i>	<i>Understand</i>	<i>Apply</i>	<i>Analyse</i>	<i>Evaluate</i>	<i>Create</i>
Pre-class task		Objective 1		Objective 3	Objective 2	
In-class task	Objective 1		Objective 2			Objective 3

However, this is not to assert that when performing pre-session activities (e.g., taking notes), higher-order learning skills (e.g., differentiating, critiquing, and planning) cannot be scaffolded or supported outside the class; instead, the core focus of those activities is to cover at least the essential information that is required before attending the class (Huang & Hew, 2018). In fact, online flipped learning echoes the importance of supporting learners in taking responsibility for their own learning with more flexibility in the sequence of performing the activities (Karabulut-Ilgu *et al.*, 2018). This means that the online pre-session activities should be supportive for those who may go beyond the minimum expectations of completing these assigned activities and show higher-order learning levels by helping them further and deepen their understanding. Although it is suggested that lower-learning skills should be covered before attending the class, it is claimed that this should be based on the desired learning objectives for each topic and its relevant learning activities (Krathwohl, 2002).

Unlike in the traditional lecture formats, where students are expected to take notes rapidly and often do so with minimal engagement with the subject matter, in flipped learning, they can pause and rewind online pre-class videos or presentations, which may help them

manage cognitive load and retain more knowledge and in-depth information (Strelan *et al.*, 2020). As Gómez-Ejerique and López-Cantos (2019) concluded in their study, if students watched the assigned videos before the actual flipped practice, this would help them to understand in advance the methods that will be used, and it would be much easier for the instructor to carry on the hands-on work in the laboratory. Attesting to this, a mixed-methods study conducted by Turan and Göktaş (2018) aimed to determine the effect of the flipped classroom strategy on students' motivation. The findings indicated that students were interested in this teaching method, as their teacher gained an overview of what was required to promote their attention during the class sessions based on their out-of-class work results.

Flipped learning is reported to create active learning environments that could foster students' ability to link new and previous knowledge (Al-Samarraie *et al.*, 2020). To achieve this, according to the Flipped Learning Network (2014), four pillars need to be considered when implementing the flipped learning strategy. Firstly, this pedagogy requires a flexible environment provided by the teacher, who should adapt the learning settings, and the lesson based on students' progression to support collaborative work or independent study. This appears to indicate that the student in this pedagogical learning approach should be able to decide when and where to learn; teachers should be flexible in terms of their expectations of evaluating each learner's achievement, as well as learning times. Secondly, as opposed to lecture-based classrooms, where the teacher's availability is at its minimum in class while the instructions are presented to learners, who often attend as passive listeners (Huang & Hong, 2016), the learning culture in flipped learning, as a learner-centred approach, should encourage them to actively take responsibility for participating in, constructing, and evaluating their own learning meaningfully, under the guidance of the instructor. Therefore, students are expected in this approach to be the decision-making centre of their learning rather than being the product of teaching and specifically, the teacher's decision making. Thirdly, learning content should be intentionally and relevantly selected based on what is needed to be taught (i.e., learning objectives) and what learning materials students can explore as self-learning to maximise in-class time. Finally, the professionalism of the instructor must be considered in this approach as an important factor. The teaching staff should be reflective in their practice, connected with others to develop their

instruction constantly, self-critical in relation to their teaching and learning methods, and should be tolerant of the controlled chaos in their classes (Flipped Learning Network, 2014).

Based on this scenario, it is claimed that flipped learning can provide students with the opportunities to direct their own learning, explore what they will study in their own time before attending the class, and prepare for in-depth and critical questions (Zainuddin & Perera, 2018). The class will likely be an interactive space in which students scaffold their knowledge and expand their ZPD collaboratively in meaningful ways, in parallel with receiving personalised guidance; the learner is considered an inquirer within a learning community (Garrison & Vaughan, 2008; ALRowais, 2014).

2.2.3 Effectiveness Of Flipped Learning Implementation

Adopting flipped learning as a teaching and learning strategy may provide various merits that are critically explored in this study. It is also important to acknowledge that some caveats and concerns have been raised in the relevant literature. Regarding its potential, the most common rationale for flipped learning is underpinned by the theoretical perspective of social constructivism, which emphasises that human beings construct their perceptions and understanding through experience and interaction between them and their world (Crotty, 1998). This approach has been reported as an 'experiential learning' facilitator that allows students to construct knowledge actively (Awidi & Paynter, 2019). Accordingly, although experiential learning can be solitary, social constructivism stresses the importance of the social aspects of learning (Lin *et al.*, 2021). These aspects are arguably supported in flipped learning through interaction with others in the class, which may contribute to developing the ability to apply and transfer one's knowledge and skills to other learning situations, leading to the acquisition of deepened understandings (Awidi & Paynter, 2019). With constructive educational philosophy as its background, the learning process is claimed to be more active when students scaffold their understanding through social interaction with peers and teachers (Lindeiner-Stráský *et al.*, 2020). In addition, many of the studies hitherto published in this particular field have suggested that the role of the teacher as a transmitter of knowledge needs to be amended to being a conceptual and motivational guide for learners, supporting their self-learning orientation (Romero-García *et al.*, 2019). Self-directed learning is a common characteristic of flipped learning, documented in the

relevant literature as a student-centred approach (Zainuddin & Perera, 2018). It refers to a process where learners assess their own learning needs to decide what approaches to apply, and then they should be able to evaluate their learning achievement (*ibid*).

Moreover, as Akçayır and Akçayır (2018) conclude, student-student and student-teacher interactions are hallmark features of flipped learning, which could be attributed to the instructor in the classroom acting as a guidance for the learners rather than being merely a content presenter (Bergmann & Sams, 2012). Accordingly, allowing the instructor to check students' understanding of the instructional content and concepts before applying them may facilitate providing meaningful feedback (Greener, 2015). Indeed, in the flipped learning strategy, in-class time is often dedicated to feedback and collaborative learning activities, such as discussions and teamwork presentations, which tend to promote students' participation. This may allow students to receive personalised feedback and trouble-shooting advice from the instructor based on measuring their performance in pre-class activities, leading to a higher level and deeper learning (Ekici, 2021). According to Tune *et al.* (2015), this scenario might be the most influential contribution of flipped-class pedagogy towards positive learning outcomes. Hence, it has been claimed that this combination of in-class sessions and out-of-class activities across diverse subject domains appears to possess the ingredients that may prompt and raise students' motivation levels, interaction, and engagement (Hsieh *et al.*, 2017; Zou *et al.*, 2018), as well as their learning performance (Cheng *et al.*, 2020).

For instance, a study by El-Banna *et al.*, (2017) reveals that learners in flipped learning environments achieved significantly higher results on their first assessment than those in a traditional classroom. Chen and Hwang (2018) also conducted a quasi-experimental design study that implemented a flipped learning model in an internet technology course, involving undergraduate university students to examine their academic achievement. The findings reveal that supporting collaborative learning in this approach could effectively enhance students' achievement. This also corresponds with action research by Kostaris *et al.* (2017), who employed a quasi-experimental research design using experimental-control groups, utilising a flipped information communication technology course. The results found that such an approach can conduce to positive changes in students' learning outcomes. Along this line, in their quasi-

experimental quantitative study, Shyr and Chen (2018) examined the effect of a flipped learning system (Flip2Learn) on sophomore university students' learning performance. The study concluded that technology-enhanced flipped learning contributed to preparing students for the in-class sessions and enhancing their learning performance. In addition, pre-class tasks such as taking learning notes may help learners to set their short-term and long-term goals, which are fundamental for performing the required assignments effectively. According to Al-Samarraie *et al.* (2020), this strategy may promote students' ability to understand complex concepts, particularly when providing them with the motivational bases for self-learning materials and independent searches for information.

However, despite the widespread agreement on the potential of the flipped learning format to provide better learning achievement, some studies have reported opposite results. For instance, Adams *et al.* (2015) conducted an experimental study to compare the effectiveness of a flipped learning method with a traditional lecture format in a university's science course. The overall findings indicate low learning achievement for students who were taught in a flipped learning class, compared to their peers taking the same course using a face-to-face teaching method. To shed light on the possible factors that may contribute to the overall lower success in the flipped learning format, an anonymous midterm survey was conducted by Adams and colleagues. The survey results show that some students in this learning method did not use the instructional videos of the pre-class recorded lectures, reflecting minimal interaction with those videos. Clark's study (2015) also implemented a flipped model approach in a mathematics class and compared students' academic performance with their peers in a traditional class format. The quantitative and qualitative findings concluded that, in the flipped-class environment, despite the improvement in students' engagement, communication and the use of class time, no significant differences were found in the performance between the two groups. This is in line with a systematic review and meta-analysis research carried out by Låg and Sæle (2019), revealing that the flipped-class method engendered a small impact on students' learning in comparison to the conventional classroom approach. Attesting to these findings, meta-analysis research by Strelan *et al.* (2020) indicates a moderate positive impact on learners' performance in the class via the flipped approach, compared to the traditional classroom. It has been claimed that the effectiveness of flipped learning is often associated with the extent to which students are

prepared before the class since the success of such pedagogical approaches relies on performing pre-class activities appropriately. This claim is supported by Long *et al.* (2017), who suggested that instructors should invest sufficient time and effort in creating or selecting engaging pre-class learning materials; otherwise, students will likely miss such activities. It is, therefore, advised that teachers should: 1) ensure students have performed pre-class tasks before attending in-class sessions; 2) provide them with clear instructions and proper motivational needs to support their preparation; 3) design pre-class learning materials based on students' feedback; and 4) provide instant support for students' learning processes during in-class activities (*ibid*). It can be said that the opportunity for well-planned learning activities is perhaps the key ingredient in the formula of flipped learning.

It is argued that learners' individual differences and learning style preferences may vary, and consequently, some of them may be reserved or reluctant to actively engage in their learning (Zainuddin & Perera, 2018). However, the characteristic of collaborative learning that is often applied to flipped-class approaches, as a main pillar, may enable them to learn and construct their knowledge through vicarious interaction, such as listening to peers' discussions and then absorbing and processing the information observed (Vonderwell & Zachariah, 2005). This is supported by Michinov *et al.* (2011), asserting that students could learn through passive participation in discussion boards by reading or listening to their peers' contributions, possibly leading individuals with reserved characteristics and dependent learning styles to learn through observation supported by the instructor's feedback. Greener (2015) claims that the involvement and engagement of others in a flipped classroom may serve as both a catalyst and catharsis in a social learning environment. In other words, unlike in lecture-based classes, in which learning often relies on the lecturer's teaching style, flipped learning environments may have the potential to address dependent and independent learning styles. This is in line with a study by Morita (2004), concluding that dependent students are likely to benefit from their peers as a main source of support and under the supervision of their teacher, leading them to their learning development, increasing the completion rate of learning tasks, and encouraging them to participate in in-class activities. In fact, since students in flipped learning are required to have prior knowledge that should be acquired by performing pre-class activities flexibly on their own

time, this could foster their ability to maintain an active role in their learning and might evoke them to engage in cohesive discussion with their peers (Kim *et al.*, 2017).

Besides the effect of collaborative learning in flipped-class approaches on learning outcomes, a study by Thai *et al.* (2017) reveals that learning motivation and self-efficacy beliefs can also play a vital role in students' learning process. Their study examines the impact of those factors in different contexts: a flipped-class setting, a blended learning situation, a traditional classroom, and an e-learning environment, on second-year undergraduate students' learning. The findings indicate that utilising the flipped-learning model yielded positive results in students' self-determined motivation and self-efficacy, and an enhancement in students' learning achievement subsequently followed these positive impacts. Indeed, students' self-determined motivation has been reported in several studies as an essential factor in the extent to which the flipped-class method influences students' learning. For example, Chuang *et al.* (2018) explored the impact of individual characteristics, including students' motivation, self-efficacy, and epistemology beliefs, on learning outcomes in a flipped-learning model. The study observed that students completed the online quizzes and pre-class videos before attending the class because they were motivated, which reflected positively on their learning. In agreement with this, some studies found that when students complete the assigned pre-class tasks, they become more motivated to attend the class as they feel prepared; thus, they could actively engage in the in-class activities (Lo & Hew, 2017; Nel, 2017). Therefore, it is argued that to achieve successful flipped-learning environments, students in such approaches need to be motivated to acquire a certain level of knowledge before the class (Hao, 2016; Ekici, 2021).

This claim is also underpinned by multiple studies which reported that less motivating pre-class work might discourage students from completing it, affecting the acquisition and construction of knowledge. For instance, in an introductory computer flipped course, a mixed-method research study carried out by Turan and Göktaş (2018) noticed that the level of students' motivation decreased when they found difficulty in keeping up with the course outside of the classroom. The study suggests that the flipped-class method needs to be designed effectively to stimulate, or at least maintain, learning motivation during the instructional course. The importance of developing effective pre-class tasks is also emphasised by He *et al.* (2016), who

assessed the effect of an extensive flipped course on undergraduate students' out-of-class study time, performance, preference, motivation, and perceptions. The study indicates that pre-class video lectures with a lack of or inadequate pedagogical and technical features could negatively impact students' learning motivation and perceived overall learning quality.

Nevertheless, according to Turan and Göktaş (2018), motivational features could be added to pre-class videos in a way that might encourage learners to watch them. The suggestions provided in this study underpin some motivational factors that can be included in flipped-learning approaches to motivate students to engage in pre- and in- class tasks; these factors are group work and gamified activities such as Kahoot. Moreover, a study published by Lin *et al.* (2021) adopted a quasi-experiment research design to gauge students' performance, motivation, and self-efficacy in a billiards flipped course at a university, intending to create active pre-class instructions and in-class sessions based on the theories of cognitive apprenticeship and reflective practice. The findings emphasise the importance of designing teaching and learning activities before and during class since this can effectively impact students' self-reflection and self-efficacy, as well as their motivation to perform pre-class activities appropriately. Consequently, designing attractive flipped-class tasks by harnessing motivational factors may increase students' achievement, engagement (Al-Samarraie *et al.*, 2020), and motivation toward such pedagogical approaches (Turan & Göktaş, 2018).

2.2.4 Challenges of Implementing Flipped Learning

An extensive range of literature indicates that flipped-learning pedagogy has both benefits and potential weaknesses. Although the notion of this approach may be seen as a successful learning intervention, there may be barriers and a lack of pedagogical rationale to an efficacious implementation, which may leave instructors and students to deal with more of a trial-and-error approach (Låg & Sæle, 2019; Strelan *et al.*, 2020). Detractors have voiced their concern that students' interaction and participation during in-class sessions can be affected negatively by a lack of the prior knowledge required to comprehend what is being discussed and worked on in the classroom (Romero-García *et al.*, 2019). Smith (2008) observed that learners did just enough preparation for examinations and often overlooked or neglected the extra work or pre-class tasks assigned by the teacher to build the required knowledge. In line with this, Lai and Foon (2019)

affirm that students' online participation in pre-class activities is not always satisfactory; they found that less than 33% of students watched the assigned pre-class videos, which consequently affected the building process of their knowledge in in-class sessions.

Indeed, there are several reasons why students might dismiss online learning materials. For instance, in Olson's study (2014), students' performance and attitudes towards flipped classes were examined before providing some advantages and disadvantages of using such a method. The findings reveal that the recorded lecture videos were found to be very long and unexciting by the students. Despite the benefits of utilising these videos in learning (Rasheed *et al.*, 2020), Kim *et al.* (2014) findings reported that students complained of long videos assigned as pre-class work. This suggests that, although students may prefer video lectures more than textbook readings (De Grazia *et al.*, 2012), the length of these videos can play an impactful role in increasing their levels of engagement and reducing the possible cognitive load (Brame, 2016). When a pre-class instructional video is found to be long and uninteresting, some students may skip such learning materials (Karabulut-Ilgu *et al.*, 2018). Giuliano and Moser (2016) noticed an inverse relationship between the length of pre-class video lectures and the students' rate of watching these videos. It can thus be suggested that the instructor should not elaborate unnecessarily in the pre-class videos, and a long lecture should be broken down into a series of short videos in a way that offers clear instructions to navigate students through the new concepts that should be included and distributed carefully in those videos in a balanced way (El Miedany, 2019). A study by Wagner *et al.* (2013), for example, found that only 35.7% of the students enjoyed watching long pre-class videos, and it was advised that in order to consider most students' attention span, the video should not be longer than 10-20 minutes (Battaglia & Kaya, 2015; Coursera, 2020). This would enable students to watch them in their free time and possibly make specific topics easier to understand (Olson, 2014).

Since the foundation of flipped learning relies on the fact that students must attend their classes prepared and ready to learn, the lack of preparation before in-class sessions may affect the learning process negatively (Keong & Jimei, 2024). Multiple studies indicate that many teachers who apply flipped learning often encounter students' resistance to this approach, which may relate to low levels of learning motivation (Greener, 2015; Strelan *et al.*, 2020; Li *et al.*, 2021).

One possible reason is that they feel overwhelmed when experiencing a new teaching method that relies on the agency of the student to take an active role in the learning process (Amresh *et al.*, 2013), in which they are required to perform the assigned material and coming to class prepared (Greener, 2015). Lai and Foon (2019) concluded that learners' willingness to engage in learning activities decreases over time when applying such an approach, and consequently, its efficiency might be reduced. This is likely to occur when learners are unable to receive immediate help or meaningful feedback while performing pre-class activities. In many flipped learning models, the only way for students to obtain support is to take notes, including their questions, and to subsequently wait for the in-class meeting to receive answers (Akçayır & Akçayır, 2018). To minimise this problem, some researchers (e.g. Hardin & Koppenhaver, 2016; Zainuddin *et al.*, 2019) have employed text messages and discussion forums to enable students to post their questions and receive the required feedback during pre-class activities. These discussion tools may enable students to interact, communicate, and collaborate via online learning materials. Rasheed *et al.* (2020) emphasise that discussion boards might be beneficial to students in giving in-depth details when explaining ideas; however, motivating them to participate in meaningful discussions is likely to be a constant challenge to many instructors (Ding, 2019; Zainuddin, Haruna, *et al.*, 2019; Xi & Hamari, 2019). It is observed that many instructors have strived to overcome students' tendencies to put off completing the assigned learning tasks (Michinov *et al.*, 2011).

In a Saudi university context, a study conducted by Sajid *et al.* (2016) assessed students' academic performance and perception towards flipped learning in comparison to lecture-based teaching. The authors concluded that students were not enthusiastic to participate in discussion boards, suggesting that considerations should be taken when attempting to implement a new learning environment. The students' unwillingness to participate in flipped-class tasks might be associated with their lack of interest or procrastination tendencies that they may experience, particularly when they find the topic boring or out of interest, impacting their level of participation in such instructional activities. This reason is underlined by Michinov *et al.* (2011), who conducted a study to explore the relationship between procrastination and performance in an online learning course and whether the level of student participation mediates this relationship. The findings indicate a negative relationship between students' involvement in online tasks and procrastination. The authors also found that there were some behavioural

differences, such as motivation and interests, between students who were high procrastinators and those who were low procrastinators. Moreover, it is argued that some students procrastinate watching the required video-based lectures prior to the class and only watch them when the exam is approaching (Nielsen, 2020). Students will likely procrastinate when they are not genuinely interested in such learning materials. This is evidenced by Senécal *et al.* (1995), who found that the learners who were motivated in a non-self-motivated way tended to have a greater rate of procrastination compared to those who were inherently motivated in an autonomous manner; hence, they suggested that procrastination and non-completion of tasks on time appear to be a self-motivation issue that may require autonomous-type motivators. This type of motivation is arguably an inherent resource for coping; thus, it is expected that the more self-determined motivation students have, the less they procrastinate (Katz *et al.*, 2014). It can be said that students learning in online courses can be affected by the attractiveness of the instructional content available in VLE (Lopes *et al.*, 2024).

A systematic review of empirical evidence has found that students' self-determined motivation has been considered the key to completing online instructional activities (Zainuddin, Chu, *et al.*, 2020). Therefore, instructors may need to provide engaging and compelling solutions that can motivate students effectively to complete the assigned pre-class activities, and through those tasks, their understanding should be evaluated before attending the in-class sessions to facilitate progression-supportive feedback (Akçayır & Akçayır, 2018); otherwise, such a learning strategy would not be effective. This notion is supported by Låg and Sæle (2019), who affirm that evaluating students' preparation through pre-class work could enhance students' learning in such flipped-class models. This also parallels a study by ALRowais (2014) in a Saudi education context, which found that improvement in engagement peer interaction may result from positive attitudes by the learners towards this strategy. The findings also shed light on the role of meaningful feedback from the instructor during in-class sessions in clarifying challenging concepts that arose while they were independently performing out-of-class activities.

Indeed, creating quality pre-class videos has been one of the most challenging tasks for teachers (Rasheed *et al.*, 2020). Such a problem was also highlighted by Zainuddin and Halili (2016), warning that when the content and design of the video lectures are unattractive, the

learners are likely to find them tedious to watch outside the class, resulting in negative learning outcomes. A study by Tang *et al.* (2020) revealed that although the combination of online learning materials with flipped learning enhanced their learning, attention, and evaluation of the lessons, learners were dissatisfied with online pre-class activities. Furthermore, based on an empirical study conducted in a Saudi university context, it is argued that many instructors believe that designing such activities, including creating video-based lectures, presentations, and meaningful in-class activities, can be time-consuming (Al Mulhim, 2020). However, it is well-known that the current advancement in online quizzes and video-sharing technology (e.g., YouTube.com/Edu, Edpuzzle, Kahoot, and Wordwall) has contributed to creating massive and rich free educational video bank and quizzes databases that are often rated by viewers, learners or subscribers; those learning resources can be freely shared and compatible with being embedded in most online learning platforms. This means that it has become possible to assess the quality and the suitability of those learning materials by reviewing the content and related comments posted by the viewers, reflecting their experience. By finding or creating high-quality pre-class videos and tasks, out-of-class preparation can be as effective as face-to-face lectures in terms of delivering concepts and information (Greener, 2015).

As an attempt to motivate students' preparation, some mechanisms have been examined and utilised, including formative testing and quizzes. For example, an experimental study by Brunsell and Horejsi (2013) provided students with individual video quizzes to motivate and challenge them to watch the required videos outside of the class. However, they found that such a strategy did not sufficiently promote students' self-motivation to become interested in watching those pre-class videos. They argued that providing students with pre-class video lectures does not necessarily mean the class is flipped; instructors must include more active learning experiences within such activities. In light of this, it can be implied that the integration of a new strategy in the flipped-learning practice is much needed to motivate students to do the assigned pre-class activities effectively (de Araujo *et al.*, 2017).

Another reported challenge that students may face when implementing flipped learning pertains to the unfamiliarity of using technology. In the Saudi context, Alebaikan and Troudi (2010) investigated the challenges university students might face in flipped learning

environments. The study found that several students might struggle with some technical tools utilised in such blended learning settings as they did not know how to use them. Similarly, Prasad *et al.* (2018) carried out a study to delineate technology barriers for international postgraduate students while adopting a flipped-learning approach to an IT project management subject. For this investigation, the study used the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003) as a theoretical framework. The study highlighted challenges in terms of unfamiliarity with using online pre-class activities, such as difficulties in dealing with different user interfaces, resistance to technology, and technological distraction from over-complexity in technology. There appears to be sound logic behind these findings when requiring students to deal with a new online learning environment that has an unfamiliar or complex user interface, which has often developed from the rapid advancement of a wide range of learning management systems, computer applications and hardware technologies (Rasheed *et al.*, 2020).

Consequently, this may lead to a lack of student competency and proficiency with the use of such variations of technological tools and interfaces, especially when performing online learning tasks outside the class. Akçayır and Akçayır (2018) stressed that in flipped learning, learners are presumed to be reasonably competent with technology, able to use online peer learning and help-seeking digital tools and that incompetency with such tools can be disastrous or at least an impediment to learners in understanding the potential of the flipped-learning approach. Indeed, implementing any new teaching strategy or learning system needs to be gradually introduced and applied to familiarise students with its requirements and the technological tools used. Undoubtedly, the recent advancement and growth of video applications, coupled with the rapidly increased capabilities of smartphones, as well as the ubiquity and still growing popularity of using YouTube among students of different ages and abilities, have facilitated the production and utilisation of educational videos with compatible and user-friendly options. In addition, El Miedany (2019) asserted the importance of providing learners with the required cognitive skills on how to use the learning platform appropriately and how to make notes while performing pre-class activities, accompanied by brief notes from the instructor, are effective and practical techniques to drive students' learning in the right direction. Therefore, before the full implementation of a flipped-learning format, instructors are advised to start with small online learning tasks as instructions to familiarise students with such a new

method, then proceed at a reasonable pace. For example, an induction week may be a good start to introduce such new learning environments, as well as to ensure that students understand what they are required to do and how.

2.2.5 Self-Regulation Across Various Flipped Learning Contexts

Since its proposal, the flipped-learning approach has been applied in a wide range of educational contexts and disciplines to investigate its impact on different learning outcomes. This approach seems to be beneficial in various domains, curriculum areas, and education levels (Bergmann & Sams, 2012; Strelan *et al.*, 2020). However, based on a review of the top 100 most cited research studies in this field, Cheng *et al.* (2020) explored the most common learning contexts that used flipped-learning strategies during the 2013–2018 period and found that 78% of the utilisation of flipped learning was in tertiary contexts. In line with this, Akçayır and Akçayır (2018) reviewed a total of 71 relevant research articles and concluded that the majority of them (80%) were applied at the higher education stage. This might be due to the non-flexible nature of many schools' policies as they have become extremely concentrated on specific cognitive goals, neglecting the adverse interests, talents, and influential factors, such as the psychological and intellectual needs of students (Ryan & Deci, 2017; Ellsworth, 2018). This is in addition to the fact that in pre- and out-of-class activities, students are often required to take their learning progression responsibly as independent learners before and after class (Chen & Hwang, 2018). Accordingly, an argument can be made that students in asynchronous learning activities may need to be more self-regulated to participate effectively (Blumenfeld *et al.*, 2006). Moreover, students with low metacognitive and self-organisational skills might struggle in flipped classrooms, as they may feel that they are not learning and are not being taught (Talbert, 2012; Clapham, 2020). Cunningham and Billingsley (2002, cited in Çakiroğlu & Öztürk, 2017) state that self-regulated students are capable of managing and organising the factors of what, when, and how to study the required learning materials and submit assignments appropriately. However, some students who may have inadequate self-regulation skills and need help to manage their studies would probably struggle when facing learning difficulties outside their face-to-face sessions (Rasheed *et al.*, 2020). This may indicate that some learners who have been familiar and

comfortable with the traditional classroom method might not engage with enthusiasm to learn autonomously in such learner-centred environments, particularly outside class time.

In fact, self-regulation learning can be supported in the flipped-class approach when it encourages students to be self-driven by allowing them to monitor or self-evaluate their learning progress. To achieve this, they should be able to set their goals and employ suitable learning strategies to control their time and resources in order to be prepared for in-class sessions (Al Mulhim, 2020). Therefore, the relevant literature emphasises that, in parallel with providing students with technical and instructional support, they may need training on how to study effectively in flipped-learning environments (Herreid & Schiller, 2013). This is due to the fact that some students may not be prepared to study independently out of class time without help from the teacher since the content that is usually provided in the class via lecturing is often rendered as out-of-class activities (Bergmann & Sams, 2012). It is suggested that university students should be provided with workshops that consider time management and resource organisation strategies to overcome such issues when implementing flipped learning (Alebaikan & Troudi, 2010). Similarly, Öztürk and Çakiroğlu (2021) suggested that, when applying such an approach, learners need to be supported in various ways to promote their self-regulation skills, motivation to study autonomously, and familiarity with the new method. Grounded on self-determination theory, a study by Vansteenkiste *et al.* (2012) measured students' autonomous motivation and self-regulation through two different levels of autonomy-support strategies in two groups. The findings indicated that the group who experienced high autonomy and clear instructions showed better autonomous motivation and self-regulation, including time management, in-depth learning, persistence, and low levels of anxiety.

Despite the independency that pre- and out-of-class activities may offer via asynchronous online modalities, it is thought that stimulating “group awareness and peer assistance” as supportive and collaborative elements through the introduction of advanced educational technology could improve students' capability for self-regulation behaviour (Lin *et al.*, 2016, p. 89). The effects of peer assistance tend to vary across students' stages or ages. For instance, university students, when working as groups in a flipped learning environment, may be more aware of and concerned about their roles as team members, and they generally spend much more

out-of-class time with peer groups than children, which means that they are more susceptible to peer-group situations which may influence their learning motivation and achievement (Wigfield et al., 2019). The role of co-regulation in groups appears to impact students' participation in pre-class activities, fostering peer interaction and regulation processes (Michinov *et al.*, 2011).

Indeed, self-regulated behaviour toward learning can be promoted by different factors. For instance, some students' behaviours may be driven by an inherent desire stemming from perceiving the learning materials as valuable, useful, or interesting, while some behaviours can be driven by attempts to avoid anxiety, failure, or rejection (Ryan & Deci, 2020). In other words, when students have an inherent desire to learn, this may support them in autonomously regulating their own learning process and growing as self-regulated learners. Nicol and MacFarlane-Dick (2006, p. 205) suggested seven principles for supporting the learner to become self-regulated:

- 1) the instructor should clarify what good performance is required from students;
- 2) the development of self-assessment should be facilitated in student's learning;
- 3) providing students with quality information about their learning progress;
- 4) supporting peer and teacher interactions around learning;
- 5) encouraging learners' positive motivational attitudes and their self-esteem to fill the gap between existing and expected performance, leading to,
- 6) providing them with opportunities needed to close this gap; and
- 7) arming teachers with information that can be used to shape and adapt their teaching approaches based on learning contexts.

These principles are substantiated by Nicol and MacFarlane-Dick's study, asserting that in order to fill the gap between what is expected from students and their actual performance, rather than merely allowing them to take full control of their learning, the instructor should facilitate the learning process by setting the course requirements, assigning learning activities, and providing feedback as formative assessment. In addition, students who need help to manage their studies could become self-regulated when given chances to practise under the teacher's

supervision (Pintrich & Zusho, 2007). Indeed, although students, in such pedagogical learner-focused approaches, are the main protagonists of their learning, the role of the instructors is more fundamental than ever as they can advise students with the appropriate strategies and provide them with learning materials, progression-supportive feedback, and resources to help them in overcoming obstacles that they may encounter when learning.

2.2.6 Metacognition and Related Self-Regulation

Metacognition and related self-regulation approaches used within teaching settings are most often used in order to support students to consider their own learning approaches much more carefully and systematically (Chen *et al.*, 2017) and to foster in them practices of critical reflection (Pintrich, 2002), so that, when used regularly and routinely, students will become aware of changes and improvements in their learning (Barber *et al.*, 2011). Much literature (Schunk, 1990; Tanner, 2012; Chen *et al.* 2017) shows that specific strategies that may be adopted most purposefully and productively, centre upon cycles of planning, monitoring and evaluating. According to research in the field, metacognition can be considered an impactful pedagogical tool with the average impact of incorporating both metacognition and self-regulation into learning, equating to an additional seven months of educational progress each year (Brown-Kramer, 2020).

Nonetheless, this is only partial evidence of efficacy. Some researchers, including Koriatic and Bjork (2005) for example, argue that students experiencing difficulties in learning, or problems related to comprehension and communication, are much less likely to adopt self-regulation, unless they are intensively coached to understand their purpose and how to adopt them appropriately in the first place. Another issue of designing metacognitive approaches is whether to embed them or to use in adjunct activities: there is evidence of both being impactful: in the case of students with multiple disadvantages, literature argues that an up-front intervention with clear add-on teaching, is the most effective way of fostering self-directed learning (Chen *et al.*, 2017). In contrast, other research argues that metacognition is best suited to in-context and in-subject applications, where students will rapidly see the impact of application to a specific curriculum area (Hofer & Yu, 2003). Whilst there are many ways of designing these strategies in practice, interventions are usually designed with a central purpose, and that is to give pupils a toolkit of strategies and techniques to choose from, and the accompanying skills that

will enable them to select the most suitable strategy for any given subject, topic or learning task (Schult *et al.*, 2017; Yazgı Yanık & Afat, 2022).

However, before going on to address particular types of metacognitive strategies, it is crucial to discuss the differences between metacognition and self-regulation, even though in much learning science literature, they are often used interchangeably (EEF, 2021). According to Narengaowa and Tunglag (2024), metacognition is the process by which students do three things in the execution of a task:

- Apply knowledge of the given task.
- Use appropriate knowledge of learning and thinking strategy.
- Use knowledge about their own strengths, weaknesses and abilities.

In order to:

- Plan for how they learn.
- Monitor how they are progressing toward a goal.
- Evaluate the results or outcomes they produce.

However, the definition of Metacognition above clearly shows the differences in definition between itself, and Self-Regulation. Metacognition is focused on the first set of actions, related explicitly *to knowledge of, and knowledge about*, whereas Self-Regulation is explicitly focused on putting that knowledge into practice, namely, through activities of planning, monitoring and evaluation. In other words, Self-Regulation's purpose is *to do, through appropriate application*.

There are many types of metacognitive strategies, as there are self-regulatory practices, and perhaps the majority are based on one of three approaches: using regulatory checklists (Schraw, 1998), using clear and replicable strategies (Lavis & Mahy, 2021), and not least, using reflection tools on learning experiences (Baothman *et al.*, 2018). In all cases, the techniques, strategies and frameworks adopted have clear defining features: students are able to apply them relatively easily so that the strategies do not simply become a complex end in themselves (Aguilar *et al.*, 2018); that students are able to understand their purpose, so that their motivation for using them will remain throughout learning episodes and develop as good learning habits (Crede & Kuncel, 2008), and finally, that once learned, they can be applied successfully to other learning contexts (Adams & Blair, 2019). With this in mind, two such strategies and the domain – either metacognition or self-regulated learning (Schraw, 1998; Bain *et al.*, 1999), that they may be applied to, are presented in Figure 2.2 and Figure 2.3 below.

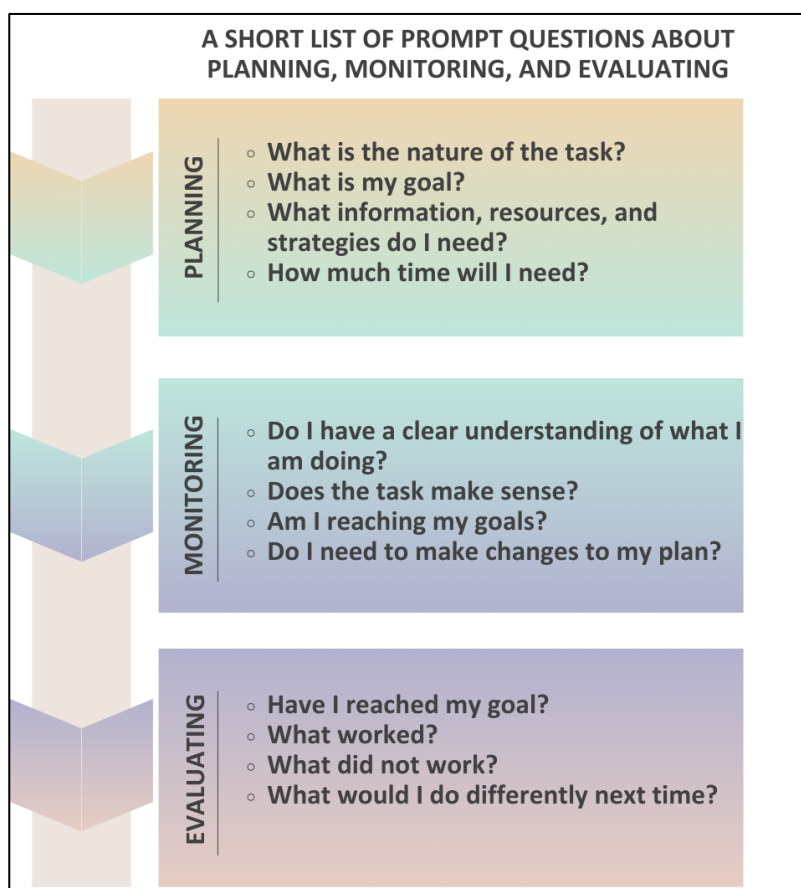


Figure 2.2: Regulatory Checklists for Self-Regulated Learning. Adapted from Schraw (1998)

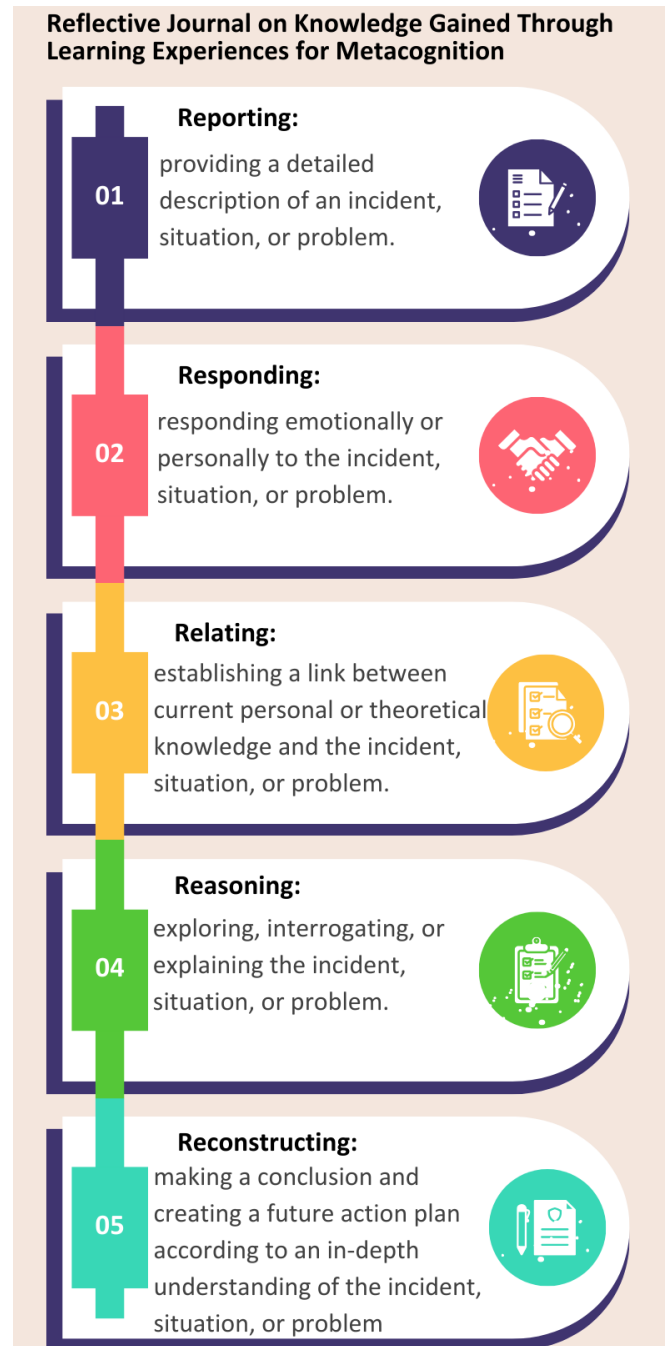


Figure 2.3: Stages of Reflection to Gain Increasingly Complex Knowledge About a Situation. Adopted from Bain et al. (1999)

The regulatory checklist for self-regulated learning, depicted in Figure 2.2, includes a short list of prompt questions about planning, monitoring, and evaluating, adapted from Schraw (1998). In addition, the reflective journaling process for metacognition, presented in Figure 2.3, is based on Bain *et al.* (1999) and is designed to help learners gain deeper knowledge from experiences. It consists of five stages, including Reporting (i.e., describing a situation), Responding (i.e.,

emotional reactions towards the situation), Relating (i.e., linking the situation to previous knowledge), Reasoning (i.e., exploring or explaining the situation), and Reconstructing (i.e., reaching a conclusion and creating a future action plan).

The literature on expertise, decision making and long-term professional and personal development, all highlights the importance of metacognitive skills. People who engage in it are more self-aware as learners, and they often reflect on why their chosen method is effective, or perhaps more importantly, why it is not (Sternberg, 2019).

2.2.7 Flipped Virtual Classroom (FVC)

The essence of flipped-class pedagogy is to create flexible and self-directed learning environments based on students' respective levels of pace and ability (Kong, 2014; Zainuddin, 2018). Utilising this strategy in remote-learning settings seems to maximise the availability of access to various learning materials through pre-class activities, in addition to the ability to record virtual in-class sessions (Phillips & O'Flaherty, 2019). During live sessions, the teacher is predicted to facilitate students' learning by providing cumulative feedback and devoting more time to struggling students to support their progress while giving high-level students a sense of freedom to progress independently (Zainuddin & Perera, 2018). Such learning processes echo the consideration of the diversity of learners that the FVC can provide through supporting autonomous learning (Ryan & Deci, 2020). This techno-pedagogical approach has recently been applied in many universities in the sudden change from campus-based lectures to online teaching settings, particularly after the pandemic and the disruption caused (Tang *et al.*, 2020). Previous research has contended that such a method could be at least as effective as conventional classroom approaches. For example, Knapp's (2018) study implemented a fully online flipped-class model in which students interacted synchronously using video conferencing tools and virtual breakout rooms. The results indicated a significant increase in their engagement levels, as they were able to participate virtually in live discussions with their peers and teachers via breakout groups. Moreover, Tang *et al.* (2020) conducted a study to investigate the efficacy of different online learning formats and to compare a proposed combination of an online and flipped-learning model to other online and conventional models. The findings report that 60.2% of the students in a conventional online learning environment were still paying attention during online live

sessions after approximately 15 minutes, compared to 74.3% of the participants who had enrolled on an FVC-format course. It seems that effective implementation and application of the flipped learning strategy in a full online learning context may produce effective learning that revolves around the learner.

2.2.8 Saudi Online Teaching Context and Flipped Learning

In the context of Saudi Arabian universities, although research that has been conducted to identify the critical success factors of online flipped learning is limited, it is argued that several factors may influence such a pedagogical approach (Akram *et al.*, 2021; Lo & Hew, 2022). In this regard, Alhabeeb and Rowley (2018) explored some of these factors by surveying academic staff and students at Saudi universities (N = 306). The results indicate that the most significant factor impacting online learning was the technology infrastructure. Alelaiwi *et al.* (2015) concluded that although the learners showed positive views on using an online learning platform, they were dissatisfied with the slow internet connection speed. This means that the application of the FVC method may encounter difficulties in terms of internet connection stability, particularly during the live online sessions. However, the effect of this problem can be reduced by making the required online learning materials asynchronous rather than synchronous. In addition, according to a report by the Communication and Information Technology Commission (2020) in Saudi Arabia, the internet service quality and speed witnessed an enhancement of 97% in 2020 compared to 2019. The report also indicates that this service in Saudi Arabia has recently been one of the top ten highest average internet speeds in the world, and it is estimated to continue increasing rapidly. This has made it possible to innovate new online learning strategies that harness developed technology. Furthermore, in the recent few years, starting from the attempts to overcome Covid-19 restrictions in education, the Ministry of Education in Saudi Arabia has massively supported the transmission of teaching and learning of some courses in universities from face-to-face mode to distance learning formats and has attempted to constantly emerge the use of online learning in their educational systems even after the disappearance of this pandemic (Al-Shargabi *et al.*, 2021). In fact, it is reported that education in Saudi Arabia has become one of the leading educational systems that has harnessed online learning technology in light of the pandemic (UNESCO, 2021). This recent development has paved the way not only for improving

online learning platforms and relevant technical equipment but also for training teachers and instructors to use such educational technologies (Al-Shargabi *et al.*, 2021; UNESCO, 2021).

However, although advanced technologies and internet services may facilitate the application of online flipped learning in Saudi universities, it is claimed that the appropriate employment of educational technology is also fundamental to achieving effective and quality learning. This is supported by Sajid *et al.* (2016), who highlight the importance of training students and faculty members when applying blended or flipped learning approaches to use online learning resources effectively. A study by Kutbi and Hashim (2017) also emphasises that in addition to technical equipment, the way that the learning environment is designed could impact the implementation of flipped learning in Saudi Arabia. Aside from this, since many educational institutions, curricula and learning materials used in Saudi universities are often not designed to be autonomously motivating for students, some students may not take online instructional tasks seriously (Alebaikan & Troudi, 2010). In line with this notion, Khalil *et al.* (2020) conducted a study to explore students' perceptions and satisfaction levels in an online flipped learning method applied in a Saudi Arabian university as a response to Covid-19 restrictions. The findings suggest that students' experiences of such a method were affected by their individual characteristics, including learning styles, the extent to which they accept the new learning modalities, their levels of engagement in online learning environments, and the way that the online learning module is implemented.

Evidently, flipped-learning literature is lacking in providing a detailed frame of the challenges pertaining to the virtuality of flipped learning. Most studies in flipped learning have concentrated on the general teaching design difficulties rather than particularly shedding light on the online learning aspect of this approach (Rasheed *et al.*, 2020; Akram *et al.*, 2021; Lo & Hew, 2022). Accordingly, since the FVC is a full online learning method, students in this format may experience even more learning flexibility and independency than in the case of conventional flipped classrooms. This could subsequently reflect negatively on students' learning when they do not receive progression-supportive feedback related to the pre-class video lectures; thereby, they might feel more isolated and unable to interact with their teacher (Schultz *et al.*, 2014). According to research conducted by Sajid *et al.* (2016) to assess students' academic performance

and perception towards flipped learning in comparison to conventional teaching in a Saudi university, a lack of student interaction during the pre-class video lectures was reported as a result of the limited opportunities offered to discuss and ask challenging questions. It was also found that some students believed that using pre-class video-based lectures for new concepts is challenging, and they preferred to interact directly with the instructor. Indeed, besides the importance of progression-supportive feedback, deciding on what concepts or content to assign as pre-work and what to be given in in-class sessions is also a crucial pillar that needs to be considered when designing the flipped learning approach (Flipped Learning Network, 2014). In parallel, Al-Hebaishi (2018) suggests that students should be encouraged to post questions and inquiries via online discussion boards when performing pre-class activities. This may promote interactions between students and peers while enabling the instructor to provide progression-supportive feedback.

In addition to self-regulation, technical challenges, and challenging concepts that students might encounter in such learning environments, Rasheed *et al.* (2020) carried out a systematic review to identify the possible challenges when using advanced online learning components in the flipped-class approach from the perspectives of students, instructors and educational institutions. The findings highlighted some noticeable problems that are likely to occur when applying a synchronous flipped-learning mode. One of which is that students may hesitate to use the video projection, speakers and microphones required to participate in the online sessions due to feeling uneasy or uncomfortable, particularly when being the centre of others' attention, leading them to fall into isolation and alienation. This is in line with a study conducted by Williams and Pury (2002, cited in Alghamdi & Alghamdi, 2021), who investigated the possible reasons that prevent students from interacting with peers while only responding to the teacher's questions. The study examined aspects, including the extent to which students use online discussion and whether they find it interesting to participate. The findings indicate that although they considered web-based discussion important since it allowed them to ask critical questions and post technical enquiries, they found such discussion spaces uninteresting. This might be a consequence of a sense of transactional distance experienced by students in such online learning environments, which can be impacted by their tendencies or characteristics, such as being reserved or vicarious learners, a lack of interaction and communication cues such as gestures and facial expressions, as

well as language barriers (Rasheed *et al.*, 2020). In line, Khalil *et al.* (2020) emphasise that one influential factor that may play a vital role in the success of online learning is psychological closeness, which is primarily associated with students' experience of the instructor's non-verbal clues. These non-verbal interactions, including eye contact and posture, are considered influential components of human communication.

Stöhr *et al.* (2020) evaluated the efficacy of an innovative online flipped-class model through the lens of the transactional distance theory (TDT) and concluded that the salient distance between students, peers, and their teacher is not spatial but transactional and impactable by the psychological and communication gap whether in-person or via online spaces (Moore, 1993). This emphasises the perspective that regardless of whether the learning environment is provided virtually (online) or physically (in-person), supporting students' interactions through active learning activities and constructive competition may contribute to shrinking the psychological and communication gap (Perryer *et al.*, 2016; Lopes *et al.*, 2024). In many cases, the student-student and student-teacher non-verbal interactions in online learning environments can be supported by the proper utilisation of advanced video-conference technology that provides virtual face-to-face sessions via synchronous online spaces coupled with effective digital tools, such as emojis that are designed to depict such interactions.

However, in many online flipped learning cases, the low completion rate of pre-session activities has frequently been mentioned in several studies. For instance, the findings of Stöhr *et al.*'s study (2020) reported that some students struggled to keep up with the course due to a lack of preparation because they missed some assigned pre-session tasks. Similarly, Ramírez-Donoso *et al.* (2021) pointed out that in such student-centred learning, the learners are not always active during in-class meetings, which could hinder the teacher in following their progress in the course. This might be attributed to the fact that online flipped learning is predominantly less teacher-centred and often relies on the learners' active participation, which means that problems such as low levels of motivation to learn and engage are likely to occur, affecting students' concentration and preparation negatively, even more than in conventional flipped classroom contexts (Panigrahi *et al.*, 2018; Jo *et al.*, 2021). In parallel, a study carried out by Aboraya and Elkot (2020) in a Saudi university context found that when implementing a flipped learning model, many

influential motivational factors might be missed, especially if there is a lack of interaction and participation between students and the instructor. Indeed, online learning activities, such as reading, assignments, and watching video-based lectures, where students are required to perform outside and before attending their online class, might be challenging, perhaps due to a lack of motivation (Rasheed *et al.*, 2020). Since students' self-motivation is an essential factor in the success of online education (Zainuddin *et al.*, 2020), understanding how to promote this factor in such FVC approaches seems to be crucial in order to reduce concerns about the method, as well as extending its potential (Turan & Göktaş, 2018). Educational contexts and climates should be attentive to the factors that may influence the satisfaction of students' innate psychological needs by providing support for their diverse capabilities and interests (Ryan & Deci, 2017). Therefore, some educationalists have called for solutions to motivate students to play more active roles when performing out-of- or in-class tasks (Ramírez-Donoso *et al.*, 2021).

Based on the scenario above, in the FVC approach, it can be said that students need to be motivated and provided with meaningful support; otherwise, they are likely to miss the pre-class activities and attend the virtual classroom without preparation (Huang *et al.*, 2019; Stöhr *et al.*, 2020). In particular, a study by Abdelshaheed (2017) was conducted in a Saudi university, and the effect of using a flipped learning model on students' achievement and satisfaction was measured. The author concluded that some students were not interested in watching the assigned pre-class video lectures as they thought that in-class sessions would be enough to learn the lessons. Moreover, among first-year university students, it was revealed that motivational issues have played a significant role in students withdrawing from some instructional courses (Hitchens & Tulloch, 2018). Accordingly, maintaining students' attention and interest in FVC environments can be one of the most challenging tasks, and even more so than in lecture-based classes or conventional flipped classrooms. It is indicated that when a subject is not interesting for the learner, this may explain the reason behind missing pre-class activities or dropping out (Páez-Quinde *et al.*, 2021).

This emphasises the importance of developing an innovative FVC that considers motivation factors among students. Nevertheless, research has revealed that to date, the incorporation of motivational elements based on a theoretical framework into the FVC context

has rarely been investigated in the literature (Sailer & Sailer, 2020; Lo & Hew, 2022). Hence, a new research direction may be needed to combine the flipped learning approach with other instructional strategies and mechanisms to address challenges (e.g., low motivation, cognitive load, and anxiety) (Keong & Jimei, 2024). Studies that aim to explore how to motivate students to engage effectively in such online learning environments by leveraging the motivational potential of an effective theory-based gamification design have been widely suggested (Zainuddin, 2018). Despite this interest, to the best of the researcher's knowledge, no study has yet been conducted on the effectiveness of the gamified flipped virtual classroom (gamified FVC) approach on students' autonomous learning motivation, which is the central concern of the current study's investigation.

2.3 Gamification

2.3.1 The Concept of Gamification

Throughout the last decade, the concept of gamification has been defined in several different ways and from diverse perspectives. This term has become widely used across relevant contemporary pedagogical research but is poorly understood (Hitchens & Tulloch, 2018). Gamification is multifaceted and generally described as the use of game components, such as points, badges, progress bars, and leaderboards, in non-game settings (Deterding, 2011). By shedding light on its purpose, Zichermann and Cunningham (2011) defined gamification as game mechanics and game-thinking processes that aim to engage users and promote their problem-solving skills. Groening and Binnewies (2019) also suggested a definition by concentrating on the design perspective of gamification and described it as the utilisation of game elements or mechanics to stimulate students' interest and motivation through a fun competition. The gamification ideology revolves around amplifying the impact of an existing learning experience by integrating the motivational techniques traditionally encountered within games that are intended to make the instructional activities more engaging (Zainuddin, Shujahat, *et al.*, 2019). These game techniques may include setting up certain competition or play rules, badges and points systems, extrinsic and/or intrinsic rewards, or punishment (Hitchens & Tulloch, 2018). Accordingly, gamification mechanics have been claimed to function as an emotional driving influence, aiming to promote emotional responses in the user. As the body of research increases, gamification has been

employed as a method or an intervention aimed at enhancing various fields, including education, as one of the central contexts (Schöbel *et al.*, 2020; Kalogiannakis *et al.*, 2021). Gamification elements have been used to support learning by integrating the fun features of games in uninteresting pedagogical situations (Jo *et al.*, 2018). It is arguably an effective method that has made significant inroads into various learning spaces in recent years (Sánchez *et al.*, 2020). Indeed, the primary aim of utilising gamification mechanisms in learning environments is to facilitate learners' efforts to achieve the desired learning goals by altering formal pedagogies into playful didactic situations (Hanus & Fox, 2015).

Moreover, using gamification in online learning contexts has gradually evolved and has become more combinable among various teaching and learning strategies (Parra-González *et al.*, 2021). As the definitions above suggest, the main concept underpinning gamification in education is to harness the motivational appeal of video games by employing game design elements in pedagogical situations (Deterding *et al.*, 2011). The aim would be to generate similar beneficial behaviour and motivational influences as that derived from games (Groening & Binnewies, 2019) in a way that can promote enjoyment and satisfaction among learners (Segura-Robles *et al.*, 2020; Do *et al.*, 2023). Although they have some similarities, gamification and game are two different terms with overlapping processes. Since this study is mainly concerned with the intervention of gamification in education, it is necessary to take a closer look at both concepts to distinguish between them; this will then help define and understand the scope of this research.

2.3.2 Difference Between Game, Educational Game, And Gamification Strategy

Over many centuries, games have been a fundamental part of human history as a form of play (e.g., Backgammon, Chess, and playing cards). People engage in games that are often defined by rules, take part in challenges and artificial conflicts, or overcome unnecessary obstacles, resulting in quantifiable outcomes (Tekinbas & Zimmerman, 2004; Kapp, 2012). Accordingly, these games have common features, including goals, points, progress, competition, rewards, and social interaction that can make the game appealing. Games can take various forms, such as video games, electronic games, board games, physical games, and computer and smartphone games. A single player can perform some of these, while other games can be played by multiple people or, recently, among many players (e.g., community gaming) via various virtual environments on the

internet (e.g., PlayStation, Xbox, etc.). The vital aspect of games is that players can participate voluntarily under the acceptance of the player's or group's goals, rules, and feedback in a challenging but exciting and frequently enjoyable atmosphere (Tekinbas & Zimmerman, 2004). In many cases, such activities have the potential to attract the participants and motivate them to work hard towards achieving specific shared game goals supported by the provision of immediate feedback (e.g., accumulated points, badges, teamwork, and levels) about their performance (Rigby & Ryan, 2011). Another form of game is educational games, which are full game systems designed with the aim of training learners (De-Marcos *et al.*, 2016). This type of game provides users with completed learning environments based on not only game elements or mechanisms but also the game itself, focusing on narrative and a storyline and offering room for exploration (*ibid*).

Conceptually, gamification is significantly different from educational gaming in the way that they approach learning objectives. While educational games often strive to hide or deal with such objectives indirectly, gamification systems use one or more game elements explicitly and display direct and clear learning objectives to learners who perform learning tasks that are linked with those game mechanisms (Naik & Kamat, 2016; Jagušt *et al.*, 2018). This means gamification takes only the elements and inspiration from game design to evoke game-like situations (Deterding, 2011) and engender enjoyable and pleasant interactive experiences (Rapp, 2013). Gamification elements can be referred mainly to visual components commonly utilised in video game interfaces, such as rewarding mechanisms (e.g. points), which function to create challenging situations among students (e.g. leaderboards), and recognitions of status (e.g. badges) (*ibid*). It is distinct from games, as education or changing students' behaviour or attitude in gamified environments is often the main goal rather than mere entertainment (Michael & Chen, 2005; Landers, 2014). Although the applications of gamification can take different forms, they are often underpinned by two sets of goals: 1) the learning goals that are associated with the instructional content, and 2) goals that are linked with adding the playful aspect of games, such as enjoyment and satisfaction, to support the learners' experiences (Werbach, 2014; Sailer *et al.*, 2017). It is not about replicating games as a whole, nor building fully-fledged games, but rather engendering flexible, fun, and safe experiences in non-game environments, aiming to

motivate students to engage in the desired learning situations (Deterding *et al.*, 2011; Zichermann & Cunningham, 2011).

Although the growing interest in the gamification of learning has been reported in the literature as a successful intervention (e.g., Jones *et al.*, 2022; Candel *et al.*, 2023; Do *et al.*, 2023), there is still insufficient research evidence that helps to understand the motivational effect of integrating different game elements into teaching-learning activities (Páez-Quinde *et al.*, 2021). It is claimed that a simple design and implementation of such activities in education might not be adequate to engender the desirable effects on learning outcomes (Hanus & Fox, 2015).

2.3.3 Effectiveness of Gamification in Educational Settings

Many studies have explored the effectiveness of incorporating gamification elements into various learning environments and have reported significant enhancements in students' motivation, engagement, achievement, and social influence (Chen *et al.*, 2020; Zainuddin *et al.*, 2020; Do *et al.*, 2023). Multiple strategies are concerned with the adaptation of gamification mechanics in educational situations to generate positive learning outcomes. For example, a quantitative study by Yildirim (2017) examines the effect of a gamification-based design course on students' achievement and attitude towards the lesson. This design was based on three dimensions: dynamics, mechanics, and components. The findings indicate that although this integration of gamification elements did not cognitively add value to the lesson, the students' achievements and attitudes towards the class were enhanced. Moreover, in an empirical study, Tsay *et al.* (2018) evaluated a combination of technology-mediated gamification within a student-centred learning context and examined its effect on undergraduate students' performance. The study reveals that students in the gamified learning environment performed better than those in the non-gamified and traditional classrooms. In line with these findings, a quasi-experimental study by Campillo-Ferrer *et al.* (2020) investigated the impact of utilising a gamified online learning system called Kahoot on students' motivation, engagement, and learning in a higher education context. The authors found that integrating gamification elements as a response system into the teaching process enhanced students' perceptions and participation and motivated them to learn actively. The study also suggests designing attractive gamified learning environments to promote students' motivation and learning experience. In agreement, Ding

(2019) carried out a mixed-methods study to gauge the effect of integrating game elements, including levels, experience points, badges and leaderboards, into an asynchronous online discussion system to promote undergraduate students' engagement. The results reveal that the gamified discussion system encouraged them to think hard and engage in their learning, which might positively influence learning achievement (Zainuddin, Chu, *et al.*, 2020). This is supported by Çakıroğlu *et al.* (2017), who utilised clinical interviews to provide an in-depth understanding of the correlations among gamification, engagement and academic achievement in a one-term ICT course. The authors concluded that designing a combination of dynamic and mechanical game elements, including quest (goal/ mission), leaderboard, points, badges, individual competition, and real gifts, could boost a positive motivational impact on engagement among some students while in contrast, other students did not engage effectively and viewed this implementation negatively.

Indeed, focusing on adding more game elements rather than understanding their purposes and how they work does not guarantee the intended effect of the gamification elements; on the contrary, this may make the learning process even more complicated (Landers *et al.*, 2015). Students may neglect some of these elements when the purpose of their design conflicts with each other. In concordance with this note, a sequential exploratory mixed-methods study was conducted by Baydas and Cicek (2019), in which they designed a gamified learning environment that utilised badges, leaderboards, grades, and points to measure their impact on the gamification process at the undergraduate level. The findings reveal that although this gamified system promoted social engagement among the students and entertained most of them, they neglected to attempt to gain the available points and rather concentrated on their formal grades. This may indicate that the over-reliance on game elements may lead the learner to stop interacting, at least with some of the gamified learning activities (Mekler *et al.*, 2013; Porto *et al.*, 2021). Therefore, De-Marcos *et al.* (2016) investigated the effect of different gamification designs on students' learning performance in an undergraduate course. They found that integrating the social aspects of gamification (e.g., team-based gamification) into teaching and learning environments could lead to better learning outcomes in terms of students' academic performance. In addition, their study's findings stress the necessity of complementarity for the balanced utilisation of gamification elements and teaching and learning methods. This suggests

that the effect of gamification design may rely on the consequence of balancing the combination of its elements (Jagušt *et al.*, 2018). In agreement, a study by Ge (2018) explored the different impacts of three reward gamification strategies (a forfeit-or-prize reward strategy, a prize-only reward strategy, and a no-prize-no-forfeit strategy) on learners' performance in an online gamified teaching process. The results revealed that the forfeit-or-prize reward design could elicit better knowledge retention for e-learners, and thus, the study called for an appropriate adaptation of game elements in learning scenarios. On this note, Hassan *et al.* (2021) also performed two experiments to measure second-year undergraduate students' performance, completion rate, and motivation in an online computer science class. The study concluded that adapting gamification elements based on the identified learning dimensions of students could significantly stimulate motivation, course completion and interests, and encourage them to interact actively with peers in the e-learning environment.

In contrast, Ding (2019) revealed that gamification failed to generate a sense of community among students, which may be attributed to several factors associated with the design and facilitation of the gamified system. According to a systematic research review carried out by Zainuddin, Chu, *et al.* (2020), the major factors that may influence the effectiveness of gamification in education are possibly associated with the utilisation of game mechanisms, instructional design, and technical challenges. The findings imply that gamification should be carefully designed and applied since the blind use of its elements does not always yield positive learning outcomes. In fact, many online learning platforms are equipped with gamification systems; however, these components should be employed only when there is a clear understanding of how they function in the educational context and what the purpose behind using each game element in light of the desired learning objectives (Ofosu-Ampong, 2020). Therefore, in their gamified learning design, Groening and Binnewies (2019) focused on one single game element (badges) as a form of digital achievement in order to gain an understanding of its motivational benefits on students' performance and enthusiasm. The results suggest that when the badges were used to represent and indicate students' achievement as the core gamification design, this could influence students' motivation and performance in addition to learning achievement.

2.3.4 Criticisms of Gamification

The application of gamification is generally reported as a successful instructional intervention in several learning contexts; however, previous studies have obtained mixed findings in terms of learning outcomes, a fact which has confounded researchers and created contestation and division between them (Hanus & Fox, 2015; Sanchez *et al.*, 2020; Kalogiannakis *et al.*, 2021). Accordingly, these mixed results, coupled with the mounting popularity of gamification, have motivated many researchers to further investigate its impact on specific learning processes. Despite its benefits, opponents have criticised gamification for being used while ignoring the fundamental aspects of real game design that are claimed to contribute to motivating and engaging students. For instance, Hanus and Fox (2015) compared two communication courses at a large midwestern university and concluded that students in a gamified learning environment had less motivation, satisfaction, and achievement than those in a non-gamified class. In line with this result, Koivisto and Hamari (2014) also reported that perceived enjoyment, usefulness, and interest declined when the gamification system was used. Therefore, it is crucial to look into how game elements can motivate learners and engender playful, educational situations (Reiners & Wood, 2015). Applying such elements without sufficient consideration towards the psychological and pedagogical foundations may negatively influence the quality of learning. Previous research on gamification has highlighted some issues and concerns related to its implementation, which are discussed in the following sub-sections.

2.3.4.1 The Shallow Implementation of Gamification

Online learning platforms have become more advanced due to the continuous support of new and innovative technology. Some game elements are already included by default in many of these platforms as built-in features and gamification plugins, enabling the instructor to easily add them to the existing course design without requiring major changes in the system (Hamari *et al.*, 2014; Göksün & Gürsoy, 2019). However, it is argued that gamification is not a one-size-fits-all design, and the simple addition of gamification mechanisms into the system, represented as gamified activities, is like taking the basic features of the game and then predicting that this can create enjoyable or interesting experiences (Deterding, 2012). Furthermore, gamification has been criticised for its provision of temporary solutions that may produce short-term effects. A

study by Sanchez *et al.* (2020), for example, examines the impact of gamification on students' performance in three gamified quizzes applied at different times. The findings indicate that gamification had a short-term positive influence on the student's performance when doing the quizzes. However, the study did not comprehensively explain the psychological underpinnings that might increase or diminish the desired impact of gamification. This short-term influence might be attributed to the novelty value of gamification, which is reported to engender enjoyment and high-level engagement when the gamified strategy is initially used; then, this effect tends to fade gradually during the period of the course (Koivisto & Hamari, 2014; Tsay *et al.*, 2018). Based on previous research, gamification can produce both extrinsic and intrinsic rewards; therefore, when designing a gamified learning environment, it is crucial to consider a balanced combination of external and internal motivators based on the desired learning objectives in a way that can encourage students to start engaging with the instructional tasks while striving to raise the students' inner desire to progress in their learning autonomously (Reiners & Wood, 2015).

2.3.4.2 Undermining Autonomous Learning

The purpose of integrating gamification into education is often to stimulate the students' desire to learn. Many utilisations of gamification designs in online learning environments have used elements such as points, badges, and leaderboards merely as extrinsic rewards, which may primarily motivate students extrinsically rather than promoting the pleasure of learning itself (Hanus & Fox, 2015; Zainuddin, Chu, *et al.*, 2020). It is widely acknowledged that different gamification designs result in various learning and motivational outcomes. To illustrate this point, Tsay *et al.* (2020) conducted a two-year empirical study to evaluate students' engagement and performance in a gamified online learning system. The authors revealed that utilising gamification merely as an attempt to coerce or control learners' actions may not suffice to sustain their engagement levels. Even though the existing gamification designs often concentrate only on providing external rewards for performing learning activities, a potential problem with solo use of extrinsic reward-based gamification occurs when the goal is to support student autonomous learning (Deci & Ryan, 2000; 2004). In other words, the use of such an extrinsic reward-based strategy without considering the inherent psychological needs of students may motivate them

extrinsically, but it can also undermine their autonomous motivation to learn. Indeed, through gamified learning activities, students are predicted to continue learning insofar as they are autonomously motivated (Ekici, 2021). Therefore, it is argued that to obtain positive impacts that can maintain students' levels of motivation to engage in their learning autonomously, such gamified tasks need to be perceived by students as useful, valuable, interesting, and/or enjoyable in a way that external rewards are internalised. This scenario is considered a significant factor in creating autonomous motivating learning environments (Ryan & Deci, 2017; Huang *et al.*, 2019; Zainuddin *et al.*, 2020).

2.3.4.3 Lack of Theory-based Gamification Design

Research has demonstrated that gamification may cause learning environments to be more stressful instead of enjoyable or may lead to a decrease in the seriousness of education. For instance, Alabbasi (2018) conducted an empirical study to explore instructors' perceptions towards integrating gamification into an online learning platform. The findings reveal that teachers expressed concerns about the competitive nature of gamification as it could provide destructive competition, leading to negative learning outcomes. This may be attributed to the heavy use of gamification elements in this study merely as competition generators without enough consideration for the psychological need aspects of such a challenging atmosphere, which might drive some learners to compete individually with peers in pressure-inducing situations controlled by an internal force such as ego involvement (Reeve & Jang, 2006; Chen, 2019). Although gamification has been reported in many studies to produce positive effects on learning outcomes, poor designing of the gamified environments, such as unclear rationale or sophisticated instructions (Ding *et al.*, 2018), the ad hoc utilisation of game elements and mechanics, unsuitable levels of difficulty in gamified learning activities, may disorientate learners and demotivate them (Markopoulos *et al.*, 2015; Mora *et al.*, 2017), producing negative outcomes among them, such as apathy and disengagement (Jagušt *et al.*, 2018). Indeed, research reveals that, in many cases, gamification is applied without following robust theoretical frameworks or considering other impactful factors, such as students' psychological needs (Mora *et al.*, 2017). Such designs may create challenges when applied in many pedagogical situations, particularly in which gamification is treated as a generic construct with over-reliance on behaviouristic

mechanisms (Tan & Hew, 2016; Jagušt *et al.*, 2018; Kalogiannakis *et al.*, 2021), which is discussed later in this section.

The impact of gamification on the psychological need for inherent satisfaction tends to depend on the quality of the design implementations. Therefore, researchers have emphasised that designing gamified learning environments based on formal procedures and theoretical frameworks is crucial to understanding and identifying the most effective gamification settings (van Roy & Zaman, 2018; Chen *et al.*, 2020). Gamification elements can arguably be used as promising solutions for motivational problems, frequently mentioned in the literature, when designed and built based on well-established application models (Werbach, 2014). Psychological studies have developed plenty of theories to explain the processes of learning and motivation. Although these theories can serve as a foundational basis for understanding gamification (Reiners & Wood, 2015), it is indicated that research on motivational design guides related to gamified context effects in online higher education is lacking (Schöbel *et al.*, 2020; Khaldi *et al.*, 2023). Therefore, it is suggested that gamification efforts should focus on identifying the designs of elements that can motivate students to engage in their learning rather than focusing merely on the aesthetic of gamification (Rapp, 2013). In other words, the potential of gamification should be discovered beyond its aesthetic design, and although the aesthetic of game elements may serve as positive reinforcement, these might not have the adequate motivating power that is required to push learners toward their autonomous learning (Landers *et al.*, 2015).

2.4 Motivation Theories Underpinning Gamification

Motivation is considered a meta-concept generally related to the reasons that drive people to take action towards a goal (Gopalan *et al.*, 2017); it includes several associated concepts, such as interest, self-efficacy, and persistence (Irvine, 2018). Due to its meta-concept nature, motivation involves countless theories and sub-theories proposed to explain human motivation (Cook & Artino, 2016). These theories can be classified into two major groups, namely content and process theories of motivation (Benke, 2019). Accordingly, content motivation theories (e.g. Herzberg's two factors theory, Maslow's hierarchy of needs theory, McClelland's theory of needs, and Alderfer's ERG approach) concern which factors that may motivate humans, while process motivation theories (e.g., self-determination theory, self-efficacy theory, flow

theory, social comparison theory, reinforcement theory, and goal-setting theory) explain how and why these factors of motivation may impact psychological and behavioural processes that humans follow (*ibid*). Process motivation theories attempt to understand these processes and the possible relationships between the motivation factors to provide explanations for the actions, reasons, and contexts that can motivate the desired behaviours (Cook & Artino, 2016).

In the context of gamification, the theoretical ability of its mechanisms to harness the motivational appeal of games in learning environments is possibly one of the main reasons behind its ubiquitous applications (Huang & Hew, 2018; Porto *et al.*, 2021). Therefore, various psychological and learning theories have underpinned different designs of gamification (Sailer *et al.*, 2017; Huang *et al.*, 2019). Such theories can be employed to provide theoretical framework guidance for practitioners and gamified system designers by identifying engaging and enjoyable gamification design elements (Landers *et al.*, 2015) based on their underlying factors, which may contribute to stimulating students' motivation (Deterding *et al.*, 2011). One main purpose of the present study is to investigate the effect of integrating gamification into an online flipped learning context on students' autonomous learning motivation, and to understand any possible correlations between the components of this variable and the completion rates of pre-session instructional activities variable. Therefore, the study sheds light on the key process motivation theories related intimately to learning motivation literature, particularly those applied in gamification studies as theoretical frameworks. With this point of departure, six key motivation theories frequently mentioned in the literature as most relevant to gamification are identified and reviewed in this study by differentiating their major attributes and critically highlighting their strengths and perceived weaknesses. These theories are self-determination theory, self-efficacy theory, flow theory, social comparison theory, reinforcement theory, and goal-setting theory. In particular, the basic motivational needs highlighted by these theories, as well as explanations on how each theory may contribute to the design of motivating learning situations, are introduced in the following subsections.

2.4.1 Self-Determination Theory (SDT)

SDT in education mainly focuses on the internal factors that may influence students' motivation to act in a particular way; it also attempts to distinguish between those factors and

external influences. (Ryan & Deci, 2000b). SDT theorises that a learning environment in which the three psychological needs (i.e., autonomy, competence, and social relatedness) are supported can positively impact students' inherent motivation to learn (Deci & Ryan, 2000); the more satisfaction of these needs, the greater autonomous motivation learners may show in instructional tasks (Huang *et al.*, 2019; Zainuddin, Chu, *et al.*, 2020). According to this theory, the need for autonomy refers to the feeling of psychological freedom and volition to choose from various learning tasks, and to allow learners to make their decisions based on their interests and values in a way that conforms with their goals and attitudes without a feeling of being controlled or coerced by external pressure or enforcement (*ibid*). In other words, the autonomy factor emphasises the importance of the role of self-direction, free options, locus of causality, and the student's perception of the learning activities. The need for competence is associated with feelings of effectiveness, mastery, and capability to progress successfully through challenging learning activities when interacting with the environment (Ryan & Deci, 2000a; Vansteenkiste & Ryan, 2013). Satisfying the need for competence is hypothesised to promote students' positive expectancies and their learning orientation (Sheldon & Filak, 2008). Moreover, the need for social relatedness refers to the feelings of belongingness, attachment, and being cared for as an important team member working in safe, collaborative learning situations (Ryan & Deci, 2000a, 2020) instead of feeling alienated or ostracised (Sheldon & Filak, 2008).

Based on the extent to which these needs are satisfied or frustrated, SDT generally classifies motivation into three main levels and suggests that each level has functionally different catalysers and consequences (Deci *et al.*, 2017). These levels are amotivation, controlled motivation, and autonomous motivation. As shown in Figure 2.4, at the far left is amotivation, which refers to a lack of factors such as intention to act, felt competent to perform, interest, or the perceived value of a learning task. The amotivation level has been considered a negative predictor of learning engagement, performance, and wellness (Ryan & Deci, 2017). The second level of motivation is controlled motivation, which concerns external regulation and introjection regulation kinds of motivation. External regulation is associated with behaviours performed to satisfy external demands or avoid punishment, anxiety, or external pressure, whilst introjection regulation refers to actions performed because of internal pressure (e.g., ego-involvement or avoiding feelings of guilt or shame for failure) (Ryan & Deci, 2020).

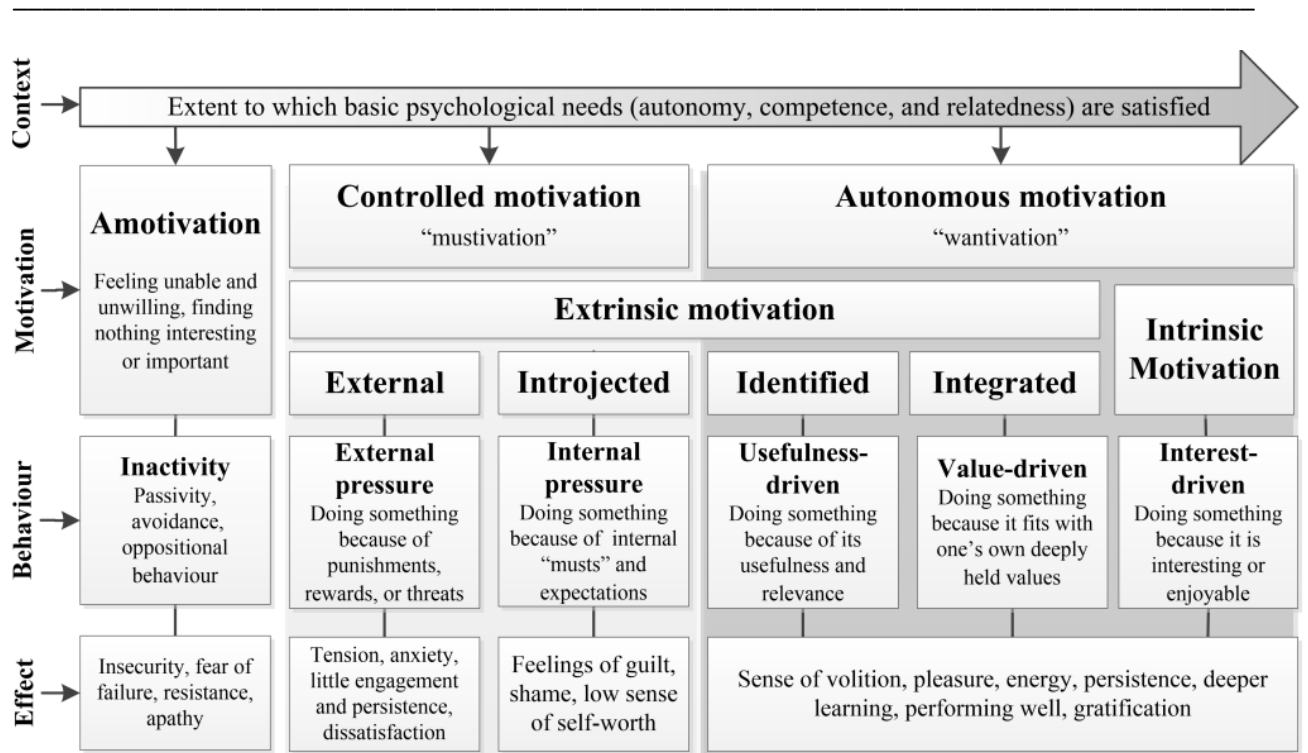


Figure 2.4: STD's Motivation Continuum. Adapted From Ryan and Deci (2000a) and Visser (2017).

While both external and introjection levels of extrinsic motivation reflect more controlled forms of motivation, extrinsically motivated students can act more autonomously at the so-called identified regulation level, in which they complete an activity because they see its importance or usefulness in achieving the desired outcomes following this activity; this has been argued to yield a relatively high degree of volitional actions (Ryan & Deci, 2000a). For instance, in the CS course context, some students may seek to understand how a specific computer hardware, software, or programming language code works because they find it a useful experience for real-life situations or to be used in other university courses (e.g., a situation in which students understand the relevance or usefulness of studying MS Excel, as one of the CS topics, in understanding a statistics course/module or facilitating data analysis skills required later for doing research). A similar level of extrinsic motivation that has recently been combined with identified regulation as one category is integrated regulation (van Roy & Zaman, 2018). This is the highest level of autonomous extrinsic motivation in which, in addition to recognising and identifying the relevance and usefulness of an activity, students may find it in line with their inner values. The identified and integrated regulation levels of autonomous extrinsic motivation indeed share some intrinsic motivation characteristics, such as high volition; therefore, those three types of motivation are

classified as autonomous motivation (Ryan & Deci, 2020). Indeed, students driven by identified and integrated reasons of motivation will likely act similarly to intrinsically motivated students. However, the main difference is that those who are intrinsically motivated may perform and engage in an activity because they feel a sense of fun, interest, or enjoyment; while those who experience identified and integrated regulations may see the activity as useful, important, or valuable, yet not enjoyable (Ryan & Deci, 2017).

Moreover, the SDT explains how extrinsic types of motivation can be more internalised as autonomous, depending on the perceived locus of causality, which is theorised to drive the motivation continuum (Ryan & Deci, 2000a; Jones *et al.*, 2022). Accordingly, the motivation reasons behind extrinsically motivated actions may be autonomously supported by facilitating the internalisation of experience, reasons for these actions, or learning outcomes; this is likely to occur when they perform a learning activity because they believe that it is a useful, valuable, interesting, or enjoyable activity. In classrooms, these reasons for autonomously motivated behaviours may be impacted by the extent to which students: understand the value of the instructional course; feel a sense of volition and freedom to choose what to complete from various options or forms of tasks; feel capable of progressing through these activities; and feel respected, socially related, and cared for by the instructor and groupmates, which may drive them to accept the value of the tasks (Ryan & Deci, 2000a). Autonomous motivation-supportive behaviours, particularly in the gamified FVC context, are discussed later in section 2.8.

The principles of SDT are argued to provide a robust theoretical framework for designing learning environments that may enhance students' autonomous learning motivation when engaging in a task (Saputro *et al.*, 2019); one of these designs is SDT-based gamification (Zainuddin, 2018). Gamified learning activities may contribute to fostering autonomous motivation when they: enable students to understand the importance and purpose of these tasks; give them a sense of ownership and volition; provide them with optimal challenges accompanied by competence-supportive feedback; and engender a sense of social relatedness and belonging in an enjoyable atmosphere without putting external controlling forces on them.

2.4.2 Self-Efficacy Theory (SET)

Self-efficacy beliefs are crucial factors in students' motivation and behaviours. Bandura's SET (1978) explains this as a person's belief in their capability to organise and take the action required to control an encountered situation. In the learning context, this concept reflects the extent to which students believe that they can complete the given learning tasks under certain circumstances (Katz *et al.*, 2014). It is a personal judgment of one's ability to perform these activities based on previous experience, prior achievements, existing skills, and self-perception of these skills or knowledge related to the task, impacting motivational beliefs of self (Zimmerman *et al.*, 1992). Self-efficacy is argued to affect students' choices of activities, effort levels, and task completion persistence; students with low self-efficacy for accomplishing learning tasks are likely to avoid these activities (Bandura, 1978). This theory hypothesises that motivation can be stimulated when students feel mastery and that they are making progress in their learning; thus, they may work harder and show persistence when encountering challenging tasks (Schunk, 1991).

However, self-efficacy is mostly domain-specific (Cook & Artino, 2016); for example, a CS student may show high self-efficacy when dealing with simple programming language codes, while they may have lower self-efficacy in other advanced programming processes. Several factors may also impact students' perceived capabilities to control their activity performance, including personal influences (e.g., goal setting and emotional status) and situational influences (e.g., social environment support, feedback, and incentives). Providing students with supportive feedback on their performance is predicted to promote their self-efficacy (Bandura & Cervone, 1983); however, those who do not believe that their inputs or actions will engender desired impacts or outcomes tend to have low incentives to act (Bandura, 1999). Outcome expectations and self-efficacy are separable factors that mainly construct the SET; the former refers to students' perceptions of positive and negative outcomes that will result from their participation in a learning task, while the latter concept is described as students' beliefs in their capabilities to complete a task (Sweet *et al.*, 2012).

In fact, positive outcome expectations do not guarantee that students will be motivated to learn (Schunk, 1991). For example, students may believe that achieving a high grade on an exam will make their teacher and parents pleased; however, they might not believe that their

capabilities are sufficient to comprehend the exam's contents successfully. Nonetheless, this is not to state that outcome expectations and self-efficacy factors are unrelated. Mixed-methods research results by Williams *et al.* (2005) revealed that there was an indirect relationship between those two factors, and that outcome belief could be a good predictor of self-efficacy. Self-efficacy may affect students' behaviours both directly and indirectly through outcome expectancy. This is justified by Schunk's study (1991), which concluded that students with high self-efficacy might put more effort and time into performing and accomplishing learning activities since they expect to achieve the desired outcomes.

Although termed differently, it can be noticed that the self-efficacy factor is acknowledged by several motivation theories (e.g., the competence factor in SDT), emphasising its importance in fostering students' motivation. Although SET is well aligned with SDT in terms of the notions that students are agents of their actions, and when performing a task, they need to feel capable of progressing through their learning process, there are crucial distinctions between and within these two motivation theories; SET and SDT view the role of self-efficacy/competence in behaviour differently (Sweet *et al.*, 2012). In SET, students' actions are driven by their feelings of capability and ability beliefs to achieve a goal or success in a task; thus, this feeling of self-efficacy is theorised to influence students' behaviour directly. Unlike SDT, SET sees motivation as a unitary concept; for example, it does not comprehensively explain the differences between extrinsic influences, such as recognition of past performance related to the last obtained formal grades and more internal impacts associated with the importance and value judgment about the task or topic (Irvine, 2018).

Moreover, autonomous learning is not explicitly acknowledged in SET, as it concerns almost exclusively the concept of competence and does not explain the role of being autonomous in one's actions. From the SET point of view, one possible way to generate a sense of self-efficacy/competence among students and thus motivate them to learn in the gamified FVC is by utilising gamification elements as contingent rewards for performing compulsory online pre-session activities accompanied by the provision of feedback. However, in such flipped learning contexts, when students are compelled to perform every pre-session learning task provided, they may feel controlled by an external force, which is argued to diminish their autonomous learning

motivation since the action of completing this activity is more likely to be externally regulated. This is justified by Jones *et al.* (2022), who concluded that when students are externally controlled by conditional rewards and extrinsic demands (e.g., compliance) that are not able to be internalised, this may engender a sense of external or internal pressure, anxiety, or feelings of guilt, which may, in turn, drive to lower interest and effort in completing tasks. Generally, in flipped learning, it seems that the way that online pre-session activities are provided (e.g., autonomously or controlling) may impact students' motivation and their persistence to complete these tasks (Zainuddin, 2018; Huang *et al.*, 2019).

2.4.3 Flow Theory (FT)

Flow theory, proposed by Csikszentmihalyi (1990), states that students who experience immersion when performing challenging activities tend to experience the 'flow' state, leading to boosting active learning engagement. Although it is a process more than a theory, this is a holistic approach that offers a widely held view of intrinsic motivation; it concerns situations where psychological influences promote enjoyment and engagement among learners by explaining the conditions in which students feel that an experience is intrinsically rewarding (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009). Several studies poignantly disclosed that the state of flow, in which students experience a sense of intrinsic enjoyment and immersion when involved in a learning task that challenges them at a suitable difficulty level, may lead to stimulating their motivation (Hamari & Sjöblom, 2017; Jaguš *et al.*, 2018; Zainuddin *et al.*, 2021).

According to this theory, in order to achieve a flow state in a learning situation, four conditions should be considered: 1) achievable learning objectives; 2) instant feedback on performance; 3) optimal challenges that can engender feelings of competence and loss of reflective self-consciousness; 4) understand the usefulness of these challenges provided in scaffolding skills (Nakamura & Csikszentmihalyi, 2009). This means that to design gamified learning activities based on the FT, one possible way is to: identify understandable and achievable pedagogical goals; provide students with immediate progression-supportive feedback (e.g., use a progress bar to indicate their progress); and design optimal competitive tasks based on students' skills, hand in hand with clarifying the benefits and usefulness of performing these challenges appropriately. The importance of providing students with optimal challenging activities parallels

the notion of the competence principle of SDT, which is a basis for self-motivation (Deci & Ryan, 2000).

However, FT does not patently address phenomena such as different motivation levels and whether different states of perceived locus of causality affect these levels (Reeve & Jang, 2006). When performing learning activities, students may do this for various reasons or motives. For example, in the gamified FVC context, one student may perform pre-session activities because these are perceived as useful, valuable, interesting, or enjoyable, while another student may do a task because of its direct role in the course's formal grades or basically to avoid feelings of guilt or shame for attending in-class sessions unprepared. This sheds light on the importance of considering the attribution of different motivation causes and underpinning reasons (i.e., external or internal to the self) that may drive other forms of motivation and, more importantly, under what circumstances these reasons can be internalised.

Furthermore, although FT emphasises the importance of providing optimal challenges for the learner, basing intrinsic motivation only on this provision seems inadequate, particularly in the gamified FVC context, since this theory seems more applicable to individual competitive situations rather than explaining how to motivate students when engaging in team-based competitions. Individual competition may lead some learners to feel isolated, stressed, and frustrated when comparing their individual performances or positions on the leaderboard with those of their peers (Hanus & Fox, 2015). Competition should be constructive rather than destructive, providing fun and collaborative learning situations where students grow positive interpersonal relationships without controlling factors such as pressure (Fülöp, 2009; Hanus & Fox, 2015). Since students in online flipped learning are often required to engage in collaborative activities (Akçayır & Akçayır, 2018), it is crucial to consider how to create a collaboration-supportive environment within a robust theoretical framework.

2.4.4 Goal-Setting Theory (GST)

Goals are what a person consciously strives to achieve; when these goals are clear, specific, understandable, and achievable, they are claimed to impact students' motivation and learning achievement (Locke & Latham, 2002). This theory suggests that to design motivating learning environments, four pillars that link the required goals with the learner's performance

should be taken into consideration: 1) situate clear and achievable goals; 2) support commitment towards these goals; 3) provide feedback on progression to reduce the negative impact of the situational constraints and difficulties associated with performing the given learning tasks; 4) support students in evaluating their own progress (Schunk, 1991; Locke & Latham, 2002, 2006; Landers, 2014). Based on these principles, designing gamified learning settings may require elements that: indicate students' progression (e.g. progress bars); show their different achievement levels (e.g., points and badges); engender a sense of competition by integrating challenging tasks (e.g., leaderboards); and provide instant feedback for each gamified task (Huang & Hew, 2018). Designing a gamified learning environment that supports setting clear and challenging goals hand in hand with providing feedback may increase one's determination to achieve those goals and is likely to improve performance in learning activities (Reiners & Wood, 2015). Research on GST shows that when providing specific challenging goals, the performance rate could increase by 10%, while the percentage might reach 17% when accompanied by feedback to support progression ability (Mento *et al.*, 1987). The importance of balancing goals and the capability to accomplish them is generally in line with the conditions for boosting the state of the flow in FT (Csikszentmihalyi, 1990), demonstrating its effectiveness in learning environment design as a robust theoretical framework.

Nonetheless, GST seems to concentrate on goal-based performance; the extent to which learners are committed to their goals may impact their persistence and the strength of the relationship between these goals and performance (Locke & Latham, 2002). Goal commitment is reported to be strong when one sees this goal as valuable and feels competent to achieve it (Locke & Latham, 1990; Ryan, 2019). Several empirical studies on GST-based gamification design have reported that some game elements (e.g., points and badges) may fully drive students' attention towards performing learning activities to achieve external goals (i.e., extrinsic rewards) (Landers *et al.*, 2017), which may undermine the learner's inherent motivation. For instance, Anderson *et al.* (2014) created a gamified MOOC course offered on Coursera and presented some badges based on goal-setting design. The findings indicate that although such a design motivated students to perform more reading compared to peers in a control class, they did not complete more activities when no badges were given. One possible explanation is that these gamification elements might be perceived as controlling or conditional rewards linked with performing

mandatory, rather than optional, tasks, leading some students to stop the desired behaviour once the rewards are stopped. It is crucial, therefore, to distinguish between external and internal motives behind a goal. Moreover, GST might not be sufficient to formulate collaboration-supportive learning, which is often essential in FVC contexts. This theory does not explicitly acknowledge the importance of supporting the group autonomy factor and the feelings of connection and belonging among students when working in groups, which is perhaps one of its perceived weaknesses when using it as a theoretical framework for a gamified FVC design.

2.4.5 Social Comparison Theory (SCT)

SCT states that people tend to evaluate their opinions and abilities based on those of others (Festinger, 1954). Students may compare their performances with those of peers in two ways: upward comparison, which may happen when they evaluate their own performance against more competent classmates and think that they are capable of performing like them; and downward comparison, when they compare their performance levels with those who are lower achievers (Molleman *et al.*, 2007). Based on this theory, some gamification elements, such as points, badges, and leaderboards through low-stakes assessments, may help students to drive self-evaluation and social comparison. To illustrate, the number of points earned or the ranking list of achievers presented on a leaderboard may facilitate upward-identification comparisons, possibly leading to positive effects on students' engagement (Chen & Chen, 2015). Although such design may provide chances for some learners to improve (Huang & Hew, 2018; Huang *et al.*, 2019), the social comparison factor can be a double-edged sword because of its ability to engender either constructive or destructive types of competition (Molleman *et al.*, 2007), depending on its nature and function, the way students conceptualise each other, and the extent to which they perceive winning or losing (Fülöp, 2009). While constructive competition is likely to occur when students aim to help each other learn in a non-controlling team-based learning environment, destructive competition is more likely to happen when students individually concentrate on beating each other, potentially driving them to feel stress, frustration, envy, or inadequacy (Rigby & Ryan, 2011). This echoes the importance of considering students' psychological needs for being related to each other rather than feeling lonely in a competitive

environment where the learner compares their performance individually with peers, which may lead to diminishing their internalised motivation.

2.4.6 Behaviour Reinforcement Theory (BRT)

The behaviourist Skinner (1953) postulated that rewards are reinforcements for new behaviour that can help people to develop corresponding habits. BRT recommends that to sustain and support desired behaviours, continuous reinforcements or scheduled incentives can be provided to the learner at the first stage of new behaviour, thus boosting every correct response. After mastering this behaviour, it can be changed to an intermittent reinforcement schedule in the next stage (Skinner, 1953, 1989). The application of this strategy to a gamified setting requires the use of gamification elements to provide positive and frequent reinforcement for every correct response. Despite being virtual rewards, these elements can still be utilised to boost or even maintain the frequency of a targeted behaviour (Landers *et al.*, 2015) or reduce the possibility or frequency of unwanted actions by removing such reinforcements or using them as punishment (Skinner, 1953). According to BRT, the motivation to complete instructional activities is a product of reinforcements or external incentives, and continuous reinforcements are necessary for students to progress and persevere.

BRT can be implemented in gamified learning practices by awarding intermittent badges to students who properly participate in learning activities, which may lead to better performance (Bai *et al.*, 2020). However, applying BRT in gamification designs has often been criticised for its tendency to control recurrent behaviour by using game elements merely as conditioned reinforcers (Landers *et al.*, 2015), which may undermine students' internalisation of the reasons behind their behaviour (Ryan & Deci, 2017). It is argued that the desired behaviour or action is likely to be extinguished once these continuous reinforcements or external rewards are removed (Reiners & Wood, 2015; Landers *et al.*, 2017). Moreover, it seems that BRT acknowledges only one type of motivation, alluding to the notion that students often perceive their actions as being controlled by evaluations of significant others (Deci *et al.*, 2017). Behaviouralist-based gamification may, therefore, raise concerns regarding neglecting students' feelings and driving them to focus merely on gaining contingent rewards and accumulating virtual wealth. Based on this, applying this theory as a theoretical framework for the gamified FVC's design could

negatively affect students' perceived internal locus of causality. In other words, rather than performing online pre-session activities based on their inner desire and volition, they may unwillingly perform them to obtain a good scores-based evaluation by the teacher or to avoid failure in the instructional course in a stressful learning environment.

2.5 Learning Motivation Within SDT

Motivating students to engage with learning materials is a fundamental goal of any educational course, whether in universities or schools. In pedagogical practice, motivation is considered one of the most important factors that is reported to promote students' performance and achievement (Zainuddin & Halili, 2016), diminish the possibility of dropout, and strengthen participation in learning situations (Chen & Chen, 2015; Aboraya & Elkot, 2020). More specifically, it is suggested that highly motivated students are likely to be more receptive to flipped-class instructions (He *et al.*, 2016). In order to stimulate students' autonomous learning motivation, basic psychological needs and relevant supportive situations must be understood (Ryan & Deci, 2000b). This is demonstrated by SDT, which sheds light on three psychological needs seen as particularly fundamental and motivational resources. Unlike many behaviouristic theories that concentrate on motivation from the outside or as a unitary concept, SDT is a broad organismic theory with effective applications for education that aims to understand how external and internal factors can influence different types of motivation among students (Ryan & Deci, 2020).

Based on this theory, motivation can be divided into controlled and autonomous types, and both of them, depending on the desired learning objectives, have a crucial role in enhancing learning outcomes (Benita *et al.*, 2014; Krijgsman *et al.*, 2017; Zainuddin, 2018). The highest type of autonomous motivation is that generated by intrinsic motivators associated with students' willingness to interact with learning activities when they find them interesting, enjoyable, and engaging, while, paradoxically, controlled motivation is epitomised by students' desire to get extrinsic rewards or to avoid being criticised or punished in a learning situation where the perceived autonomy is likely to be low (Deci & Ryan, 2000). Although the key differentiation between intrinsic and extrinsic motivation pertains to the nature of each category and the perceived locus of causality, in many cases, learners are likely to internalise extrinsic motivation as autonomous motivation (Deci & Ryan, 2004; Taylor *et al.*, 2014; Kalogiannakis *et al.*, 2021).

Autonomous motivation can be identified from its direct linkages to actions that students take as a result of their internal desire to engage in learning activities (Ryan & Deci, 2000a). The levels of this type of motivation are associated with the extent to which students gain satisfaction for the three inherent needs (i.e., autonomy, competence, and relatedness) when performing and engaging in an instructional task (*ibid*). This suggests that autonomously motivating activities may interest and challenge students; however, their reward will be their feelings of inherent satisfaction.

2.5.1 Why SDT?

SDT has been chosen for the current study as a theoretical framework since its perspective is constructed based on a wide range of motivational components which partly overlap with numerous other perspectives, and are underpinned by many key motivation theories; besides its practical applications that have been widely reported in the contexts of gamification (Ryan *et al.*, 2006; Rigby & Ryan, 2011; Zainuddin, 2018; Ofosu-Ampong, 2020). For instance, although labelled with different terms, competence and/or relatedness principles are, at least partially, mentioned across many process motivation theories (e.g., self-efficacy, social-comparison, and flow theories). However, one main difference between these theories and SDT is that the latter emphasises the role of the perceived locus of causality and views the autonomy factor as one of the main causal influences of self-determined motivation, in addition to competence and relatedness (Reeve & Jang, 2006). Accordingly, autonomy, a focal factor for adaptive functioning and autonomous motivation, is described as “self-regulation and integration in acting” (Ryan & Deci, 2017, p. 402). Thus, SDT conceptualises the role of autonomy support in the extent to which external motivation can be internalised, and the satisfaction of competence and relatedness psychological needs is facilitated, while controlling contexts and situations are hypothesised to disrupt the satisfaction of autonomy and the other two needs.

Moreover, many contemporary motivation theories that distinguish between external control and self-control conceptualise the latter as a positive motivation factor; however, self-controlled motivation may not always result in high-quality motivation (Niemic & Ryan, 2009; Ryan & Deci, 2017). In other words, students’ motivation can be controlled by various reasons associated with the self that should be taken into consideration. These may include, for instance,

the attempts to avoid feelings of guilt or shame that may result from failing to complete an activity or to gain a personal reputation in the class or other reasons such as perceiving an activity as useful or valuable for success in other university courses or real-life situations. Since these reasons can engender various types or levels of motivation, the SDT may provide a more extended framework to classify and characterise different forms of controlled and autonomous motivation, as well as to explain how to internalise external types of motivation (Ryan & Deci, 2000b).

It is widely acknowledged that the online flipped learning strategy, which was utilised in the gamified FVC, often incorporates collaborative learning as a fundamental axis (Akçayır & Akçayır, 2018; Phillips & O’Flaherty, 2019; Marshall & Kostka, 2020). It allows students to work in group-based activities and learn collaboratively both in and out of class sessions. This strategy also emphasises learners’ autonomous learning when performing online pre-session activities in which they may accept responsibility for their learning and regulate their actions to complete these tasks independently and volitionally before attending the online class (Wang, 2019).

In addition, looking at the pertinent literature, one aim of integrating gamification into flipped learning is typically to create competitive learning situations, which goes hand in hand with providing feedback-supportive practices in which students may feel a sense of self-efficacy or competence when performing the gamified learning tasks (Huang *et al.*, 2019; Sailer & Sailer, 2020; Zainuddin *et al.*, 2021). Based on these resolves, designing the gamified FVC based on a theoretical framework while considering these aspects seems crucial. It could be true that several motivation theories may provide a basis for supporting collaborative learning (e.g., social comparison theory) or competitive learning situations (e.g., self-efficacy theory, flow theory, goal-setting theory, reinforcement theory, and social comparison theory) (see Table 2.2). However, unlike SDT, these theories do not explicitly explain whether pre-session learning activities should be provided as mandatory tasks that students must complete or as optional tasks that they volitionally choose to do. A critical comparison is provided in section 2.4.

Table 2.2: Guiding Gamified FVC Design Checklist for Choosing a Motivation Theory

Theory Design question	SET	SDT	GST	SCT	BRT	FT
Are the students offered choices to find what most suits their interests?		✓				
How are social features of gamification explicitly included in the gamified FVC?		✓		✓		
How should the gamified FVC be explicitly designed to support students in working on shared goals?		✓	✓			
Does the gamified FVC emphasise the importance of success belief in performing the given learning tasks?	✓					✓
How should the gamified FVC be explicitly designed to support students earning points and badges while reducing the feeling of external pressure?		✓				✓
How do students feel connected to others?		✓	✓	✓		
How should the gamified FVC explicitly provide students with rewards for performing the learning tasks?		✓			✓	
How should the task's deadline be given?	✓	✓	✓		✓	✓
Does the gamified FVC allow students to communicate with peers?		✓	✓	✓		
How to design team-based gamification in a way that supports positive competition?		✓		✓		
How should gamified pre-session tasks be provided (e.g., compulsory or optional)?		✓			✓	
How should the gamified FVC be explicitly designed to generate the feeling of accomplishment while performing pre-session activities?	✓	✓				✓
How should feedback be provided in a way that may support students' progression?	✓	✓	✓			✓
How does the gamified FVC approach the notion of being responsible for performing pre-session activities?		✓	✓			
How should the gamified FVC be designed to support the internalisation process when performing the gamified pre-session tasks?		✓				✓
How should the gamified FVC be explicitly designed to provide collaborative and competitive learning tasks?		✓	✓	✓		
How should challenging tasks be designed in a way that considers students' abilities?	✓	✓	✓			✓

Indeed, the perceived locus of causality and control can play a vital role in students' motivation since the reasons underpinning behaviours may influence the quality of motivation and its internalisation process. Hence, based on the review of motivation theories provided earlier in this chapter (section 4.2) and the guiding gamified FVC design questions' checklist shown in Table 2.2, SDT was hypothesised in the current study to provide a theoretical framework for a possible motivating gamified FVC, in which the provision of pre-session activities and collaborative and competitive learning aspects are considered and theoretically framed.

2.5.2 Critique of SDT

SDT is a process motivation theory that has been empirically researched for over 40 years. It distinguishes between different levels of controlled and autonomous motivation as one of its core principles (see Figure 2.4). For instance, students might be intrinsically motivated when they find a learning activity engaging, while their motivation may be controlled when they experience external or internal forces or feel that they must act (Ryan & Deci, 2017). However, several empirical studies utilised SDT as a theoretical framework and reported mixed findings (e.g., Taylor *et al.*, 2014; Zainuddin, 2018; Schürmann & Quaiser-Pohl, 2022). Although this theory has been considered a common motivation theory in various fields, including education, work environments, and health, it does not go without criticism.

One major critique of SDT could be that allowing students to autonomously perform out-of-class work without imposing deadlines as external prompting to submit their work on time is extremely rare in formal education environments. Amabile *et al.* (1976) conducted an experimental study to investigate the effect of imposing external deadlines on students' interest in a word game task. The study concluded that giving deadlines could undermine the autonomous type of motivation among students. Similarly, Reader and Dollinger (1982) examined the impact of providing learning activities with or without time constraints. The findings stressed that tasks bound by deadlines negatively impacted students' autonomous motivation compared to those assigned without deadlines. Therefore, it is argued that such deadline-based tasks can never be truly autonomously motivating.

Indeed, learning tasks with deadlines can be controlling when they drive students to perceive the locus of causality for their behaviours as external (Amabile *et al.*, 1976; Chia *et al.*,

2016). This may occur when using such imposed demands as an attempt to force them to complete a learning activity, which may drive them to feel pressured or have a sense of ‘*must do*’, thus reducing their interest in the activity (Sheldon & Filak, 2008). However, deadlines can be perceived or even presented either as controlling or non-controlling goals, depending on how these represent the reasons for pursuing the goals (Ryan & Deci, 2017). In other words, the context in which the deadline is provided may positively or negatively impact motivation. When autonomous students are given a deadline for an activity submission, they are basically being advised to set a goal for themselves. To illustrate, a context in which students have the freedom to choose what to complete from optional forms of online pre-session learning activities, based on their own desire and volition, might have a different effect on motivation compared to another situation in which students are asked to do compulsory activities, although both involve deadlines. Benita *et al.* (2014) compared autonomous versus controlled classroom settings in relation to goals (e.g., submission deadline) and found that providing these goals in autonomy-supportive situations could positively impact students’ emotional experiences and engender more interest and engagement than the context in which the motives behind the goals were externally controlled. Reeve and Jang (2006) justified this by concluding that deadlines and such external factors may internally motivate students when perceived as volitional opportunities for choices instead of mere constraints. It is therefore claimed that goals, including deadlines, can be motivation-supportive when they are achievable and set in autonomous and non-controlling ways based on clear rationales that reflect usefulness, self-endorsed values, and interests (Deci & Ryan, 2000). Internalising the “why” component of goal pursuits, such as a task’s deadline, is the key to shifting students’ perceived locus of causality from external to internal, epitomised by the SDT’s taxonomy (see Figure 2.4) with the concept of controlled versus autonomous regulations (Ryan & Deci, 2017).

Moreover, building on the perspective of several personality theorists (e.g., Gough & Heilbrun, 1983; Murray, 2007), an argument can be made that having autonomy-supportive settings in which students experience full freedom without any demands, rules, expectations, schedules, or standards would simply result in chaos and a lack of clarity as to what they are supposed to do and how. In fact, autonomy is frequently and erroneously defined as the removal of structure, where students act without constraints or requirements (Reeve, 2006; Chia *et al.*,

2016; Neufeld, 2021). Being autonomously motivated does not imply that students are not subjected to these external influences but rather concerns the extent to which these external inputs reflect the direction they desire to follow (Ryan & Deci, 2017). According to SDT, students are expected to accept following the requirements voluntarily when they concur with those external demands. For instance, a student may willingly join a long queue for a lunch break because they believe in the value of following this rule, while another student who has not internalised its importance may join the line to avoid punishment or being criticised by others, so they feel controlled at that moment. A more pertinent example is when some students attend a series of workshops because attendance is required to get the course's certificate, while others may attend the same workshops due to their importance or value for their self-development aspects. Indeed, both groups may follow the same instructions and requirements, yet the behaviours of the first group might be motivated by external influence (e.g., receiving the certificate). In contrast, the other group might internalise the instructions and requirements of the course because their actions were autonomously motivated. Thus, it can be said that autonomy concerns the legitimacy of the imposed restraints or demands.

Similarly, allowing students to take responsibility for their learning does not necessarily contradict the internalisation of motivation. It is argued that a student can willingly and volitionally endorse and accept responsibility to direct their own learning based on the desired goals; when the provided instructional materials or learning situations are in line with what they want to do or achieve, they are perceived as internally valuable or interesting (Ryan & Deci, 2017). This means that the effect of responsibility on students' autonomous motivation is likely to pertain to how such an obligation is taken and perceived. Students in an autonomy-supportive learning setting may endorse and accept taking ownership of their learning progress when: they are provided with convincing rationales for engaging in the learning activities (Reeve & Jang, 2006); it is articulated why the undertaking is important or useful (Liu *et al.*, 2016); the choice is emphasised instead of controlling instructions (Ryan *et al.*, 2006); progress-supportive feedback is offered (Fong *et al.*, 2019); self-evaluation is encouraged rather than formal grading, avoiding stressful or threatening demands on them (Vansteenkiste & Ryan, 2013). These elements, according to Ryan and Deci (2000a), are theorised to conduce internalising responsibility and valuing extrinsic goals.

Another critique of SDT is that while autonomous learning can be beneficial for independent students, it may not be suitable for those more dependent on instructors. This criticism stems from the perspective that casts autonomy merely as independence and detachment (e.g., Jordan, 1991; Markus & Kitayama, 1991) rather than volition, choice, freedom, and concurrence (Deci & Ryan, 2000). SDT indeed implies that independence can be a situation that is conducive to autonomy; however, independent learning does not fully describe the concept of autonomous learning. The theory strongly distinguishes between independence and autonomy and argues that students can be autonomously dependent or autonomously independent (Chirkov *et al.*, 2003; Ryan & Deci, 2017). Accordingly, in autonomy-supportive learning contexts, dependent students may willingly and autonomously seek help, feedback, or guidance from the instructor or peers, and this is often a positive behaviour facilitated in such environments. In other words, autonomous dependent students can be provided with choices of various forms of gamified learning tasks so that they can freely and volitionally choose what to complete. They can take control of their own learning but may still rely or reflect on external guidance and seek support to some extent to help them progress and achieve their goals (Chirkov *et al.*, 2003). Therefore, an autonomy-supportive instructor can play an essential role as an assistant for those who autonomously ask for guidance and a facilitator for their development as autonomous learners (Reeve & Jang, 2006).

2.6 Gamified Online Course Designs

Gamified online learning courses that consist of a set of game elements require a sophisticated design for each element. Depending on how this is designed, the same set of gamification elements applied with different designs can result in different effects on learning outcomes (Ding, 2019). The blind application of gamification without an adequate understanding of the relevant psychological influences may generate a reverse effect on students' performance and motivation (Hanus & Fox, 2015). It is claimed that gamification can promote learning motivation only when executed properly. This is alluded to by Páez-Quinde *et al.* (2021), who emphasise that three critical elements should be considered when implementing gamification in online learning contexts. These are 1) gamification elements used in the educational course should be linked to a very specific topic or content; 2) these elements should not be integrated

without a precise purpose, but rather, they should be used to facilitate understanding the value of each gamified task; 3) the strategy used in these gamified tasks should not be too complex to avoid possible negative consequences, and the desired goals of the gamified learning must be achievable. Although the importance of designing gamified online learning based on robust theoretical frameworks (Toda *et al.*, 2019), there is a scarcity of research evidence based on theoretical foundations to sufficiently explain the motivational effectiveness of gamification as a possible instructional intervention (Sanchez *et al.*, 2020; Kalogiannakis *et al.*, 2021; Khaldi *et al.*, 2023). This suggests the importance of understanding how such game elements, in their operational and practical forms, can facilitate the design of effective gamified learning platforms in a way that maintains or stimulates students' motivation. According to a qualitative study conducted by Oe *et al.* (2020), if appropriately designed, gamification could play a vital role in supporting students' self-learning during Covid-19 lockdown periods, when learning needs to be delivered entirely remotely. Recent publications on gamification in online learning contexts investigate the concepts of different designs utilised to boost students' levels of motivation and engagement (Zainuddin *et al.*, 2020; Lin *et al.*, 2021; Xiao & Hew, 2023; Lopes *et al.*, 2024). Reviewing various aspects of game element designs and their relationships with intrinsic and extrinsic motivation provides the researcher with building blocks for classifying gamification-based learning designs into two major categories.

2.6.1 Extrinsic Reward-Based Gamification Design

The application of gamification based on extrinsic rewards mainly utilises points, badges, and leaderboards with the aim of encouraging students to engage in their learning (Hanus & Fox, 2015; Toda *et al.*, 2019). Such an approach can be a powerful motivator when it boosts the desire for rewards through completing a learning task (Kuo & Chuang, 2016). It is also a possible way to incentivise the learner to start engaging in instructional activities (Nicholson, 2012b; Forndran & Zacharias, 2019). Reward-based gamification as an extrinsic motivator is reported, in some cases, to engender competitive learning situations, which could, in turn, foster students' performance (De-Marcos *et al.*, 2016). For instance, a study conducted by Evans *et al.* (2013) sheds light on the utilisation of badges as a gamified system in evaluating learning outcomes. The findings indicate that learning could be acquired by repeating an action a certain number of times to gain rewards.

This means that such reward mechanisms may strengthen students' performance if they are allowed to repeat and try to complete learning activities that pertain to earning particular badges.

However, it is implied that this positive effect might result from the novelty of gamification, which is likely to fade over time as a short-term impact (Koivisto & Hamari, 2014). This suggests that gamified activities that focus merely on incentivising students might be suitable for some learning situations. According to Reiners and Wood (2015), such an approach can be beneficial when the learning environment aims to achieve immediate or short-term changes in students' behaviour (e.g., encourage students to start their engagement in an activity). In many cases, gamification in this mould tends to generate an instant increase in students' engagement, as they often endeavour to discover such new gamified settings (Nicholson, 2015). If performing learning activities must be based on such external rewards with the aim of motivating students, sooner or later, they may not show a genuine interest in these activities (Landers *et al.*, 2015). In many educational institutions, controlling strategies are often the predominant scenario as a formal approach instead of harnessing gamification in supporting the internalisation process of motivation among students (Ryan & Deci, 2017). Hence, care should be taken when using reward-based gamification design or scheduled rewards to ensure that the desired learning objectives are achieved (Hanus & Fox, 2015).

2.6.2 Meaningful Gamification Design

Meaningful gamification can be described as the utilisation of game elements to help students find interests and meaning in a non-game setting, in parallel with facilitating their learning through building self-determined learning motivation (Nicholson, 2012b). Although the fact that each student has a different frame of interest, and what is meaningful for some students might not be the case for others, the notion of meaningful gamification is to focus not only on rewarding them as achievers but also on enabling them to find what triggers their interests by harnessing optional forms of gamified student-focused activities (Tan & Hew, 2016) that can facilitate the internalisation of those tasks (Liu *et al.*, 2016). Facey-Shaw *et al.* (2020) emphasise that badges should attract students and represent their accomplishments and achievement efforts rather than being used simply as attendance badges, which might not be seen as valuable. This coincides with organismic integration theory (OIT) (Deci *et al.*, 1996), which stresses that

when students interact with learning activities because they find them attractive, they are likely to have autonomous motivation and more positive perspectives towards those activities than when they are driven by external motivators such as conditional rewards or punishments that are perceived as formal scores (Deci & Ryan, 2004). One significant problem with using gamification merely as a formal scoring system might be that it could replace internal with external motivation due to the controlling concepts of such evaluation systems, which may result in reduced autonomy among students (Mekler *et al.*, 2017).

To develop gamified learning strategies that harness gamification meaningfully, Nicholson's study (2012a) explored the concepts behind meaningful learning. The author emphasised that learning approaches need to enable students to opt for when and how to engage and socialise with peers based on shared perspectives in a non-controlling, playful and collaborative learning environment. Accordingly, encouraging students to learn from each other's views and exchange their thoughts in gamification and team-based learning contexts is likely to create meaningful engagement and positive perception (Lopes *et al.*, 2024). This particular notion is also supported by Bandura's social learning theory, which claims that students can learn by observing and imitating the observable behaviours of peers and that both cognitive and environmental factors can affect their learning progress (Bandura, 1971). Therefore, meaningful learning and social relatedness can be provided by motivating students to participate in teamwork tasks in the same gamified system, and most importantly, they should not be forced to socialise immediately during the initial stages of using this system to allow them to become accustomed to it; otherwise, it could drive them away from their learning (Nicholson, 2012a). Indeed, the ideology of providing team-based gamification is supported by SDT, which stresses that students' social relatedness can play an essential role in stimulating positive mental well-being and inherent propensities (Deci & Ryan, 2004). However, it is worth noting that group interaction is not equivalent to the concept of social relatedness; increasing inter-group communication does not necessarily mean that students' performance is supported (Warden *et al.*, 2024).

Although some studies have revealed that creating gamified competitive learning situations might motivate certain types of students to engage actively in their learning (e.g.,

Jagušt *et al.*, 2018; Zainuddin *et al.*, 2020), the same situations may also discourage others and could generate a sense of anxiety and frustration as a consequence of losing points while performing learning tasks (Hanus & Fox, 2015; Ding *et al.*, 2018). In other words, some students who are top-scoring might be motivated as a result of gaining the largest accumulation of points shown on the public leaderboard, while others may feel frustrated if they lack points (Landers *et al.*, 2015). Such gamified learning activities, however, are often designed as single-learner experiences that encourage students to compete individually rather than collaboratively (Nicholson, 2015). Creating competitive situations based on individual competition, in which the student focuses merely on personal success in a negative sense or on the classmate as someone who must be beaten or removed from the competitive process, may negatively impact students' collaboration and could yield more external types of motivation (Fülöp, 2009). In contrast, supporting competitive learning environments by utilising team-based motivators is likely to contribute to perceiving the feeling of social relatedness as an internal reward among the group members (*ibid*). Following this line of thought, Perryer *et al.* (2016) argued that gamification designs should facilitate students' need satisfaction by emphasising collaborative competition rather than mere individual competition. This means that engaging learners in competitive activities through team-based gamification design can arguably encourage them to concentrate on their individual roles as important group members; thus, they may strive to contribute to their team by completing the learning activities (Greener, 2015; Chen & Hwang, 2018; Ellsworth, 2018; Huang *et al.*, 2019).

Moreover, instead of relying on a single learning resource or viewpoint, as Mayer *et al.* (1999, cited in Hill & Brunvan, 2018) argue, students should gain opportunities to construct their own meaningful learning from various perspectives and representations of the same material. The notion of providing such opportunities is supported by the SDT, which emphasises that learners should experience a sense of freedom and volition while learning in a way which increases their autonomous motivation (Ryan & Deci, 2017). In addition, well-designed meaningful gamification may combine competitive and collaborative factors through previous allegiances, such as in football teams, thereby producing challenging learning situations that require students to engage collaboratively for the team's sake (Nicholson, 2015). Such a

combination may encourage each group member to focus on his responsibility and work effectively with his team to achieve the shared goals.

Under the umbrella of collaborative learning, this may underpin the provision of peer feedback and the sharing of goals, knowledge, and ideas among students, leading them to feel capable, competent, and socially related (Chen & Chen, 2015; Sailer *et al.*, 2017). One method to achieve this is to integrate the concept of gamification into a learning strategy underpinned by SDT. This approach is hypothesised to facilitate non-controlling team-based learning by motivating students to engage in competitive in-class tasks while constructing their learning based on pre-class instructional activities (Tan & Hew, 2016). This is also echoed by Tan's (2018) study, which investigates the impact of designing a meaningful gamified flipped classroom on students' motivation levels in a higher education context. The findings indicate a positive influence on students' autonomous motivation, comprehension, and completion rates when engaging with gamified learning materials. It can be argued that autonomous motivation is likely to be enhanced when learning situations promote autonomy, competence, and relatedness by considering the motivation-supportive aspects of gamification (Ryan & Deci, 2017).

Table 2.3: MDA Gamification Approach Adapted from Zichermann and Cunningham (2011)

Mechanic: Includes the gamification elements used to construct the gamified system and represent the play rules.	Dynamic: Represents the interaction with the elements	Aesthetic: Concerns the feelings and emotions evoked by the interaction with the elements	Possible support for SDT factors
Points	Accumulate points / Self-monitoring	Accomplishment	Competence
Badges	Competition	Recognition/Acknowledgement	
Leader board	Positions	Progress/mastery/effectiveness	
Progress bar	Progression status		
Unlock extra tasks	Levels		
Team name / Logo / Avatar	Team collaboration	Team loyalty / Trust / Care	Relatedness
Play again	Try and fail	Freedom	Autonomy
Different paths of tasks with different numbers of points and types of badges	Decision making	Choice	

Gamification elements can mainly be categorised into three aspects, namely, mechanics, dynamics, and aesthetics (Zichermann & Cunningham, 2011; Harms *et al.*, 2014). As Table 2.3 shows, the mechanical aspect of gamification encompasses elements such as points, badges, leaderboards, and progress bars as foundational components that construct a gamified system or platform and often appear on its user interface to represent the mechanical processes or the play rules used. Moreover, the dynamic aspect concerns operating gamification mechanisms and represents the situations in which students interact with these mechanisms (e.g., competition, changes in progression status and positions, team collaboration, and decision-making). The last aspect of gamification is the aesthetic element, which concerns the student's feelings, emotional responses, and reactions (e.g., a sense of accomplishment, mastery, team loyalty, freedom, and choice) resulting from involvement in the gamified system and the interaction with its elements. Therefore, when utilising SDT-based gamification, rather than solely focusing on the structural components or its aesthetics, it is crucial to consider all three aspects of each gamification element by understanding its function, purpose, and, most importantly, how this can target and promote each psychological basic need (i.e., autonomy, competence, or relatedness).

2.7 SDT, Enjoyment, and Gamification Research

The more regulations are internalised, the better autonomous motivation foundations are supported. According to SDT, this is based on the extent to which students perceive situational factors as supporters for their three basic needs underlying psychological wellness (Ryan & Deci, 2000a). One way to satisfy these needs is to support them by providing enjoyable learning situations, as several studies emphasise the appropriateness of defining and measuring enjoyment as a strong predictor for high-level autonomous motivation (Ryan, 2006; Tamborini *et al.*, 2010; Eyupoglu & Nietfeld, 2019; Ryan, 2019). These studies also suggest a relationship between the satisfaction of autonomy, competence, and relatedness needs and interest/enjoyment, considering the latter as a proxy for autonomous intrinsic motivation. Moreover, Tamborini *et al.* (2010) conducted an experimental study to validate this perspective of enjoyment by manipulating gamification elements based on satisfying these needs and examining their relative impacts on enjoyment. The findings reveal positive relationships between the satisfaction of these needs and enjoyment. The application of gamification can be associated

with the frustration or satisfaction of these innate needs. Based on SDT, the current study hypothesises that satisfying the three basic psychological needs through gamification may create an enjoyable and/or interesting learning environment, leading to a high level of autonomous motivation.

Indeed, the implementation of gamification may address factors that facilitate or undermine both intrinsic and extrinsic motives to affect or improve behaviour in learners (Jones *et al.*, 2022). Accordingly, this should be based on how a gamified learning environment is designed and what instructional objectives need to be achieved. In educational practices, since intrinsic motivation refers to students performing learning activities because they are inherently interesting or enjoyable, it is argued that motivation theories should address factors that are linked with supporting the hedonic elements of enjoyment in a way that may appeal to students' basic psychological needs and motivational propensities (Ryan *et al.*, 2006), which tend to promote self-determined forms of motivation (Ryan & Deci, 2000a). Learning activities that are enjoyable or interesting to students reflect how they are autonomously intrinsically motivated (Landers *et al.*, 2015). Designing gamified learning tasks based on SDT, as a motivational theory, is argued to produce a sense of enjoyment when the fun part of games is integrated into uninteresting learning contexts (Tamborini *et al.*, 2010; Jo *et al.*, 2018; Do *et al.*, 2023).

2.8 Structure Facilitates Internalisation and Gamified FVC

Providing the motivational factors within online flipped learning might be a key solution for one of the most reported problems in such learning environments, which is missing the assigned pre-session tasks by students (Palmer, 2015; Huang *et al.*, 2019; Stöhr *et al.*, 2020). One possible way to reduce the negative consequences of such a problem is through utilising autonomous motivation-supportive gamification elements in a way that can make students internalise the instructional tasks as important, useful, valuable, interesting or enjoyable. According to SDT, this can generally be achieved by supporting the feeling of being the owner of the learning, being capable of progressing successfully through learning tasks, and being an important part of a group or team (Deci & Ryan, 2004). Accordingly, the self-determination perspective emphasises the importance of the learning environment's design and the teachers' behaviours and actions in internalising and integrating students' motivation. Internalisation is

described as the transformation process of the regulation of action from outside the individual to emanate from their sense of self; the integrated regulation is the highest level of the autonomous form of extrinsic motivation (Ryan & Deci, 2000b). Based on Deci and Ryan's (2000) self-determination taxonomy (see Figure 2.4), students may begin engaging in learning activities because they feel extrinsically motivated; however, internalising extrinsic motivations can be facilitated depending on the context's structure and how they experience its situational factors.

When utilising points, badges, and leaderboards, it is acknowledged that these can be perceived as external rewards that may encourage low-motivated students or convince them to start engaging or participating in learning tasks (Gopalan *et al.*, 2017; Forndran & Zacharias, 2019). Indeed, at this point, they may have a low level of extrinsic motivation. Thought of as a continuum, the motivation reasons underpinning their engagement are likely to be internalised and become autonomous motivational cues (van Roy & Zaman, 2018) by shifting the locus of causality perceptions of students' actions gradually from external to become more internal (Ryan & Deci, 2017). This may encourage them to act based on self-endorsement of their goals, and get involved in the learning activities because they may find them inherently satisfying (Ryan & Deci, 2000a). One possible way to achieve these, according to SDT, is by supporting a sense of autonomy, competence, and relatedness through structuring an SDT-based teaching and learning environment in which the teacher acts as a facilitator for satisfying those three factors (Reeve, 2006). Understanding how to design such environments in which psychological needs are considered is much in demand (Ryan *et al.*, 2006; Zainuddin, 2018). Therefore, within SDT, gamified FVC is hypothesised in the current study to facilitate autonomous learning motivation and the internalisation of motivation reasons when it supports students' basic psychological needs, as demonstrated in the following sub-sections.

2.8.1 Autonomy-Supportive Gamification

Autonomy support suggests that students in the gamified FVC should be provided with choices or different forms of online pre-session learning activities so they may feel a sense of freedom to volitionally opt for what to complete based on their interests, rather than asking them to perform compulsory activities selected previously by others. This is theorised by SDT, stressing that students who experience a sense of agency and choice in their studies will likely feel more

ownership of learning activities and possibly high-level autonomy (Ryan & Deci, 2020). In addition, this theory argues that internalising or integrating the reasons behind extrinsic motivation is associated with the extent to which the three psychological needs are met and that autonomy is critical for this process (Cook & Artino, 2016; Ellsworth, 2018). One way to achieve this is to enable them to gain points by deciding which tasks they want to undertake from different types or forms of gamified instructional tasks and in what order they wish to complete them (Nicholson, 2015). In other words, to design effective gamified pre-class activities in a way that may support autonomy, different forms of these tasks should be worth different numbers of points so students can opt on what path they should take to reach the total number of points required from each member as a shared team-based goal (Klemke *et al.*, 2018; Saputro *et al.*, 2019), which may result in an enhanced autonomous motivation (Ryan & Deci, 2000a). Substantial evidence emphasises that autonomy-supportive teaching strategies can boost more autonomous types of motivation (Reeve, 2006), as well as high-quality engagement and performance, compared to controlling teaching strategies (Ryan & Deci, 2017).

Therefore, it is claimed that learning environments and instructors' behaviours can play essential roles in the internalisation process of motivation and the facilitation of shifting in the perceived locus of control from external to internal of the self (Reeve & Jang, 2006). From the perspective of SDT, this internalisation can be facilitated or hindered by the degree to which the instructor's teaching style is autonomy-supportive or controlling. Behaviours that have been reported to support students' autonomous motivation are as follows (Deci *et al.*, 1996; Reeve & Jang, 2006; Wallace *et al.*, 2014; Chia *et al.*, 2016; Fong *et al.*, 2019):

- a) Offer opportunities for students to get involved in performing the learning activities they find interesting. This may be achieved in the current study by providing choices and various forms of gamified pre-session tasks where possible and encouraging students to take responsibility for choosing what to perform from those tasks based on their own plan or shared goals (e.g., the number of points, value, or importance).
- b) Provide meaningful rationales for each gamified learning activity to explain its usefulness, importance, and value, possibly by referring the instructional content to real-life situations or future practices.

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- c) Listen and respond to students' questions and comments in a way that implies considering their perspectives and acknowledging their experiences and contributions.
 - d) Allow time for students' independent learning tasks and provide progress-enabling hints for those behind or facing difficulties (e.g., using a feedback-based progress bar).
 - e) Acknowledge their efforts, contribution to the team, and signs of improvement and mastery (e.g., using special badges).
 - f) Integrate autonomy-supportive language, such as '*you could do*' or '*you might consider*', into the instruction of the learning activities to imply that the student is in control of their own action.

In contrast, some instructional actions can be categorised as controlling behaviours and autonomy thwarts, including: providing students directly with the right answer before allowing them to try and try again; giving directives and commands without convincing rationales; and using controlling questions and words, such as "*you should*", "*you must*", and "*you have to*" (Reeve & Jang, 2006). Therefore, it might be important to consider the effect of instructional design and the adapted teaching and learning strategies on students' feelings of autonomy. Gamified flipped learning has been reported as a practical learning design in which the autonomy factor can be supported (Zainuddin, 2018; Zainuddin, Shujahat, *et al.*, 2019). It is argued that gamification and flipped learning, when combined and implemented carefully, may together promote students' autonomy, leading to greater motivation when dealing with learning situations (Parra-González *et al.*, 2020). It is also worth pointing out that autonomy-supportive teachers may also contribute to facilitating students' competence and relatedness (Ryan & Deci, 2017). The following subsections delineate some possible ways, mentioned in the relevant literature, that may fulfil the need for competence and relatedness among students.

2.8.2 Competence-Supportive Gamification

The need for competence signifies students' perceived effectiveness and mastery or belief in their ability to deal with the learning environment in which they are situated (Fong *et al.*, 2019). In other words, this psychological need is associated with students' perception of their ability to overcome situational challenges or obstacles; thus, they may feel capable of progressing in the learning process and acquiring new skills and concepts. It is argued that providing learning

situations in which students have the opportunity to learn new skills based on clear and achievable goals, hand in hand with offering cumulative feedback, can play a vital role in increasing the satisfaction of competence needs (Xi & Hamari, 2019). Taking into account the current study context, the satisfaction of the psychological need for competence, according to research (e.g., Peng *et al.*, 2012; Ryan & Deci, 2017; Jones *et al.*, 2022), can be supported within a well-designed learning environment, yet should be provided within an autonomy-supportive context that facilitates the following elements:

- a) Provide an optimal range of challenges (e.g., different forms of gamified pre-session tasks) that are moderately difficult in a way that engages students and provides them with a sense of accomplishment and progression.
- b) Identify misunderstandings and difficulties students may encounter when performing these pre-session activities to be demonstrated during the in-class sessions. In the gamified FVC, the instructor may review the leaderboard, which shows the accumulated points and badges students earned based on their performance and accomplishment of the gamified pre-session tasks so those who are behind or need help can be identified even before attending the online class.
- c) Supported by the above element, students may receive relevant and informational feedback in a non-controlling (non-judgmental) way to maintain their subsequent performance and their feeling of progression.
- d) Foster an internal, instead of external, perceived locus of evaluation. This means that the gamification elements (i.e., points, badges, progress bar, and leaderboard) should not be linked with the course's formal grades to evaluate the student's performance; instead, these elements can be used to enable self-monitoring of each of their progress.

2.8.3 Relatedness-Supportive Gamification

Relatedness refers to the feeling of connection and belonging to a group; SDT theorises relatedness as an inner psychological need that can influence students' learning motivation (Ryan & Deci, 2020). The satisfaction of the relatedness need is likely to be supported in the gamified FVC context when considering the following elements (Niemic & Ryan, 2009; Ryan & Deci, 2017; Saputro *et al.*, 2019):

-
- a) Offer opportunities for students to work with peers in team-like groups of four to six members and encourage team loyalty (e.g., using a specified team logo and name they choose to represent the team), hand in hand with paying attention to good collaborative attitudes that might be observed in these groups.
 - b) Provide students with choices of team-based gamified activities in which they can collaborate and earn points and badges as they perform them.
 - c) The points and badges collected by each group member should contribute to the total team points' account presented on a team-based leaderboard, so they compete together to level up their team's position. Those earned points may be perceived as shared goals among the team.
 - d) Support constructive team-based competition among students by showing care, respect, and emotional support and allowing them to help each other progress in their learning while competing rather than merely focusing on beating each other individually.
 - e) Offer spaces for discussion or chat rooms as social components to boost peer interactions.

Moreover, it is claimed that a learning environment that supports competence and relatedness but not autonomy may yield introjected regulation, a controlled type of motivation; while providing autonomy support in this context can arguably drive integrated self-regulation, an autonomous form of motivation (Ryan & Deci, 2000a). This may suggest that if an institution aims to improve the quality of the motivation level when performing a learning task, it might be crucial to ensure that the gamification aspects (i.e., Mechanic, Dynamic, Aesthetic) are designed to support the three psychological needs of autonomy, competence, and relatedness (Reiners & Wood, 2015; Sailer *et al.*, 2017). Accordingly, SDT-based gamification is hypothesised in the current study to contribute to supporting the innate psychological needs mentioned above in a way that may motivate students autonomously to learn.

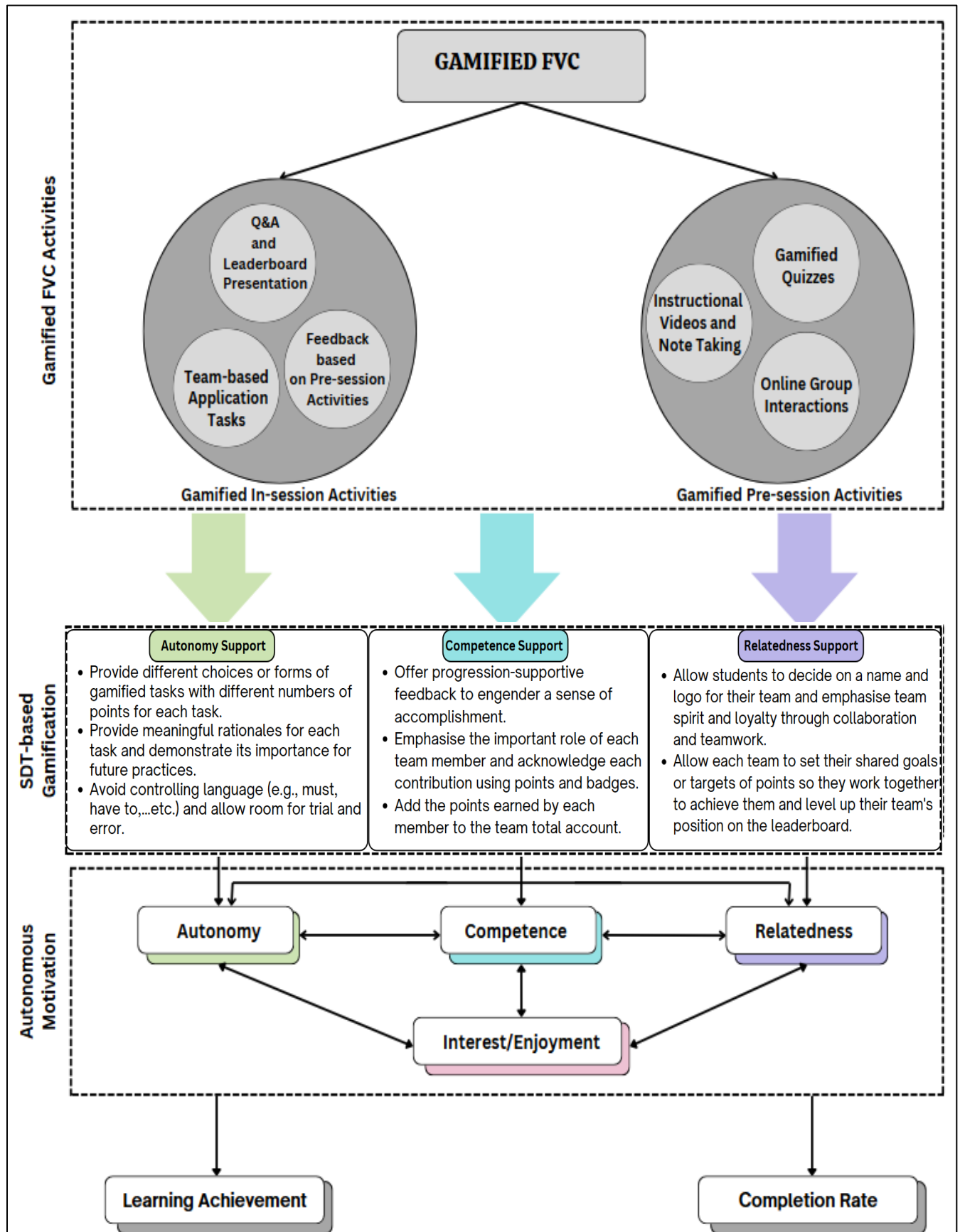


Figure 2.5: Conceptual Framework of the Study

Based on the discussion above, the conceptual framework of the current study illustrated in Figure 2.5 provides an overview of the research concepts and variables (this figure can be zoomed in for more readability). The gamified FVC mainly consists of pre-session tasks, including instructional videos, quizzes, and group interactions. In addition, it includes in-session activities such as Q&A, supportive feedback based on students' performance in the pre-session phase, and team-based tasks and applications. These activities are gamified based on SDT to provide supportive practices for the three psychological needs (i.e., autonomy, competence, and relatedness) considered predictors of autonomous motivation. The relationship between these three factors and the intrinsic motivation (i.e., interest/enjoyment) variable as well as the association between motivation and the completion rate variable, is also investigated to assess the strengths and directions of these possible associations. Finally, the effect of the gamified FVC on the completion rate and learning achievement is examined and explored.

2.9 Flipping Learning Through Gamification

The notion of integrating gamification into a contemporary pedagogical approach such as flipped learning is reported, in some studies, as an alternative and effective strategy to promote learning outcomes (Jo *et al.*, 2018; Zainuddin, 2018; Huang *et al.*, 2019; Lo & Hew, 2020; Zainuddin *et al.*, 2021). Although it has been indicated that gamification might have immediate and short-term positive effects on learning (Dichev & Dicheva, 2017), the integration of game mechanisms into flipped learning might be an influential method to enhance students' learning over the long run (Huang & Hew, 2018). In line with this, Lai and Foon (2019) conducted a two-year design-based study to examine the effectiveness of this incorporation in developing a self-designed learning platform. Their findings reveal that such integration increased completion rates of the learning activities by 80%, in conjunction with enhancing long-term learning, as the learners were motivated to engage in their learning of physics.

Indeed, gamification and flipped learning strategies can be easily combined since both are compatible with many online learning platforms (Ekici, 2021). Nevertheless, it is warned that learning outcomes resulting from the utilisation of gamification may differ based on several factors, including the nature of the learning environment, teacher behaviour, and the teaching strategy used. For instance, a study by Durrani *et al.* (2022), which is, to the best of the author's

knowledge, the only study conducted in an Arabic context to compare the impact of a gamified flipped classroom to a lecture-based class in two different undergraduate groups, carried out a research experiment lasted for over six weeks at a university in UAE. The data was quantitatively collected from 106 participants (experimental and control groups) who responded through an online survey, and then two focus groups of students were recruited and interviewed to collect data qualitatively. The results revealed that those in the comparison group who were taught in a traditional classroom achieved better than peers in the experimental group in which a gamified flipped-class method was utilised. These findings are inconsistent with the positive learning outcomes reported in several previous studies that have integrated gamification into conventional flipped learning (Aşıksoy, 2017; Huang & Hew, 2018; Sánchez *et al.*, 2020; Zainuddin *et al.*, 2021). However, in Durrani *et al.*' (2022) experimental research, the participants in the two groups were exposed to completely different subjects and content, as the experimental group was taught Accounting, Finance, Marketing, and Management, while the students' subjects in the control group were related to computer science. Such differences between the two groups may weaken the findings obtained since the content relevance could be an influential factor that this study did not consider.

Furthermore, significant research shows that shallow gamification might disorientate learners, lead to decrements in their autonomous motivation (Markopoulos *et al.*, 2015), and yield frustration (McDaniel *et al.*, 2012). In fact, when employing game elements in an ad hoc style, such as utilising leaderboards and badges, without considering their impact on students' psychological needs (Mora *et al.*, 2017), this may disregard a significant aspect of the integration of gamification into flipped learning, which may pertain to harnessing the motivational appeal of game elements effectively (Hanus & Fox, 2015). Indeed, the over-reliance on these elements, such as linking the formal course grades with how many points or badges students collected, is likely to frustrate some students and weaken their intrinsic interest levels (McDaniel *et al.*, 2012); thus, they may stop interacting with the assigned gamified learning materials, including pre-session tasks. This is supported by Mekler *et al.* (2013), who claim that if the aim of merging gamification into a flipped learning environment is to stimulate students' autonomous motivation, then the simple addition of points, levels, and leaderboards without theoretical underpinnings or framing would not be sufficient to design an engaging and meaningful gamified

system. To reiterate, the main goal of such incorporation is to positively impact certain factors, such as motivation and achievement, as well as to boost students' engagement in the learning content (Kalogiannakis *et al.*, 2021). It seems that the way that this content is structured, gamified, and presented is equally crucial, as it can affect learning quality (Huang & Soman, 2013). Despite the rapid development in digital teaching and learning toolkits based on gamification pedagogies, maintaining students' engagement and learning motivation in such student-centred approaches remains challenging and needs to be investigated further (Ding *et al.*, 2018; Durrani *et al.*, 2022).

Combining the merits of constructive competition with a spirit of cooperation through team-based gamification, as Zainuddin *et al.* (2020) argue, tends to promote students' engagement, motivation, and, consequently, learning outcomes. According to Deci and Ryan (2004), allowing students to interact collaboratively in non-controlling competitive learning activities may stimulate a sense of social relatedness, thus motivating them to engage in their learning autonomously. The non-gamified flipped learning strategy can be effective in promoting students' feelings of competence and mastery since they have opportunities to prepare and learn at least the basic knowledge provided through pre-class activities, which is essential to be acquired before attending in-class sessions. However, students must be motivated to engage in the pre-class part of flipped learning; otherwise, they may attend in-class sessions without preparation (Huang *et al.*, 2019; Stöhr *et al.*, 2020), affecting their competence and mastery of the subject (Mekler *et al.*, 2013; Sailer & Sailer, 2020).

In order to design competence-supportive flipped learning environments, SDT-based gamification can be integrated in a way that may help stimulate a sense of mastery, control, and progression among students (Zainuddin, Shujahat, *et al.*, 2019). This is coherent with the findings revealed by Sailer *et al.* (2017), which emphasise that badges, leaderboards, and performance graphs could positively impact students' competence needs; for example, performance bars can be utilised as visual indicators to reflect progress, while badges and leaderboards can be used to assess a series of individual's actions, thereby offering sustained and cumulative feedback. Therefore, the feedback aspects of gamification elements may evoke a feeling of competence, as this is directly linked with supporting the success of students' actions. Creating optimal challenges

and constructive competition are fundamental aspects of gamified learning task design, aiming to stretch students' abilities to new levels of mastery (Rigby & Ryan, 2011). In addition, challenging gamified quizzes connected with cumulative points, badges, leaderboards, and progress bars can be embedded into pre-session instructional activities, including pre-class videos, to test students' understanding, and accordingly, meaningful feedback based on their progression can be provided.

Moreover, keeping students linked with each other through team-based gamified tasks may have a great impact on motivating them to progress in their learning collaboratively, leading to the satisfaction of social relatedness needs (Aboraya & Elkot, 2020). According to Páez-Quinde *et al.* (2021), the social aspect of gamification can be provided when the achievement is socialised through collaborative challenges or missions perceived as shared goals. This notion may be supported in gamified flipped learning contexts where students are encouraged to collaborate and compete as teammates. Such cooperative reward structures may help them concentrate on interdependence, shared goals, and unified effort (Chen & Hwang, 2018). Flipped learning environments can be boosted by gamification features, including teams, competition, chat, and voting; these are likely to provide students with a sense of belonging as a result of experiencing high-frequency communication and role and idea exchanges (Francisco-Aparicio *et al.*, 2013; Xi & Hamari, 2019).

Based on this reasoning, the FVC can be gamified with an adherence to the SDT principles as an attempt to fulfil the three inherent motivational needs, which may help steer students' learning motivation in the right direction (Sailer *et al.*, 2017). Since the lack of research on exploring the possible effect of gamifying the FVC approach on autonomous learning motivation (Schöbel *et al.*, 2020; Khaldi *et al.*, 2023), it is suggested that such studies are urgently required to examine and explore different aspects of SDT-based gamification intervention when integrated into online flipped learning strategies (Lo & Hew, 2020; Kalogiannakis *et al.*, 2021). Therefore, it is claimed that gamification can be employed not only in conventional flipped classroom approaches but also in online flipped learning models (Zainuddin *et al.*, 2021). Incorporating these gamification aspects into active pedagogical learning approaches, such as the FVC, is hypothesised in the current study as a possible effective motivational strategy to engender

meaningful experiences, enhancing online flipped learning quality. This study can provide an established design framework that could guide other studies in similar contexts and significantly simplify the practical implementation of such an approach.

2.10 Summary

This chapter has reviewed the literature relevant to the current study based on nine main topics/sections. The first section concerned flipped learning, including an explanation of its main concepts, knowledge construction, and implementation effectiveness reported in previous studies. Section two shed light on the challenges of implementing flipped learning globally and the Saudi online learning context. The third section reviewed gamification, including its definitions, relevant concepts, various implementations in educational settings, and design criticisms. The following section explored different motivation theories underpinning gamification design, while the fifth section justified the application of self-determination theory as a theoretical framework for the current study and highlights key criticisms of this theory considering gamification design. Sections six and seven reviewed the main gamified online course designs reported in gamification and SDT research. The last two sections explained how SDT-based gamification mechanisms were integrated into online flipped learning before reviewing the relevant studies. Throughout these sections, the research variables of this study were reviewed, including autonomous motivation, learning achievement, and completion rate of pre-class activities.

The literature review on integrating gamification into the flipped-class approach seems promising in relation to supporting students' motivation, achievement, and completion rate of pre-class tasks. However, the mixed findings and uncertainty in the gamified flipped learning research and, most importantly, the lack of rigorous studies particularly on the utilisation of gamification into fully online flipped learning, may render the significance of the current study and thus contribute to the development of higher education. Indeed, it can be noticed that most studies have investigated the effect of gamified flipped classrooms that include face-to-face classes. However, examining the impact of this approach in fully online learning on students' autonomous motivation and achievement has not yet been extensively researched. In addition, the relationship between autonomous learning motivation and the completion rate of pre-

session activities in this context has not been sufficiently investigated. According to the existing literature, the completion rate has been one of the most reported problems when employing flipped learning, and this has been widely noticed during and after the Covid-19 pandemic. Hence, investigating those variables will maximise the critical contribution of the current study to the research field. A study such as this one focuses on the Saudi higher education context since there has been limited attention to harnessing advanced technologies in teaching and learning environment design despite the existing access to various advanced online technologies. The following chapter will shed light on the research design and methods utilised in the current study, considering its research aims and questions.

Chapter Three - Methodology

Flipped learning has received significant attention worldwide as a student-centred teaching and learning approach. This instructional approach allows students to prepare before attending their class, often by completing pre-class tasks to free up class time for applying in-class activities to facilitate knowledge construction. However, the existing literature has raised challenges in its implementation, and one of the most reported problems is students' non-completion of activities in the pre-class phase. In fact, this phase, according to the literature review, is considered the key to the success of many flipped learning models (see Chapter Two, section 2.3). The current study, therefore, aims to investigate the possible effects of employing gamification within an online flipped learning environment upon Saudi students' higher education learning experiences, including autonomous motivation, learning achievement, and the completion rate of pre-session activities. It also explores their perceptions of utilising this gamification intervention and the relevant key adoption and design considerations based on their experience. The theoretical framework adopted for this study was self-determination theory (SDT), as it emphasises autonomous learning as a foundational principle. The literature review in Chapter Two discussed key concepts in the study, including flipped learning, gamification, motivation theories underpinning gamification designs, relevant potentials and criticisms, justifications for using SDT-based theoretical framework, and the integration of gamification into flipped learning based on SDT, which is called the gamified flipped virtual classroom (gamified FVC) in the current study.

The present chapter describes the study methodology, including the research methods, design, and instruments utilised in this study to address the following quantitative and qualitative research questions as well as examine the relevant hypotheses:

1) To what extent did the integration of gamification into FVC affect students' learning achievements in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores.

2) To what extent did the integration of gamification into FVC affect students' autonomous motivation in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation.

3) To what extent did the integration of gamification into FVC affect students' completion rate of pre-session tasks in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks.

4) To what extent did the students' autonomous motivation correlate with their pre-session task completion rate when gamification was integrated into FVC?

H₀: No linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC.

H₁: There is a linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC.

5) How did the Saudi university students perceive their gamified FVC experiences?

6) What are the key adoption and design considerations that need to be addressed when implementing the gamified FVC method for autonomously motivating learning?

Key methodological approaches were considered to determine the most appropriate for achieving the study's aims and addressing these research questions. The researcher ultimately applied a mixed-methods research approach underpinned by the pragmatic paradigm. Based on this, a combination of a quasi-experimental study with a pre-post control group and explanatory sequential mixed-methods research design was applied in the present study to uncover the possible effect of integrating SDT-based gamification into an FVC on students' autonomous motivation, learning achievement, and completion rate of pre-session tasks, as well as to explore students' perceptions and experiences.

This chapter consists of six main sections. The first section describes philosophical assumptions and research paradigms, including the pragmatic approach and the rationale for adopting this approach in the current study. The following two sections consider the mixed-methods approach, research design, and instructional course design. The fourth section explains the quantitative element of the study, comprising: quantitative research instruments, relevant data collection methods and procedures, validity and reliability, and quantitative data analysis explanations. Section five describes the study's qualitative element, including the semi-structured interview instrument, the relevant data collection method and procedures, qualitative data analysis, and trustworthiness. The final section addresses the ethical considerations regarding the participants and their involvement in the research and describes the researcher's role.

3.1 Philosophical Assumptions and Research Paradigm (Pragmatism)

Social scientists adopt various perspectives when seeing and explicating social reality. Cohen *et al.* (2018) assert that such perspectives should be viewed through the direct and indirect philosophical assumptions underpinning these views. Determining the research paradigm can facilitate explaining the reasons behind selecting qualitative, quantitative, or mixed-methods approaches for a research study (Creswell & Creswell, 2022). A paradigm is described as a way of researching phenomena or a mutual basic set of beliefs or world views that frames thoughts, opinions, and practices into a logical whole; thus providing signposts on the research design and how to address relevant research questions (Robbins, 2009; Cohen *et al.*, 2018). According to Guba (1990), these research paradigms are characterised by: 1) ontology, which concentrates on the nature of reality; 2) epistemology, which is concerned with the nature of knowledge, its limits,

how we come to know; and 3) methodology, which investigates the process of research and the methods that can be employed to find this knowledge.

In general, paradigms include positivism, post-positivism, and interpretivism (Guba, 1990; Teddlie & Tashakkori, 2009). Positivism and post-positivism predominantly rely on quantitative methods, although they may also incorporate some qualitative methods (Mackenzie & Knipe, 2006). Positivism considers reality a tangible thing that exists only objectively, detachedly, and independently of social actors (Saunders *et al.*, 2009). Post-positivism, on the other hand, is a perspective on human knowledge that does not support the idea that this knowledge is based on secure foundations. Instead, it recognises that knowledge is a product of social, cultural, and historical processes which are subjected to human limits and researchers' shortcomings (Popper, 2000). In line with this notion, Guba (1990) claims that, in post-positivism, there are multiple realities and that knowledge comprehension seems broad, imperfect, multifaceted and dynamic, and is always conjectural and questionable. In other words, the role of interpretation, subjectivity, and context in shaping our understanding of the world is acknowledged in this paradigm. Conversely, interpretivism, also referred to as 'constructivism' or 'social constructivism', is typically thought of as an approach to qualitative research that often relies on the participant's perceptions of the situation being researched to delve into the understanding of human behaviour (Creswell & Creswell, 2022). Accordingly, this approach seems to serve broad or open-ended research questions in which participants construct subjective meanings of an experience, typically through interaction or discussion with others.

Building on the above explanation and given the research questions and objectives, the present study attempts to objectively assess the possible changes in students' autonomous motivation, learning achievement, and completion rates of pre-session activities before and after the application of the study's intervention. In addition, it aims to subjectively allow the participants to provide constructive perceptions of their gamified experience, which is expected to deepen the understanding of the phenomena and possibly develop future implementations and applications of such practices. This suggests that, on the one hand, a positivist-realist ontology and objective epistemological stance appears to help address the first, second, third, and fourth research questions of the present study (i.e., gauging any possible changes in

motivation, learning achievement, and completion rate variables, both before and after applying the gamified FVC intervention, and examining the relationships between those variables). In line with this, Thomas (2013) affirms that in this approach, the researcher's mission is to put specific research variables in practice in a given context, examine the variation, and look at any possible correlations between the variables. On the other hand, an interpretivist-naturalistic ontology and subjective epistemological stance could be the key empowerment to addressing the fifth and sixth research questions, related to interpreting students' perceptions of their experience, and attempting to understand the nature, value, practical usefulness, and effect of the SDT-based gamification intervention from their personal point of view (*ibid*).

The positivistic approach may not be sufficient for studying the complexity of human behaviour and social phenomena, such as some problems related to learning and human interactions in classrooms and school contexts; therefore, a more subjective, practical, and flexible approach to addressing the qualitative research questions and understanding the relevant data seems required (Cohen *et al.*, 2018). Conducting non-positivist interviews that include interactive conversations between the interviewer and interviewees and then analysing them deductively and inductively is expected to provide deeper inter-subjectivity, thus supporting the interpretation of the social phenomena with a greater depth (*ibid*).

Based on the above reasoning, a methodological step was taken in the current research to combine quantitative and qualitative methods (i.e., mixed-methods research), where different forms of data were collected to gauge the effect of the gamified FVC, followed by more subjectivity involving the integration of semi-structured interviews. An affinity between paradigms and methods may exist, but there is no deterministic link that always dictates the use of a particular paradigm with a certain set of methods (Morgan, 2014). It is argued that mixed-methods research does not only mix data, but may also put paradigms and methodologies alongside and draw on each when appropriate, to produce a comprehensive depiction of the phenomenon under study in a way that fulfils research aims and answers research questions (Cohen *et al.*, 2018). Considering the mixed-methods research questions, positivism in its foundational assumptions might not be sufficient for the current study to address some aspects associated with understanding the subjective nature of human experiences based on practical

situations. In other words, besides examining the effectiveness of SDT-based gamification intervention quantitatively, the present study also seeks to address questions that cluster around understanding the research problem from the participants' perspectives and inductively identify any further practical issues and useful suggestions that should be considered for future applications of the gamified FVC method. Therefore, investigating the usefulness and practicality of this gamified experience based on mixed-method research required a flexible paradigm, focusing on addressing various research questions and understanding different aspects of the suggested gamified method regarding its theoretical and practical implications.

A commonly given paradigm, pragmatism, concentrates on the problem under research and the consequences of the study intervention, often underlying the mixed-methods research base, including different analytical approaches to produce socially valuable and practical knowledge, and provides an alternative worldview to those of positivism, post-positivism and interpretivism (Morgan, 2014). This paradigm supports the notion of combining the strengths of quantitative and qualitative approaches and integrating their relevant data to address the research questions practically, rather than based on philosophical claims and basis (Morgan, 2014; Tashakkori & Teddlie, 2009). While this paradigm does not adhere to a single philosophy or reality, researchers who adopt pragmatism often concentrate on the '*what*' and '*how*' of the problem or phenomenon being researched (Creswell & Creswell, 2022) and treat the differences between philosophical approaches to research as social contexts for inquiry (Morgan, 2014). The logic of pragmatism may encompass: deduction, which involves examining theories or hypotheses; induction, involving discovering patterns; and abduction, which concentrates and reflects on the best interpretations of the research outcomes considering participants' perspectives (Onwuegbuzie & Leech, 2005; Bryman, 2012).

3.1.1 Pragmatism and Critical Realism

In literature within education and social sciences, pragmatism and critical realism have frequently been positioned as at worst, conflicting and diametrically opposed (Elder-Vass, 2019), but at best, competing for the same methodological and philosophical ground (Elder-Vass, 2022). According to Stutchbury (2022), this situation has arisen because of the 'purist' approaches that have been adopted within social sciences, but over the last decade, these have been tempered

so that their respective claims overlap (Hoddy, 2019). Partly, the reason for this is that increasing notice has been taken over their subtleties: neither position is monolithic, and in fact, according to Fletcher (2017), pragmatism is characterised by its strength and recognition of diversity, being made up of different elements in different ways, depending upon the context of its adoption. In contrast, however, critical realism has been viewed as having less emphasis on diversity and been envisioned more as a reactive and deconstructive model that has a more explicit purpose to reject particular ways of looking at philosophy and methodology (Brönnimann, 2022).

However, with a relatively recent acknowledgement of shared concerns, it is possible, as it is in this thesis, to argue that critical realism strengthens the choice of pragmatism to underpin this thesis. I will examine this assertion for three points of argument now:

- a. The fallibilist understanding of knowledge.
- b. The underpinning legacy of pragmatism within critical realism.
- c. The increasing synthesis of pragmatism and critical realism within philosophical positions in methodology.

a. The fallibilist understanding of knowledge

In everyday use of language and action, according to Zhang (2023), truth has two meanings: a shared understanding of replicability – that is, what someone says, is consistent and consistently understood in its meaning; second, that a motivation has representational quality – that is, it is a truthful playing out of why what happened, actually happened. However, for these meanings to be ‘true’ requires that there is a correspondence – that is, a shared acceptance of standards of speech and thought. Realist philosophers split these two elements, arguing that only one has a claim to pure ‘truth’, and that is, the first one of constancy. The second, that is the representation, realists would argue is merely a form of ‘commendation’. Pragmatists, in contrast, would term both aspects ‘truth’, but at the same time, accept the notion of ‘truth as ideal’ – that is, open to falsity, to misinterpretation, and above all, a reflection of fallibility. Within this thesis, these notions of ‘truth’, correspondence and perspective are very important: in emergent areas of research such as mine, there are necessarily multiple claims on the veracity of evidence, and critically, on the testimony of different actors within the study. When knowledge is still being tested and concepts are emerging, it is critical that

perspectives are given weight and visibility according to the possible significance, without first making a judgement as to their 'truth'.

b. The underpinning legacy of pragmatism within critical realism

One of perhaps the most significant movements within philosophical approaches to methodology in social science is the tangled debt of each movement to other movements. According to Willis (2023), the most significant claim to the importance of pragmatism within research studies in social science is the practicality of it, and the lack of emphasis on the theoretical elements. Zhang (2023) argues that in parallel, its claims to diversity make it a very practical approach and thus to lend itself to many different research contexts. Ironically though, some researchers claim that its adoption of many different elements, and its acknowledgement of diverse areas of understanding, make it almost a semi-rigid and very structural approach, and thus, almost approaching critical realism in the formality of its claims. Barman rejects this though, on the grounds that in social science at least, 'value is understood as a social construction' (Barman, 2015, p.10), and so argues that it is not a sign of the structural quality of pragmatism, but rather an acknowledgement of the needs of social science.

c. The increasing synthesis of pragmatism and critical realism within philosophical positions in methodology

One of the most important reasons that I adopted a synthetic model of critical realism and pragmatism within this study, was my concern with structure and systematicity in my thesis topic. As a quasi-experimental study, with statistical analysis of variables but also a rich account of participants' experiences, I was and am, concerned to be both clear and, responsive to the needs of the study to have integrity and form. One of the observations of methodologies in educational contexts is their under-recognition of the significance of structure and structural dynamics (Baert, 2005), including cultural frames, relationships, networks, actors and so on (Fletcher, 2017). I recognised this as a potential weakness in my own study and was therefore concerned to develop a philosophical position and consequently, a research design that was both able to reflect the complex structure of my study, but also the influence of the discursive environment in generating complex understandings of the mechanisms of learning within my study. Essentially, I had elements

of pragmatism related to fallibility, but also, needed to theorise a clear framework that was systematic and able to respond to larger structural forces and that ultimately was able to be flexible enough to help me understand the needs of developing theory in this context.

The crucial step in mixed-methods research is integrating results from different approaches, which could offer a more profound understanding of the research problem and the complex aspects of social and cultural factors that frame human behaviours (Teddlie & Tashakkori, 2009). It might be argued that the mixed-methods approach could be applied to any paradigm; however, the pragmatic paradigm considers the research problem and questions as central (Creswell, 2014). Therefore, data collection and analysis were carried out in the present study without adhering to a single philosophical view, focusing pragmatically on addressing the research questions and discovering more of their insights.

3.2 Mixed-Methods Approach

The study quantitatively assesses the impact of integrating SDT-based gamification into an FVC on students' autonomous learning motivation, achievement and the completion rate of pre-session tasks. It also aims to understand students' perceptions of this integration, as well as obtain an in-depth interpretation of the adoption and design considerations of the gamified FVC method, which need to be addressed, by utilising a qualitative research method (Creswell & Creswell, 2022) (see Figure 3.1).

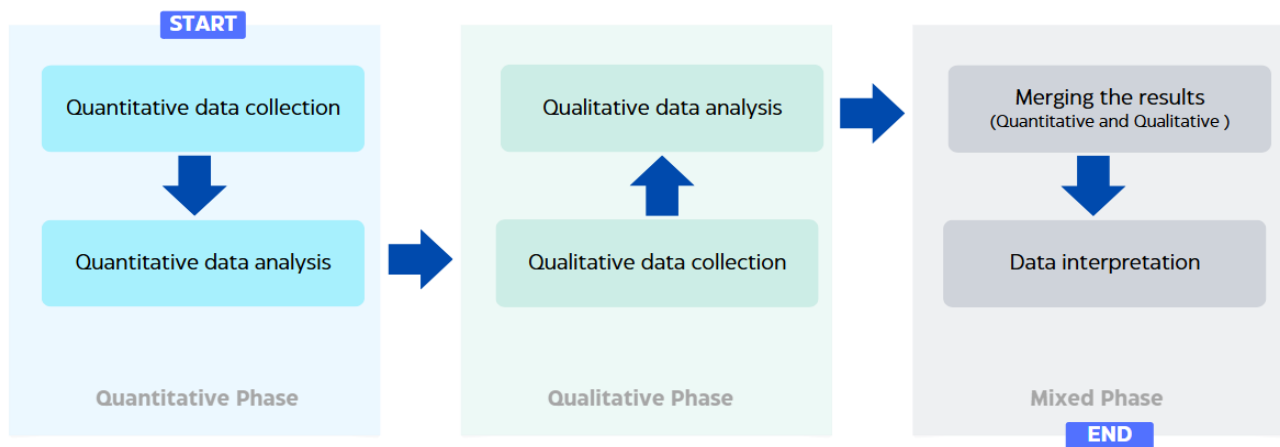


Figure 3.1: Mixed-methods Research Approach

Indeed, choosing the research approach should be based on the research problem or relevant questions being investigated (*ibid*). Several social studies have merged the two research methods and reported significant findings (e.g., Sohrabi & Iraj, 2016; Huang *et al.*, 2019; Zainuddin *et al.*, 2020), emphasising the importance of such mixed methods in paving the way for methodological triangulation and supporting the findings with extra validation (Creswell, 2012); thus, addressing research questions more deeply and tangibly. Similarly, this perspective is supported by Kelle (2006), who states that choosing an appropriate research method is often based on substantive research questions and not merely on epistemological and methodological considerations since all methods have limitations as well as strengths. Employing mixed-methods research allows researchers to increase confidence in the findings (Schoonenboom & Johnson, 2017). For instance, in the current study, in addition to addressing the qualitative research questions (i.e., Q5 and Q6) relevant to students' perceptions and experience-based suggestions by conducting semi-structured interviews, this could also clarify why the integration of SDT-based gamification into online flipped learning might impact students' learning motivation and achievement, compensating for what would not have been disclosed through quantitative evidence (Creswell, 2014). Therefore, it was assumed that the mixed-methods approach was the most suitable for fully answering the research questions and supporting the researcher's desire to enrich the data analysis with intensity and breadth.

3.2.1 Research Design

The current study combines a quasi-experimental procedure and explanatory sequential mixed-methods research design that utilises both quantitative and qualitative approaches. Therefore, and considering the research questions, a well-known approach to quasi-experimental research called the *non-equivalent (pre-test and post-test) control-group design* was employed. According to Creswell (2014), this design can be applied to a quasi-experimental study when the intervention group *A* and the control group *B* are not equated randomly and where both groups take a pre-test and post-test; yet the research treatment is only given to the experimental group. One possible challenge when applying such research design is that the intervention group may receive special methods or strategies as part of the treatment; while the control group may experience less attention or be left to their normal routine (Gravetter & Forzano, 2018). Based on

this notion, it is claimed that there is often contamination, which might, in turn, impact the reliability of the educational experimentation, the validity of the findings and the intervention effect's claims (Saunders *et al.*, 2009). Accordingly, this contamination may include the Hawthorne effect, which is related to the situation in which the participant's behaviour is affected by being aware of being under observation; the John Henry effect, which is associated with the participants in the control group feeling left out or neglected, so their performance may be impacted by frustration or they may try to outperform themselves; and the Halo and Horns effects, which are commonly used to refer to the researcher's prior judgement regarding the goodness or badness of the participants. In the present study, to mitigate these effects, whenever possible, several design and practical considerations were taken into account (Harrell *et al.*, 2013; Oswald *et al.*, 2014; Cohen *et al.*, 2018) as follows:

- 1) The study was conducted throughout the university term, during which the participants could regularly experience the gamified learning activities and flipped learning in and out of the session times. Thus, there may have been enough time for them to act in natural patterns, and possibly for the novelty effect of gamification to be reduced.
- 2) A control group was used as a comparison and was entirely separated and independent from the SDT-based gamification intervention, in an attempt to capture its effect as much as possible.
- 3) The participants in the control and experimental groups were assured that the research purpose was to improve the online learning design and process and that all their responses in the whole experiment were anonymous, confidential, and separate from any formal evaluation, grades, or results associated with their university studies.
- 4) All the participants' names on the tests, questionnaires, and online learning platform records were anonymised but coded, to enable the researcher to identify each participant for data analysis purposes.
- 5) The completion rates of the learning activities were collected indirectly through automatic data capture tools available privately on the VLE.
- 6) The identity of the control and experimental groups was unknown to each other, and each group did not know what the other group was given or applied to them. This implies that

the students in each group might not know whether they were participating in the control or the experimental group.

- 7) The direct interactions between the researcher and the participants were minimised throughout the duration of the study intervention to allow them to act naturally as much as possible.
- 8) The participants were informed that any personally identifiable information would be removed from their responses. This information will be anonymous, confidential, and not shared with their teacher or a third party. This might increase their comfort when sharing their opinions and experiences. However, it is acknowledged that although this step could have prompted the participants to share more open responses, it could also have caused a decrease in truthful answers, possibly due to reduced accountability. Therefore, caution was taken when collecting the data and interpreting the responses.
- 9) The process of mixed methods employed in the current study utilised more than one research method (i.e., quantitative and qualitative) for the investigation; this is believed to increase confidence in the obtained responses and findings.

Furthermore, according to Gravetter and Forzano (2018), adding a pre-test measurement in such a research design allows the researcher to reduce the potential effect of the differences between the participants in the two groups, which is a problematic issue that often appears in non-equivalent group studies. To illustrate this design, the letters 'O' and 'X' are used by which 'X' represents the intervention or treatment, whilst 'O' signifies the measurement or observation, as shown in Table 3.1.

Table 3.1: Non-equivalent Quasi-experimental Design

Treatment/experimental group	<i>O</i>	<i>X</i>	<i>O</i>
Non-equivalent control group	<i>O</i>		<i>O</i>

In the current study, the researcher strove to control crucial characteristics between the two groups, such as initial learning motivation, prior CS knowledge and online self-regulation skills, to eliminate, or at least reduce, their effects on the research results as much as possible. To facilitate this, the pre-test and post-test experimental design was applied. All the participants

were assigned to an experimental or a control group. The experimental group was taught in a gamified FVC environment, in which gamified learning activities were used with the aim of promoting the participants' autonomous learning motivation and achievement, as well as the completion rate of pre-session instructional tasks. In contrast, the control group was taught in a similar way but without using the SDT-based gamification (i.e., non-gamified FVC).

3.2.2 Explanatory Design

In addition to the pre- and post- test design, an explanatory sequential mixed-methods design was also used. Quantitative data were collected in the first phase through pre-and post-tests and a questionnaire, followed by collecting qualitative data using semi-structured interviews at the end of the intervention (see Figure 3.2). This design is classified as a form of mixed-methods research (Venkatesh *et al.*, 2016; Guetterman *et al.*, 2019) and defined as sequential phases in which the results obtained from an initial quantitative phase are clarified by a subsequent qualitative phase (Creswell & Creswell, 2022). For instance, in the present study, the researcher wanted to quantitatively compare the differences in autonomous learning motivation and achievement (dependent variables) among the students who enrolled on two CS classes, before and after the utilisation of the gamified FVC method and a conventional FVC format (independent variables).

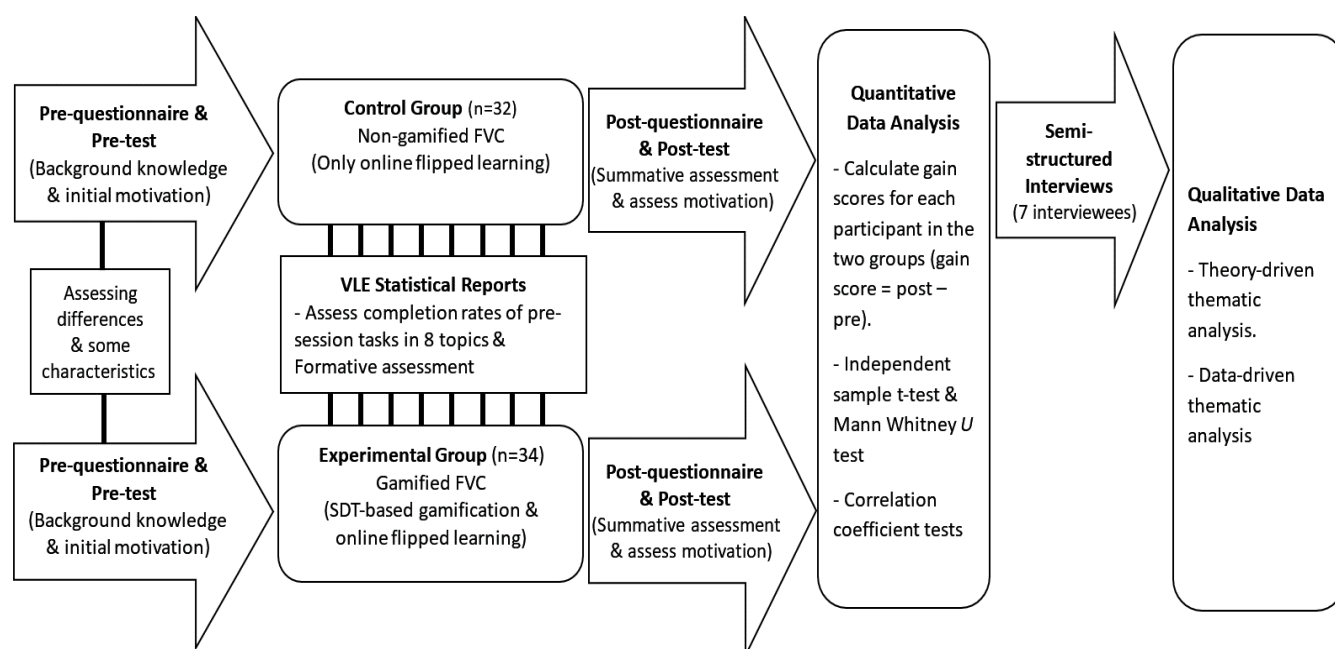


Figure 3.2: Explanatory Sequential Mixed-Methods Design

At the same time, the researcher needed to have an in-depth understanding of the possible reasons behind those differences as well as explore students' perceptions of the gamified instructional intervention. Therefore, it was believed that this research design would provide multifaceted insights into the findings of the study's experiment by juxtaposing quantitative and qualitative data components. This rationale is in line with the mixed-methods process explained by Creswell (2014), who asserts that the reasons behind quantitative results can be interpreted using qualitative data. Indeed, unlike quantitative research tools, conducting semi-structured interviews could provide in-depth explanations of participants' experiences from their own perspectives. This was also believed to clarify any misunderstandings that were expected to arise from the analysed quantitative data. The interview instrument also enables the researcher to notice important indicators not evident through quantification, such as body language, facial expressions, intonation, and hesitation, which in turn can help to elucidate on the nuances of the participants' experiences and perspectives (Denscombe, 2007) of the gamified FVC environment.

3.2.3 Computer Science Course Descriptions

This section sheds light on the CS instructional module, Computer Science Foundational Skills, that both groups (i.e., experimental and control classes) were taking. The purpose of this course, according to the Education and Training Evaluation Commission (ETEC, 2020), is to provide an overview of various contemporary topics in the field of computer science and information technology. These topics range from providing principles of CS knowledge and skills, cyber security and safety, to some more advanced applications necessary to prepare and support students during their university studies and future careers. This course is registered for all first-year students as one of the mandatory instructional modules counting towards their overall GPA, eventually affecting admissions decisions regarding students' majors. The CS coursebook, learning materials, and programme structure were designed by the Faculty of Science and Computer Engineering and approved by the Research and Consultation Institute at the host university. The academic course comprised 50-minute online classes, three days a week (i.e., one theoretical class and two application-based sessions) and eight teaching weeks in total.

3.2.4 Main Objectives and Outcomes of the CS Course

The current study seeks to find out which learning setting—FVC with or without SDT-based gamification—is more effective in terms of motivation, learning achievement, and the completion rate of pre-session activities, by investigating any possible changes in these variables among students in the control and experimental groups. The FVC method was particularly applied to the CS instructional module because it includes a variety of conceptual and practical knowledge, such as foundational computer skills, computer networks, software, and hardware, allowing the researcher to examine the application of the study's intervention in various topics. Learning in this module can occur mainly through the process of performing online pre-session tasks, often received, at least, as preparatory knowledge (Kim *et al.*, 2017). Then, this prior knowledge is connected and related to in-depth concepts and practical tasks through synchronous sessions, including application-based instructional activities, group discussions, problem-solving tasks, and project presentations (Zainuddin *et al.*, 2018).

Therefore, learning achievement, particularly in such CS courses, often relies on the extent to which students successfully absorb and apply the knowledge and skills throughout the module; this was predicted to vary among students. The researcher in the current study believes that the achievement test, in its summative assessment form, might not sufficiently assess these aspects, since it is basically summative and often concentrates on what students have learnt at the end of the module period (Cohen *et al.*, 2018). Therefore, formative and summative assessments, including online quizzes, tests, and practical activities based on the course's learning objectives, were used to evaluate students' learning achievements more accurately throughout the weeks and at the end of the CS instructional course. These learning materials and assessments were assessed by two other CS instructors and three experts in the same field to ensure that they adequately covered each topic's learning objectives. These were only utilised for the study's purposes and were not included in the course's formal evaluation.

According to existing research, in such flipped courses, students are often expected to learn at least basic concepts or functions of certain orders or formulas before performing or practising them in their class or lab (Chis *et al.*, 2018; Taladriz, 2021). As Table 3.2 below shows, each topic in this course had specific learning objectives that students were expected to achieve.

These objectives were built based on Bloom's taxonomy, approved by the Research and Consultation Institute at the University of Jeddah and were applied to both groups (i.e., gamified FVC and non-gamified FVC), so the students in the two groups were exposed to the same topics. This means that each online flipped learning phase (i.e., pre-session tasks and in-session activities) in both groups was also specified by a set of relevant learning objectives and outcomes from the different weeks. Therefore, assessing students' learning achievements was essential to evaluate the extent to which they mastered these learning objectives throughout the course.

Table 3.2: The CS Course's Topics, Learning Objectives, Outcomes, and Assessments

Week	Topic	Main Objective of the course	General Learning Outcome	Instructional Activities and Assessment
1	• Introduction • Main types of computers • Cloud computing	• To train students on how to complete the online learning activities and quizzes and how they work. • Define key terms related to the main computer types and cloud computing (Remember). • Understand different types of computers based on their uses, designs, and capabilities. (Understand). • Select the appropriate type of computer for a specific task based on its uses and limitations. (Apply) • Create a cloud account and collaborate with peers on documents utilising cloud-based tools. (Apply)	• Students will differentiate between the types of computers and cloud computing tools and models. (Remember) • They will be able to choose the appropriate computer type and cloud computing service for the given tasks. (Apply)	• Watch pre-session videos and complete online quizzes and tasks before class (formative assessment). • Participate in in-class discussions. • Engage in workshops and application-based activities.
2	• Computer hardware components • Operating systems • Computer networks	• Identify and describe the basic terms related to different types of hardware, operating systems, and networks (Remember). • Understand the basic functions of external and internal units of computer components (Understand). • Identify different hardware components and computer networks based on the display pictures and explain their functions. (Apply) • Participate in online group discussions related to hardware, operating systems, and computer networks. (Evaluate)	• Students will identify and describe critical terminologies related to different hardware components, operating systems, and computer networks. (Remember) • They will understand the functions and utilisation of the main internal and external computer parts and units. (Understand) • They will recognise different types of hardware components, operating systems, and computer networks and explain their functions. (Apply and evaluate)	• Work on collaborative projects applying the acquired concepts to the given real-world tasks and situations. • Present research and share the acquired knowledge and skills with peers.
3	• Artificial intelligence and robotics • World Wide Web applications	• Define key terms related to AI, robots, and main Internet applications. (Remember). • Analyse real-world examples of AI, robots, and web applications, discussing their impact and limitations. (Analyse) • Select the appropriate AI technique and robots for a given task based on their uses, features, and situational requirements. (Evaluate)	• Students will define basic terms related to AI, robots, and Internet applications. (Remember) • They will analyse real-world examples of these advanced technologies, discussing their positive and negative impacts. (Analyse) • They will be able to select appropriate AI technology and robot types for the given tasks or situations. (Evaluate)	• Informal learning achievement test, based on the learning objectives, at the end of the term.

4	MS Word applications	- Identify the essential components and functions of the MS Word interface (Remember). - Collaborate on a document with peers, applying different Word features (e.g. tools, styles, and designs, and track changes and comments) (Apply).	- Students will be familiar with the interfaces of Microsoft software, including Word, Excel, and PowerPoint. (Remember) - They will be able to collaborate online on writing reports, essays, and similar tasks or documents using MS Word features. (Apply) - They will be able to deal with and visualise the given data (research data, project data, or data for presentations) using MS Excel. (Apply) - They will collaborate on online presentations using PowerPoint via cloud services, applying main design principles. (Apply) - They will peer-review online presentations based on design, clarity and audience engagement. (Evaluate)	
5	MS Excel applications	- Identify the main components and functions of the MS Excel interface (Remember). - Understand the main principles of creating graphs and charts in order to visualise data. (Understand) - Collaborate on a document with peers to analyse and solve real-world problems and situations using Excel tools, formulas, and functions. (Apply)		
6	MS PowerPoint applications	- Identify the main components of the MS PowerPoint interface (Remember) - Collaborate on presentations with peers, sharing content and design elements to create and deliver short presentations on the given topics. (Apply) - Peer-review presentations based on design, content clarity, and audience engagement. (Evaluate)		
7	Online protection (cyberbullying, identity theft, phishing, plagiarism)	- Define key terms related to Internet safety and security (cyberbullying, identity theft, phishing, and plagiarism). (Remember) - Research and deliver a presentation to explain common Internet threats (e.g., cyberbullying, identity theft, and phishing). (Create). - Participate in group-based discussions related to Internet safety and ethics (Evaluate).	- Students will define critical terminologies related to Internet safety and security threats. (Remember) - They will be able to research and deliver presentations on common Internet threats. (Create) - They will participate in online discussions about Internet safety and ethics. (Evaluate)	
8	Cyber security in Saudi Arabia	- Identify the primary and standard cyber security regulations and initiatives in the Saudi Arabian context. (Remember) - Identify and use secure and reliable online service platforms and practices related to the Saudi Arabian context (e.g., government e-services). (Apply)	- Students will be able to identify critical cyber security standards and regulations in Saudi Arabia. (Remember) - They will recognise and use secure and reliable online service platforms related mainly to the Saudi context. (Apply)	

3.2.5 Gamified FVC Course Design and Implementation

The course design was checked by three CS instructors with broad experience teaching CS instructional modules similar to the one used in the current research. This step aimed to ensure that the instructional content aligns with the learning objectives, check for any difficulties or technical problems when assigning or using the learning materials, and identify any relevant gaps or redundancies. Although the feedback obtained from the instructors was generally positive, minor refinements were suggested regarding instruction clarity in two tasks related to the cybersecurity topic and one relevant to the computer components topic. Based on this feedback, the course design was carefully revised and refined. The gamification intervention was based on an SDT-based theoretical framework. The SDT theory posits that considering students' inner needs for autonomy (i.e., to progress through optional forms of learning tasks with feelings of volition and choice), competence (i.e., to feel capable of effectively progressing and engaging in learning situations), and relatedness (i.e., to work and interact collaboratively with others as an important team member) (Sergis *et al.*, 2017) is likely to stimulate autonomous learning motivation (Ryan & Deci, 2000a), performance and persistence (Dicheva & Dichev, 2016).

Accordingly, the course design's gamification elements revolved around gaining and accumulating points to receive badges and thus obtain high positions on the team-based leaderboard. The purpose of using such mechanisms was to engender learning situations as "game-like" as possible to encourage motivation. A range of gamified pre-class activity forms were assigned to a virtual learning environment (i.e., Blackboard VLE) in which students could participate in team-based competitions and earn a different number of points for completing each task. These activities included watching pre-session videos, note-taking, completing different forms of gamified online quizzes and tasks before class, group discussions, presentations, workshops, and application-based activities and collaborative projects. Each student was allocated to a group to work in teams. To reduce the possible effect of characteristic differences between the groups as much as possible, students were divided into groups based on assessing their prior knowledge and initial self-regulation skills (see Figure 3.2). By completing individual pre-class activities, each team member could earn points and badges, which were

eventually added to their group account and displayed on a team-based leaderboard with coded students' names.

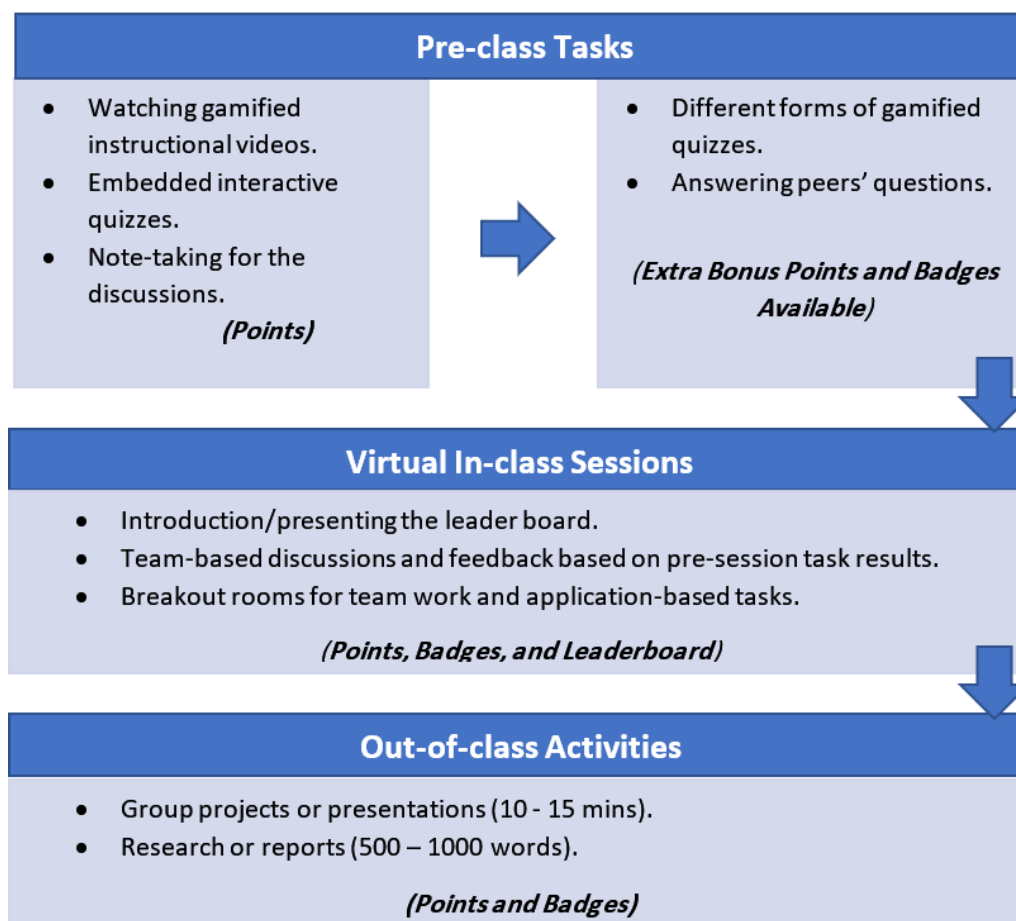


Figure 3.3: Experimental Group Study Design

In detail, as shown in Figure 3.3, the course design generally encompasses three stages. The first stage includes watching instructional videos with embedded gamified quizzes, taking notes, different forms of gamified quizzes and tasks, and answering peer questions. In this stage, as an attempt to provide students with a sense of choice and freedom (i.e., autonomy support), they were allowed to earn badges, points, and extra points by completing different options and forms of gamified tasks. Each of those tasks included a short description to explain its value and relevant learning objectives and outcomes and was presented minimally in, at least, three different forms of game-like settings (e.g., Quiz Show, Find the Match, Wordsearch, and Open the Box) designed by a free quiz creator platform called Wordwall. This scenario aimed to stimulate

a sense of value, interest, or enjoyment among students and motivate them to take part in more activities autonomously.

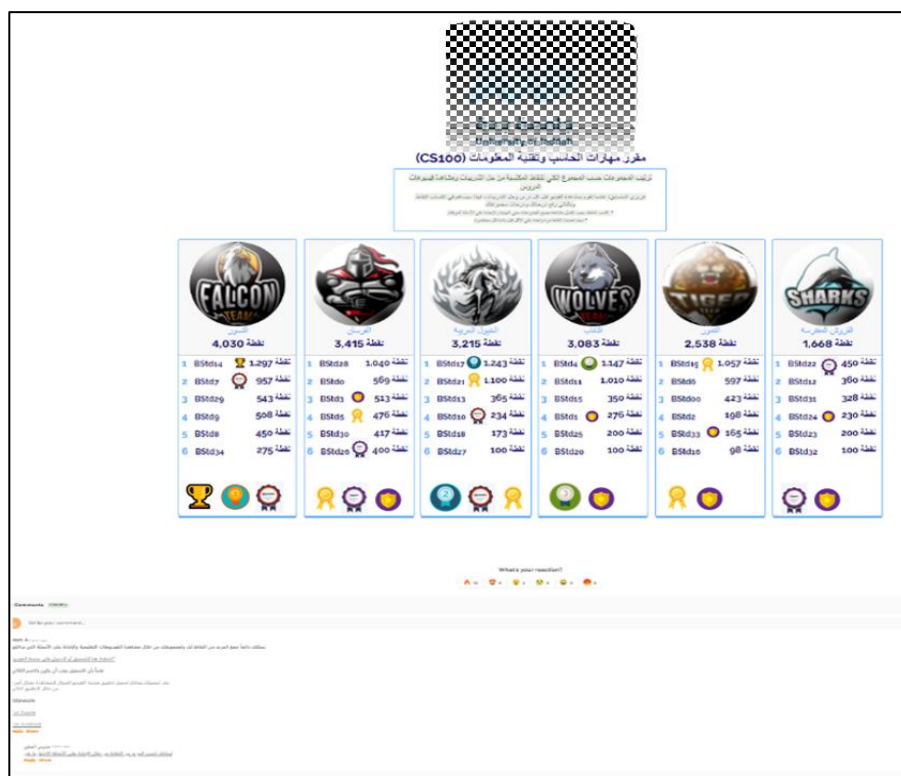


Figure 3.4: The Leaderboard Used in the Gamified FVC

In the second phase, the students were invited to synchronous virtual in-class meetings on Blackboard; these in-class activities included an introduction, a presentation of the leaderboard (see Figure 3.4), team-based discussions, feedback based on the pre-section task results, teamwork, and application-based tasks. By participating in these activities, students could earn badges and points as teams, ranked via team-based leaderboards based on accumulating these points and badges. According to Sailer *et al.* (2017), these particular gamification mechanisms can be used as competence-supportive elements that may affect students' autonomous learning motivation as they may engender a sense of progression (Sailer & Sailer, 2020). Besides these activities, the students were asked once a week, as groups, to complete collaborative out-of-class tasks, such as reports, projects, and presentations, which were informally evaluated (quantitatively and qualitatively) by the instructor using points and badges. The points earned by each student were eventually added to the team's total points account, aiming to support a feeling of contribution to the team as important and effective members; each

team had their own unique avatar and name. These settings were aimed to promote team loyalty, social relatedness and belonging among students, which may affect their autonomous learning motivation (Deci & Ryan, 2004).

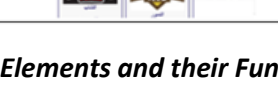
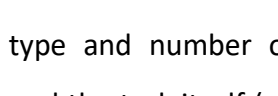
Gamification Element	Requirement / Function
	Number one on the entire leaderboard.
	Number two on the entire leaderboard.
	Number three on the entire leaderboard.
	Answering peers' questions correctly (+100).
	Performing all the learning activities and earning all the available points for the week (+150).
	Star of the week (+80).
	Remarkable enhancement in performance (+50).
	The winner of the week
 1,297 نقطة	Accumulated Points
	Progression status
	Trial and fail
	Teams' names and avatars

Figure 3.5: Gamification Elements and their Functions

Moreover, the type and number of points students earned for performing a task depended on the stage and the task itself (see Figure 3.5). Generally, four types of points could be won via gamification-related activities: (1) individual points, awarded for watching the pre-class videos and answering the embedded gamified quizzes individually (see Figure 3.6); (2) total team points, calculated as the accumulated points earned by each team member; (3) class participation points, awarded by the instructor for good class participation, such as asking or

answering critical questions or helping other classmates; and (4) bonus points, earned by performing extra learning activities or early submissions.

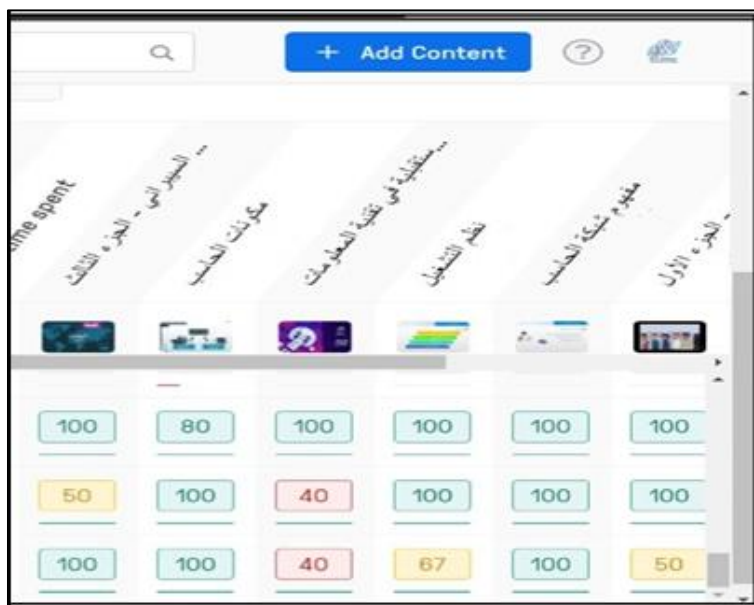


Figure 3.6: Instructional Video Platform

Likewise, the control group followed a similar scenario and stages with the same course content, instructor, and class times and durations; however, the gamification strategy intervention was excluded, as shown in Table 3.3.

Table 3.3: The Different Elements of the Gamified FVC and Non-gamified FVC Groups

	Gamified FVC	Non-gamified FVC
Course Duration	12 Weeks	12 Weeks
Number of Sessions	Three per week (50 Mins)	Three per week (50 Mins)
Pre-session Activities	Instructional videos with embedded gamified quizzes, taking notes, different forms of gamified quizzes and tasks, and answering peer questions.	Instructional videos with embedded quizzes, taking notes, other quizzes and activities via Google Forms, and answering peer questions.
In-session Activities	Introduction, presentation of the leaderboard, team-based discussions, feedback based on the pre-session task results, teamwork, and application-based tasks.	Introduction, group discussions, Q&A on the pre-session tasks, and application-based tasks.
Out-of-session Tasks	Team-based reports, projects, and presentations.	Group-based reports, projects, and presentations.
Gamification elements	Yes	No
Instructor Role	To facilitate, monitor and informally evaluate students' learning and participation using points and badges.	To facilitate, monitor and formally evaluate students' learning and participation using course grades.

3.3 Mixed-research Questions and Data Collection Methods

For the current study, five research instruments, based on the research questions, were utilised: tests; formative assessments; VLE statistical reports (all in the Arabic language); a closed-ended questionnaire, and semi-structured interview questions, delivered to the participants in the Arabic version. Table 3.4 demonstrates that six research questions were intended to be addressed in the current study using various data collection methods.

Table 3.4: Research Questions and Methods

<i>No</i>	<i>Research Question</i>	<i>Data Collection Instrument</i>	<i>Sample Size</i>	<i>Sample Type</i>
1	To what extent does the integration of gamification into FVC affect students' autonomous motivation in Saudi higher education computer science?	Pre- and post-closed-ended questionnaires	66 students, both intervention and comparison groups.	Convenience
		Semi-structured interviews	7 students, intervention group	Stratified purposive
2	To what extent does the integration of gamification into FVC affect students' learning achievement in Saudi higher education computer science?	Pre- and post-tests	66 students, both intervention and comparison groups.	Convenience
		Eight formative assessments		
3	To what extent does the integration of gamification into FVC affect students' completion rate of pre-session tasks in Saudi higher education computer science?	VLE statistical report - completion percentages of pre-session tasks in eight weeks	66 students, both intervention and comparison groups.	Convenience
4	To what extent does the students' autonomous motivation correlate with their pre-session task completion rate?	Pre- and post-closed-ended questionnaires	66 students, both intervention and comparison groups.	Convenience
		VLE statistical report - completion percentages of pre-session tasks in eight weeks		
5	How do Saudi university students perceive their learning experience in the gamified FVC?	Semi-structured interviews	7 students, intervention group	Stratified purposive
6	What are the key adoption and design considerations that need to be addressed when implementing the gamified FVC method for autonomously motivating learning?	Semi-structured interviews	7 students, intervention group	Stratified purposive

Before starting the data collection process, in addition to the ethical approval obtained from Newcastle University, as set out in Appendix A, Appendix C also shows the permission obtained from the host university where the actual study was conducted. It also contains further

information about the sample participants and the course name for both the intervention and comparison groups. The outside study confirmation and the informed consent forms to participate in this study are also provided (see Appendix B and Appendix D).

In educational research, it is highly recommended that the methods should be directed by the research questions (Creswell, 2014). These methods are the processes utilised to collect data in relation to particular study questions or hypotheses (Crotty, 1998). Therefore, to address the research questions, pre- and post-tests and formative assessments were designed based on the course learning objectives and were used to assess the possible changes in students' learning achievement and performance. Subsequently, semi-structured interviews were held as the second phase of the data collection procedure, to answer the research questions relevant to the students' subjective perceptions of the gamified FVC and the adoption and design considerations when utilising this method. This qualitative phase also aimed to provide illumination on the interpretation of the quantitative data related to the possible effect of SDT-based gamification mechanisms (Cohen *et al.*, 2018). The following sections and subsections provide more explanation about the research instruments used in the quantitative and qualitative data collection phases.

3.4 Quantitative Element of the Study

3.4.1 Test and Formative Assessment

The current study employed a pre- and post-test within a quasi-experimental research design in which two intact groups were assigned as experimental and control (Creswell, 2014). In the quantitative data collection phase, the process of utilising the pre- and post-test was in line with the seven-phase practical guideline for test construction (i.e., purpose, define, prepare, generate, review, pilot, refine) proposed by Buffum *et al.* (2015). First, the purpose of conducting the test was identified, which was to examine whether integrating SDT-based gamification elements into an FVC could have a significant effect on Saudi higher education students' learning achievement in the CS instructional module, assessing any perceived changes in the dependent variable (i.e., students' test scores) for both the experimental and control groups. Then, this test was defined as a set of questions chosen from an official test bank constructed and reviewed by the Education and Training Evaluation Commission (ETEC, 2020) based on the course learning

objectives. Next, the test format was prepared, and the items were generated: consisting of 40 multiple-choice questions using Google Forms. Each question was given a score of one and was corrected automatically, so the total achievable score was 40. According to Buffum *et al.* (2015), the multiple-choice test format can be scalable to many students and can be transparently and objectively graded. After that, to ensure the face and content validity of the test, it was formally reviewed by experts in the Computer Science and Engineering Faculty at the host university, including teachers with broad experience in teaching this module. A pilot study was subsequently conducted on a representative sample to check the suitability of the test items. Eventually, the test was refined based on the feedback obtained from the previous two phases. The validity, reliability and pilot study procedures are further explained in subsections 3.4.4 and 3.4.5.

3.4.2 Questionnaire

Questionnaires allow researchers to obtain standardised and open responses from a large sample or population on a range of topics or dimensions that need to be investigated or assessed (Creswell, 2014). Nonetheless, several issues might influence the design and development of a questionnaire, including its length, frequency, organisation, and types of questions (Saunders *et al.*, 2009). Indeed, it is essential to consider the questionnaire's length when designing a survey, as this may influence the motivation of the participant to answer in a particular way, or affect the production of the data or response rate (e.g., skip items or simply stop filling out), possibly due to experiencing negative feelings about it (*ibid*). In many cases, it is unlikely that all the relevant research variables are addressed in one questionnaire for several reasons: such as time availability and the possible influence of respondents' motivation to complete a lengthy questionnaire (Bryman, 2012). Therefore, in the current study, the researcher strived to ensure that the elements included were the most relevant dimensions representing the main issue under investigation. In addition, these dimensions were addressed in-depth in Chapter Two and were chosen mainly based on the applied theoretical framework and the research questions.

Questionnaire Structure and Design

After reviewing the relevant literature and previous studies and considering the research questions and the objectives, the questionnaire comprised six sections and the sections that are related to assessing autonomous learning motivation were mainly designed based on four

variables (i.e., autonomy, competence, relatedness, interests/enjoyment) (see Appendix F). These variables have been considered in many studies as strong predictors of autonomous motivation (Ryan *et al.*, 2006; Tamborini *et al.*, 2010; Ryan & Deci, 2017; Eyupoglu & Nietfeld, 2019) and theorised by the SDT as basic psychological needs for self-motivation (see Chapter Two, section 2.4.1). The structure of the questionnaire and the procedures used to verify its authenticity and reliability are described as follows:

- 1) The first questionnaire section concerned socio-demographic questions related to information about the participants, such as age, location, technology availability, electronic device preferences, educational background, and prior experience, while providing a guarantee of anonymity and confidentiality of the data obtained and reassurance that it will be used for scientific study purpose only.
- 2) The second section comprised six items relevant to the autonomous learning dimension (e.g., perceived choice, freedom, volition, and control over one's learning).
- 3) The third section included the competence dimension, comprising seven items related to whether students perceived the learning activities with a sense of effectiveness and capability of progressing in their learning.
- 4) The fourth section contained six items about the social relatedness dimension to assess students' perceptions regarding their ability to interact with peers and whether they felt a sense of belonging and connection when working on group-based instructional tasks.
- 5) The fifth section is the interest/enjoyment sub-scale, considered one of the most direct self-report measures of the highest level of autonomous motivation (i.e., intrinsic motivation) and consists of items that assess the perceived value, importance, interest, and enjoyment (Plant & Ryan, 1984).
- 6) The final section dealt with self-regulation in terms of time management and online learning task strategies and consisted of seven items.

In detail, the items associated with the competence and intrinsic motivation (interest/enjoyment) dimensions were mainly adopted from the IMI scale and used in many experimental studies related to autonomous and intrinsic motivation (e.g., Ryan, 1982; Deci *et al.*, 1994; Zainuddin, 2018), while autonomous learning and social relatedness dimensions were

adopted from Zainuddin (2018). All those sub-scales are considered highly reliable (> 0.981 and > 0.898) based on Cronbach's alpha of internal consistency coefficient. In addition, McAuley *et al.* (1989) conducted research to test the validity of the IMI scale and found strong support for it. The dimension of self-regulation in online learning contexts, particularly in relation to time management and learning task strategies, was also intended to evaluate and address the differences among the participants in terms of these factors. The items related to those two factors have been used in many studies (Lan *et al.*, 2004; Barnard *et al.*, 2008; Chumbley *et al.*, 2018), and the internal consistency score obtained for both subdimensions was $\alpha = 0.87$ (Chumbley *et al.*, 2018). These items were slightly modified to suit the CS course domain and time context.

The questionnaire format was based on a five-point Likert scale and consisted of closed-ended questions to reinforce the responses from the participants. The answers ranged from 'strongly agree' to 'strongly disagree'. This format made the questionnaire easier for the participants to complete as it usually takes less time; additionally, such a type of questionnaire facilitated the researcher's administration of data collection as a comparatively straightforward method (Bryman, 2012). Moreover, to produce a high-quality questionnaire design, Wimmer and Dominick (2000) suggested the following points that the researcher did consider in the current study: 1) support complex or difficult questions, if any, with instructions whenever needed; 2) provide the participants with an instructive and clear introduction to maximise the response rate; 3) delete any unneeded questions to avoid overwhelming the responders; 4) support the design with an attractive layout; 5) refine the questions after piloting the questionnaire. In addition, it is suggested that leading, double-barrelled, vague, and insensitive questions should be avoided (Lodico *et al.*, 2006; Cohen *et al.*, 2018). The author also attempted to ensure that each dimension and item in the questionnaire was relevant to specific aspects of the study, to address the research questions and as a result, made the questionnaire more relevant to the aims of the study.

The questionnaire was delivered via Google Forms, an online platform that provides survey, collection, and analysis tools. The web-based questionnaire type was chosen for three reasons. First, other survey delivery methods, such as in-person, by phone or via conventional

postal mail, were not feasible for this study as the entire course was delivered online, and the participants' physical locations were far from the study site. Furthermore, the learning management system (i.e., Blackboard) in the host university did not provide the participants' postal addresses or phone numbers, which made these delivery methods impossible to use. The only two possible official ways to deliver the online questionnaire were through the messages tool provided in the learning management system (LMS) and the email service. The researcher decided to use the former delivery method since some students may not regularly use or check their emails, particularly at the early university stage. This was expected to make the online questionnaire link more accessible for the participants since it could be delivered via the LMS messages tool available on Blackboard. Second, one advantage of a good questionnaire is that it should make the response process as easy as possible for the participants (Wang *et al.*, 2018). Therefore, it was attempted to ensure that they could access the questionnaire at any time via the online platform without requiring them to pay for printing or postage. Finally, an online questionnaire is an affordable instrument for distribution to the entire study sample at a low cost. This could facilitate the process of distributing the questionnaire to a large sample, which might reduce the possibility of any sampling errors (Cooksey & McDonald, 2019). However, it should be noted that researchers who deploy a web-based questionnaire may encounter methodological issues, such as technical and internet security issues and low response rates (Bryman, 2012). The current study carefully considered such issues when designing the questionnaire to reduce the possible effect on the participants' completion rate and thus maximise the response rate. Technological issues were addressed using a reliable and secure online survey platform, Google Forms, and the participants were provided with simple guidance on what to do when such problems occur and how to get support.

3.4.3 Back Translation

The researcher had to translate the research instruments into Arabic since the study was conducted in a Saudi university, where the participants' first and mother language was Arabic. Therefore, in order to ensure an accurate translation of the Arabic version and support its validity in such cross-cultural studies, the back-translation technique was used as one of the most well-known translation techniques (Saunders *et al.*, 2009). Accordingly, to apply this technique in the

current study, the researcher first had to translate the instrument's original version (i.e., English) into the other required language (i.e., Arabic). This was done by two experts who received their PhD in applied linguistics from the UK and whose mother tongue is Arabic. Subsequently, this Arabic version of each instrument was back-translated into English by two other reviewers who were PhD students in the same discipline with Arabic as their first language; however, they did not have access to the original English version. The two English versions of each instrument were then compared, and it was confirmed that the items and questions were similar and had the same meanings in the two versions, indicating that the Arabic version was acceptable. In addition, the Arabic version of each instrument was sent to an Arabian expert with a PhD in educational technology to check the structure and clarity of the sentences and their relevance to the participants and the subject matter. Each Arabic instrument version was eventually improved following the pilot study procedures.

3.4.4 Pilot Study

Before applying the main research experiment, a pilot study was conducted to check further and improve the format and content of the achievement test questions, the questionnaire items, and the semi-structured interview questions. This was to ensure that the participants could respond appropriately to the research instruments and for the researcher to check individual test items and identify, adjust, and exclude any redundant and misleading (Hassan *et al.*, 2006; Cooksey & McDonald, 2019). In fact, the purpose of the pilot study was not only to check the clarity and the initial response rates but also to serve as a practice run towards enhancing and administering the actual research experiment. Twelve participants were selected from a different CS class who were not involved in the main research experiment. Those pilot participants were recruited from the same academic year and level, taught by the same instructor, used the same online platform, and took the same CS instructional content, to ensure close representativeness of the target population of the main experiment.

First, the researcher introduced the experiment procedures before obtaining the participants' consent forms with the help of the course instructor. Next, the participants were given practical instructions on using the online platform and the embedded learning materials and activities. This was to identify any possible technical difficulties and evaluate the extent to

which they were familiar and comfortable with this online learning environment. Throughout this process, useful feedback was gathered from the participants and the instructor regarding the accessibility of some of the instructional tasks. Afterwards, the test and questionnaire instruments were sent to the pilot participants in test conditions similar to the experiment environment where the main study intervention was implemented (i.e., the same teacher for managing this process and the same online platform that was used later for the actual study intervention). This was to ensure items' consistency, adequate instructions, and the time needed, as well as to identify and check for any errors, typos, clarity, and technical issues when conducting these instruments (Hassan *et al.*, 2006; Cooksey & McDonald, 2019). The participants spent on average, around 20 minutes completing the questionnaire and 50 minutes for the test, and they were able to make notes on any item that they felt required clarification. Then, based on their feedback, the researcher added more guidance and navigation details to some of the learning materials and the instructions. These procedures also helped the researcher ensure the research instruments' feasibility and suitability for data collection and study protocols. Ultimately, the online learning environment, the provided learning materials, and all the test and questionnaire items appeared accessible, clear, and understandable to the participants.

3.4.5 Validity and Reliability

Although the test items and the questionnaire dimensions were adopted from sources (e.g., IMI, ETEC) that showed high levels of validity and reliability, the current study also double-checked those two important criteria. The validity of a research instrument can be described as "the degree to which it measures what it is supposed to measure" (Pallant, 2020, p.7). The content validity of the test and questionnaire instruments was checked through a thorough development process and consultation with experts, as suggested by Creswell (2014). The review was carried out and the consequent approval was given by five education experts at Newcastle University and the University of Jeddah. Then, based on the feedback received, the instruments were slightly improved regarding the order of some of the test items; while a few questionnaire items were carefully rephrased to suit the study context and CS course (e.g., "*The computer science I learnt was more valuable to me than the grade I received.*"). Expert reviews can also support the internal validity to help the researcher produce a research instrument with clear and relevant items,

reducing the possible measurement error that could affect validity negatively (Cohen *et al.*, 2018). Furthermore, according to Creswell (2014), internal validity can be affected by several threats, including those related to participants, experimental treatment, and the procedures followed in the experiment. The current study strived to minimise the possible effect of these threats by considering the following: 1) the participants in the experimental and control groups experienced the same online learning environment, teacher, instructional content and materials, main course design and procedures; however, the only difference between those two groups was the integration of gamification as the primary experimental treatment in order to capture its effect, as much as possible; 2) the participants in the control group had generally similar demographics, were in the same academic year and expected to have relatively similar baseline knowledge as the intervention group, based on their initial pre-test and pre-questionnaire scores; 3) applying this step also could reduce the possible effect of having participants with extreme scores (i.e., outliers) as initial characteristics; 4) the researcher kept the two groups as separate as possible throughout the experiment to ensure that their responses would not be affected by their communication with each other; 5) remembering responses by the participants for post-test and post-questionnaire might also impact the internal validity, therefore, the researcher ensured there was a long time interval between the earlier and later tests and questionnaire; 6) using the same instrument for the pre- and post-measures could mitigate the possible influence of instrumentation on internal validity (Cohen *et al.*, 2018; Creswell & Creswell, 2022).

The reliability of the test and questionnaire was also tested. Reliability is defined as the extent to which the questions or items included in the measurement gauge the same topic of investigation, indicating the degree to which the scale is free from random error (Pallant, 2020). In this study, Cronbach's alpha test, one of the most commonly accepted methods included in the SPSS statistical package (Gravetter & Forzano, 2018), was applied to measure the reliability and internal consistency of the test and questionnaire instruments. The value of this statistical test varies from zero to one, and the level of reliability is high when the value is close to one; typically, it needs to be greater than 0.7 to be accepted as internally reliable (Johnson & Christensen, 2013; Cooksey & McDonald, 2019). Tables 3.5 and 3.6 below show the internal reliability values of those two research instruments.

Table 3.5: Cronbach's Alpha for Internal Reliability of the Achievement Test Instrument

Research Instrument	n	N of Items	Cronbach's Alpha
Achievement Test	12	40	0.81

Table 3.6: Cronbach's Alpha for Internal Reliability of the Questionnaire Dimensions

Dimensions of the Questionnaire	n	N of Items	Cronbach's Alpha
Autonomy	12	6	0.81
Competence		7	0.77
Relatedness		6	0.76
Interest/Enjoyment		8	0.77
Self-regulation in terms of time management and learning task strategies		7	0.79
Overall Questionnaire	12	34	0.93

The tables above indicate that based on Cronbach's alpha test results, the internal reliability values were 0.81 for the test and 0.93 for the questionnaire, suggesting that both scales were internally reliable. In addition, the current study assessed the four-factor structure of the autonomous motivation measurement scale and the extent to which this factorial structure fitted the data adequately by using SPSS Amos 29 to model a confirmatory factor analysis (CFA) (Taylor *et al.*, 2014; Brown, 2015). According to Tabachnick and Fidell (2007) and Humble (2020), a good model should have an S-RMR below 0.08, and the fit index value for CD, TLI and CFI should be greater than 0.8 to indicate an acceptable fit and above 0.9 represents a good fit. The results from CFA revealed that the structure fitted the data reasonably well, $\chi^2(318) = 555.3$, $p < 0.001$, CFI = 0.92, TLI = 0.91, S-RMR = 0.063, and all the indicator loadings were above 0.42, with $p < 0.001$.

3.4.6 Participants' Background and Sampling Strategy

The participants were recruited from a Preparatory Year Programme (PYP), comprising 66 students who enrolled in the Computer Science Foundational Skills course (CCIT 100) in the second semester of the 2021/22 session at a public university in Saudi Arabia. No specific prerequisites were required for registration in this module. This module was chosen for the current study because of its diversity in theoretical and practical knowledge, which allowed the researcher to examine the SDT-based gamification intervention in a variety of topics. Moreover,

the educational system in this country is gender segregated, so all the participants were males. They were all aged between 18 and 20, and all were Saudi nationals who had finished high school stage in the same city in Saudi Arabia, as PYP admission in the university accepts only students who have graduated from specific high schools that are located in the same city as one of the university eligibility requirements. None of the participants had been given any advanced discipline-specific information associated with the course; however, they were expected to have at least basic computer skills. In addition, they all took pre-tests and pre-questionnaires to ensure that they had similar backgrounds and CS knowledge. Depending on the overall GPA obtained in the PYP stage, all the students are allowed to choose their desired streams at the end of the second semester when they have completed this stage.

Different techniques in terms of scope and type have been utilised in quantitative research for sampling, which can play a fundamental role in the validity, reliability, and generalisability of study findings. According to Creswell (2014), these techniques should represent the population of the study sample in order to minimise the possible margins for error. Therefore, the differences between the sample and the larger population should be identified using an appropriate sampling strategy. Generally, the three sampling strategies most commonly used in education research are convenience, purposive, and probability sampling (Teddlie & Tashakkori, 2009). In many experimental studies, including the current research, convenience sampling is the only possible strategy since the researchers often have to deal with groups that have already been formed based on specific criteria (e.g., GPAs), such as in some classrooms and universities, in which the quasi-experimental method might be the most suitable and feasible (Creswell, 2014). It is strongly advised that selecting a non-random sample might not be appropriate for answering research questions sufficiently, as it may result in biased data (Teddlie & Tashakkori, 2009). However, the researcher selected the participants from the same university stage and course and pre-assessed some crucial characteristics among them, including initial motivation, previous CS knowledge and experience, and online learning self-regulation skills, which might play a vital role in forming a sample with reduced differences in terms of the participants' backgrounds (Cohen *et al.*, 2018).

3.4.7 Quantitative Phase Practical Procedures

The mixed-method research design was used to benefit from the quantitative and qualitative research instruments, thus providing an in-depth understanding of the research phenomena. As mentioned earlier in this chapter, the quantitative phase design was a non-equivalent (pre-test and post-test) control-group design in which data were gathered before, during, and after the research experiment, forming the data collection procedures (Creswell, 2014). The following subsections and Figure 3.7 below explain the quantitative data collection phase and practical procedures before shedding light on the qualitative data methods and relevant procedures.

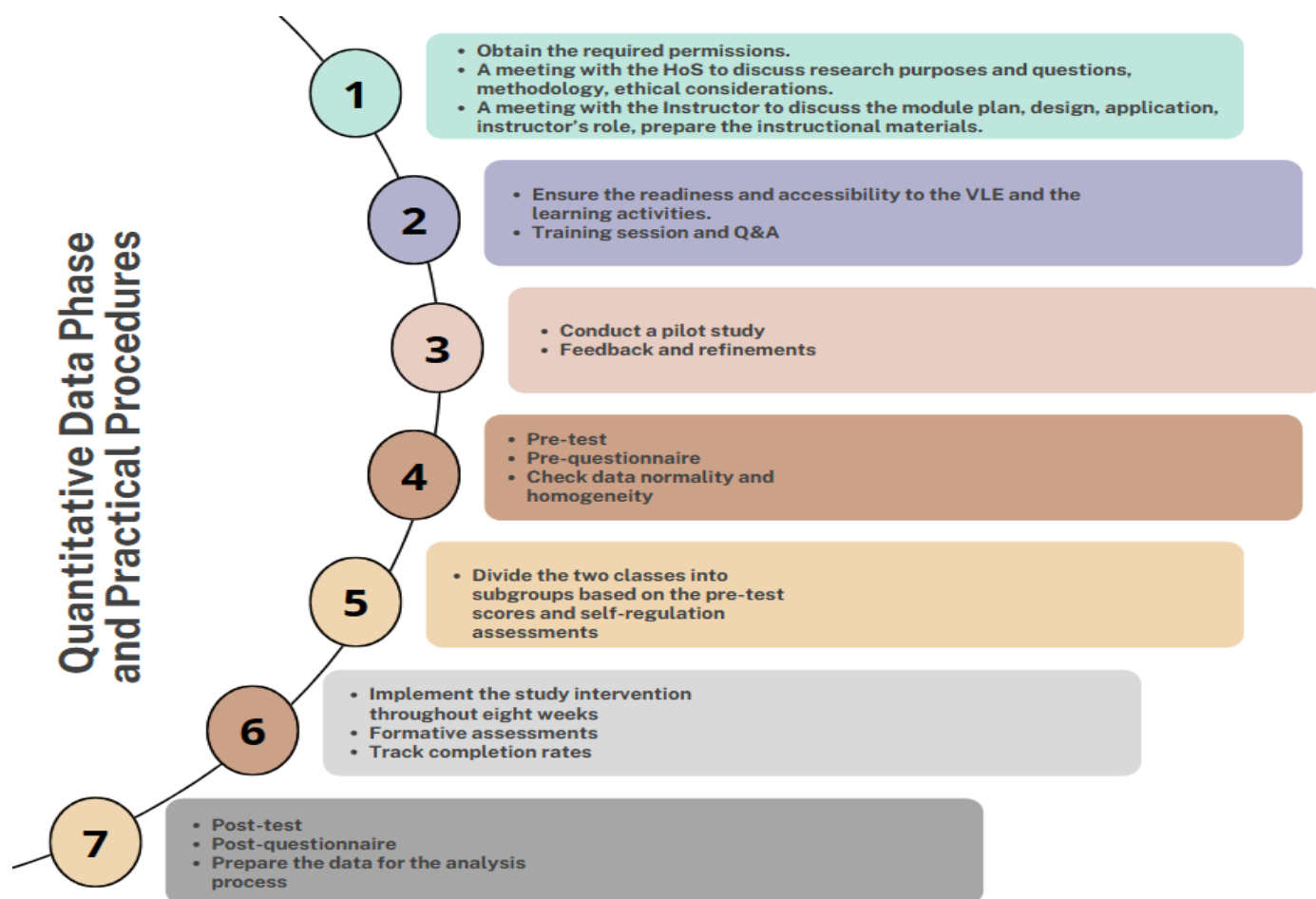


Figure 3.7: Quantitative Data Collection and Practical Procedures

The First Step

After obtaining the required permissions to implement the study from the host university and the Engineering and Computer Science Faculty, two meetings were held. The first meeting was on 6 February 2022, with the head of the school and the instructor. This aimed to explain: the main purpose of the study and its questions that need to be answered; the specific field of the research and its potential benefits; an overview of the research methodology; and the ethical considerations. Additionally, the available classes (i.e., four classes) and how the students are usually assessed were explained to the researcher in this meeting. The researcher numbered these available classes and randomly selected two for the study.

On 7 February 2022, the second meeting was held online with the instructor to discuss the module plan, design, and application (i.e., the session weeks, instructional content, learning objectives, and avenues for communication throughout the research experiment). Based on this, a guideline for the instructor's role in both groups and the process of applying the gamified FVC method was created. The researcher and instructor started to design and assign the online instructional materials (i.e., pre-session videos, quizzes, and in-session activities) for each group based on the timeline, the course design, and the desired learning objectives of each topic.

The Second Step

The instructor and researcher reviewed the online learning materials once again and ensured their readiness and accessibility via the online platform (<https://lms.uj.edu.sa/webapps>). The instructor practised the process of both the gamified FVC and the conventional FVC for training purposes under the researcher's supervision. During this training session, the instructor asked some questions about using breakout rooms for group-based tasks, which the researcher answered and explained to the instructor.

The Third Step

A pilot study was conducted before providing the participants with an induction and overview of the online learning environment. This step is described in Table 3.7 below.

Table 3.7: Process of Induction and Overview Date

Date	Task	Description
10 – 13 Feb	Pilot the research instruments and test the online learning environment.	- Select students (i.e., 12 participants for piloting the online learning environment, test and questionnaire, then select 5 participants for the semi-structured pilot) from a different CS class who would not be participating in the study, to check and improve the format and content of the test questions, the questionnaire items, the semi-structured interview questions, the online platform and the learning materials.
15 February	Workshop 1 (one workshop for each group)	- Explain the purpose of the research: 15 minutes. - Distribute the consent forms: 5 minutes. - Demonstrate the gamified FVC method to the experimental group and the conventional FVC to the control group: 30 minutes.
16 February	Workshop 2 (one workshop for each group)	- Obtain the consent forms: 5 minutes. - Explain how to access the online platform and the course instructional materials (e.g., videos and tasks): 25 minutes. - Explain the use of online discussion tools and group-based tasks: 20 minutes.
17 February	Workshop 3 (one workshop for each group)	- Allow the participants to access and explore the online platform and practise the instructional materials: 30 minutes. - Open the session for the Q&A: 10 minutes. - Each participant was randomly given a coded username to be used throughout the participation period instead of their real name. - Ensure students understand how to access with their coded usernames: 10 minutes.

The Fourth Step: conducting the Pre-test and Pre-questionnaire

The pre-questionnaire also aimed to evaluate technology availability and accessibility, prior experience with gamification and FVCs, and self-regulation skills related to time management and online learning task strategies. Furthermore, this step helped the researcher to test the normality of the data distribution and check if there were any outliers in the participants' responses (i.e., Shapiro-Wilk test) (Royston, 1992), as well as to examine the homogeneity between the groups (i.e., Levene's test) in terms of the variables assessed, before applying the intervention (Pallant, 2020).

The Fifth Step

Based on the results obtained from the previous step, the students in the gamified FVC (experimental group) and the conventional non-gamified FVC (control group) were divided into collaborative subgroups based on their existing CS knowledge and self-regulation skills by calculating the total mean scores of those two variables for each student. This step aimed to reduce the possible characteristic differences (i.e., prior CS knowledge and self-regulation online

learning skills) between the subgroups when engaging in group-based activities. The instructor received a list of the group members' coded usernames and agreed on the divided subgroups.

The Sixth Step: Study Intervention

After the pre-test phase, the SDT-based gamified activities were applied only to the experimental group as the study treatment, while the conventional flipped-class activities (i.e., non-gamified activities) were used with the control group (see section 3.2.5 for details about the intervention implementation process). Figures 3.8 and 3.9 below show each week's topic and examples of the learning activities.

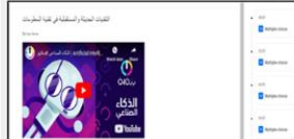
WEEK 1	WEEK 2	WEEK 3	WEEK 4
• Introduction • The main types of computers • Cloud computing	• Computer hardware components • Operating systems • Computer networks	• Artificial intelligence techniques • Robotics • The World Wide Web applications	• MS Word applications
 	 	 	 

Figure 3.8: Weekly Topics (1 to 4) and Example Activities (screenshots)

WEEK 5	WEEK 6	WEEK 7	WEEK 8
• MS Excel applications	• MS PowerPoint applications	• Online protection (cyberbullying, identity theft, phishing, plagiarism)	• Cyber security in Saudi Arabia
 	 	 	 

Figure 3.9: Weekly Topics (5 to 8) and Example Activities (screenshots)

Moreover, students' performances in the learning activities and the completion rates of these tasks were informally assessed each week based on the learning objectives of each topic, using formative assessments and VLE statistical reports. This step allowed the researcher to monitor students' progress and follow any possible changes in their learning performance in the experimental and control groups throughout the CS course period.

The Seventh Step: Post-test and Post-Questionnaire

On the 1st of May 2022, a post-test was used to examine students' learning achievement in the experimental and control groups at the end of the study intervention (Creswell, 2014). This research variable was formatively and summatively assessed in the two groups throughout and at the end of the instructional intervention, to evaluate the students' knowledge and application abilities in the CS module based on the course's learning objectives. The formative assessment included quizzes and project-based tasks each week; while the summative assessment consisted of 40 multiple-choice questions that covered all the topics presented in the instructional module. Although the achievement test could provide valuable results that would help the researcher in assessing the changes in students' learning achievements before and after the intervention, this instrument is summative in nature (Johnson & Christensen, 2013); therefore, using formative assessments was important in this study. In addition, a post-questionnaire was given on the 3rd of May to the participants in both groups at the end of the study's intervention, to help assess the possible differences in students' autonomous learning motivation based on four indicators (i.e., autonomy, competence, relatedness, and interests/enjoyment).

It is worth noting that the changes between the pre- and post-test scores and between the pre- and post-questionnaire scores were eventually assessed for the students in each group using the gain score method (Campbell & Stanley, 1963). This analysis method is explained in the following section.

3.4.8 Quantitative Data Analysis Procedures

The data analysis procedures in the current study have adhered to the research's relevance and aims (Cohen *et al.*, 2018). The researcher utilised the statistical package for social sciences (SPSS) and MS Excel software to analyse the data obtained from the assessments and questionnaires. The SPSS is one of the most widely used digital statistical software packages for

analysing quantitative data in social science research (Bryman, 2012). It provided the researcher with descriptive, inferential, and sophisticated statistics, facilitating the research data analysis procedures and thus contributing to addressing the quantitative research questions. Indeed, among these procedures, it was crucial to test the study hypotheses to facilitate the statistical comparisons in terms of the possible changes, variability, and differences within and between the experimental and control groups in relation to the research variables. In other words, the current study seeks to address the research questions concerning the potential effect of integrating SDT-based gamification into FVC on students' learning achievement, the completion rate of pre-session activities, and their autonomous motivation to learn.

Therefore, the data related to students' learning achievement variables were collected through pre- and post-tests to assess the possible changes within each group before and after the intervention. The normality of the pre-test data distribution for each group and the achievement level was first ensured using the Shapiro-Wilk test (Royston, 1992; Pallant, 2020), and the homogeneity test was also applied using Levene's statistical test for equality of variances, indicating that the data of the two groups were homogeneous in their variances (Gravetter & Forzano, 2018). The independent sample t-test was then conducted to assess the possible differences between the two groups regarding prior CS knowledge associated with the instructional course. After ensuring similar baseline CS knowledge, the study intervention was implemented, during which eight formative assessments were carried out. The post-test was then applied to assess the students' learning achievement after the intervention.

However, although the overall pre-test results indicated no significant difference between the experimental and control groups before applying the study intervention, which means that both groups seemed to have similar baseline CS knowledge, this does not necessarily mean no differences at all, as many researchers may mistakenly think. Therefore, after comparing the pre-test scores between the two groups based on a classification of three different levels (i.e., based on the distribution similarities in the scores: top, medium, and low achievers), the gain score method was used to increase validity when assessing the effect of the study intervention on each achievement level, overall and separately (Campbell & Stanley, 1963; Knapp & Schafer, 2009). This method was applied in which the differences between the pre-test and post-test scores were

computed (i.e., gain score = post minus pre) for each student in the experimental and control groups, to ensure that only the changes in the students' scores were included in the statistical analysis (Campbell & Stanley, 1963; Huang & Hong, 2016). Subsequently, the collected data related to the gain scores was checked in terms of normality and homogeneity. The results indicated that the data was not normally distributed, suggesting that a non-parametric test should be used to compare the possible differences between the two groups (Wang *et al.*, 2018). Therefore, the Mann-Whitney non-parametric *U* test was conducted on these gain scores, while the independent sample t-test was used to analyse the formative assessment results separately after ensuring the assumptions of this statistical test.

Moreover, the research question related to the students' autonomous learning motivation variable was addressed by analysing the data collected from the pre- and post-questionnaire. Before applying the intervention, the pre-questionnaire was used; then, the normality and homogeneity of the collected data were checked to test its comparability. Based on this, the pre-questionnaire data were analysed using an independent sample t-test and Mann-Whitney non-parametric test to ensure a similar baseline of students' initial motivation and self-regulation skills in the control and experimental groups. At the end of the intervention, the post-questionnaire was employed, and the relevant data were gathered. Although the pre-questionnaire results indicated no significant difference between the two groups in terms of the indicators of students' autonomous motivation (i.e., autonomy, competence, relatedness, and interest/enjoyment), the initial trivial difference in the pre-questionnaire scores should be accounted for as a covariate in the analysis when analysing the relevant scores of the post-intervention, in order to increase precision in the estimation of the intervention effect. Therefore, the One-way ANCOVA (Analysis of Covariance) statistical test was used after considering its assumptions (i.e., linearity, reliable measurement of the covariate, normality, and homogeneity of variance and regression slopes). According to Creswell (2014), this statistical test can be used to check the significant difference in the post-intervention scores between the two groups after accounting for the pre-intervention scores.

In addition, the gain score method was used to determine only the changes regarding these indicators within each group. The scores were computed (gain score = post score–pre score)

for each indicator and each student. According to Campbell and Stanley (1963), this method is used in quasi-experimental research designs because it allows the researcher to concentrate the statistical analysis on the possible differences within both groups regarding the dependent variables over time, while controlling baseline levels that may affect the results. Eventually, after ensuring the normality and homogeneity of this data, the independent sample t-test was applied to the calculated gain scores' means. More importantly, the size of the effect of the group's differences regarding all research variables was also statically assessed using Cohen's d to determine the effectiveness of the differences.

The collected data relevant to the research question concerning the possible impact of the gamified FVC on students' completion rate of pre-class activities was also analysed using the Mann-Whitney non-parametric test, since the data was found to be not normally distributed (Pallant, 2020). The researcher also attempted to address the research question about the possible correlation within and between the predictors of autonomous motivation and the completion rate variable. Therefore, depending on the results of the normality and homogeneity tests, the statistical correlation coefficient test type (i.e., parametric or non-parametric) was determined. While the Spearman correlation coefficient test was applied to determine any trend between the completion rate variable and autonomous motivation predictors, the Pearson correlation coefficient test was also used to examine the possible relationship between autonomous motivation predictors. This was to assess the direction and strength of the potential associations (*ibid*). Generally, in terms of the interpretation of those two tests, the Spearman r_s value and the Pearson r value indicate the strength of this association lying between 0 (no relationship) and 1 (a perfect relationship); while a positive and negative value indicates the direction of the relationship (Bryman, 2012). However, it is crucial to note that identifying a relationship between two variables does not necessarily represent a cause-and-effect correlation (Cohen *et al.*, 2018), but rather, it indicates that as one variable increases/decreases, the other variable is predicted to increase/decrease according to the r_s or r value (strength) and whether this value is positive or negative (direction) (Bryman, 2012).

3.5 Qualitative Element of the Study

The previous section described the quantitative phase of the methodology used in the current explanatory sequential mixed-methods study. According to Creswell and Creswell (2022), in such a mixed-method research design, the quantitative phase typically utilises surveys and experiments to assess variables or identify patterns and associations; however, this phase might not provide in-depth information associated with the “why” and “how” behind these obtained findings. The present study aimed not only to examine the effect of integrating SDT-based gamification into an FVC on students’ autonomous learning motivation and possible relationships between this variable and the completion rate of pre-session activities, but also to understand the underlying reasons that might motivate students to learn in such contexts and their perceptions of the gamified learning experience. Furthermore, suggestions and considerations related to the adoption and design of this experience that can be employed as an improvement for relevant future implementations were sought. Therefore, conducting the qualitative phase was mainly to address research questions 5 and 6; while it could provide valuable meanings associated with the quantitative results of questions 2, 3, and 4 (see Table 3.4). The following subsections explain the qualitative phase in which semi-structured interviews were carried out.

3.5.1 Semi-structured Interviews

Semi-structured interviews were conducted mainly to explore the participants' perceptions and experience of integrating SDT-based gamification into an online flipped learning course. They also aimed to gain deeper insights into the possible effect of this integration on the students' motivation and activity completion rate. According to Lincoln and Guba (1985), interviews can be employed in a study for several purposes, including understanding motivation, feelings, activities, design concerns and considerations. Indeed, interviewing the participants could help the researcher tap into their experience to gain a better understanding of the research contexts and the possible issues encountered when experiencing the gamified FVC (Gravetter & Forzano, 2018). Another reason for conducting semi-structured interviews was that only seven out of twelve invited students agreed to participate in the interview. Since selecting those participants was mainly based on a purposive sampling strategy that included students with three different motivation levels (see section 3.5.2), using a focus group with such diversity or

unbalanced motivation dynamics might make some participants hesitant or less inclined to feel secure to talk freely in group-based conversations. The students in semi-structured interviews were more likely to share their perspectives and innermost thoughts individually based on their own experiences, and the researcher was more able to drive the conversation based on each student's motivation level separately (i.e., low, moderate, and high).

Moreover, the rationale for choosing the semi-structured form of the interview was its flexibility in adapting the questions throughout the interview sessions. In other words, the sequence of the questions could be amended when required by the researcher, as the participants might raise specific issues from one interview to another. Therefore, this type of interview allowed the researcher to rephrase, alter, or even exclude any difficult or unsuitable questions. This flexibility would better serve the study aims and facilitate answering the research questions more deeply. According to Cohen *et al.* (2018), the method can generate more informal and flexible research settings, allowing researchers to benefit from multi-sensory cues such as gestures and verbal cues, heard and spoken indicators that could enrich understanding of the participants' behaviour. As a result, the semi-structured interviews could produce in-depth information that was not provided by quantitative instruments. Hence, the current study conducted interviews after collecting quantitative data from the questionnaire, since a questionnaire was highly unlikely to offer such a level of data and information when used alone. In addition, this scenario is believed to provide the benefits of both methods as a mixed-methods approach (Creswell & Creswell, 2022).

3.5.1.1 Semi-structured Interview Design

When designing an interview, it is crucial to ensure that its content is designed to help the researcher address the research questions (Bryman, 2012). Therefore, based on the current study's questions, some of the interview questions were based on the study's theoretical framework (i.e., autonomy, competence, relatedness, and interest/enjoyment), while others concerned aspects related to students' perceptions and adoption and design considerations. In addition, since the type of the interview was semi-structured, some content and questions were based on what was noticed and heard from the participants during these interview sessions and the results obtained from the quantitative phase. When the interview questions were devised,

several aspects were taken into consideration (Arksey & Knight, 1999; Cohen *et al.*, 2018) as follows:

- The questions were formulated based on clear and understandable language and simple vocabulary.
- Harmful, sensitive, vague, imprecise, leading, double-barrelled, and presumption-based questions were avoided.
- The questions considered that the responses or events should be easy for the interviewees to recall.
- The questions did not previously assume that the participant had the required or predicted responses.

Moreover, the interview content was formulated and constructed based on the research questions and classified into eight sections as follows:

- 1) The introduction included an explanation of the purpose of the research and its nature, anonymity assurance, and asking for the interviewee's consent to record the interviews for research purposes (Lo & Hew, 2020).
- 2) General questions were asked to provide an overview of the participants' backgrounds and previous gamification and flipped learning experiences, particularly before participating in the current study.
- 3) Questions related to the competence dimension were asked to understand how the learning activities were perceived and how the participant felt about their ability to progress through these tasks, earning points and badges, and their team's position on the leaderboard.
- 4) Questions were constructed to explore aspects intimately associated with the autonomy factor. These aspects included time management, learning environment control, and the participants' feelings of freedom versus constraint, volition versus external control, and choice versus compulsion.
- 5) A set of questions were about the relatedness dimension. The participants were asked about their opinions on the team-based gamified tasks they experienced, their feelings towards their teams and teammates, and the peer interaction situations.

-
- 6) The interviews also included questions about factors considered strong indicators of autonomous motivation (i.e., enjoyment, value, usefulness, importance, and interest).
 - 7) Some questions were about the participants' perceptions of the gamified FVC, practical suggestions, and adoption and design considerations for the future utilisation of this method. Other questions related to these aspects were also generated based on each participant's responses to the above questions.
 - 8) Eventually, there was a conclusion in which the participants were thanked and provided contact information in case they needed to ask or talk about the research.

It is worth noting that before conducting the semi-structured interview phase, the main interview questions were piloted to ensure their suitability, as described in the following subsection.

3.5.1.2 Semi-structured Interview Pilot

The semi-structured interview instrument was piloted to increase its effectiveness in the current study, allowing the researcher to gain experience, refine its main content, and ensure the adequacy of time and instructions as well as its ability to collect high-quality data (Bryman, 2012). To achieve this, on the 14th of February 2022, three students who participated in the pilot study and not in the actual experimental research were selected to participate in the semi-structured interview pilot after obtaining their consent forms (*ibid*). The interview sessions were then held online via the Zoom application in settings similar to those planned for the actual study. Conducting pilot interviews allowed the researcher to ensure the flow of the interview questions and gain some experience as an interviewer. The interview questions were re-ordered based on what was observed throughout the pilot interview process. Eventually, the interview content seemed clear, concise, and comprehensible, and the average time spent on the interviews was generally around 20 minutes.

3.5.2 Sampling Strategy

In relation to the qualitative sample, a stratified purposive sampling strategy was used with the experimental group (see Figure 3.10). This strategy is defined as a type of non-probability sampling that can be used in mixed-methods studies as a qualitative research feature, in which the population or group is divided into distinct subgroups based on specific characteristics; then,

the participants are purposefully selected from these subgroups according to this selection criterion that is pre-defined based on the research questions being investigated (Teddlie & Tashakkori, 2009; Wang *et al.*, 2018).

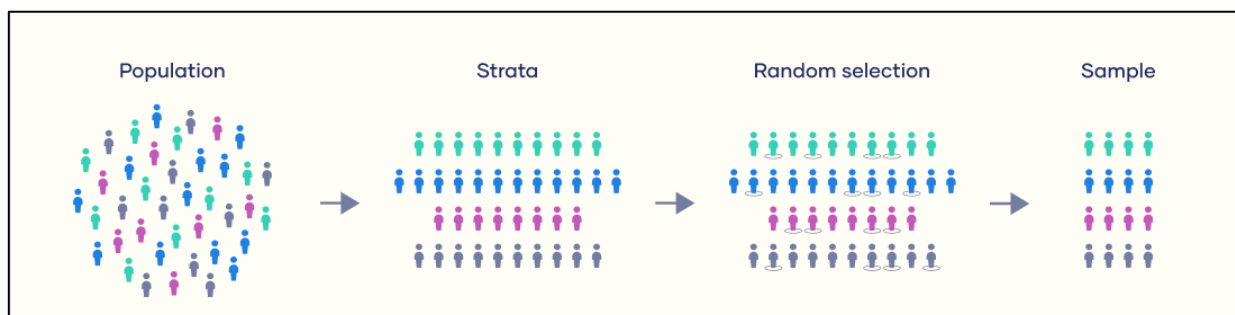


Figure 3.10: Stratified Purposive Sampling Strategy

In the current study, students in the experimental group (i.e., gamified FVC) were listed based on their calculated gain scores of autonomous motivation from low to high. This list was then divided into three subgroups (i.e., 25% low, 50% moderate, and 25% high). This sample size strategy aimed to increase the information saturation and diversity in students' perspectives by specifying a large proportion of the cases be situated in the centre of the list (50%), while keeping a balance and proportionality between the low and high subgroups (25% for each) (Teddlie & Tashakkori, 2009). In order to reduce the possibility of researcher subjectivity and bias related to selecting the cases from each subgroup, four students were randomly selected and invited from each subset, which also could have provided equal representation for all the subgroups' members, yielding a more representative sample within each stratum (Cohen *et al.*, 2018). However, a total of seven participants from the experimental group agreed to be selected for the semi-structured interviews, consisting of two low-motivated students, three students with moderate motivation levels, and two highly-motivated students.

The main aim of conducting semi-structured interviews was to address the research questions about: 1) students' perceptions of using the gamified FVC method; 2) the key adoption and design considerations that need to be addressed when implementing this method for autonomously motivating learning; and 3) understanding the effectiveness of SDT-based gamification, particularly when integrated into the FVC, as well as providing illumination and possible validation of the interpretation of the relevant quantitative findings obtained in the first

phase (Creswell, 2014). Moreover, the interviewees were selected from the gamified FVC for the following reasons: 1) the quantitative data analysis phase indicated no significant differences between the pre-test and post-test, as well as between the pre-questionnaire and post-questionnaire in the control group regarding the effect of the conventional FVC method on the study's dependent variables. This may reduce the value and usefulness of the data obtained from interviewing the participants in this particular group, as there was no significant effect to investigate; 2) the focus of the qualitative phase was mainly to provide a more detailed understanding of the participants' experience, attitude, and perceptions of the gamified FVC, and the associated adoption and design considerations that should be taken into account when utilising this method. Since SDT-gamification was applied only to the experimental group, only this group was interviewed because interviewing the control group might not provide in-depth insights into the processes and mechanisms underlying the gamified FVC method (Sandelowski, Voils & Knafl, 2009; Cohen *et al.*, 2018); 3) interviewing the control group was impossible for the researcher because of the limitations in time and interview incentives; and 4) interviewing the experimental group could inform future interventions or policy decisions regarding new practices for the conventional flipped learning models.

While the current study's primary focus is on investigating the gamified FVC method, it is acknowledged that conducting interviews with control groups may help answer research questions about the reasons for the low motivation and completion rates of online pre-class activities in the conventional flipped learning group. Future research should take this limitation into account and delve deeper into understanding the participants' perceptions and experiences when using such methods, both with and without SDT-based gamification.

3.5.3 Qualitative Data Analysis

The data collected for the current study was related to quantitative and qualitative research questions. Thus, determining a qualitative analysis method that could be used to understand the data collected from the semi-structured interviews and answer the relevant research questions was essential (Johnson & Christensen, 2013). The coding-based thematic analysis method was used in the current study to analyse such data. The reason for choosing this

method can be explained in the following paragraph (Cohen *et al.*, 2018; Braun & Clarke, 2006, 2019; Creswell & Creswell, 2022).

First, one of the research questions was aimed at understanding the participants' perceptions regarding their experiences of the gamified FVC method. Thematic analysis enables the researcher to explore and inductively identify patterns and themes that may emerge from the interviews to address this research question. Second, this method was aimed to help the researcher look at any meaningful frequency, similarities, or patterns in the interview content to answer a particular research question about the future adoption and design suggestions that need to be considered for the advancement of the gamified FVC method. This might not be achieved without understanding the experience from the participant's point of view. Third, coding-based thematic analysis is considered a transparent method in which other researchers can be allowed to review the themes and codes identified, to understand how these were clustered and eventually analysed. Thus, it can reduce possible biases or preconceived notions that might impact the data analysis and support the findings' trustworthiness. Finally, it was a low-cost analysis technique and easy to use since its processes did not necessarily require costly software or special equipment.

Several types of thematic analysis can be employed depending on the research questions and the type of data. These include, but are not limited to, inductive, deductive, content, and reflexive thematic analysis (Bryman, 2012; King & Brooks, 2016; Braun & Clarke, 2019). The present research utilised coding-based thematic analysis deductively and inductively to answer various research questions. Furthermore, deductive thematic analysis was used to support the quantitative data related to the second, third, and fourth research questions. The aim of using this method was to provide in-depth insights into the principles of the SDT that were hypothesised to drive students' autonomous learning motivation. Although this form of thematic analysis might generally yield fewer data descriptions, it could enrich some aspects with meaningful and more relevant details ascribed to its theory-driven nature (Braun & Clarke, 2006). The researcher started by reading through the interview transcripts to deductively identify codes, sub-themes, and themes in the data based on a pre-established set of categories (e.g., autonomy, competence, relatedness, and interest/enjoyment) induced by the research questions and the theoretical

framework underlying the study. For instance, quotes that mentioned the control of one's learning were encoded under the autonomy theme, while those related to the competence theme comprised statements about the feelings of being capable of progressing through challenging learning activities. This process of coding and identifying themes was carried out until all the relevant data was analysed.

Moreover, inductive thematic analysis was then used to address the fifth and sixth research questions pertaining to students' perceptions and suggestions for future adoption and design of the gamified FVC. This entailed generating themes that were not driven by the research's theoretical framework or the researcher's analytic preconception (Braun & Clarke, 2006; Creswell & Creswell, 2022). The researcher needed to examine the interview transcripts to identify possible patterns and then inductively classify them into sub-themes and themes without a pre-existing coding frame. These phases of the thematic analysis were adapted from Braun and Clarke (2006), emphasising that deciding between deductive and inductive thematic analysis should be based on how and why the data is coded. The researcher needed to code for specific research questions (i.e., Q2, Q3, Q4) built on a more theoretical approach. After that, the other research questions (i.e., Q5 and Q6) were addressed through the data-driven coding process (*ibid*). NVivo v12 and v14 software were utilised for the qualitative data analysis to organise these themes and codes.

3.5.3.1 Doing the Analysis

A six-phase guide by Braun and Clarke (2006) was used in this study as a framework for conducting the thematic analysis, moving forward and backwards from one step to another as needed. This provides a systematic approach to identify, analyse, and report patterns (themes) within the qualitative data supported by NVivo for organising and analysing the data. The six-phase framework is illustrated in Figure 3.11 and explained as follows:



Figure 3.11: Thematic Analysis Steps Based on Braun and Clarke (2006)

- 1) Become familiar with the data by reading and re-reading the transcripts to immerse myself in the dataset. This step was in parallel with documenting and noting initial reflections as memos using NVivo to highlight key ideas and emerging patterns. These were linked to the research questions, particularly for SDT-driven and data-driven analysis.
- 2) Initial codes were then generated utilising a deductive approach, mainly based on the SDT constructs (i.e., autonomy, competence, and social relatedness). Simultaneously, an inductive approach was applied to identify additional patterns and themes emerging directly from the data (e.g., advantages, challenges, and pre-class activities design). Each data excerpt was categorised under one or more nodes to represent deductive and inductive codes using NVivo.
- 3) These codes were grouped into broader sub-themes and themes. Deductive themes were directly linked with the research questions concerning, for example, autonomous motivation effect and completion rate, while inductive themes attempted to capture emerged insights (e.g., unexpected challenges in the gamified tasks and design

suggestions for further development). These themes were cross-referenced with the research questions to cover both predefined and emerging areas.

- 4) These preliminary themes and sub-themes are then refined, modified, or eliminated based on the extent to which each theme is supported by enough data that can make sense. Accordingly, any overlaps between the sub-themes were avoided to maximise coherence across the dataset. For example, due to insufficient nodes and overlap with other sub-themes (e.g., *Informational Feedback*), the sub-theme *Purpose of Feedback* was eliminated. This process helped the researcher to increase the accuracy and ensure that the themes reflect the data meaningfully. A thematic map was created to support this process (see Figure 4.24).
- 5) The themes were eventually refined to “...identify the ‘essence’ of what each theme is about.” (Braun & Clarke, 2006, p.92), and were named to reflect the relevant sub-themes and nodes. A description of each theme was reported, supported by specific quotations from the interview transcripts.
- 6) The task of the write-up of thematic analysis is to produce the final report of the data in a way that makes sense for the reader in light of the research questions and to support the validity of the analysis. The coding reports, thematic maps, and memos were produced using NVivo to document the analytical rigour of the procedures.

Finally, to ensure transparency and rigour throughout the analytical process, an audit trail was maintained in which thick descriptions regarding deductive and inductive coding and how each code was categorised under the sub-themes and themes using tables to exemplify this process (see Chapter Four). In addition, recording reflexive memos was also important to capture how the insights and thoughts evolved, and the deductive and inductive findings interplayed. For instance, some quotes that are related to the completion rate of pre-class tasks were mentioned in more than one theme to provide meaningful interpretations regarding the potential interrelationships between autonomous motivation components (i.e., autonomy, competence, relatedness, and interest/enjoyment) and the extent to which students complete the activities. The thematic analysis was peer-reviewed to increase the verification and validation of the themes and sub-themes and their alignment with the research questions, the theoretical framework, and the emerging insights. The peer interviews resulted in some amendments. For example, the

Freedom and *Sense of Choice* sub-themes were combined to become one sub-theme, namely, the *Free to Choose* sub-theme, while the *Learning Responsibility* was integrated into the *Independent Learner* sub-theme due to insufficient quotes. More description in relation to the trustworthiness of qualitative methods is provided in the following sub-section.

3.5.4 Trustworthiness of Qualitative Methods

Validity and reliability are typically statistical analyses related to quantitative research; however, establishing trustworthiness is equally essential in qualitative research studies (Wang *et al.*, 2018). Trustworthiness facilitates assessing the qualitative phase procedures and ensures their quality and rigour. The level of trustworthiness and quality of qualitative methods can be increased by considering credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985; Bryman, 2012). Compared to quantitative research, the criteria of credibility is equal to internal validity, while transferability is equivalent to external validity. Dependability in qualitative research is more associated with reliability, whereas confirmability is comparable with objectivity (Lincoln & Guba, 1986). The researcher adhered to those criteria as follows:

Credibility

This criterion concerns the determination of research transparency, accuracy and acceptability to others; this can be evaluated by different strategies such as thick description, triangulation, persistent observation, reflexivity, and member reviews (Lincoln & Guba, 1986; Lodico *et al.*, 2006; Johnson & Christensen, 2013). Thus, the present research carried out a pilot study to assess the research tools, provide a sufficient basis for the actual research process, and improve understanding levels of the study context. Indeed, this allowed the researcher to reevaluate the semi-structured interview tool to ensure its effectiveness in capturing the appropriate data. The researcher additionally endeavoured to provide rich and detailed descriptions of the research procedures and participants' perceptions and experiences. Further, synthesising the findings obtained from the quantitative and qualitative methods in the current research may increase its credibility level by focusing on understanding these results through different processes and data collection methods (Creswell & Creswell, 2022). The utilisation of various research instruments, including pre- and post-tests, formative assessment, VLE statistical reports, pre- and post-questionnaires, and semi-structured interviews, could provide multiple

data sources that support the understanding of the research findings (Cohen *et al.*, 2018), yielding increased credibility (Onwuegbuzie & Collins, 2017). In addition, the interview transcript was verified in terms of its content to boost the research credibility; while the protocol and process of its design and implementation were checked by five individual experts from Jeddah University and Newcastle University, including the research supervisory team.

Dependability

The criterion of dependability parallels reliability in quantitative research; it concerns the stability and consistency of the research process when replicated with similar samples and settings (Bryman, 2012). As Lincoln and Guba (1985) suggest, researchers should consider an 'auditing' approach in order to achieve research dependability. Accordingly, this requires making all the study process records available for access and review by peers who act as auditors. Therefore, these processes need to be reported comprehensively to enable future quality studies to understand, review, and maybe apply the same methods, considering that these would not necessarily produce the same outcomes (*ibid*). To enhance this criterion, it was crucial that the researcher acknowledge and clarify his position in the current study as an insider researcher, and detail what procedures were undertaken to mitigate the potential bias, as Fleming (2018) suggested (see section 3.6). Based on these considerations, the process of research instruments' design, sampling strategies, data collection phases, and ultimately, the data analysis and interpretation were all reported in detail. This will make it possible for other researchers to review and adopt the same qualitative methods (Lincoln & Guba, 1985).

Confirmability

This element of trustworthiness describes the objectivity and neutrality of the research outcomes and the extent to which the researcher's claims, justifications, and interpretation conform with the data collected (Lincoln & Guba, 1986), bearing in mind that complete objectivity is often impossible to achieve in social science studies (Bryman, 2012). In other words, confirmability focuses on ensuring that the research results reflect the data collected and not the researcher's preconceived judgment. Several steps were taken into consideration in the current study to augment the criteria of confirmability, including reflexivity, triangulation, and an audit trail (Johnson & Onwuegbuzie, 2004; Cohen *et al.*, 2018). The researcher consciously

acknowledged and disclosed his role in the research and continuously practised self-awareness throughout the research process. The research procedures and analysis were justified and reported in detail, and then these were discussed with colleagues and the supervisory team to identify and minimise potential researcher influences. In addition, the semi-structured interviews were all recorded to enable the production of accurate transcriptions, which were also reviewed and re-examined. The data were generated through the quantitative and qualitative methods used in the present study, which could create more confirmability. The researcher eventually correlated the findings with the literature and the underlying theoretical framework to check the interpretations' logic and consistency.

Transferability

Another element that should be considered to ensure trustworthiness is transferability, which can be described as the extent to which the findings can be applied to a different context (Fleming, 2018). According to Lincoln and Guba (1985), the level of this criterion can be supported by producing thick descriptions, including details on the culture or research context, in a way that allows others to make their decisions or judgements about the possibility of transferring the findings to other milieux. In addition, the quality of research design and interpretations can play a vital role in maximising transferability to other settings (Tashakkori & Teddlie, 2009). Accordingly, the researcher attempted to increase the potential of transferability by: employing a purposive sampling strategy for the semi-structured interviews, to capture the diversity of students' experiences based on different motivation levels in light of the research questions; and by providing detailed descriptions of the research context, methods, design, procedures, sampling strategy, data collection, and justifications for interpretations, which can be used as a database for others to decide on the possibility of transferability to different contexts (*ibid*). This study was also conducted at a state university in Saudi Arabia, where all universities belong to and are regulated by the same higher educational organisation, with similar CS course content applied at the same university stage. This might support the transferability of the investigated gamified FVC method and the results, at least, to other similar contexts.

3.6 Ethical Issues

Ethical consideration is crucial for a research study to be conducted legitimately, which reflects on its process (Creswell, 2014). This required the researcher to carefully ensure the issues of informed consent, permission, and ethics on the basis of the British Educational Association's ethical guidelines for educational research (BERA, 2018). This guidance provides comprehensive and valuable ethical instructions for researchers; therefore, it was meticulously considered during all the study procedures. As shown in Appendix A, ethical approval was obtained from the School of Education, Communication, and Language Sciences at Newcastle University, allowing the researcher to conduct the current study. In addition, since the research was conducted outside the UK, Outside Study Approval was also obtained from the University (see Appendix B). In addition, Appendix D presents the informed consent forms that were completed by the participants to confirm their understanding and acceptance of the procedures. Since the research instruments contained items and questions that needed to be translated from English into Arabic, and then from Arabic back into English, potential ethical matters were closely considered, and all the translations were reviewed and validated by five experts to ensure the desired meanings and sense were presented.

Moreover, it was anticipated that the study would encounter certain ethical issues that needed to be considered during the research process, such as participants' privacy and confidentiality. Since the online sessions and interviews were recorded, this process would naturally raise ethical concerns. Therefore, to ensure the privacy and confidentiality of the participants' data, the following procedures were considered: 1) the researcher had sole access to the required participants' information and resulting data, and these were stored on the researcher's private computer and protected by a strong password; 2) the permissions for this access were officially obtained from all relevant parties; 3) the participants' consent forms to take part in this study were also carefully considered and clearly explained to the participants before completion and subsequent collection; 4) the participants were allowed to withdraw from the research experiment at any time without being required to give an explanation or justification; 4) the participants' responses and information obtained from the research experiment have been used only for the purposes of the study and have not been shared with any other parties; 5) the

participants' names were not recorded on the tests, questionnaires, and interviews; instead, coded signifiers were used for the research purposes; 6) all the participants' records were anonymised at the point of translation, transcription, and analysis, and once the study is completed, all these will be destroyed when no longer required for the purposes of this study.

Furthermore, several key ethical considerations were safeguarded concerning the experimental research procedures. First, ensuring that the study intervention would not influence the participants' scores on the formal course assessments was vital. Therefore, the evaluated quizzes and the points earned by the participants throughout the intervention were not linked with the formal academic course grading. In other words, all the participants were informed that all the collected assessments and evaluations were entirely separate and unconnected to the course requirements and, therefore, not included in their formal course results. In addition, to avoid the possible impact of the dual role of instructor and researcher on the research claims and outcomes, both the intervention and comparison groups were taught by the same person, the official course instructor. This may have mitigated the researcher's possible influence on attitudes, expectations, and beliefs. Finally, the researcher attempted to ensure that the participants in the intervention group did not know what the comparison group was doing, to avoid contamination between the two groups.

Insider Research

Insider research can generally be defined as undertaking a research study “within an organisation, group or community where the researcher is also a member” (Fleming, 2018, p. 311). In the current study, the dual roles of being an academic member in an institution where the study was conducted and, at the same time, an insider researcher could arguably influence the research procedures. Since familiarity with the field work may influence the research objectivity, it was necessary to adopt several steps carefully to take advantage of the available opportunities while dealing with the possible challenges or ethical issues (e.g., power and potential bias) that may face an insider researcher in an environment where the researcher works and the *research* experiment was carried out (Unluer, 2012).

In terms of the available opportunities, being an insider researcher accelerated the formal procedures of obtaining official permission from the University administration to conduct the

study without violating the formal regulations. In addition, on the University's online learning platform (i.e., Blackboard), the researcher already had a member account similar to the one used by the instructor, allowing him to test the platform functions, familiarise himself with the VLE's interface, and understand any recent updates or changes in the online learning environment, even before the implementation of the research experiment. Such facilitation could have been more difficult for an outsider to obtain.

Although the fact that the insider status provided the researcher with several benefits in relation to rapport, familiarity, and piloting and implementing the study, it should be highlighted that certain relevant challenges need to be considered in this case, specifically, those associated with researcher bias, which could threaten the validity of the study (Cohen *et al.*, 2018; Fleming, 2018). This reflects that being an insider researcher is like holding a double-edged sword; despite the possible facilitation within the institution under research, insider researchers have to deal with the fact that informants may know them and their research area, which may lead to preconceptions about the study results, yielding biased or less detailed data (Mercer, 2007). In fact, insider research takes place on a continuum that is based on the researcher's identity positioning and the extent to which the researcher is close to the environment being researched (Trowler, 2011). In other words, insiders might investigate parts of an institution previously unknown to them or gather data from strangers, even though they are staff members of the same institution (Fleming, 2018). Although being an insider researcher, the participants in the current study were recruited from the Engineering and Computer Science Faculty, which is completely different from the environment in which the researcher works. Additionally, the investigator did not know the instructor who taught the students; he also did not have any administrative role in the faculty; thus, no power or authority was practised over the staff or students.

Moreover, the instructor did not know how to use some of the online platform tools, such as assigning the gamified activities and using group-based breakout rooms; therefore, the researcher used his own member account (i.e., an instructor user account) on the same platform to train him on how to use these functions. Furthermore, the familiarity that the researcher had with the online learning platform and its functions in the context of the host university undoubtedly gave him a better pre-understanding of the procedures that needed to be followed

when technical issues occurred, as well as an understanding of how the instructor and participants interacted and dealt with the online learning environment. Thanks to this familiarity, the researcher already knew what type of data was available and accessible for the instructor, based on his user account type. Given the considerations related to insider research, the study was naturally affected by the researcher's prior knowledge of the study fieldwork, which generally facilitated the implementation of the research experiment procedures.

Chapter Four – Findings

4.1 Quantitative Findings

4.1.1 Introduction

The study findings are based on a mixed-methods approach to address the research questions listed in Table 4.1. These findings are written in two main parts that construct this chapter: Quantitative Findings (4.1) and Qualitative Findings (4.2). In terms of the quantitative phase, a quasi-experimental research design was applied to determine whether there was a significant effect from integrating SDT-based gamification into a flipped virtual classroom (gamified FVC), as the independent variable used with an experimental group, on the dependent variables, namely, learning achievement, autonomous motivation indicators (i.e., learning autonomy, competence, relatedness with others, and interest/enjoyment) in addition to the completion rates of pre-session tasks. A comparison to a control group, which used a conventional flipped virtual classroom without gamification (non-gamified FVC), was then made. After shedding light on some critical characteristics of the two study groups, this part of the chapter presents the quantitative data analysis associated with the first three research questions (see Table 4.1). The section reviews the key analysis findings of the pre-post-achievement test scores, formative assessment, the VLE statistical report, and the pre-post questionnaire items concerning Saudi university students attending the Computer Science (CS) course at a preparatory stage.

The participant responses related to their background in the two study groups are presented in the following section to provide insights into students' preferences and prior experiences regarding gamification, flipped learning, and, generally, using technology in their education. In addition, the researcher attempted to control crucial characteristics of the treatment and comparison groups before applying the study intervention. These included prior knowledge and skills particularly associated with the CS module concepts, existing initial learning motivation, and self-regulation skills in terms of time management and learning task strategies with online learning to control or, at least, mitigate their effects on the research results and assumptions as far as possible.

Table 4.1: Research Questions and Instruments

N	Research Question	Achievement Test	Formative Assessment	VLE Statistical Report	Questionnaire	Interview
1	To what extent did the integration of gamification into FVC affect students' learning achievement in Saudi higher-education CS?	√	√	√		
2	To what extent did the integration of gamification into FVC affect students' autonomous motivation in Saudi higher-education CS?				√	√
3	To what extent did the integration of gamification into FVC affect students' completion rate of pre-session tasks in Saudi higher-education CS?			√		√
4	To what extent did the students' autonomous motivation correlate with their pre-session task completion rate when gamification was integrated into FVC?			√	√	√
5	How did the Saudi university students perceive their gamified FVC experiences?					√
6	What are the key adoption and design considerations that need to be addressed when implementing the gamified FVC method for autonomously motivating learning?					√

It was necessary, therefore, to apply a pre-test and pre-questionnaire before exposing the participants to the instructional intervention to ensure the comparability of the two groups and assess their broad features as well as any possible initial differences between them regarding the characteristics above. The normality of the data distribution and the groups' homogeneity of variance were also statistically checked, and then, based on the results and relevant test assumptions, parametric tests or non-parametric tests were decided to be used for the data analysis (Pallant, 2020). For example, when the normal distribution assumption of the data was violated, the non-parametric test, namely, the Mann–Whitney *U* test, was used as an equivalent of the independent sample t-test to provide a statistical comparison between medians and analyse rankings of the data points instead of comparing the differences in means between the two groups (Cohen *et al.*, 2018; Cooksey & McDonald, 2019; Pallant, 2020). Histograms in the current study are provided to present the data distributions side by side for comparison reasons, and a detailed evaluation can be made by zooming in on each figure in this document.

Furthermore, the effect size of the study intervention was computed using Cohen's d to check, if any, the size of the difference. Cohen and colleagues (2018) emphasise that when the intervention is applied only to the experimental group, Cohen's d criteria are widely used in such research to statistically determine the extent to which the effect of the difference between this group and the control group is significant. The effect size, therefore, was gauged based on this guideline for d as follows: a d -value below 0.21 indicates a weak effect, a value between 0.21 and 0.50 represents a modest effect size, a value between 0.51 and 1.00 shows a moderate effect, while a d -value greater than 1.00 indicates strong effect size (Cohen, 1988; Cohen *et al.*, 2018). The correlation coefficient tests (i.e., Pearson's r and Spearman's r_s) were also carried out to determine the direction and strength of the relationships that may exist within and between the research variables, including autonomy, competence, relatedness, interest/enjoyment, and completion rate of pre-session tasks. Based on the results of r or r_s , the correlation value generally is situated between -1 (no correlation) and +1 (perfect correlation). In detail, a value below 0.30 reflects a small correlation, and a value between 0.30 and 0.49 represents a medium correlation, while a value of 0.50 and above indicates a strong correlation between two variables; the negativity and positivity of this value indicates the nature of the relationship (i.e., negative or positive correlation) (Cohen *et al.*, 2018).

In terms of the organisation of the quantitative findings part, the first section (4.1.2) sheds light on some crucial characteristics of the two groups (i.e., gamified FVC and conventional FVC) to assess comparability. The second section (4.1.3) presents the data analysis and findings related to students' learning achievement and performance, including the students' scores from the pre- and post-tests and formative assessments. Moreover, section three (4.1.4) displays the analysis findings from comparing factors associated with autonomous motivation, including autonomy, competence, relatedness, and interest/enjoyment between students in the gamified FVC and their peers in the conventional FVC. The fourth section (4.1.5) highlights the findings obtained from comparing the completion rates of pre-session learning tasks between the two groups, while the fifth section (4.1.6) sheds light on the correlations between students' autonomous learning motivation and their completion rates of pre-session activities.

4.1.2 Characteristics of the Two Groups

The two groups in the current study statistically showed an extent of similarity in some characteristics. All the participants in the two groups were males due to the gender segregation system in Saudi higher education. The primary data in Figure 4.1 below shows that all students in the two groups had experienced online learning technology and enrolled, at least, in one online flipped course before the current CS instructional course. This might be attributed to the fact that many university modules have already been provided and delivered using online flipped learning.

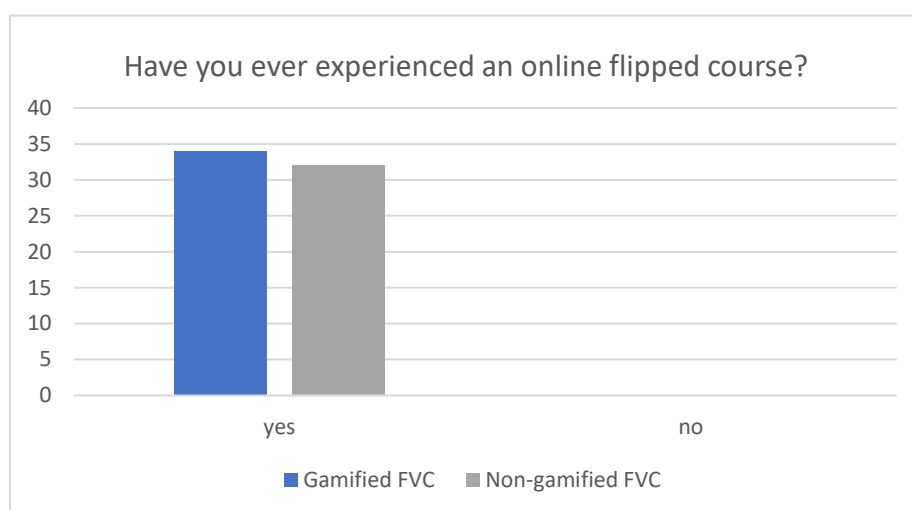


Figure 4.1: Previous Experience of Online Flipped Learning

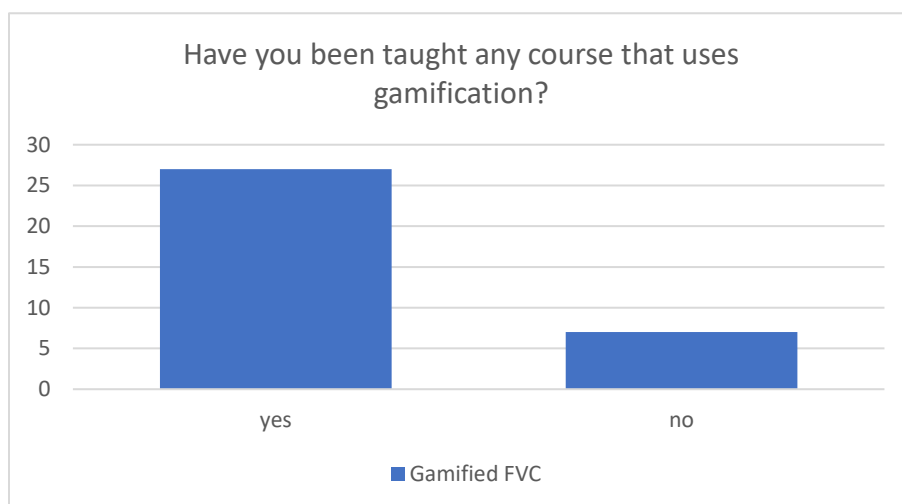


Figure 4.2: Previous Experience of Gamification

Meanwhile, Figure 4.2 indicates that 27 of 34 (79.4%) students in the gamified FVC had been exposed to a gamified learning method. These similarities and prior experiences might minimise the possible novelty effect of online technology, flipped learning, and gamification.

Furthermore, the primary data also aimed to ensure internet access and availability for the participants at home, and the result shows that all participants in both classes had access to this service, indicating no digital divide in the study's context.

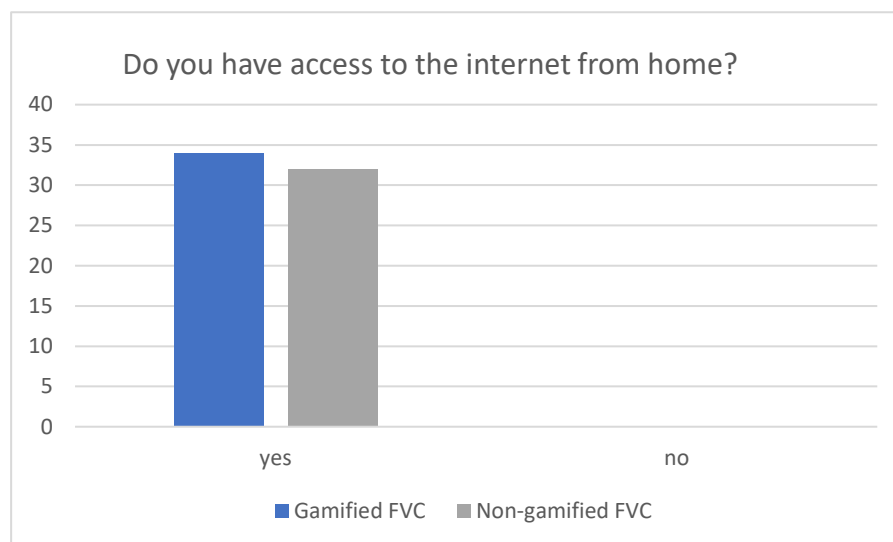


Figure 4.3: Home Internet Availability

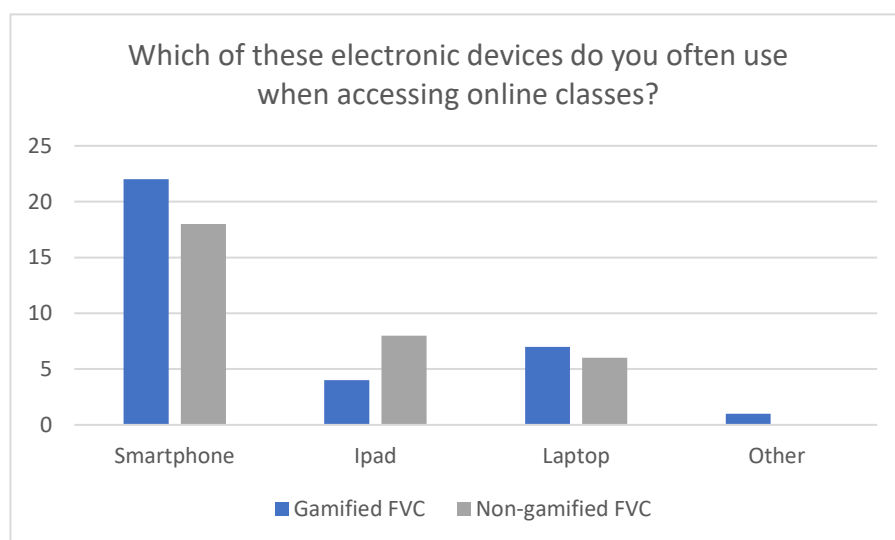


Figure 4.4: Electronic Device Preferences for Online Learning

All the participants were also asked about the devices they often use to access online learning materials. Figure 4.4. illustrates that 64.7% of the students in the gamified FVC and 52.9% of those in the conventional FVC used their smartphones to study online. This might indicate that they could flexibly access the online learning platform from everywhere. Based on their preferences for electronic devices, 20.5% of the participants in the gamified FVC preferred to use laptops, compared to 17.6% in the conventional FVC. Overall, the results suggest that when

designing out-of-class learning videos and materials, these should be compatible with the devices used by students. This was considered in the current study to avoid any possible technical issues associated with accessing the online learning materials and allow students to use their preferred devices for the online learning environments.

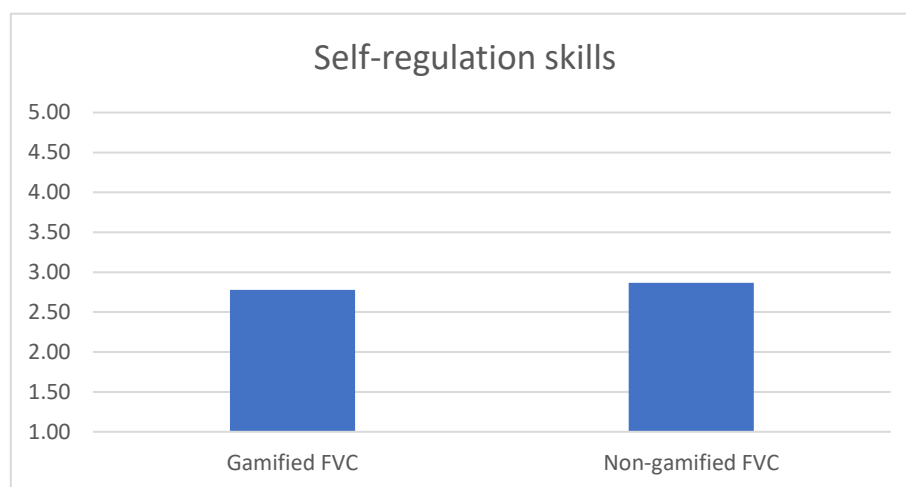


Figure 4.5: Overall Results of Self-Regulation in Terms of Time Management and Learning Task Strategies

Table 4.2: Independent Sample T-test to Compare the Mean Differences between the Non-Gamified FVC and Gamified FVC Groups in terms of Self-Regulation Skills

Variable	Group	<i>n</i>	Mean	SD	<i>t</i>	<i>p</i>
Self-regulation skills	Non-gamified FVC	32	2.87	0.44	0.81	0.423
	Gamified FVC	34	2.78	0.46		

In addition, other statistical tests were used to assess the data distribution and comparability between the two groups concerning this factor. These series tests included the homogeneity test (i.e., Levene's test) to check the data variation between the two groups, and the normality test (Shapiro-Wilk's test) to ensure the normality in the data distribution for each group (Royston, 1992; Stockemer, 2019). After ensuring that the relevant data were normally distributed and the two groups were largely homogeneous in the variances of the responses, the statistical t-test was applied to assess the self-regulation variable, and the results revealed no significant differences ($p = 0.423$, $t = 0.81$, $p > 0.05$) between those groups regarding students'

regulation skills (see Table 4.2). This result suggests that this factor did not significantly affect the assumption of the study intervention.

4.1.3 Students' Learning Achievement and Performance

The current study applied pre-test, post-test, and formative assessments to address the first research question concerning the possible effect of the gamified FVC method on students' learning achievement and performance, compared to the conventional FVC (a non-gamified FVC format). The pre-test was used to assess the students' prior knowledge and skills related to the CS instructional module concepts, while the post-test attempted to evaluate and compare any potential changes in learning achievement between the two groups after the experiment in this module. Each test consisted of 40 multiple-choice questions with a maximum score of 40 (see Chapter Three, Section 3.4.1). While this test was used to assess changes in students' learning achievement at the end of the course, the formative assessments were applied to evaluate students' knowledge accumulation throughout eight topics in this instructional module. This section presents the data analysis processes of the students' test scores obtained from the pre-test, post-test, and formative assessments, aiming to address Question One. This data analysis will also test the first hypothesis associated with this research question (see Figure 4.6 below).

To what extent did the integration of gamification into FVC affect students' learning achievement in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores.

Figure 4.6: Question One and Hypothesis

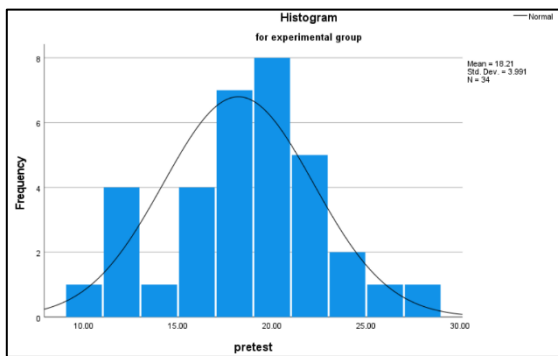


Figure 4.7: Achievement Histogram of the Data Distribution of Experimental Group

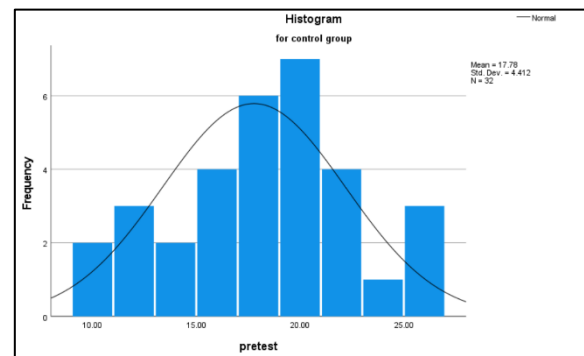


Figure 4.8: Achievement Histogram of the Data Distribution of Control Group

As illustrated in Figures 4.7 and 4.8, the pre-test scores collected from the control group (Shapiro-Wilk = 0.489, $N = 32$, $p > 0.05$) and the experimental group (Shapiro-Wilk = 0.696, $N = 34$, $p > 0.05$) were found to be normally distributed. The homogeneity of the groups was also tested using Levene's statistical test for equality of variances, revealing that the two groups were largely homogeneous ($p = 0.478$, $p > 0.05$). Therefore, the independent sample t-test was used to determine the mean differences between the study's groups in terms of students' prior knowledge and skills associated with the CS instructional module. The pre-test mean scores of these groups were found to have no significant differences (experimental group: $M = 18.21$, $SD = 3.990$; control group: $M = 17.78$, $SD = 4.412$) with $t = 0.41$, $p = 0.68$, $p > 0.05$, suggesting that students in both groups had a relatively similar baseline of prior knowledge related to this specific course. Based on this result and the demographic data analysis, it can be assumed that before applying the study's intervention, the participants in the control and experimental groups were unfamiliar with the course's instructional content and relevant learning materials.

In relation to the formative assessments, the descriptive statistics demonstrated that the data obtained from the non-gamified FVC group (Shapiro-Wilk = 0.216, $N = 32$, $p > 0.05$) and the gamified FVC group (Shapiro-Wilk = 0.272, $N = 34$, $p > 0.05$) were also normally distributed. Furthermore, Levene's test for equality of variances revealed that the two groups were relatively homogeneous in the variances of the formative assessment data ($p = 0.070$, $p > 0.05$).

Table 4.3: Independent Sample T-test to Compare the Mean Differences between the Experimental and Control Groups in Terms of Overall Performance

Overall performance	Group	n	Mean	SD	t	p	d
Formative assessments	Control group	32	45.89	11.28	6.66	0.001*	1.6
	Experimental group	34	67.33	14.55			

* $p < 0.05$

The independent sample t-test was therefore applied, and the overall result showed a significant difference between the experimental (Mean = 67.33, SD = 14.55) and the control (Mean = 45.89, SD = 11.28) groups, with $t = 6.66$, $p = 0.001$, $p < 0.05$, and large effect size ($d = 1.6$) (see Table 4.3). This finding generally indicates that students in the gamified FVC performed better in the online learning activities than their peers in the non-gamified FVC.

At the end of the course, a post-test of learning achievement was carried out to assess any potential changes within and between the two study groups in terms of the student's acquisition of the course's knowledge and concepts. It was determined that using the gain score method (post-test score minus pre-test score) would be more appropriate to capture the changes in the students' achievement scores before and after the study intervention application (Campbell & Stanley, 1963; Knapp & Schafer, 2009) (see Chapter Three, Section 3.4.8). Therefore, the pre-test-post-test gain scores for each question for each student were first statistically computed. This statistical analysis was used to evaluate the differences between pre-test and post-test scores in the experimental and control groups and to address any possible gaps or variances in the students' pre-test scores when comparing the two groups (Campbell & Stanley, 1963; Williams & Culpepper, 2018).

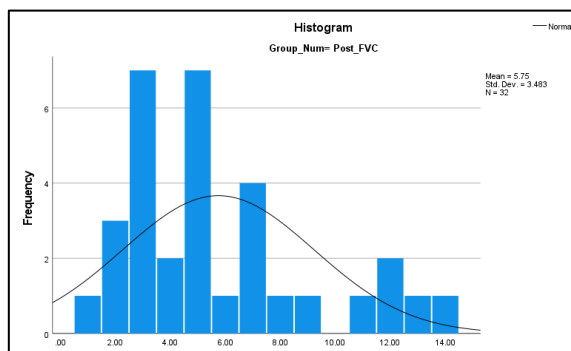


Figure 4.9: Gain Scores' Data Distribution of The Non-Gamified FVC Group

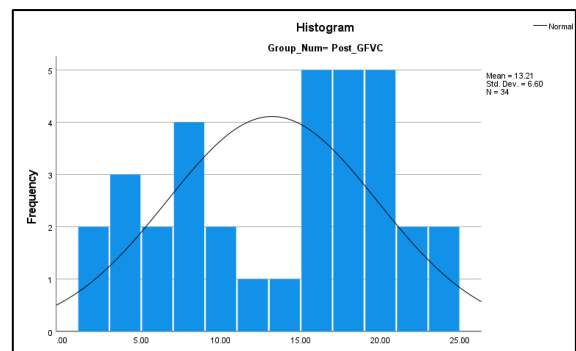


Figure 4.10: Gain Scores' Data Distribution of The Gamified FVC Group

The normal distribution of the calculated gain scores was then tested for both the gamified FVC group (Shapiro-Wilk = 0.021, $N = 34$, $p < 0.05$) and the non-gamified FVC group (Shapiro-Wilk = 0.003, $N = 32$, $p < 0.05$), revealing that the data were not normally distributed (see Figures 4.9 and 4.10). This implies that an alternative non-parametric test should be used to analyse this data statistically based on median rather than means (Cohen *et al.*, 2018).

Table 4.4: Mann-Whitney Test for Achievement Test Gain Scores (post minus pre) between the Gamified FVC and Non-gamified FVC Groups

Achievement test	Group	<i>n</i>	Med	SD	M-rank	U	Z	P	<i>r</i>
Gain scores	Control group	32	5.0	3.48	22.69	198	-4.452	0.001*	0.55
	Experimental group	34	15.5	6.60	43.68				

* $p < 0.05$

Therefore, a further step was taken to check if there were statistically significant differences and test the relevant hypothesis. The Mann–Whitney U test was applied, and the result indicated significant differences in the gain scores between the experimental group (Med = 15.5, SD = 6.60, M-rank = 43.68) and the control group (Med = 5.0, SD = 3.48, M-rank = 22.69) with $U = 198$ ($z = -4.452$), $p = 0.001$, $p < 0.05$ (see Table 4.4). The analysis results of the data obtained from the achievement test gain scores generally implied positive changes for the two groups based on the students' pre-test and post-test scores; however, these changes were found to be significant and greater in the gamified group compared to the non-gamified FVC group. This means that H_0 has been rejected while H_1 can be confirmed (see Figure 4.6). Furthermore, the effect size was then calculated based on the z-score ($r = z / \sqrt{N}$) to determine the extent of the difference approved by the Mann-Whitney U test (Field, 2009); Table 4.4 shows an r -value of 0.55, revealing that there is a moderately large difference between the two groups, with the experimental group showing considerably higher values or ranks. These statistical results suggest a positive impact of the gamified FVC method on students' CS module scores.

4.1.3.1 Learning Achievement Score Based on Different Achievement Levels

In addition to examining the difference between students' learning achievement based on their gain scores, the present research assessed the effect of gamified FVC on different achievement levels in comparison to the conventional FVC. Thus, the frequency of participants'

scores in the pre-test was used to create a classification of three achievement levels based on the similarities in the distributions (i.e., top, medium, and low scores), as presented in Table 4.5 below.

Table 4.5: Different Levels of Students' Achievement Based on the Frequency Distribution of Pre-Test Scores

Group	Low	Medium	Top
Gamified FVC	10	11	13
Non-gamified FVC	11	9	12
Total	21	20	25

Table 4.6: Mann-Whitney Test Results of the Gamified FVC and Non-Gamified FVC Groups based on the Initial Achievement Levels

Test	Achievement level	FVC Group	<i>n</i>	Mean	SD	Med	Z	<i>p</i>	<i>r</i>
Pre-test	Low	Non-Gamified	11	13.0	2.32	13	-0.50	0.65	0.06
		Gamified	10	13.4	2.27	13			
	Medium	Non-Gamified	9	17.8	0.97	17	-0.81	0.46	0.01
		Gamified	11	18.1	0.83	18			
	Top	Non-Gamified	12	22.2	2.33	21.5	-0.03	0.98	0.00
		Gamified	13	22.0	2.12	22.0			
Post-test	Low	Non-Gamified	11	16.9	2.99	18.0	-2.44	0.02*	0.30
		Gamified	10	22.4	4.84	24.5			
	Medium	Non-Gamified	9	22.1	1.17	22.0	-3.78	0.00*	0.47
		Gamified	11	30.6	2.73	30.0			
	Top	Non-Gamified	12	30.7	5.38	28.0	-3.65	0.00*	0.45
		Gamified	13	39.1	1.11	39.0			

* $p < 0.05$

Table 4.6 above illustrates the results of students' achievement scores according to different achievement levels for the pre-test of gamified FVC and non-gamified FVC groups. According to these results, no significant difference was found in the student achievement scores between the two groups for all three classifications. In the non-gamified FVC group, the mean scores of the pre-test related to the low achievers were reported at $M = 13.0$, $SD = 2.32$, while for the medium achievers, $M = 17.8$, $SD = 0.97$, and for the top achievers was $M = 22.2$, $SD = 2.33$. These

results did not seem to differ much from the gamified FVC group levels in the same achievement pre-test, indicating a similar CS knowledge baseline for both groups. However, the statistical results revealed significant differences in student's post-test scores based on the three different achievement levels, implying that the gamified FVC group achieved higher scores than their peers in the non-gamified FVC group. In detail, the Mann-Whitney test was used to compare the differences between different students' levels (i.e., low, medium, top) based on their achievement scores in the post-test. The results reported significant differences across all levels: Low $U = 20.5$, $Z = -2.44$, $p = 0.02$, $p < 0.05$; Medium $U = 0$, $Z = -3.78$, $p = 0.00$, $p < 0.05$; and Top $U = 12.0$, $Z = -3.65$, $p = 0.00$, $p < 0.05$. From these results, it can be noticed that the low achievers, medium achievers, and top achievers in the gamified FVC group showed better learning achievement scores when compared to similar achievement levels in the non-gamified FVC group. It was also found that the effect sizes of the differences in the three levels were generally moderate (Low: $r = 0.30$, Medium: $r = 0.47$, Top: $r = 0.45$). Hence, it can be inferred that students in the gamified FVC group had better academic learning achievement than their peers in the non-gamified FVC group in all different levels of their achievement.

4.1.4 Survey Questionnaires

Pre-and post-questionnaires were employed to determine and compare the changes in autonomous motivation indicators (i.e., autonomy, competence, relatedness, and interest/enjoyment) between the students in the gamified FVC group and the non-gamified FVC group, by requesting them to provide their responses to statements relevant to each dimension. This was aimed at helping the researcher address the second research question, which concerned the possible effect of integrating SDT-based gamification elements into an online flipped learning approach on Saudi university students' autonomous learning motivation in the CS course. This research question and its related hypothesis are presented in Figure 4.11 below.

To what extent did the integration of gamification into FVC affect students' autonomous motivation in Saudi higher-education CS?

H₀: No significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation.

H₁: There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation.

Figure 4.11: Question Two and Hypothesis

At the outset of the quantitative data analysis phase, the normality test was applied, and Quantile-Quantile (Q-Q) plots were plotted to assess the normality of the data distribution for all the questionnaire dimensions in the two groups. The Shapiro-Wilk test results show that the autonomy, competence, and interest/enjoyment data were all within the normal distribution rate ($p > 0.05$); however, an initial exploration of the data associated with the relatedness dimension suggested that it was not normally distributed (see figures 4.12 to 4.19). Finally, the homogeneity test (Levene's test) was used to check the variance of all the dimensions between the experimental and control groups, revealing no significant differences and indicating that the two groups were statistically homogenous in their variance regarding those assessed variables.

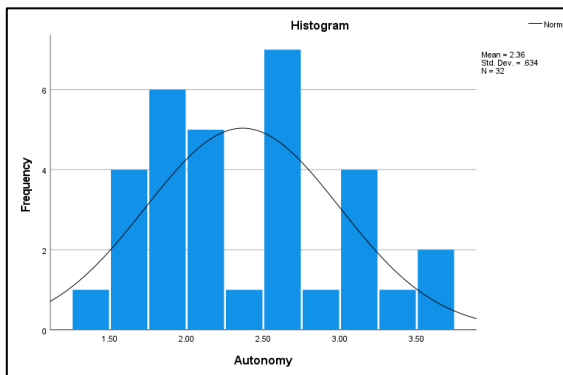


Figure 4.12: Autonomy Data Distribution of the Non-Gamified FVC Group

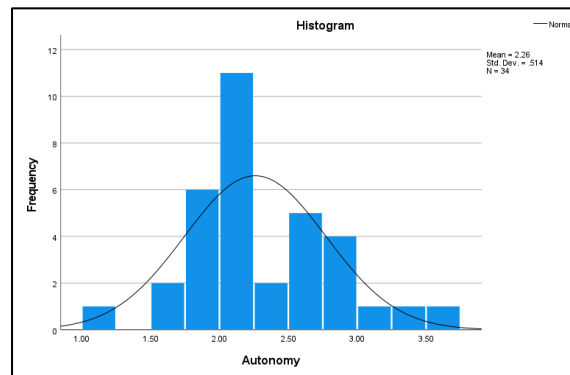


Figure 4.13: Autonomy Data Distribution of the Gamified FVC Group

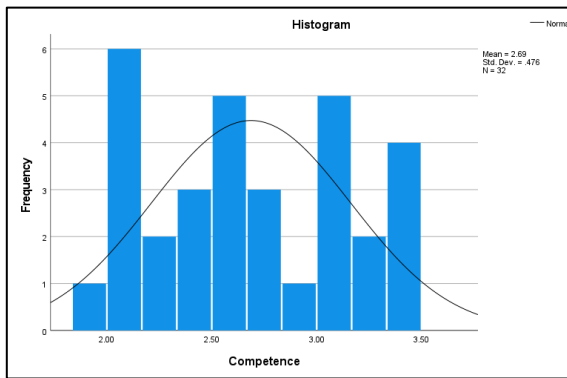


Figure 4.14: Competence Data Distribution of the Non-Gamified FVC Group

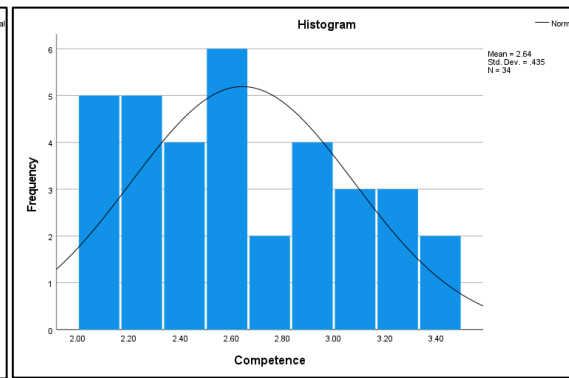


Figure 4.15: Competence Data Distribution of the Gamified FVC Group

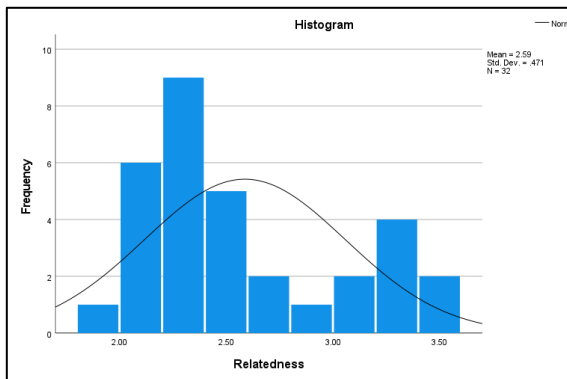


Figure 4.16: Relatedness Data Distribution of the Non-Gamified FVC Group

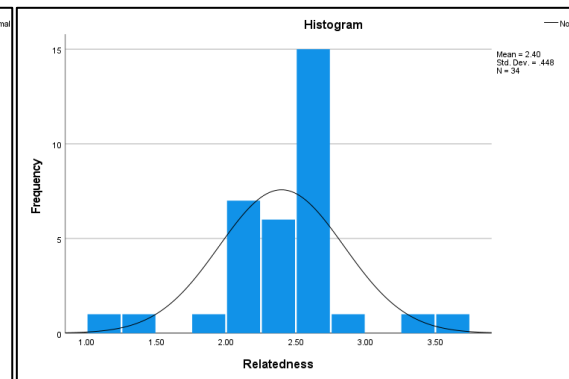


Figure 4.17: Relatedness Data Distribution of the Gamified FVC Group

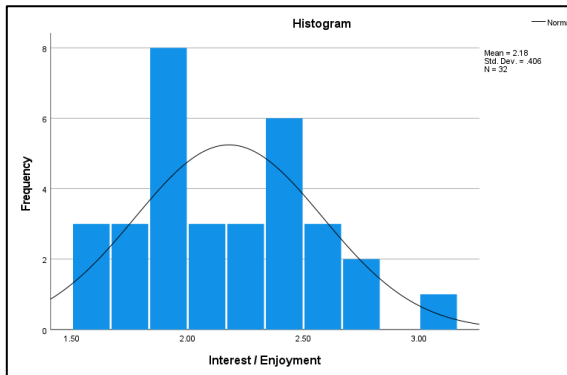


Figure 4.18: Interest/Enjoyment Data Distribution of the Non-Gamified FVC Group

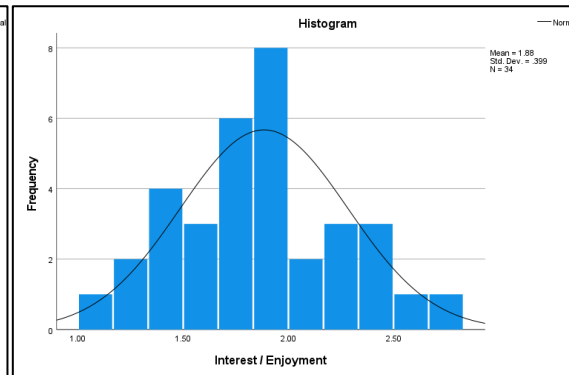


Figure 4.19: Interest/Enjoyment Data Distribution of the Gamified FVC Group

Based on the above initial statistical test results, an independent sample t-test was found applicable to analyse the data obtained from the pre-questionnaire related to autonomy, competence, and interest/enjoyment dimensions, while a non-parametric test (i.e., Mann-Whitney *U* test) was used to analyse the data related to relatedness dimension. As depicted in

Tables 4.7 and 4.8 below, the overall results indicate that there were no significant differences between the experimental group and the control group in terms of students' autonomy, competence, and relatedness dimensions, while a significant difference was detected in the interest/enjoyment dimension for the control group.

Table 4.7: Independent Sample T-test Results of Pre-questionnaire to Compare Autonomy, Competence, and Interest/Enjoyment Factors between the Two Groups

Dimension	Group	n	Mean	SD	t	p
Autonomy	Control group	32	2.37	0.634	0.75	0.459
	Experimental group	34	2.26	0.514		
Competence	Control group	32	2.69	0.476	0.39	0.698
	Experimental group	34	2.64	0.435		
Enjoyment/Interest	Control group	32	2.18	0.406	2.97	0.004*
	Experimental group	34	1.88	0.399		

* $p < 0.05$

Table 4.8: Mann-Whitney U Test Results of Pre-questionnaire to Compare Relatedness Factor between the Experimental and Control Groups

Dimension	Group	n	Med	SD	M-rank	U	Z	P
Relatedness	Control group	32	2.42	0.47	35.61	476.50	-0.879	0.379
	Experimental group	34	2.50	0.45	31.51			

At the end of the study's intervention, the post-questionnaire was applied to the gamified FVC group and the non-gamified FVC group. The gain scores (post minus pre) were eventually computed for each participant and each item to address the potential baseline differences associated with the assessed dependent variables and, thus, determine and statistically compare only the possible changes between the participants in the two groups regarding the learning autonomy, competence, relatedness to others, and interest/enjoyment factors (Knapp & Schafer, 2009; Cohen *et al.*, 2018). The following sub-sections shed light on the analysis of these four indicators of autonomous motivation (Sheldon & Filak, 2008; Peng *et al.*, 2012; Krijgsman *et al.*, 2017), attempting to address the second research question (see Table 4.1) concerning the impact

of the gamified FVC method on students' autonomous motivation, particularly in the CS course, compared to the non-gamified FVC format.

4.1.4.1 Students' Learning Autonomy

Autonomy is considered one of the self-determined motivation indicators, according to the relevant literature (e.g., Sheldon & Filak, 2008; Peng *et al.*, 2012; Benita *et al.*, 2014; Krijgsman *et al.*, 2017). In the current study, the calculated gain scores related to the pre- and post-questionnaires of the autonomy factor were found to be normally distributed, and the data variance in the two groups was found homogeneous. Therefore, the independent samples t-test was applied to analyse the questionnaire items from 1 to 6 relevant to the autonomy dimension.

Table 4.9: Independent Samples' T-test Results of the Gain Scores' Means to Measure the Changes in Students' Learning Autonomy in the Experimental and Control Groups before and after the Instructional Intervention

Item	Group	n	Mean	M (gain Score mean)	SD	t	P	d
1	Non-gamified FVC	32	2.38	0.41	1.07	6.32	0.001*	-1.56
	Gamified FVC	34	4.21	2.15	1.16			
2	Non-gamified FVC	32	2.41	0.38	0.91	7.21	0.000*	-1.78
	Gamified FVC	34	4.06	2.15	1.08			
3	Non-gamified FVC	32	3.63	0.97	1.06	2.26	0.027*	-0.56
	Gamified FVC	34	3.71	1.65	1.35			
4	Non-gamified FVC	32	2.44	0.41	1.07	4.03	0.000*	-0.10
	Gamified FVC	34	3.85	1.56	1.24			
5	Non-gamified FVC	32	2.44	0.44	1.37	3.33	0.001*	-0.82
	Gamified FVC	34	3.94	1.41	0.99			
6	Non-gamified FVC	32	2.44	0.56	1.24	3.19	0.002*	-0.79
	Gamified FVC	34	4.15	1.44	0.99			
Overall Autonomy	Non-gamified FVC	32	2.62	0.53	0.82	6.25	0.001*	-1.54
	Gamified FVC	34	3.99	1.73	0.74			

* $p < 0.05$

As shown in Table 4.9 above, the descriptive statistics of item 1 revealed that most students in the experimental group ($M = 2.15$, $SD = 1.16$) agreed that they experienced a sense of freedom to opt for what to complete from the assigned learning tasks whenever they were able to do so, compared to peers in the control group ($M = 0.41$, $SD = 1.07$) with $t = 6.32$, $p = 0.001$, $p < 0.05$. Furthermore, unlike the non-gamified FVC class ($M = 0.38$, $SD = 0.91$), item 2 showed that students in the gamified FVC class ($M = 2.15$, $SD = 1.08$) also felt that the pre-session tasks they completed reflected what they wanted to do ($t = 7.21$, $p = 0.000$, $p < 0.05$). In line with this, the analysis of item 3 indicated a significant difference between the experimental group ($M = 1.65$, $SD = 1.35$) and the control group ($M = 0.97$, $SD = 1.06$), with $t = 2.26$, $p = 0.027$, $p < 0.05$. This result generally suggests that students in the gamified FVC felt more freedom to express their ideas to their teammates when working on the tasks than those in the non-gamified FVC. The overall results of items 4 to 6 also showed significant differences between the two groups. For instance, item 4 reported that students in the treatment group ($M = 1.56$, $SD = 1.24$) were more able to control their online learning environment when performing pre-session activities than those in the control group ($M = 0.41$, $SD = 1.07$), with $t = 4.03$, $p = 0.000$, $p < 0.05$. The analysis of items 5 and 6 revealed that students in the experimental group had improved their abilities to control and manage learning speed and time more than those in the control group.

Overall, the statistical results indicated that students in the gamified FVC ($M = 1.73$, $SD = 0.74$) had greater autonomy in their learning than peers in the non-gamified FVC ($M = 0.53$, $SD = 0.82$), with $t = 6.25$, $p = 0.001$, $p < 0.05$. In addition, while the p -value was calculated to determine whether there was a significant difference between those two groups, it was also important to statistically evaluate how large this difference was since a significant difference does not reflect its effect size. Therefore, as shown in Table 4.9, Cohen's d was used to assess the effect size of the difference (Cohen, 1988), and the overall result ($d = -1.54$) revealed a significant effect from the detected difference.

One further statistical analysis step was taken into consideration in this study to ensure that the possible influence of autonomy scores of the pre-questionnaire was accounted for as the covariate in this analysis while analysing the relevant scores of the post-intervention by using the One-way ANCOVA (Analysis of Covariance) test after considering its assumptions (i.e., linearity,

reliable measurement of the covariate, normality, and homogeneity of variance and regression slopes). The statistical result of this test also confirms the significant difference between the two groups even after accounting for the autonomy pre-intervention scores ($F= 55.0$ and $p= 0.001$, $p < 0.05$, partial eta squared= 0.47) with trivial or no correlation between the pre- and post-intervention autonomy results, as revealed by a partial eta squared value of 0.017 (Knapp & Schafer, 2009).

4.1.4.2 Students Competence When Performing Learning Tasks

The competence factor has been considered another substantial indicator of students' autonomous motivation, as explained earlier in Chapter Two. One of the questionnaire's sections, therefore, asked the students to respond to seven statements (i.e., items 7 to 13) related to this factor. The gain score method was then computed to account for the possible groups' baseline differences and assess any changes in students' competence in both the experimental and control groups before and after applying the study's intervention. After ensuring its assumptions, the independent sample t-test was used to analyse the gain score means of the relevant items to measure any potentially significant differences between the two groups regarding the competence dimension.

As presented in Table 4.10, the statistical analysis of item 7 is $M= 1.59$, $SD= 0.99$ in the gamified FVC group, while $M= -0.06$, $SD= 1.13$ in the control group with $t= 6.31$, $p= 0.001$, $p < 0.05$. The result denotes that most students in the experimental class thought they did well in the provided learning activities compared to how their control class peers thought in this regard. The analysis of item 8 reported that, after working on these activities for a while, students in the gamified FVC group also felt more competent in achieving their learning goals ($M= 1.97$, $SD= 0.94$) than those in the non-gamified FVC group ($M= -0.16$, $SD= 1.35$), with $t= 7.48$, $p= 0.000$, $p < 0.05$. This reduction in the control group's scores was also observed in the total gain scores mean result ($M= -0.16$, $SD= 1.22$) of item 9 when the participants were asked about the extent to which they felt skilled at the provided pre-session tasks, compared to the experimental group ($M= 1.56$, $SD= 1.11$), with $t= 5.99$, $p= 0.000$, $p < 0.05$.

Table 4.10: Independent Samples' T-test Results of the Gain Scores' Means to Assess the Changes in Students' Competence in the Experimental and Control Groups before and after the Instructional Intervention

Item	Group	n	Mean	M (gain scores)	SD	t	p	d
7	Non-gamified FVC	32	2.47	-0.06	1.13	6.31	0.001*	-1.56
	Gamified FVC	34	4.18	1.59	0.99			
8	Non-gamified FVC	32	2.53	-0.16	1.35	7.48	0.000*	-1.84
	Gamified FVC	34	4.35	1.97	0.94			
9	Non-gamified FVC	32	2.47	-0.16	1.22	5.99	0.000*	-1.47
	Gamified FVC	34	4.21	1.56	1.11			
10	Non-gamified FVC	32	2.50	-0.06	1.05	5.67	0.000*	-1.40
	Gamified FVC	34	4.21	1.56	1.26			
11	Non-gamified FVC	32	2.41	-0.19	1.31	6.41	0.000*	-1.58
	Gamified FVC	34	4.26	1.71	1.09			
12	Non-gamified FVC	32	2.56	-0.16	1.22	5.78	0.000*	-1.42
	Gamified FVC	34	4.26	1.44	1.02			
13	Non-gamified FVC	32	3.59	0.50	1.16	2.99	0.004*	-0.74
	Gamified FVC	34	4.21	1.35	1.15			
Overall Competence	Non-gamified FVC	32	2.65	-0.04	0.74	9.34	0.001*	-2.31
	Gamified FVC	34	4.24	1.60	0.68			

* $p < 0.05$

For items 10 and 12, the statistical test of the gain scores' means revealed significant differences ($p = 0.000$, $p < 0.05$) and suggested that most students in the gamified FVC (item 10: $M = 1.56$, $SD = 1.26$; item 12: $M = 1.44$, $SD = 1.02$) felt more satisfied with their learning performance when doing the learning tasks compared to peers in the non-gamified FVC class (item 10: $M = -0.06$, $SD = 1.05$; item 12: $M = -0.16$, $SD = 1.22$). Furthermore, in line with the previous items, item 11 implied that students of the gamified FVC ($M = 1.71$, $SD = 1.09$) felt more competent in completing complex learning tasks related to the instructional course compared to the other class ($M = -0.19$, $SD = 1.31$). This finding was also supported by the analysis result of item 13, "*Outside of the class sessions, I could not do the learning activities well.*", a reversed question that was used

randomly to add more validity to the competence dimension and reduce the possibility of bias and layout effects in the responses (Cohen *et al.*, 2018). After reversing the collected scores of this item, the analysis reported a significant difference between the experimental group ($M = 1.35$, $SD = 1.15$) and the control group ($M = 0.50$, $SD = 1.16$), with $t = 2.99$, $p = 0.004$, $p < 0.05$.

The overall result indicated that students in the gamified FVC group (Mean = 4.24, $M = 1.60$, $SD = 0.68$) felt more competent than those in the non-gamified FVC group (Mean = 2.65, $M = -0.04$, $SD = 0.74$) with $t = 9.34$, $p = 0.001$, $p < 0.05$. To assess how big the effect of this significant difference was, Cohen's d was calculated, and the result ($d = -2.31$) implied a large effect size.

In addition, a further statistical analysis step was used in this study to ensure that the possible influence of competence scores of the pre-questionnaire, as a covariate, was statistically considered while analysing the competence scores of the post-questionnaire by utilising the One-way ANCOVA (Analysis of Covariance) test after checking its assumptions and statistical applicability. The result of ANCOVA indicates a significant difference between the two groups even after accounting for the competence pre-intervention scores ($F = 151.8$, $p = 0.001$, $p < 0.05$, partial eta squared = 0.71), with a trivial or no association between the pre- and post- intervention competence scores, according to a partial eta squared value of 0.003. Based on these findings, it can be assumed that the SDT-based gamified instructional tasks provided for the experimental group were likely to contribute positively to students' need satisfaction for competence compared to their peers in the control group.

4.1.4.3 Students' Relatedness with Others

As one of the autonomous learning motivation indicators (Sheldon & Filak, 2008; Peng *et al.*, 2012; Krijgsman *et al.*, 2017), the relatedness factor was assessed through six questionnaire statements (items 14 to 19). This sub-section sheds light on the statistical analysis of these items.

The calculated gain scores related to the pre- and post-questionnaires of the relatedness factor were found to be normally distributed according to the Shapiro-Wilk test results, and the data variance in the two groups was found homogeneous. Therefore, the independent samples t-test was applied to analyse the relevant questionnaire items. As shown in Table 4.11, items 14 and 15 implied that the students in the gamified FVC group tended to be more able to interact

with peers during and out-of-class time, as they had more opportunities to relate to each other while doing the learning tasks compared to the non-gamified FVC group. This finding is based on the independent sample t-test result of the gain scores' means, which revealed significant differences ($p = 0.000$, $p < 0.05$) between the control class (item 14: $M=0.06$, $SD=1.24$, $t=6.48$; item 15: $M=-0.06$, $SD=1.05$, $t=7.65$) and the intervention class (item 14: $M=1.79$, $SD = 0.91$, $t = 6.48$; item 15: $M = 1.85$, $SD = 0.99$, $t = 7.65$).

Table 4.11: Independent Samples' T-test Results of the Gain Scores' Means to Assess the Changes in Students' Relatedness in the Experimental and Control Groups before and after the Instructional Intervention

Item	Group	<i>n</i>	Mean	M (gain scores)	SD	<i>t</i>	<i>p</i>	<i>d</i>
14	Non-gamified FVC	32	2.47	0.06	1.24	6.48	0.000*	-1.60
	Gamified FVC	34	4.15	1.79	0.91			
15	Non-gamified FVC	32	2.44	-0.06	1.05	7.65	0.000*	-1.89
	Gamified FVC	34	4.15	1.85	0.99			
16	Non-gamified FVC	32	3.66	1.00	1.52	0.18	0.857	-0.04
	Gamified FVC	34	3.65	1.06	1.10			
17	Non-gamified FVC	32	3.59	0.88	1.26	1.62	0.110	-0.40
	Gamified FVC	34	3.71	1.32	0.98			
18	Non-gamified FVC	32	2.44	-0.16	1.05	6.67	0.000*	-1.64
	Gamified FVC	34	4.00	1.68	1.17			
19	Non-gamified FVC	32	2.56	-0.09	1.09	7.27	0.000*	-1.80
	Gamified FVC	34	4.09	1.65	0.85			
Overall Relatedness	Non-gamified FVC	32	2.86	0.27	0.79	7.61	0.001*	-1.87
	Gamified FVC	34	3.96	1.56	0.57			

* $p < 0.05$

However, although the gamified FVC group showed higher means for items 16 and 17 than the non-gamified FVC group, there were no statistically significant differences in the responses. For those two items, the students were asked whether they liked working on the learning activities and discussing their own ideas with their teammates. For instance, for Item 16, a trivial

difference was reported between the gain scores' mean of the experimental group ($M = 1.06$, $SD = 1.10$) and that of the control group ($M = 1.00$, $SD = 1.52$), with $t = 0.18$, $p = 0.857$, $p > 0.05$. Furthermore, items 18 and 19 implied that working on team-based learning activities in the gamified class helped to stimulate students' critical thinking skills and assist their understanding of the learning materials, compared to those in the non-gamified class. For example, item 18 reported an improvement in the interventional group's responses, according to the gain score mean ($M = 1.68$, $SD = 1.17$), while a decrease was observed in the other group's gain score mean ($M = -0.16$, $SD = 1.05$), with $t = 6.67$, $p = 0.000$, $p < 0.05$.

Generally, the findings suggest that students in the gamified FVC group felt more related and connected with others than those in the non-gamified FVC class. This assumption is based on an overall significant difference found between the experimental group (Mean= 3.96, $M = 1.56$, $SD = 0.57$) and the control group (Mean= 2.86, $M = 0.27$, $SD = 0.79$) with $t = 7.61$, $p = 0.001$, $p < 0.05$. The effect size of this statistical difference was also calculated using Cohen's d , and the overall result showed a large effect ($d = -1.87$). Based on this statistical analysis, it can be said that the SDT-based gamification integrated into the FVC had a significantly large impact on students' feelings of relatedness to others. For this variable, it was not possible to apply the One-way ANCOVA test since one of its assumptions (i.e., homogeneity of variance) was not statistically achieved based on Levene's test for equality of variances (Pallant, 2020).

4.1.4.4 Interest/Enjoyment towards the Course

The feeling of inherent interest and enjoyment has been considered a robust intrinsic motivation indicator (Vansteenkiste *et al.*, 2006), often used to distinguish between extrinsic and intrinsic types of motivation (Peng *et al.*, 2012; Benita *et al.*, 2014). Therefore, the participants in the gamified and non-gamified FVC were asked to respond to eight questionnaire statements, with the aim of assessing their responses on the interest/enjoyment dimension at the end of the study's intervention. The gain scores' means of this dimension were then calculated for the two groups and analysed using the independent sample t-test after asserting its statistical assumptions, including the groups' homogeneity of variance and the normality of data distribution.

Table 4.12 depicts significant differences observed for most questionnaire items from 20 to 27. The statistical analysis of items 20, 21, 25, and 26 indicated that, unlike the control group, most students in the experimental class enjoyed performing the provided learning activities. As noted in the result of item 21, for instance, most of them ($M = 2.74$, $SD = 0.86$) found the pre-session tasks were fun to do, in comparison to the other group ($M = 0.06$, $SD = 1.13$), with $t = 10.81$, $p = 0.000$, $p < 0.05$.

Table 4.12: Independent Samples' T-test Results of the Gain Scores' Means related to the Changes in Students' Interest/Enjoyment in the Experimental and Control Groups before and after the Instructional Intervention

Item	Group	<i>n</i>	Mean	M (gain scores)	SD	<i>t</i>	<i>p</i>	<i>d</i>
20	Non-gamified FVC	32	2.47	0.66	1.00	9.04	0.001*	-2.23
	Gamified FVC	34	4.59	2.76	0.89			
21	Non-gamified FVC	32	2.03	0.06	1.13	10.81	0.000*	-2.66
	Gamified FVC	34	4.26	2.74	0.86			
22	Non-gamified FVC	32	2.16	-0.09	1.38	8.63	0.000*	-2.13
	Gamified FVC	34	4.32	2.50	1.05			
23	Non-gamified FVC	32	3.78	0.91	1.30	0.92	0.363	-0.23
	Gamified FVC	34	3.91	1.18	1.09			
24	Non-gamified FVC	32	2.25	0.13	1.23	4.12	0.001*	-1.00
	Gamified FVC	34	3.62	1.71	1.80			
25	Non-gamified FVC	32	2.31	-0.22	1.07	11.04	0.000*	-2.72
	Gamified FVC	34	4.24	2.50	0.93			
26	Non-gamified FVC	32	1.84	-0.09	1.20	10.64	0.000*	-2.62
	Gamified FVC	34	4.62	2.85	1.05			
27	Non-gamified FVC	32	1.81	-0.09	1.35	9.72	0.000*	-2.39
	Gamified FVC	34	4.59	2.85	1.10			
Interest / Enjoyment	Non-gamified FVC	32	2.34	0.16	0.69	13.54	0.001*	-3.33
	Gamified FVC	34	4.27	2.39	0.65			

* $p < 0.05$

The first group ($M = 2.85$, $SD = 1.10$) also described these learning activities as interesting, as reported by the analysis result of item 27, revealing a significant difference with the control group ($t = 9.72$, $p = 0.000$, $p < 0.05$). Items 22 and 24 were reversed questions used randomly to support the validity of the dimension's scale and the quality of responses (Cohen *et al.*, 2018). These questions concerned whether the participants in the two groups found the online learning activities boring or did not hold their attention. The collected scores were reversed, and the gain scores and means were then calculated. The t-test results of both items revealed that most students in the gamified class responded positively toward the provided learning tasks, compared to peers in the non-gamified class, who found these activities relatively boring and unattractive. For instance, item 24 showed a significant difference between the experimental group ($M = 1.71$, $SD = 1.80$) and the control group ($M = 0.13$, $SD = 1.23$), with $t = 4.12$, $p = 0.001$, $p < 0.05$.

In contrast, item 23 showed no significant difference in students' responses between the intervention group ($M = 1.18$, $SD = 1.09$) and the other group ($M = 0.91$, $SD = 1.30$) when they were asked whether the computer science concepts that they learned, were more valuable to them than the course's grades ($t = 0.92$, $p = 0.363$, $p > 0.05$). Overall, the statistical results implied a significant difference between students in the gamified FVC (Mean = 4.27, $M = 2.39$, $SD = 0.65$) and the non-gamified FVC (Mean = 2.34, $M = 0.16$, $SD = 0.69$) regarding their feeling of interest and enjoyment when performing the learning tasks with $t = 14.54$, $p = 0.001$, $p < 0.05$. This significant difference was also found to have a large size effect (Cohen's $d = -3.33$), and the negative d value indicates that the mean of the gamified FVC was greater (Gravetter & Forzano, 2018). Finally, after ensuring its assumptions, the One-way ANCOVA (Analysis of Covariance) test was used to ensure that the possible influence of interest/enjoyment variable scores of the pre-questionnaire was statistically controlled while analysing the relevant scores of the post-questionnaire. The result confirmed that there was a significant difference between the two groups even after accounting for the pre-intervention scores ($F = 195$ and $p = 0.001$, $p < 0.05$, partial eta squared = 0.76), with trivial or no association between the pre-questionnaire and post-questionnaire, based on a partial eta squared value of 0.001.

4.1.4.5 Overall Autonomous Motivation

As mentioned above, autonomous motivation was assessed based on four strong indicators: autonomy, competence, relatedness, and interest/enjoyment (Sheldon & Filak, 2008; Peng *et al.*, 2012; Krijgsman *et al.*, 2017). The previous four subsections showed that integrating SDT-based gamification into FVC could positively impact students' autonomous learning, competence, relatedness, and interest/enjoyment. In this subsection, the statistical results of these four indicators were combined to test the second research hypothesis concerning whether there was a significant difference in students' autonomous motivation between the gamified FVC group and the non-gamified FVC group.

Table 4.13: Overall Results of Autonomous Motivation in the Gamified FVC and Non-Gamified FVC Groups

Dimension	Group	<i>n</i>	Mean	M (gain score)	SD	<i>t</i>	<i>p</i>	<i>d</i>
Autonomous Motivation	Non-gamified FVC	32	2.62	0.23	0.57	11.97	0.001*	-2.95
	Gamified FVC	34	4.12	1.82	0.51			

* $p < 0.05$

Table 4.13 above shows that the overall mean of students' autonomous motivation in the gamified FVC (Mean= 4.12) was more statistically significant than in the non-gamified FVC (Mean= 2.62). Further analysis was also considered to reduce the possible effect of the variation in students' autonomous motivation differences at the beginning of the instructional course by conducting a pre-questionnaire and post-questionnaire and then calculating the gain scores in parallel with using the One-way ANCOVA test. The overall mean results of the gain scores reported that students' motivation scores in the gamified FVC group (M= 1.82, SD= 0.51) were higher than those in the non-gamified FVC group (M= 0.23, SD= 0.57). These differences suggest that students in the gamified FVC tended to be more autonomously motivated than their counterparts in the non-gamified FVC. However, checking the significance of the reported difference was crucial in accepting or rejecting the hypotheses. Therefore, the independent sample t-test was carried out, and the result indicated that the difference between the two groups was statistically significant, with $t = 11.97$, $p = 0.001$, and $p < 0.05$. Based on this, the researcher rejected the null hypotheses, and the alternative hypotheses could be accepted, emphasising the difference in students' autonomous motivation between the gamified FVC and

non-gamified FVC. In addition, the effect size of this difference was also measured (Cohen's $d = -2.95$), indicating that the second mean (i.e., gamified FVC's mean) was significantly higher. Another statistical test was utilised to verify that the possible impacts of pre-existing autonomy, competence, and interest/enjoyment scores in the pre-intervention were all accounted for while analysing the mean scores of autonomous motivation in the post-questionnaire. This could be achieved by utilising the One-way ANCOVA (Analysis of Covariance) test after ensuring its assumptions and requirements for applicability (Pallant, 2020). The results confirmed the observed significant differences between the two groups even after controlling the pre-intervention autonomy, competence, relatedness, and interest/enjoyment of scores as possible covariates (respectively: $F = 174.3$ and $p = 0.001$, partial eta squared = 0.74; $F = 167.2$ and $p = 0.001$, partial eta squared = 0.73; $F = 168.7$ and $p = 0.001$, partial eta squared = 0.73; $F = 144.3$ and $p = 0.001$, partial eta squared = 0.70; ($p < 0.05$)). Overall, it can be assumed that gamifying the FVC based on the SDT positively affected students' autonomous motivation compared to the non-gamified FVC design. Most of the items associated with the four indicators of autonomous motivation revealed significantly positive changes after applying the gamified FVC method.

4.1.5 Completion Rates of Pre-session Learning Tasks

This section sheds light on investigating the possible effect of integrating SDT-based gamification into an online flipped learning environment on students' completion rates of pre-session activities. Therefore, students' activity completion rates in the pre-session stage were compared between the gamified FVC and non-gamified FVC to answer the third question in the study and test its hypothesis, presented in Figure 4.20.

To what extent did the integration of gamification into FVC affect students' completion rate of pre-session tasks in Saudi higher-education CS?

H_0 : No significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks.

H_1 : There is a significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks.

Figure 4.20: Question Three and Hypothesis

The two groups' session attendance records were first considered, and they were found to have relatively similar attendance patterns. The activity completion rates of the experimental and control groups were then assessed for each topic in the CS instructional module. Overall, the descriptive data revealed no significant differences between the two groups regarding the completion rates of topics 1 and 2, while the gamified class showed significantly higher completion rates in the topics from 3 to 8 compared to the control class.

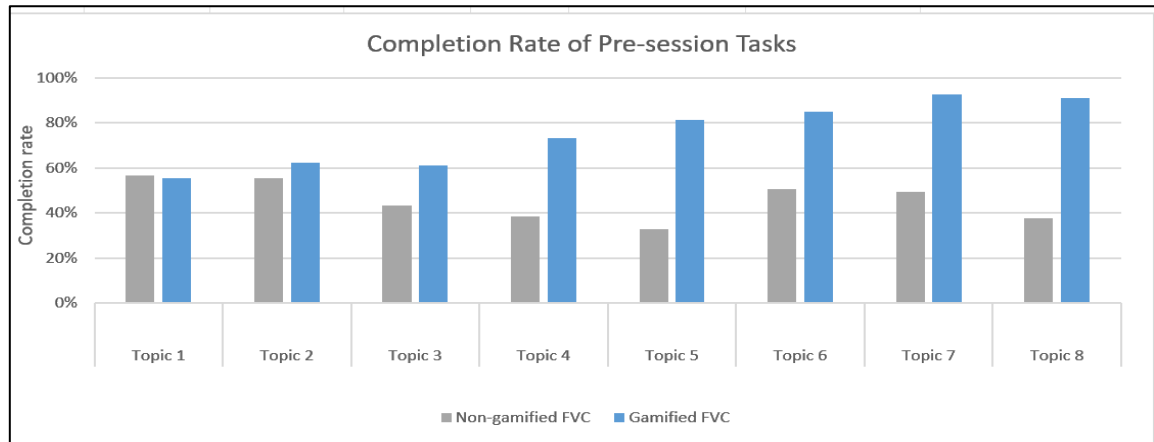


Figure 4.21: Pre-Session Activities' Completion Rates

Table 4.14: The Mann-Whitney U Test for Analysing Pre-session Activity Completion Rates of the Experimental and Control Groups

Pre-session activities	Group	<i>n</i>	Med	M-rank	Z	P	<i>r</i>
Topic 1	Control group	32	50.0	35.11	-0.67	0.504	0.08
	Experimental group	34	55.4	31.99			
Topic 2	Control group	32	42.5	34.56	-0.45	0.654	0.06
	Experimental group	34	40.0	32.50			
Topic 3	Control group	32	38.5	28.75	-1.98	0.048*	0.24
	Experimental group	34	41.5	37.97			
Topic 4	Control group	32	31.5	22.89	-4.46	0.001*	0.55
	Experimental group	34	100	43.49			
Topic 5	Control group	32	30	18.48	-6.30	0.001*	0.78
	Experimental group	34	100	47.63			
Topic 6	Control group	32	45.0	22.19	-4.80	0.001*	0.59

	Experimental group	34	100	44.15			
Topic 7	Control group	32	45.0	19.52	-5.98	0.001*	0.74
	Experimental group	34	100	46.66			
Topic 8	Control group	32	32.5	18.59	-6.34	0.001*	0.78
	Experimental group	34	100	47.53			
Overall	Control group	32	40.6	21.1	-5.10	0.001*	0.63
	Experimental group	34	75.7	45.2			

* $p < 0.05$

A non-parametric statistical test was used since the preliminary checks (i.e., Shapiro-Wilk test) revealed that the data related to the completion rate variable was not normally distributed. Based on this, the Mann-Whitney U test was applied to determine whether there were significant differences in the activity completion rates between the gamified FVC and non-gamified FVC groups. As both Figure 4.21 and Table 4.14 above show, the statistical results of Topic 1 revealed that although there was no significant difference between the two groups ($U = 492.5$, $Z = -0.67$, $p = 0.504$, $p > 0.05$, $r = 0.08$), the participants in the non-gamified FVC completed 56.6% of the pre-session tasks, compared to 55.4% in the gamified FVC group. Similarly, the analysis of Topic 2 also showed no significant difference between the two study groups ($U = 510.0$, $Z = -0.45$, $p = 0.654$, $p > 0.05$, $r = 0.06$); however, the task completion rate of the experimental class (62.4%) was higher than that of the control group (55.3%). This implies that students in both groups completed relatively the same rate of learning activities in relation to the first and second topics. In contrast, Topic 3 witnessed a significant change in the completion rate between the two groups ($U = 392.0$, $Z = -1.98$, $p = 0.048$, $p < 0.05$); however, the magnitude of the difference between the two groups was found to be small ($r = 0.24$). An interesting trend was that the online activity completion rates in the gamified FVC class increased as time went on, compared to the non-gamified FVC group. In addition, a statistically significant difference was observed between the two groups ($U = 204.5$, $Z = -4.46$, $p = 0.001$, $p < 0.05$) regarding Topic 4: the gamified FVC group (73.1%) was more likely to complete the assigned pre-class tasks than the FVC group (38.3%), with a large effect size ($r = 0.55$). Significant results were also found between the two groups ($U = 63.5$, $Z = -6.30$, $p = 0.001$, $p < 0.05$, $r = 0.78$) concerning Topic 5's pre-session tasks with a percentage of 81.4% in the gamified FVC, while it was lower by 32.8% in the conventional FVC environment. Finally, for Topics 7 and

8, students in the experimental class showed the highest completion rates at 92.7% and 91.1%, while a decrease was observed in the control group from 49.2% to 37.7%, respectively, with a large effect size for both topics, as presented in Table 4.14. These findings suggest that when the gamified FVC method was used, the completion rate of the pre-session learning tasks tended to increase compared to the non-gamified FVC format, which means that the null hypothesis can be rejected while accepting the alternative hypothesis (see Figure 4.20).

4.1.6 Correlations between Autonomous Motivation and Completion Rate

This section attempts to address the fourth research question concerning the possible correlations between autonomous motivation indicators (Sheldon & Filak, 2008; Peng *et al.*, 2012; Krijgsman *et al.*, 2017) and the student's completion rate of pre-session learning tasks (see Figure 4.22 below). It will then shed light on the strength and direction of the associations within and between autonomy, competence, and relatedness factors and the interest/enjoyment factor as an indicator of intrinsic motivation.

To what extent did the students' autonomous motivation correlate with their pre-session task completion rate when gamification was integrated into FVC?

H₀: No linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC.

H₁: There is a linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC.

Figure 4.22: Question Four and Hypothesis

Indeed, it is crucial to bear in mind that analysing a correlation does not mean that one variable causes another (Cohen *et al.*, 2018). Instead, this analysis was used to uncover the direction and strength of the relationship between the variables and whether the variation in one variable concurs with the variation in the other variable (Bryman, 2012). Since the normality test (i.e., Shapiro-Wilk test) revealed that the completion rate variable data were not normally distributed, the Spearman's rank correlation coefficient (rho) test was employed to reveal any possible relationship between students' autonomous motivation indicators and the completion rate of pre-session activities. This test is a non-parametric statistical measurement used to

determine the direction and strength of a relationship between two variables. Cohen *et al.* (2018) suggested that to interpret the strength of an association, a correlation coefficient value less than 0.30 represents a small correlation; a value between 0.30 and 0.65 can be considered a moderate correlation; a value between 0.65 and 0.85 indicates a strong correlation; and a value over 0.85 indicates a very strong relationship.

Table 4.15: Correlation Coefficient Analysis between Students' Completion Rate of Pre-Session Tasks and the Autonomous Motivation Indicators

Variable	N	r_s	r^2	p
Autonomy	66	0.37	0.14	0.002*
Competence	66	0.47	0.22	0.001*
Relatedness	66	0.34	0.12	0.005*
Interest/Enjoyment (IM)	66	0.54	0.29	0.001*
Autonomous Motivation (combined)	66	0.52	0.27	0.001*

* $p < 0.05$; based on Spearman's Rank Test

As shown in Table 4.15 above, the statistical results revealed significant ($p < 0.05$) positive correlations between all self-determined motivation indicators (autonomy, competence, relatedness, and enjoyment/interest) and students' completion rate of the pre-class activities. However, the correlation coefficient test generally reported a moderate relationship between students' completion rate of tasks and their perceived autonomy ($r_s = 0.37$, $p = 0.002$), as well as their feelings of competence ($r_s = 0.47$, $p = 0.001$). Moreover, relatedness ($r_s = 0.34$, $p = 0.005$) and enjoyment/interest ($r_s = 0.54$, $p = 0.001$) were also found to be moderately positively correlated with students' completion rates. The overall autonomous motivation (combined) reported a moderately positive association with the completion rate variable ($r_s = 0.52$, $p = 0.001$). These findings suggest that when self-determined motivation indicators (i.e., autonomy, competence, relatedness, and interest/enjoyment) increased, the completion rates of pre-session learning tasks tended to increase. Based on this, the researcher was able to reject the null hypothesis and accept the alternative one (see Figure 4.22). It is also worth noting that the completion rate of the pre-session tasks variable was found to be positively strongly correlated with the performance variable ($r_s = 0.93$, $r^2 = 0.86$, $p < 0.001$) and positively moderately associated with the achievement ($r_s = 0.38$, $r^2 = 0.14$, $p = 0.002$) variable according to Spearman's rank

correlation coefficient test. However, it is important to remember that a positive association between two variables does not necessarily mean that one variable can perfectly be predicted based on the other variable's values (Cohen *et al.*, 2018). The research question concerned the directions and strengths of the associations between the variables rather than causes, effects or predictions.

Table 4.16: Correlation Coefficient Analysis between Autonomy, Competence, Relatedness, and interest/enjoyment (IM) (N= 66)

Variable	Autonomy			Competence			Relatedness			Interest / Enjoyment (IM)		
	<i>r</i>	<i>r</i> ²	<i>p</i>	<i>r</i>	<i>r</i> ²	<i>p</i>	<i>r</i>	<i>r</i> ²	<i>p</i>	<i>r</i>	<i>r</i> ²	<i>p</i>
Autonomy	1	1	---	0.71	0.51	0.001*	0.67	0.45	0.001*	0.69	0.48	0.001*
Competence	0.71	0.51	0.001*	1	1	---	0.73	0.53		0.80	0.64	
Relatedness	0.67	0.45		0.73	0.53	0.001*	1	1	---	0.75	0.56	
Interest / Enjoyment (IM)	0.69	0.48		0.80	0.64		0.75	0.56	0.001*	1	1	---
Autonomous Motivation (Combined)	0.85	0.73	0.001*	0.91	0.83	0.001*	0.88	0.77	0.001*	0.92	0.85	0.001*

**p* < 0.01; based on Pearson Correlation Coefficient

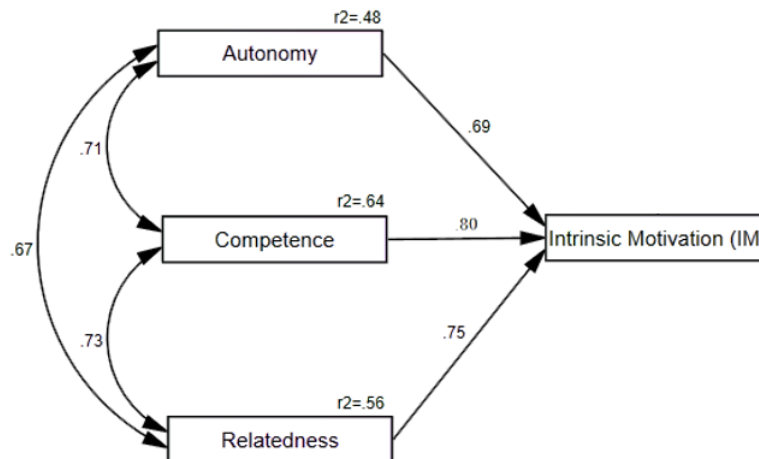


Figure 4.23: Associations between Autonomy, Competence, Relatedness, and IM

In addition, the current study assessed the extent to which autonomy, competence, and relatedness are correlated with interest/enjoyment. This factor has been considered a subscale of a high level of intrinsic motivation (IM) (Ryan & Deci, 2000a; Jones *et al.*, 2022). Therefore, the

Pearson correlation coefficient parametric test was carried out after verifying its assumptions. As shown in Table 4.16 and Figure 4.23 above, the statistical analysis results revealed that autonomy was strongly correlated with interest/enjoyment (IM) with $r^2=0.48$ and a statistically significant correlation coefficient ($r=0.69, p < 0.01$). This means that 48% of the changes in students' intrinsic motivation may be associated with the extent to which students felt autonomous in their learning. For perceived competence, there seemed to be a strong positive correlation with interest/enjoyment (IM) at $r^2=0.64$ and a correlation coefficient being statistically significant ($r=0.80, p < 0.01$). This indicates that 64% of the changes in IM might be related to perceived competence. In terms of perceived relatedness, there appeared to be a strong association between this variable and students' feelings of interest and enjoyment (IM), with $r^2=0.56$ and a significant correlation coefficient ($r=0.75, p < 0.01$). Overall, the statistical results suggest that autonomous motivation indicators are all positively correlated with each other, as the correlation coefficient test indicated.

4.1.7 Quantitative Findings Summary

This section has highlighted the key quantitative findings related to the first four research questions of the current study (see Table 4.1). It started with reviewing the statistical analysis of some crucial pre-intervention characteristics of the experimental and control groups, attempting to ascertain their comparability as much as possible. In addition, the study's variables (i.e., learning achievement and performance, autonomous learning, competence, relatedness, interest/enjoyment) were also assessed before conducting the instructional intervention to determine any possible pre-existing significant differences between the two groups in terms of these variables and to statistically adjust for baseline differences related to those variables when comparing the two groups after the study's intervention.

The students' performances and completion rates of the CS learning activities were evaluated throughout the course period based on eight topics, using formative assessments and VLE statistical reports, respectively. A post-test was then carried out to assess their learning achievement at the end of the study's intervention. In addition, a self-reported questionnaire (post-questionnaire) was utilised to evaluate the autonomy, competence, relatedness, and interest/enjoyment variables as the main indicators for students' autonomous motivation.

Eventually, the gain score method (post minus pre) was statistically calculated for all those variables.

Depending on the preliminary data checks (e.g., data normality and homogeneity of variance) for each variable, the independent sample t-test or the Mann-Whitney U test were then applied to assess and analyse the changes (gain scores) in these variables, between the gamified FVC and non-gamified FVC groups. The strength and direction of the relationship between the completion rate variable and autonomous motivation indicators were evaluated using Spearman's rank correlation coefficient test, while the associations between those indicators were statistically assessed using the Pearson correlation coefficient test. Finally, the overall results of the statistical analysis suggested that integrating the SDT-based gamification into the FVC might have a positive effect on Saudi university students' learning achievement, autonomous motivation, and completion rate of pre-session activities, particularly in computer science courses. The analysis of the correlation coefficient tests also reported statistically positive relationships between autonomous motivation and the completion rate of pre-session activities. These quantitative results will be explained and interpreted further in Chapter Five. Before this, an in-depth qualitative investigation was required to add validity to these quantitative findings, as well as to address the fifth and sixth research questions (see Table 4.1). Hence, the researcher has specified the following separate section to shed light on the qualitative data analysis and findings.

4.2. Qualitative Findings

4.2.1 Introduction

A mixed-method research design was utilised in the current study, in which quantitative and qualitative research data were sequentially collected and then combined (Creswell & Creswell, 2022) to more deeply understand the possible changes in specific educational outcomes among students when integrating gamification based on the self-determination theory (SDT-based gamification) into a flipped virtual classroom (FVC) environment. Those educational outcomes and research variables are as follows:

-
- Autonomous motivation.
 - Completion rates of pre-session activities.
 - Correlation between the completion rate variable and the autonomous motivation variable.
 - Students' perceptions of the gamified FVC method.

The study also critically explored relevant adoption and design considerations and suggestions that will contribute to the improvement of this method. A range of suitable data collection methods were therefore used: pre- and post-tests, pre- and post-questionnaires, and semi-structured interviews to address the mixed-method research questions. The first part of this chapter (4.1) showed the quantitative results obtained from analysing the data relevant to pre- and post-tests, formative assessments, VLE completion rate reports, and pre- and post-questionnaires to statistically assess the effect of the gamified FVC on learning achievement, autonomous motivation, and completion rates of pre-class tasks, in comparison to a conventional FVC format.

The qualitative data were then collected from the gamified FVC group through semi-structured interviews to gain an in-depth understanding of students' experiences while learning with the gamified system. In other words, the semi-structured interview was mainly directed at explaining the why behind the possible effect of SDT-based gamification and how to enhance its pedagogical application. Other studies such as this one evidence a similar approach to qualitative data collection (e.g., Huang & Hew, 2018; Ahmed & Asiksoy, 2021; Tarhan & Öztürk, 2022). Therefore, the interviewees were recruited from the treatment class alone since the core focus was to determine and understand the students' perceptions of gamifying the flipped virtual classroom (see Chapter Three, section 3.5.2). This procedure is typical in such an explanatory sequential mixed-methods approach in which quantitative data related to the experiment are collected in the first phase, analysed, and followed up with qualitative semi-structured interviews to help explain participants' responses about their experience (Creswell, 2014). The current part (4.2) of this chapter presents the qualitative findings associated with students' perceptions of the gamified FVC method, as well as the relevant adoption and design considerations when utilising this method aiming to support the researcher in addressing the research questions: "Q5" and

“Q6”. These findings have also provided crucial insights into understanding how SDT-based gamification might affect students’ motivation and completion rate pertaining to the research questions from 2 to 4 (see Table 4.1).

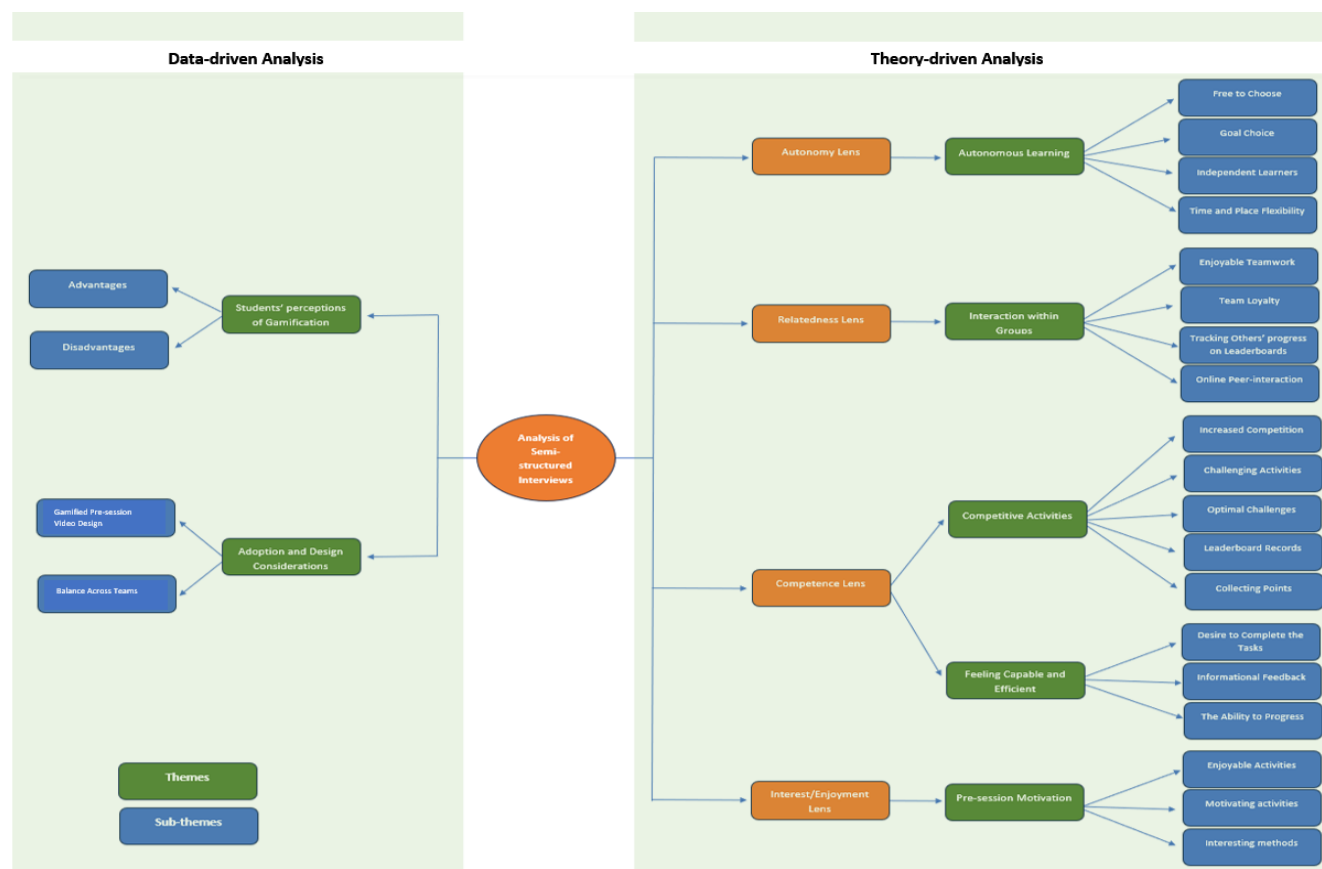


Figure 4.24: Themes and Sub-themes of Semi-structured Interviews Analysis

Through the qualitative data analysis, seven broad themes emerged from the semi-structured interview transcript, which comprised several sub-themes (see Figure 4.24 above). These themes were:

- 1) pre-class learning motivation;
- 2) autonomous learning;
- 3) competitive activities;
- 4) feeling capable and efficient;
- 5) interaction within groups;

-
- 6) students' perception of the gamified FVC; and
 - 7) adoption and design considerations.

In this thematic analysis, the first five main themes were classified based on a theoretical data analysis framework. Accordingly, five tables were created with sub-themes and example quotes and linked with the four autonomous motivation indicators (i.e., competence, autonomy, relatedness, and interest/enjoyment). In addition, the sixth and seventh themes were data-driven, categorised and presented to provide an in-depth understanding of the student's experiences and perceptions of gamifying the FVC and help the researcher identify the adoption and design considerations related to the SDT-based gamification implementations.

4.2.2 Pre-session Learning Motivation (Interest/Enjoyment)

In online flipped learning, it has been argued that the simple provision of outside-class learning activities and the process of instructing students to complete them and take notes without motivating them to do so might not be sufficient to create engaging online flipped learning settings (Ekici, 2021). Indeed, employing motivating instruction is much needed in such learner-centred environments. In this light, integrating an innovative setting of gamification into the flipped virtual classroom based on the SDT has been hypothesised in this study to motivate students' autonomous learning. Students in the gamified FVC were required not only to do the pre-session learning tasks but also to understand the content and be motivated to answer the gamified online quizzes to achieve the desired learning objectives for each course topic.

Table 4.17: Sub-themes of Pre-class Learning Motivation (Interest/Enjoyment)

Sub-theme	Example Quote	Indicator of Autonomous Motivation (Ryan & Deci, 2000b)
Enjoyable Activities	"This method of collecting points through doing the learning activities and competition between groups was really fun and challenging." (BSTD11). "I think some of the videos were quite fun..." (BSTD27). "I think the method was creative and fun..." (BSTD28).	Enjoyment/fun
Motivating Activities	"The use of this system contributed to reducing the boredom that we usually feel as students" (BSTD3). "It was a good experience in terms of increasing motivation among us" (BSTD11). "...learning and winning at the same time in a fun and motivating atmosphere." (BSTD22).	Fun/reduce boredom
Interesting Methods	"I think that the method was very interesting and useful for me" (BSTD21). "It also supported my thinking skills and helped me to find my interests" (BSTD28). "I was keen and interested in completing the provided gamified quizzes because they were fun to do..." (BSTD3).	Interest

The interviews' responses to this main theme provided explanations about whether they felt motivated or demotivated to engage in the instructional activities within the gamified FVC environment. This theme includes three sub-themes, namely, *Enjoyable Activities*, *Motivating Activities*, and *Interesting Methods*. Table 4.17 above presents some example quotes relevant to the *Enjoyable Activities* sub-theme. The students acknowledged that performing the gamified learning activities in an online learning environment, where they could compete as teams by earning points and badges, was challenging and enjoyable. They stated that the game elements, integrating into FVC, could make the competition more fun and challenging while completing the learning activities. This perspective is demonstrated in the following examples:

"...collecting points through doing the learning activities and competition between groups was really fun and challenging." (BSTD11).

"...the method was creative and fun..." (BSTD28)

"I think some of the gamified videos were quite fun..." (BSTD27).

Moreover, in response to a question about the reason behind his preparation and why he completed watching almost all the asynchronous instructional pre-class videos available on the platform before attending the online sessions, Student BSTD21 stated:

“...this gamified method motivated me to prepare before the online class, and because the points earned from the correct answers depended on the video content, I tried to complete watching most of them...” (BSTD21).

Based on analysing data from the interviews, it seems that gamifying the flipped-class learning activities motivated students to learn the pre-class content and thus prepared them before attending their in-class sessions, which might play an essential role in their progress in such an online learning environment.

In addition to the abovementioned, the *Motivating Activities* sub-theme also shows that the integration of SDT-based gamification was reported to decrease boredom among students as they felt that the gamified activities were similar to playing a game. When the interviewees were asked about their opinions on using a gamification system that consisted of points, badges, and leaderboard elements in their CS learning course according to their previous experience in the other university courses, two students commented:

“The use of this system contributed to reducing the boredom that we usually feel as students...” (BSTD3).

“Generally, I think that this course was quite different; I can say that when I was doing the tasks in this course, I did not feel bored because each task was presented in different forms.” (BSTD11).

In parallel with this perspective, when the students were asked to express their thoughts about the way that the online learning platform and the learning activities were gamified, including instructional videos and reading content, in addition to the other collaborative tasks, student BSTD22 implied that integrating gamification into the learning environment allowed the students to learn and win points at the same time in a fun atmosphere. Another student also supported this notion and denoted:

“To be honest, I am one of those students who quickly get bored, especially when I must read an article or written information. The gamification of the activities made them like playing a game...” (BSTD28)

Furthermore, the participants generally found the innovative gamified learning activities useful and interesting when doing them, as the *Interesting Methods* sub-theme shows. This can be exemplified in two quote examples as follows:

"I think that the method was very interesting and useful for me..." (BSTD21).

"I was keen and interested in completing the provided gamified quizzes because they were fun to do..." (BSTD3).

In line with this, two students who took part in the interview indicated that the gamified activities helped them to support their learning and find what interested them. For example, one demonstrated:

"...it also supported my thinking skills and helped me to find my interests" (BSTD28).

Expanding on this perspective, in response to a question about what they found interesting, student BSTD27 explained, *"Allowing me to explore different forms of the gamified tasks was really interesting."*

Interestingly, the data analysis revealed that the gamified tasks could make some students interested in discovering the next task once they complete the previous one, as three students mentioned in the following statements:

"The game-like tasks made me interested to see what the next challenge would be..." (BSTD22).

"Once I completed each task, I realised that using such a method could make the other tasks really interesting. This is because I could compete with my team and help my teammates earn points and badges and win the competition." (BSTD11).

"...the options of tasks kept me interested in seeing what I could do next. I wanted to know how many points I could earn by completing each task since each had a specific number of points." (BSTD3).

Overall, these findings imply that integrating gamification elements into a flipped virtual classroom environment might have the potential to generate a sense of fun and enjoyment and to support students' interests while learning. The gamified FVC method also seemed to reduce the boredom that students may experience in online learning environments. All typical quotes

presented in Table 4.17 indicate that students were more motivated to engage in their learning when they found the gamified learning activities fun, enjoyable, and interesting. These results are generally in line with the quantitative findings relevant to the interest/enjoyment questionnaire dimension.

4.2.3 Autonomous Learning

In this theme, the interviewees expressed their perspectives regarding the extent to which they perceived their learning as autonomous or controlling in the gamified FVC. This is crucial since the autonomy factor has been considered a robust autonomous motivation indicator.

Table 4.18: Sub-themes of Autonomous Learning

Sub-theme	Example Quote	Indicator of Autonomous Motivation (Ryan & Deci, 2000b)
Free to Choose	"I was free to choose what I wanted to complete from the activities... So, I think that providing more forms of activities is much better than having only one type for each task." (BSTD3). "I felt that I had the chance to choose between the available activities...The provision of these activities in a non-compulsory and free manner increased my desire to complete more learning activities and exercises..." (BSTD22). "I think that giving me the freedom to choose what to perform from options of learning activities was a good thing that motivated me to be more creative." (BSTD28).	Perceived autonomy
Goal Choice	"I wanted to benefit from the information related to the course that we were studying...I was gaining information and at the same time playing to earn more points." (BSTD3). "...that there was a specific goal, which was to get as many points as possible." (BSTD28). "I felt that I was not collecting points without a goal, but rather learning and winning at the same time..." (BSTD22).	Perceived autonomy and competence
Independent Learner	"...focused on watching videos to help me answer the quizzes effectively before the beginning of each lesson." (BSTD11). "I wanted to prepare for these lessons before attending the online sessions...and this helped me a lot in understanding most of the lessons' points." (BSTD3). "I tried to answer the quizzes through the information I acquired in the course. The quizzes that were embedded into the videos helped me focus on the information presented in these videos..." (BSTD21).	Perceived autonomy
Time and Place Flexibility	"I also liked that the learning activities were not limited to a specific time or a limited number of attempts..." (BSTD11). "I could watch the educational video before each lecture at any time based on my personal time and daily schedule...to complete the activities according to my abilities and capabilities and my time." (BSTD3). "...that took into account... my time and convenience." (BSTD25).	Perceived autonomy

Therefore, this sub-section aimed to understand students' feelings associated with the psychological need for autonomy based on their experience of the SDT-based gamification elements integrated into an online flipped learning CS course. The theme presents the data analysis results relevant to four sub-themes, including *Free to Choose*, *Goal Choice*, *Independent Learner*, and *Time and Place Flexibility*. The overall findings revealed that the students experienced forms of autonomous action when engaging in the gamified FVC environment. As the *Free to Choose* sub-theme in Table 4.18 shows, the interviewees reported their feelings about experiencing a sense of choice and freedom when doing the instructional tasks. They mentioned that integrating game elements into the flipped online class provided them with the opportunity to choose what to complete from different forms of instructional tasks, which could give them a sense of freedom when performing those gamified activities. For example, one participant illustrated:

"I was free to choose what I wanted to complete from the activities...So I think that providing more forms of activities is much better than having only one type for each task." (BSTD3).

In relation to this notion, some students elaborated on which specific types or parts of the activities contributed to their desire to participate. One emphasised that his desire to do the tasks was associated with the sense of choice that he experienced as well as the way that those tasks were provided:

"I felt that I had the chance to choose between the available activities...The provision of these activities in a non-compulsory and free manner increased my desire to complete more learning activities and exercises..." (BSTD22).

Two other informants in the interviews also echoed those views. While one student pointed out, *"...giving me the freedom to choose what to perform from options of learning activities was a good thing that motivated me to be more creative."* (BSTD28), another interviewee expanded on this perspective and asserted:

"Usually, students in most university courses do not have options when homework is assigned. There is often only one option for all students, and they are required to do it; yes, there is no other option for them...." (BSTD27)

In addition, student BSTD11 eluded to the notion that providing the gamified activities with more than one form for each task motivated and encouraged him to participate with peers and compete with them to complete the instructional activities.

"I felt that I did not have to choose the same type of activity because there was more than one option, and this motivated me more to compete with my team and earn points in more than one way."

It can be inferred from those views that the way that the instructional activities are delivered could play a vital role in supporting autonomous learning among students. Providing different choices or forms of gamified tasks would likely increase their desire to complete more of those tasks. This qualitative result parallels the quantitative findings obtained particularly from items 1 and 2 in the questionnaire, which reported that students felt a sense of freedom when performing the out-of-class activities, helping them to choose what reflected their preferences. These findings suggest that students in the gamified FVC group tended to feel more autonomous in deciding what they wanted to complete from the tasks based on their desire rather than providing the task as one form or option.

Furthermore, the goal that a learner chooses to achieve may also influence the students' feelings of autonomy. The findings related to the *Goal Choice* sub-theme revealed that different types of goals might have different impacts on the student's desire to complete the gamified tasks. The students in the semi-structured interview reported their reasons or goals for completing the learning activities. For example, one goal was to benefit from the new CS knowledge provided in the course, as Student BSTD22 expressed:

"...one of the reasons why I completed the activities was because I wanted to learn and apply new skills..."

Student BSTD21 also described that the gamified tasks provided entertaining learning situations in which his goal was to learn and gain skills:

"I wanted to learn more about computers and acquire computer-related skills, and the method of presenting information helped me a lot because it was similar to entertaining learning applications."

Benefiting from the instructional course was not the only goal for completing the tasks. Participating in the gamified team-based tasks and competing with others by earning points and

badges to win was also revealed by some students as their own goals (BSTD22, BSTD11, BSTD28). For instance, student BSTD3 demonstrated:

"I wanted to benefit from the information related to the course that we were studying...I was gaining information and at the same time playing to earn more points".

"...there was a specific goal, which was to get as many points as possible." (BSTD28).

Another goal for completing the gamified quizzes, which was embedded in the pre-class videos, was to support the preparation process for the competitive in-class activities, as indicated by student BSTD11 in the following documented quote:

"I focused on answering the embedded quizzes correctly and making the most of the presented content...I was thinking of collecting points as much as I wanted to finish watching all the educational videos and quizzes before each lecture to prepare for the online class competition..."

This is in association with the sub-theme, *Independent Learner*, presented in Table 4.18. The findings reported that students were able to independently prepare for the online sessions before attending them, which might positively contribute to their understanding of the course's topics. For instance, student BSTD3 stressed:

"I wanted to prepare for these lessons before attending the online sessions...and this helped me a lot in understanding most of the lessons' points."

In line with this, two students explained that the pre-class videos could help them answer the embedded gamified quizzes independently before each class. This is exemplified in the following statements:

"...focused on watching videos to help me answer the quizzes effectively before the beginning of each lesson." (BSTD11)

"Each student in my team could individually earn points by completing some activities outside of class and thus contributing to the team..." (BSTD28)

"To collect points, I relied heavily on the pre-class videos, and I re-watched some of them more than once to reach the correct answers for the quizzes." (BSTD27)

It seems that students were able to prepare and construct their own subject knowledge

through different forms of online learning tasks that they could choose and perform. In addition, they could independently find the answers to quizzes by reviewing the instructional content of the pre-class videos uploaded on the online learning platform (BSTD11, BSTD21).

This result suggests that students aimed not only to compete by collecting points and badges but also to set their goals independently to learn and construct new knowledge through participating in pre-class and in-class learning activities. This finding is consistent with the quantitative results of questionnaire item 4, which reported that the gamified FVC supported students in controlling their out-of-class learning environment and allowed them to collect points and badges by performing the gamified tasks based on their convenience, which tended to prepare them for the competitive in-class activities.

Similarly, the *Time and Place Flexibility* sub-theme indicated that the interviewees experienced flexibility in time and answer attempts when performing the pre-class activities. For example, one student acknowledged:

"I also liked that the learning activities were not limited to a specific time or a limited number of attempts..." (BSTD11).

"I think that taking some online activities outside of class time was a good idea because I could complete them at a time that suits my daily schedule. I was able to continue watching some videos and answering quizzes even late at night..." (BSTD27).

This is also supported by other interviewees who asserted that the gamified FVC method considered their availability and use of time and their abilities, as they could watch the pre-class videos and collect points at any time before each online session.

"I could watch the educational video before each lecture at any time based on my personal time and daily schedule...to complete the activities according to my abilities and capabilities and my time." (BSTD3).

"...that took into account... my time and convenience." (BSTD25).

These qualitative findings are in parallel with the quantitative results of items 5 and 6 in the questionnaire, which reported that most students in the gamified FVC setting were able to control their learning environment when performing the out-of-class activities; they took

responsibility for competing and learning by managing their own learning time and speed, thus supporting their independent learning.

When providing students with an autonomy-supportive learning environment, they likely feel a sense of choice, freedom, and flexibility, so they may feel more autonomous in their actions; this notion is in line with the SDT principles. The quantitative and qualitative findings related to autonomous learning also suggest that students' psychological need for autonomy might be stimulated by encouraging them to earn points and badges freely through various options or forms of gamified learning activities. Providing students with non-controlling learning challenges was likely to support them in setting their shared goals and making their own decisions about which tasks they want to complete based on their own pace, time, and place. These findings are relevant to several studies reported in the literature (e.g. Nicholson, 2015; Reiners *et al.*, 2015; Zainuddin & Perera, 2018) suggesting that gamified systems could be designed based on the SDT to provide an autonomy-supportive learning environment in which students may feel more autonomous in their learning.

4.2.4 Competitive Activities

In this main theme, the interviewees explained how the competitive activities affected their feelings of competence. The thematic data analysis of the semi-structured interviews generated five sub-themes, which include *Increased Competition*, *Challenging Activities*, *Optimal Challenges*, *Leaderboard Records*, and *Collecting Points*. The example quotes in Table 4.19 show that the interviewees generally agreed upon the notion that the gamified FVC method encouraged them to engage competitively in the instructional activities that integrated SDT-based gamification elements. The findings related to the *Increased Competition* sub-theme indicated that students felt that the team-based gamified tasks increased their competitive spirit within the team. This perspective is further exemplified as follows:

One participant stated:

"This method contributed to increasing the competition between us in groups...my group was 3rd on the leaderboard, and we were excitedly trying to get 2nd and then 1st... and at the same time gaining more points." (BSTD3)

It was also reported that the team-based gamification made the competition more fun, as stated by student BSTD28:

"To be honest, I do not usually like competitions, but this group way of playing encouraged me to compete with my team. It was so much fun!"

Student BSTD21 also explained that chasing the other teams was not easy; however, they were eager to achieve higher team positions:

"Sometimes it was difficult for us to score a number of points similar to some of the competing teams, but the feeling of enthusiasm in our team was important for us to achieve that."

Table 4.19: Sub-themes of Competitive Activities

Sub-theme	Example Quote	Indicator of Autonomous Motivation (Ryan & Deci, 2000b)
Increased Competition	"This method contributed to increasing the competition between us in groups...my group was 3rd on the leaderboard, and we were excitedly trying to get 2nd and then 1st... and at the same time gaining more points." (BSTD3). "...It was good to have options to answer each task...this method was useful and made the course more competitive..." (BSTD22). "To be honest, I do not usually like competitions, but this group way of playing encouraged me to compete with my team. It was so much fun!" (BSTD28).	Perceived competence
Collecting Points	"The competition to collect points was exciting for me to reach my goals and collect as many points as possible." (BSTD22). "...and thus gaining more points through them." (BSTD11). "When I earned a new badge, we celebrated for the team because this meant a lot of points from each badge. This also reflected our progression." (BSTD3).	Perceived competence
Leaderboard Records	"I could easily know my balance of points at any time." (BSTD21). "...especially when you see the total points go up on the leaderboard after finishing each learning activity...these things are awesome." (BSTD11). "...when the goal was to earn 2000 points and reach a high level on the leaderboard, my group had to challenge the other groups while collecting the desired points." (BSTD28).	Perceived competence
Challenging Activities	"As for the other learning activities, I think they needed more effort to be answered; earning points through some of them was not easy." (BSTD11). "...but it was kind of a challenge to achieve high points." (BSTD28). "I did not aim to win as much as I desired to challenge myself..." (BSTD21).	Perceived competence
Optimal Challenges	"...they [the pre-class activities] were not very easy nor very difficult, but I think they were quite balanced in level, and I could answer most of these quizzes and complete the learning activities just by focusing on them enough." (BSTD22). "I think that having the options that I could choose from was an excellent way that took into account my interests and what suited me in terms of the difficulty levels..." (BSTD25). "...this method is better than taking only one type for each out-class activity, which may be challenging for some students." (BSTD11).	Perceived competence

Another student mentioned that the availability of gamified tasks in different forms was not only useful but also competitive:

"...It was good to have options to answer each task...this method was useful and made the course more competitive..." (BSTD22).

It seems that allowing students to obtain points and badges by performing various forms of gamified learning activities added a sense of excitement to the learning environment. In this scenario, students had the opportunity to earn points and badges not only outside the class but also during online session time. Some students emphasised that they needed to gain several points to reach their targets and thus win the competition (BSTD3, BSTD28).

Similarly, the qualitative results associated with the *Collecting Points* sub-theme also aimed to understand how students perceived the method of earning points and badges when completing the available tasks. Two interviewees reported:

"The competition to collect points was exciting for me to reach my goals and collect as many points as possible." (BSTD22).

"...and thus gaining more points through them." (BSTD11).

This is also revealed by student BSTD3, who interestingly explained:

"When I earned a new badge, we celebrated for the team because this meant a lot of points from each badge. This also reflected our progression."

Moreover, the *Leaderboard Records* sub-theme highlighted the role of the leaderboard as one of the gamification elements in making the learning environment more competitive. The accumulation of points and badges was displayed on a leaderboard in every online session and could be accessed by the students at any time. One student demonstrated:

"I could easily know my balance of points at any time." (BSTD21).

Another interviewee stated that the gamified method was fun: *"...especially when you see the total points go up on the leaderboard after finishing each learning activity..." (BSTD11).*

This is also in line with the perspective of student BSTD22, who said:

"It was also exciting to see my team's name going up on the leaderboard so quickly."

Moreover, participant BSTD28 illustrated:

"...when the goal was to earn 2000 points and reach a high level on the leader board, my group had to challenge the other groups while collecting the desired points."

These qualitative findings were in line with the quantitative results of items 7, 8 and 12 of the questionnaire regarding students' feelings of capability and competence when performing the learning activities.

The *Challenging Activities* sub-theme also uncovers important findings relevant to the students' feeling of competence when participating in the competition. Although the participants described some gamified pre-session tasks as challenging, they desired to compete with peers to earn more points and progress. For example, one student who collected a high number of points stated that some gamified tasks *"...needed more effort to be answered; earning points through some of them was not easy."* (BSTD11). This view was also supported by student BSTD27, who demonstrated:

"The embedded quizzes in some videos were a bit challenging for me..."

Another interviewee perceived the gamified tasks as self-challenges, reporting the following statement:

"I did not aim to win as much as I desired to challenge myself..." (BSTD21).

Student BSTD3 also emphasised the influential role of delivering the gamified challenges in different forms:

"Providing the tasks in more than one form of challenge made me believe that I could do more than I thought."

Indeed, providing students with challenging learning tasks to perform and master did not seem enough to promote a sense of competence among them. These challenges might need to be optimal in such a way that considers both the student's capabilities and the difficulty level of the tasks. This notion was reported in the *Optimal Challenges* sub-theme, revealing the importance of students perceiving the gamified tasks as optimal or with a balanced difficulty level,

which may impact their feeling of competence. For example, one student shed light on the pre-session tasks and stressed:

“...they were not very easy nor very difficult, but I think they were quite balanced in level, and I could answer most of these quizzes and complete the learning activities just by focusing on them enough.” (BSTD22).

This could be attributed to providing choices or various forms of gamified activities for the participants to master, which might allow the student to try different forms of these tasks and find what suits their ability. This is demonstrated by some students as the following:

Student BSTD28 highlighted:

“The availability of gamified activities in different formats means that there is something suitable for everyone...”

Students BSTD11 and BSTD25 also agreed with this perspective by stating:

“...this method is better than taking only one type for each out-class activity, which may be challenging for some students.” (BSTD11)

“I think that having the options that I could choose from was an excellent way that took into account my interests and what suited me in terms of the difficulty levels...” (BSTD25).

From the findings above, it seems that considering the way that the competition and challenges are provided in which the gamified tasks are delivered with a sense of choice to help students find what is optimal for them can play a vital role in the effectiveness of the SDT-based gamification as a possible competence-supportive method.

4.2.5 Feeling Capable and Efficient

Students' feelings of capability and efficiency are associated with the extent to which they feel competent in each learning situation. This main theme aimed to provide a further understanding of such feelings of competence. As shown in Table 4.20, three sub-themes were generated from the thematic data analysis process related to this theme, including the *Desire to Complete the Tasks, Informational Feedback, and Ability to Progress*.

In relation to the *Desire to Complete the Tasks* sub-theme, some students eluded to the notion that they had the opportunity and desire to complete the available gamified learning activities (BSTD11, BSTD21, BSTD22). For example, student BSTD11 mentioned:

"I felt the opportunity and much desire to complete all the tasks without skipping any activity."

In line with this view, another interviewee justified his desire to complete the gamified activities and commented:

"...my view of the balance of points was somewhat motivating for me towards completing the existing activities." (BSTD21).

Table 4.20: Sub-themes of Feeling Capable and Efficient

Sub-theme	Example Quote	Indicator of Autonomous Motivation (Ryan & Deci, 2000b)
Desire to Complete the Tasks	"I felt the opportunity and much desire to complete all the tasks without skipping any activity." (BSTD11). "... my view of the balance of points was somewhat motivating for me towards completing the existing activities." (BSTD21). "... and thus gain more points by performing these activities as it was up to my personal desire without any force on me..." (BSTD22).	Perceived competence
Informational Feedback	"...also provides feedback on the level you have reached throughout the course in a much deeper and more detailed way than the official grades do, which often depend only on overall performance in exams rather than the level of students' understanding of learning activities." (BSTD28). "...they helped me to consolidate the acquired information and concepts as I needed to remember them..." (BSTD21). "...the feedback on my progress was important in keeping me on track. I was confident that I would be able to learn from my mistakes, so I was not afraid to make them and to try again." (BSTD25).	Perceived competence
Ability to Progress	"...I was able to answer the quizzes and complete almost all the learning activities that were available even though I could not answer some questions correctly on the first attempt because I could not understand exactly what was shown in one of the videos." (BSTD3). "...this has increased my desire to complete extra activities." (BSTD11). "...This method helped us to do more tasks." (BSTD22).	Perceived competence

In addition, while student BSTD22 explained that personal desire was behind his completion of the tasks, *"...it was up to my personal desire without any force on me..."*, student BSTD3 stated, *"...I really wanted to support my team by completing the quizzes as much as I could, in fact, going up on the leaderboard was dependent on the achievement of each team member..."*. This result suggests that when completing the pre-session activities, those students were likely to

have the desire to achieve personal satisfaction by earning more points and badges based on their different capabilities; such behaviour is potentially related to the feeling of mastery and capability when performing an activity.

In the current study, the points, badges, and leaderboards used in the gamified FVC were also reported to provide meaningful feedback on the student's performance. Indeed, feedback seemed essential in the gamified FVC environment, as the *Informational Feedback* sub-theme indicated. For instance, student BSTD28 talked about the gamified system and asserted:

"... [it] also provides feedback on the level [he has] reached throughout the course in a much deeper and more detailed way than the official grades do, which often depend only on overall performance in exams..."

Furthermore, an interviewee demonstrated that this method helped him to remember the information acquired from the pre-session videos when answering the gamified online quizzes (BSTD21). The feedback might also be important in reflecting the progress of each student and supporting self-evaluation, as documented in student BSTD25's statement, *"...the feedback on my progress was important in keeping me on track. I was confident that I would be able to learn from my mistakes, so I was not afraid to make them and to try again."*

As a result, some students emphasised that they were able to attempt to complete the pre-class activities and answer most of these gamified quizzes, as reported in the *Ability to Progress* sub-theme. For example, student BSTD3 stressed that although he could not answer some questions presented in one of the pre-class videos on his first attempt, he felt the ability to *"...achieve high positions by earning as many points as possible..."*; in turn, the student expressed, *"...I felt a sense of achievement and progression...increasing our enthusiasm for progressing in the course"*. The ability to progress was also mentioned by students BSTD11 and BSTD22, respectively, as follows:

"...this has increased my desire to complete extra activities."

"...This method helped us to do more tasks."

This result suggests that providing competitive gamified tasks and challenges accompanied by meaningful feedback may support a sense of mastery and progression among

students, thus potentially stimulating their feeling of competence. These findings are consistent with the overall quantitative results relevant to the competence questionnaire dimension. Further discussion of these findings is provided in Chapter Five.

4.2.6 Interaction within Groups

This main theme attempts to understand how students interacted with each other and the way that they perceived social interaction situations. This is related to the social relatedness factor as a possible contributor to student motivation. Based on the thematic analysis process, the *Interaction within Groups* theme includes four sub-themes, namely, *Enjoyable Teamwork*, *Team Loyalty*, *Tracking Others' Progress on the Leaderboard*, and *Online Peer Interaction*. The interview data examples presented in Table 4.21 generally indicate that students liked integrating the team-based gamification elements into the online flipped learning environment.

The data analysis relevant to the *Enjoyable Teamwork* sub-theme revealed that students in the gamified FVC were likely to enjoy learning through teamwork that used SDT-based gamification mechanisms in its design. For instance, three interviewees mentioned:

"I think we enjoyed working together as a team...and increased my enjoyment of working as a team." (BSTD3).

"...cooperation was very important to the success of the group, and I enjoyed working with my group because we were cooperative and aware." (BSTD22).

"...I enjoyed doing these collaborative activities..." (BSTD11).

This qualitative finding was particularly in line with the quantitative result of item 14, which indicated that the participants in the gamified FVC were able to interact with others, either in pre-sessional tasks or during online sessions, compared to the conventional FVC group. One possible reason behind the students' desire to interact and work collaboratively on team-based tasks might be that they felt a sense of loyalty to their teams, so they strived together to win the competition, as reflected in the *Team Loyalty* sub-theme. This is demonstrated by some students as follows:

"...every member in my group wanted to motivate the others..." (BSTD3).

"When we needed help, we could help each other and that also contributed to the success of our team...this method, I think, is better than working individually." (BSTD22).

"...and add more points to my balance and, of course, the total balance of my group." (BSTD11).

Table 4.21: Sub-themes of Group Interactions

Sub-theme	Example Quote	Indicator of Autonomous Motivation (Ryan & Deci, 2000b)
Enjoyable Teamwork	"I think we enjoyed working together as a team...and increased my enjoyment of working as a team." (BSTD3). "I think that cooperation was very important to the success of the group and I enjoyed working with my group because we were cooperative and aware." (BSTD22). "...I enjoyed doing these collaborative activities..." (BSTD11).	Perceived relatedness
Team Loyalty	"When we needed help we could help each other and that contributed to the success of our team; this method I think is better than working individually." (BSTD22). "...and add more points to my balance and, of course, the total balance of my group." (BSTD11). "...every member in my group wanted to motivate the others..." (BSTD3).	Perceived relatedness
Tracking Other's Progress on the Leaderboard	"...the team's ranking was going higher and higher on the leaderboard," (BSTD11). "...my group was 3rd on the leaderboard, and we were excitedly trying to get 2nd and then 1st." (BSTD3). "...this affected our group's position on the leaderboard." (BSTD21).	Perceived relatedness and competence
Online Peer Interaction	"Working in my group was great as it helped motivate me to complete the activities..." (BSTD3). "I also liked to help my colleagues in my group whenever I was able to do so..." (BSTD22). "...I was able to discuss my thoughts during the online sessions and share my knowledge about the online quizzes..." (BSTD11).	Perceived relatedness

This qualitative result parallels the quantitative findings of items 15, 16, and 17 in the questionnaire, which reported that students in the experimental group felt closer to each other when working as teams on the out-of-class and in-class activities. This finding suggests that the gamified FVC method provided students with more opportunities for peer interactions and might engender a sense of group belonging among them when engaging in gamified online learning tasks.

In line with the aforementioned sub-theme, the *Tracking Others' Progress on the Leaderboards* sub-theme revealed that integrating gamification elements into the FVC enabled most students to track their team's performance on the leaderboard while they were competing

and collecting points and badges. The example quotes in Table 4.21 show how students perceived the gamification elements integrated into the team-based tasks. For instance, some students reported:

"...the team's ranking was going higher and higher on the leaderboard..." (BSTD11).

"...my group was 3rd on the leaderboard, and we were excitedly trying to get 2nd and then 1st." (BSTD3).

"...this affected our group's position on the leaderboard." (BSTD21).

Moreover, it seems that students were not merely striving to collect points by completing the gamified out-of-class activities but also trying together to do extra learning activities in the online class sessions to add more points and badges to their group balance, as reported in the *Online Peer Interaction* sub-theme. For example, one group member commented, *"I also liked to help my colleagues in my group whenever I was able to do so..."* (BSTD22).

In line with this perspective, student BSTD11 asserted, *"...I was able to discuss my thoughts during the online sessions and share my knowledge about the online quizzes..."*. Consequently, providing such peer-interaction spaces while working as a team seemed to be motivating. For example, one interviewee alluded to the notion:

"Working in my group was great as it helped motivate me to complete the activities..." (BSTD3).

These findings were also in parallel with the results obtained from the quantitative data analysis of items 18 and 19 in the questionnaire, which revealed that working on the gamified learning activities collaboratively as teams helped students to understand the instructional materials and supported their critical thinking skills. This suggests that the gamified FVC method motivated students autonomously to interact effectively with their peers while feeling related to their team, which appeared to impact the completion rates of the team-based pre-class tasks.

4.2.7 Students' Perceptions of Gamification

One aim of the current study was to understand how the SDT-based gamification elements were perceived by the students, which allowed the researcher to identify several advantages and disadvantages of integrating such mechanisms into the online flipped learning environment. As

mentioned earlier, unlike the previous themes, the thematic analysis used with this main theme was data-driven. Based on this, the data analysis generated two sub-themes, including the *Advantages* and *Disadvantages* of the gamified FVC.

In terms of the *Advantages* sub-theme, the students in the gamified group expressed their opinions about the effectiveness of the SDT-based gamification intervention. As the example quotes show in Table 4.22, most students in the gamified FVC thought that their learning experience on the CS course was useful and generally positive. The interviewees pointed out that integrating gamification into the learning activities provided a good learning experience and made the course more interesting.

Table 4.22: Sub-themes of Students' Perceptions of Gamification

Sub-theme	Example Quote
Advantages	"...there were embedded quizzes after every short time when watching each video and thus earn points while watching...Honestly, the experience was good...the way that the videos were provided was generally interesting." (BSTD27)
	"...I think this method is appropriate and I consider it an awesome experience..." (BSTD11).
	"I could attend the session knowing in advance the educational content required..." (BSTD3).
	"...[the tasks] contributed positively to the information recall in my memory...I think that the educational video activities were distinctive, easy and more fun..." (BSTD21).
	"I think I did not like the quizzes embedded into the videos, but rather, I liked the other gamified tasks in the form of readable information and the separate quizzes related to them because I could do them quickly." (BSTD25).
	"I did not feel pressured to complete the learning activities..." (BSTD28).
	"...we could help each other and that contributed to the success of our team..." (BSTD22).
	"...I believe that every student has his own interests and preferences when doing any activities; these interests and preferences often differ from student to student...So, in my opinion, the freedom to choose between the activities was very important in this course." (BSTD28).
Disadvantages	"I was also not able to skip certain parts of some videos because of the embedded quizzes...so, in order to collect all the points, I felt I was forced to watch the entire video as I could not skip some unimportant information." (BSTD25).
	"...the embedded quizzes were asked at some points of the video and neglected some other parts of the instructional content." (BSTD3).
	"I think the video should be creatively designed so that the information in it should be linked with daily life." (BSTD28).
	"...I was the leader of my group, and because of my family circumstances and lack of time, I felt that I negatively affected the overall performance of my group..." (BSTD28).
	"...we did not have enough cooperation when we needed to do some in-class activities..." (BSTD27).
	"...this was due to the period of exams that I had so I was quite busy throughout some weeks..." (BSTD22).

For example, student BSTD22 said, "*I think the experience was interesting, useful and motivating for me and my groupmates as well...*". In line with this opinion, some students mentioned:

“...there were embedded quizzes after every short time when watching each video and thus earn points while watching...Honestly, the experience was good...the way that the videos were provided was generally interesting.” (BSTD27)

“...I think this method is appropriate, and I consider it an awesome experience...” (BSTD11)

The gamified FVC method also seemed to encourage students to prepare before attending the online sessions. This was described by student BSTD3, who stated, *“I could attend the session knowing in advance the educational content required...”*. In addition, some students reported that the gamified pre-session tasks improved their overall learning experience and information retention. For instance, student BSTD21 explained: *“...[the tasks] contributed positively to the information recall in my memory...”* The student then added, *“...I think that the educational video activities were distinctive, easy and more fun...”*

Moreover, the integration of team-based gamification elements into the FVC method might also bring the class together to compete as teams in an enjoyable learning environment. This was highlighted by some students who revealed:

“The points and working in a group also encouraged me a lot and increased my enjoyment...” (BSTD3).

“...we could help each other and that contributed to the success of our team...” (BSTD22).

“The teamwork could make the activities more enjoyable because the achievement was not for one member or individually, but it was the responsibility of everyone in the group.” (BSTD28).

“...I tried to win and contribute with them [his team] to earning more points...” (BSTD11).

Those elements also tended to stimulate students to achieve shared goals and thus perform more learning activities, particularly outside class sessions. Most interviewees (e.g. BSTD3, BSTD21, BSTD22, BSTD28) realised that they had the opportunity to choose what form of the task to perform and decide how many points to earn for the team, thereby motivating them to compete and go that extra mile, participating in more activities without pressure. For instance, student BSTD28 emphasised, *“...I believe that every student has his own interests and preferences when doing any activities; these interests and preferences often differ from student to*

student...So, in my opinion, the freedom to choose between the activities was very important in this course.” Then, the participant expanded on this notion and added:

“...I did not feel pressured to complete the learning activities...”.

Student BSTD3 also commented, *“I was free to choose what I wanted to complete from the activities...”*. Based on these choices, student BSTD25 expressed his preference, *“I think I did not like the quizzes embedded into the videos, but rather, I liked the other gamified tasks in the form of readable information and the separate quizzes related to them because I could do them quickly.”*, while student BSTD27 preferred the gamified video-based quizzes and explained that the reason for this preference was that these videos were not that long; thus, he *“...could earn more points by watching it and answering the quizzes integrated into each video...”*

Although the fact that these pre-class tasks were provided to both study groups and the integration of SDT-based gamification elements into their activities was the only interventional difference between those two groups, unlike the control group, most students in the gamified group found these activities interesting and thus wanted to complete and understand the displayed instructional content to be able to answer the gamified quizzes correctly and earn more points as a result. One explicitly mentioned:

“I did not want to speed up the video or skip some parts because most of the videos were interesting...”
(BSTD21).

The overall findings showed that the integration of gamification into the pre-class videos might contribute to delivering the learning content of the CS course in different forms so that students were able to choose what might be interesting for them.

However, although the quantitative findings indicate that students in the gamified group accomplished significantly more pre-session tasks than those in the other group, some students thought there were some drawbacks according to their experience of the gamified FVC method, reported in the *Disadvantages* sub-theme.

One crucial point highlighted was that the quality of the student's participation should be considered when earning points and badges to encourage them to produce high-quality teamwork. This is because some participants' contributions might not be adequately insightful,

particularly when engaging in group discussions or collaborative tasks. For instance, interviewee BSTD27 commented:

"...sometimes, we did not have enough cooperation when we needed to do some in-class activities..."

while student BSTD28 said, *"...we were not very active in the group..."*.

Indeed, several reasons might also affect students' engagement, such as being busy preparing for other subjects, as mentioned by student BSTD22, who justified his non-completion of some pre-session tasks by saying:

"...this was due to the period of exams that I had so I was quite busy throughout some weeks..."

Similarly, student BSTD28 acknowledged, *"...I was the leader of my group, and because of my family circumstances and lack of time, I felt that I negatively affected the overall performance of my group..."*. Concerning the lack of quality in some students' contributions to their teams, the student suggested using some online tools (e.g., like or dislike) that might be useful to encourage the group members to produce quality participation. (BSTD28).

Moreover, when they were asked about their thoughts regarding the gamified activities, some students shed light on issues related to the pre-session task design that might affect their completion rate of those activities. For instance, student BSTD25 commented:

"I was also not able to skip certain parts of some videos because of the embedded quizzes...so, in order to collect all the points, I felt I was forced to watch the entire video as I could not skip some unimportant information."

Student BSTD3 also argued, *"...the embedded quizzes were asked at some points of the video and neglected some other parts of the instructional content."*

Therefore, student BSTD28 suggested that to make the instructional content more attractive and desirable, it should be introduced considering some real-life situations:

"I think the video should be creatively designed so that the information in it should be linked with daily life."

These qualitative findings indicate the key role of the gamified pre-session task design in the effectiveness of flipped learning, highlighting that it needs to be carefully considered to maximise students' preparation for the in-class sessions; otherwise, the flipped learning process may fail to achieve its purpose. This will be further explained in the following sub-section as well as in Chapter Five.

4.2.8 Adoption and Design Considerations

The aim of this main theme is to provide insights into the adoption and design considerations in relation to the SDT-based gamification elements integrated into the online flipped learning environment. This helped the researcher to address the sixth research question in the current study (see Table 4.1).

Table 4.23: Sub-themes of Adoption and Design Considerations

Sub-theme	Example Quote
Gamified Pre-session Video Design	"I enjoyed the videos that provided information in a simple and easy way and in an informal language that was more game-like and understandable to me... some of the videos were explained in formal and academic language I think it was quite unclear..." (BSTD3). "...the definitions of some terms, the function of particular devices or parts of the computer, or certain software commands that were shown in the pre-class videos were easy to be understood and answered and thus gaining more points..." (BSTD11). "I liked the integrated videos and quizzes more than other types of learning activities...because they presented the information in an interesting way, in the form of gamified videos..." (BSTD22). In my opinion, there were some negatives in the length and quality of some educational videos. I think some of them were excellent and some were not..." (BSTD3). "I think they [the videos] were clear and not very long or boring...if the videos were long (for example, more than 15 minutes), I would not be able to focus and I would therefore miss some of the information in those videos and I would not be able to complete the quizzes properly...So I think the length of the videos is very important." (BSTD28). "I think one of the videos was a bit long, but the other videos were not that long...I think that the length of each video should be between ten to fifteen minutes." (BSTD11). "...the title of the video is also important in attracting attention...the title should be more attractive and not just a title that reflects the lesson content. For example, in a lesson "Using MS Excel", the title should not be as simple and boring as this, but rather, it should be more attractive." (BSTD28). "...it's also better if something new is added to the method every once in a while to avoid boredom...the student's registration for each lecture should be linked with completing the activities and watching the videos before attending the lecture..." (BSTD25).
Balance Across Teams	"...I think it is important to divide students into balanced groups based on their abilities rather than creating the groups randomly." (BSTD28). "...I believe that dividing the students into groups should be done in a balanced way so that there is a kind of performance equality between the groups." (BSTD25). "...I believe that changing team members from time to time can add more excitement to the competition between teams so that the strength of the team changes with the change of members." (BSTD27). "...students' performance should be evaluated before creating groups to have balanced groups." (BSTD28). "Our team was so strong to compete with other teams because all of us were active and wanted to win the competition." (BSTD3).

Based on the thematic data analysis of this main theme, which was driven by the data rather than the theory, two sub-themes emerged, including the *Gamified Pre-session Video Design and Balance Across Teams*. Despite the overall positive comments indicating that most students enjoyed performing the gamified learning tasks in a cooperative and competitive atmosphere, some interviewees provided suggestions that will contribute to the gamified FVC improvement. As the typical quotes in Table 4.23 present, the qualitative data analysis related to the *Gamified Pre-class Video Design* sub-theme implied that how the pre-class videos were provided and presented played a vital role in students' experiences of flipped-class instructional activities. In this regard, some students pointed out:

"...the content in some videos was explained in clear informal language and the information was not provided directly but was presented in indirect but interesting ways at the same time." (BSTD3).

"The content and concepts in the educational videos were very clear and understandable..." (BSTD11).

Another student commented that he preferred the videos that used informal language (i.e., colloquial Arabic dialect) in delivering the gamified instructional content over those in which formal or academic language was used, as stated by student BSTD3:

"I enjoyed the videos that provided information in a simple and easy way and in an informal language that was more game-like and understandable to me...some of the videos were explained in formal and academic language I think it was quite unclear..."

Therefore, some students reported that they were more interested in earning points through watching the pre-class videos than the other tasks, such as the reading activities, as student BSTD11 put it:

"...the definitions of some terms, the function of particular devices or parts of the computer, or certain software commands that were shown in the pre-class videos were easy to be understood and answered and thus gaining more points..."

Another interviewee (BSTD22) justified:

"I liked the integrated videos and quizzes more than other types of learning activities... because they presented the information in an interesting way, in the form of gamified videos..."

Student BSTD11 also added, *"I liked the quizzes embedded into the videos the most because the instructional content was clear, and the questions were timely."* As a result, student BSTD21 emphasised, *"The quizzes that were embedded into the videos helped me focus on the information presented in these videos..."*

However, although participant BSTD3 reflected a similar notion, reporting that those quizzes helped him to understand the lesson's points, he then revealed:

"In my opinion, there were some negatives in the length and quality of some educational videos. I think some of them were excellent and some were not..."

In line with this opinion, when a student was asked about the non-completion of some pre-class videos, he mentioned that some videos were long and suggested, *"...I think it would have been better to separate the quizzes and their points from the videos so that we could answer them all together and collect points quickly instead of having to watch the entire video and wait for each quiz to appear."* (BSTD25).

Indeed, it seems that the video length could play a vital role in impacting students' engagement with the instructional video content and the gamified quizzes embedded into the pre-class videos. One student supported this claim and stated:

"I think they were [the videos] clear and not very long or boring...if the videos were long (for example, more than 15 minutes), I would not be able to focus and I would therefore miss some of the information in those videos and I would not be able to complete the quizzes properly...So I think the length of the videos is very important." (BSTD28).

In addition, student BSTD11 said that although most of these videos were short and useful, *"...one of the videos was a bit long."* He continued, *"...I think that the length of each video should be between ten to fifteen minutes."*

In relation to this design issue, it was suggested that the title of the instructional video should also be considered part of the gamified pre-class activities' design in a way that may reflect a playful atmosphere. This view surfaced mainly in the response of student BSTD28, who commented:

"...the title of the video is also important in attracting attention...the title should be more attractive and not just a title that reflects the lesson content. For example, in a lesson "Using MS Excel", the title should not be as simple and boring as this, but rather, it should be more attractive."

Another suggestion was provided by student BSTD25, who self-reported low autonomous motivation based on the quantitative results. The participant pointed out that in order to create a fun competition, the number of points earned from participating in the learning tasks should be linked with some useful badges that are related to some special and official course rewards or count towards the overall course grades. The student then added:

"...it's also better if something new is added to the method every once in a while to avoid boredom...the student's registration for each lecture should be linked with completing the activities and watching the videos before attending the lecture..." (BSTD25).

The qualitative findings indicated that a few learners who reported low autonomous motivation might need an integration of both extrinsic and intrinsic rewards, which could potentially encourage them to start engaging with the learning activities. One suggestion provided by student BSTD25 is to use extrinsic rewards at the end of the competition; thus, the winning group would be those who collected the highest number of points.

Moreover, the data analysis relevant to the *Balance Across Teams* sub-theme also uncovered an important issue when grouping the students into teams. It was suggested to consider minimising the potential gap or imbalance between the teams or groups in terms of their engagement abilities and performance levels as much as possible. When the interviewees were asked about their opinions regarding the competition level between the teams in general, two participants mentioned:

"...I believe that changing team members from time to time can add more excitement to the competition between teams so that the strength of the team changes with the change of members." (BSTD27).

"...I think it is important to divide students into balanced groups based on their abilities rather than creating the groups randomly." (BSTD28).

In addition, some students asserted that ensuring balance in team performance would play a vital role when engaging in collaborative and competitive learning tasks (BSTD27, BSTD11).

For example, one reported, *"...I believe that dividing the students into groups should be done in a balanced way so that there is a kind of performance equality between the groups."* (BSTD25). Another interviewee highlighted:

"I think that working in groups depends on how active each team member is..." (BSTD22).

This is also supported by student BSTD3, who affirmed that the enjoyment they felt when engaged in teamwork stemmed from the team's strength. This seemed to positively impact their feelings of competence as influential team members and might make them progress actively by completing more gamified activities and thus earn more points and badges. The student then reported:

"Our team was so strong to compete with other teams because all of us were active and wanted to win the competition."

Hence, it was recommended that *"...students' performance should be evaluated before creating groups to have balanced groups."* (BSTD28). This will contribute to shrinking the possible engagement gaps among the groups when competing in collaborative learning tasks. Finally, the above findings and suggestions shed light on several aspects that should be considered when utilising the gamified FVC method in an online learning environment to support its instructional adoption and design, which will be further discussed in the following chapter.

4.2.9 Qualitative Findings Summary

The qualitative data were collected from the CS students at the Saudi higher education level by conducting semi-structured interviews involving seven students selected from the experimental group. The data were then analysed to deepen the investigation of the effectiveness of integrating SDT-based gamification into online flipped learning environments. Through the data analysis, this chapter unravels the intricate tapestry of students' motivations, reporting several factors that might impact this variable. It also sheds light on students' learning experiences when adopting the gamified FVC method. Regarding the research question about autonomous motivation, the findings revealed that most students enjoyed the competition between the teams and felt the desire to complete the gamified learning activities, as they wanted to collect more points and badges to level up their team's positions on the leaderboard.

Some students justified their desire to complete those activities by mentioning their feeling of loyalty towards their teams when performing the activities, and thus, they endeavoured to help each other. They also felt the ability to progress through these gamified tasks and wanted to drive the team to win the competition. Moreover, the students reported several possible factors behind their feelings; for example, they found most gamified CS activities interesting and fun and contributed to reducing the boredom of conventional teaching and learning methods. They also mentioned the flexibility in time and place they experienced when performing the pre-class tasks and the freedom to choose what they wanted to complete and decide how many points to earn based on their interests and shared goals. These factors might contribute to stimulating students' autonomous motivation to prepare for the online sessions by completing the learning activities before attending these sessions.

Indeed, most students believe that the combination of SDT-based gamification mechanisms and online flipped learning provided them with positive learning experiences. However, some disadvantages in the gamified FVC environment were pointed out, such as the quality of some gamified pre-class videos in terms of their length and the dialect used to deliver the instructional CS content. In addition, the findings revealed that some students who showed low motivation to begin engaging in the learning activities were interested in certain external evaluations, such as involving the official course grades. These results helped the researcher address the fifth research question related to the students' perceptions of the gamified FVC experiences.

The findings were also utilised to address research question six, which pertained to the adoption and design suggestions that need to be considered when implementing the gamified FVC method. One of those considerations was to employ both external and internal rewards when designing gamified learning activities. While extrinsic motivators were suggested to encourage some students to start engaging in these tasks, internal rewards should then be engendered from the gamified task itself, particularly when perceived as non-controlling, enjoyable, interesting, useful, or valuable. The results indicated that when students understand the usefulness and value of the CS activities or enjoy performing them and find them interesting, this could promote their autonomous motivation. The findings also stressed that a degree of caution is required when

designing gamified flipped learning activities, which can affect the completion rates of these tasks. Students should also be supported by meaningful feedback to increase the quality of their participation; this support might include the utilisation of peer-evaluation mechanisms, such as voting tools. In terms of the gamified pre-session videos, according to the findings, informal language was preferable to the students for the presentation of the instructional content in a way that reflects the game atmosphere, which might positively impact their attention span when watching these videos. Meanwhile, the length of these gamified videos should not be long to reduce the feeling of boredom among students and maintain their interest. Moreover, the findings also suggested that students should be grouped purposively, rather than randomly, based on certain criteria that can contribute to minimising the differences between the groups as much as possible.

Overall, several learning practices and mechanisms were highlighted by the students in the semi-structured interviews. These included: enjoyable and competitive gamified pre-class tasks which they desired to complete and compete with other groups to earn more points and badges; learning progression support; autonomous learning and flexibility in time and place; online group collaboration; and the feeling of loyalty when performing the gamified learning activities. Accordingly, such practices were likely to be supported by aligning the SDT-based gamification design with an online flipped learning environment, as shown in the present research. This combination is considered unique, at least, for the Saudi educational context, since it provokes continued dialogue and invites a deeper examination of the complexities underlying students' autonomous online learning motivation. The quantitative and qualitative findings are discussed further in the next chapter before highlighting the positive contribution that the present study will provide to the research in the context of both gamification and online flipped learning.

Chapter Five – Discussion

5.1 Introduction

The current study investigated the effects of integrating gamification into an online flipped virtual classroom (gamified FVC) environment on students' learning experiences in Saudi Arabian higher education, using self-determination theory (SDT) as a theoretical framework. It also shed light on a common problem, according to the literature, that can occur when applying the conventional online flipped learning approach, which is that many students tend not to complete pre-session activities and, therefore, attend online sessions with insufficient preparation. Since students' preparation is foundational to the effectiveness of flipped learning applications, examining and understanding the impact of integrating SDT-based gamification into FVCs on the completion rate of pre-class tasks is crucial. Therefore, the main aim of this study was to investigate the impact of this incorporation as a study intervention on students' autonomous motivation, learning achievement, and completion of pre-session activities in a Saudi university computer science (CS) course.

Table 5.1: Research Questions and Relevant Null Hypothesis

N	Research Question	Null Hypothesis (H ₀)
1	To what extent did the integration of gamification into FVC affect students' learning achievement in Saudi higher-education CS?	No significant difference between the gamified FVC and the non-gamified FVC in relation to students' test scores (<i>rejected</i>)
2	To what extent did the integration of gamification into FVC affect students' autonomous motivation in Saudi higher-education CS?	No significant difference between the gamified FVC and the non-gamified FVC in relation to students' autonomous motivation (<i>rejected</i>)
3	To what extent did the integration of gamification into FVC affect students' completion rate of pre-session tasks in Saudi higher-education CS?	No significant difference between the gamified FVC and the non-gamified FVC in relation to students' completion rate of pre-session tasks (<i>rejected</i>)
4	To what extent did the students' autonomous motivation correlate with their pre-session task completion rate when gamification was integrated into FVC?	No linear relationship between students' autonomous motivation and their pre-session task completion rate when gamification was integrated into FVC (<i>rejected</i>)
5	How did the Saudi university students perceive their gamified FVC experiences?	
6	What are the key adoption and design considerations that need to be addressed when implementing the gamified FVC method for autonomously motivating learning?	

To address the research questions presented in Table 5.1, the study utilised an explanatory sequential mixed-methods with a quasi-experimental research design. This helped the researcher to assess the impact of the gamified FVC on CS students' learning experiences by comparing an experimental group that used the gamified FVC method with a control group that utilised an online flipped learning environment without gamification (i.e., non-gamified FVC). Indeed, this mixed-methods research design paved the way for determining why and how such a gamified setting might be effective. In addition, students' perceptions of SDT-based gamification were explored to highlight its potential advantages and challenges, as well as to gain in-depth insights into its adoption and design. Hence, the present study included both quantitative and qualitative research questions to serve its aims.

Chapter Four presented the analysis of the quantitative data that were obtained from pre- and post-tests, pre- and post-questionnaires, VLE reports, and formative assessments, which helped the researcher to quantitatively assess the changes in students' autonomous motivation, learning achievement, and completion rate variables to address research questions 1 to 4 (see Table 5.1). The chapter also introduced the qualitative findings and explained the relevant analysis procedures of the data collected from the semi-structured interviews, which facilitated the process of understanding the quantitative data. The qualitative phase was also crucial in addressing research questions 5 and 6, which pertained to exploring students' perceptions of the gamification intervention and identifying their suggestions for its adoption and development.

Table 5.2: Relevance of Discussion Chapter Sections to Research Questions

Section	Research Question					
	1	2	3	4	5	6
5.2 Impact of Integrating Gamification into FVC on Learning Achievement	√					
5.3 Impact of Integrating Gamification into FVC on Autonomous Learning Motivation		√				
5.4 Impact of Integrating Gamification into FVC on Completion Rate of Pre-session Tasks			√			
5.5 Correlation Between Autonomous Motivation and Completion Rate				√		
5.6 Students' Learning Experiences in Gamified FVC					√	
5.7 Key Adoption and Design Considerations in Gamified FVC Implementation						√

The previous chapter showed that the null hypothesis related to students' achievement was rejected since there was a significant difference between the experimental and control groups regarding this research variable. Similarly, the null hypothesis of autonomous motivation, completion rate, and the relationship between those variables were rejected, while the alternative hypotheses were accepted based on the relevant quantitative results. Considering the research questions, the present chapter consists of six main sections (see Table 5.2) in which the quantitative and qualitative findings are discussed and subsequently evaluated in correlation with the existing literature.

5.2 Impact of Gamified FVC on Learning Achievement

One of the study's aims was to assess the effect of the gamified FVC method on students' achievement scores. The current section discusses the quantitative results emerging from the analysis of the pre- and post-tests and, sequentially, the calculated gain scores of the gamified and non-gamified FVC groups. The study statistically compared the two groups based on three achievement levels (i.e., low achievers, moderate achievers, and high achievers) to better understand the possible effects of the study intervention across different achievement levels. In addition, students' performance, which was assessed through analysing the statistical data related to the formative assessments of the online learning activities, is also discussed in this section to investigate possible changes in students' learning achievement and performance in and between the two groups. This discussion section particularly addresses the first research question:

To what extent did the integration of gamification into FVC affect students' learning achievement in Saudi higher-education CS?

The results of the pre-test revealed that there was no significant difference in students' scores between the experimental group and the control group (see Chapter Four, Section 4.1.3). This indicated similar baseline test scores at the starting point of the study experiment. After the pre-test and the research intervention, the post-test was applied. The gain score results (post-minus pre-) of the achievement tests were obtained, with positive changes detected in both groups' scores. However, according to the Mann-Whitney U test ($U = 198$, $z = -4.452$, $p < 0.05$), the overall achievement scores in the gamified FVC were higher than in the non-gamified FVC,

showing a statistically significant difference between those two groups, with an effect size of $r = 0.55$. According to Cohen's criteria (1988), an r -value of 0.2 indicates a small effect size, 0.5 represents moderate, and a value of 0.8 is considered a large effect size, indicating the strength of the association between the study intervention and the outcome variable. This means that the FVC group with gamification showed a moderately larger improvement in their overall achievement compared to the non-gamified FVC group. This result also suggests that the observed improvement in this variable is likely to be attributed to the gamification intervention more than the chance. However, this effect size also does not suggest an overwhelming difference; therefore, further studies might be needed to provide an in-depth understanding of this impact. Moreover, the comparison analysis of the two groups based on the three achievement levels (i.e., low, medium, and top achievers) revealed statistically similar findings. These results suggest that integrating SDT-based gamification design into the online flipped learning approach, adopted in this experimental class as a teaching and learning method, is likely to have a positive effect on students' achievement scores in a range of levels of student achievement in the context of Saudi higher-education computer science (CS). The above findings concur with several research studies that found a similar positive impact of the gamified flipped learning approach on students' achievement in higher education (Aşıksoy, 2017; Yildirim, 2017; Huang & Hew, 2018; Jo *et al.*, 2018; Ekici, 2021).

In contrast, a study by Durrani *et al.* (2022) reported contrary results of this combined approach regarding students' learning outcomes when compared to a traditional learning classroom. However, the comparison method used in Durrani *et al.*'s study design would probably not be able to determine the potential impact of integrating gamification into a flipped classroom since it experimentally compared a gamified flipped classroom in which gamification and the flipped-class model were combined as two independent variables with a traditional learning environment that did not include any of those variables. Thus, it is difficult to determine whether the observed effect on students' learning achievement might be attributed to the integration of gamification elements or to the nature of the flipped learning approach. The present study's approach was different in that it compared a gamified flipped-class group with a non-gamified flipped-class cohort to isolate the possible effect of gamification intervention and understand its adoption in the flipped learning approach, yet in a fully online learning context.

The current study further examined the possible impact of SDT-based gamification on students' performance by analysing the data obtained from the VLE statistical reports to compare the differences in this variable between the two groups through eight formative assessments. The overall findings revealed that students in the gamified FVC environment ($M = 67.33$, $SD = 14.55$) outperformed their peers in the other group ($M = 45.89$, $SD = 11.28$), with $t = 6.66$, $p = 0.001$, $p < 0.05$, and the magnitude of this difference was significantly large (Cohen's $d = -1.64$) (Cohen, 1988). Although the results implied that each group started with relatively similar performance scores, particularly in topics 1 and 2, the scores of those in the gamified FVC group significantly increased over time, while they tended to decrease in the conventional online flipped learning class (non-gamified FVC). One possible explanation for this decrease might be the positive relationship between the completion rate of pre-session activities and student performance reported in the current study. The finding of Spearman's rank correlation coefficient test suggests a strong positive correlation ($r_s = 0.93$, $r^2 = 0.86$, $p < 0.001$) between these two variables. This analysis outcome implies that 86.49% of the changes in students' performance can be statistically explained by this correlation. In line with this result, a positive relationship between the extent to which students engaged in the learning activities and their achievement and performance levels was reported in a study by Çakiroğlu *et al.* (2017), with gamification having a key positive effect on student engagement.

On the other hand, the result relevant to the non-gamified FVC is in parallel with an empirical research study by He *et al.* (2016), reporting that a positive effect of flipped learning on students' performance was pronounced in the early weeks of the course and then gradually diminished over time. They concluded that pre-class study non-compliance was a serious issue and that under-prepared students were more likely to have difficulty performing the flipped-class activities. Several studies support these findings, emphasising that students' disengagement in out-of-class tasks is a major problem when using the flipped learning approach (e.g., Palmer, 2015; Long *et al.*, 2017; Stöhr *et al.*, 2020). For instance, Palmer (2015) reported that over 70% of students did not complete the pre-class activities and, therefore, attended their classes without preparation. When students omit pre-session tasks, their performance and understanding during their classes are likely negatively impacted since the success of flipped learning is closely

associated with the preparation process (Long *et al.*, 2017; Huang *et al.*, 2019; Gündüz & Akkoyunlu, 2020).

These results were consistent with the outcomes of other research studies (e.g., Tsay *et al.*, 2018; Zainuddin, 2018; Sailer & Sailer, 2020) in the relevant literature, suggesting that flipped learning instruction can be advanced by incorporating an effective gamified design. Although some studies have reported positive effects of gamifying the flipped-class pedagogical approach on students' CS learning achievement (e.g., Huang & Hew, 2018; Jo *et al.*, 2018; Ekici, 2021), there has been a distinct limitation in previous studies in the context of fully online CS education. Importantly, most of these studies lack motivational theories as foundational frameworks for flipped learning instructional design, which may affect its motivational potential (Turan & Göktaş, 2018; Schöbel *et al.*, 2020; Lin *et al.*, 2021; Khaldi *et al.*, 2023). Therefore, the current study has investigated employing an entirely online flipped learning environment with integrated SDT-based gamification, aiming to improve students' achievement and performance scores., which has not been covered by past studies.

Indeed, previous studies that have attempted to develop the flipped learning pedagogical approach have mostly focused on conventional flipped classroom environments, reporting mixed results and no unanimity regarding the effect of such an approach on students' learning achievement (Karabulut-Ilgu *et al.*, 2018; Zainuddin, Haruna, *et al.*, 2019; Lin *et al.*, 2021). Although not entirely conclusive, several empirical and systematic review studies have alluded to the positive influences of flipped classrooms on students' achievement and performance; however, there has also been an emphasis on some relevant challenges that flipped-class instructors may face when it comes to applying an online flipped learning environment (e.g., Phillips & O'Flaherty, 2019; Galway & Cameron, 2020; Lin *et al.*, 2021). In the Saudi CS higher education context, flipped-class learning activities are often adopted to address specific learning objectives related to various types of theoretical and practical knowledge achievement, such as computer networks, AI, cybersecurity, and computer hardware and application-based skills. These topics often require students to prepare before attending online sessions, thus allowing more time for practice during the synchronous sessions. Flipped learning has the advantage of enabling instructors to provide essential theoretical information and knowledge through pre-class

activities and then to use the whole time of the sessions for intensive practice under the instructor's supervision (Bergmann & Sams, 2012). However, designing pre-class activities with inadequate pedagogical and technical features, such as a lack of self-motivators, has been reported to negatively influence students' overall learning achievement (He *et al.*, 2016; El-Banna *et al.*, 2017). This is broadly explained in Chapter Two.

Based on the findings discussed above, the current study argues that online flipped learning can be developed as a practical gamified environment that may reshape the CS learning process and support students to prepare before attending online sessions, which might contribute to their learning achievement scores. The gamified FVC method based on SDT was adopted in this study as a possible development for online flipped learning environments, and the findings seemed promising. This integrated method appeared to boost students' performance when collaborative and competitive SDT-based gamified tasks were included.

However, integrating gamification elements into learning environments might fail and negatively influence students' achievement when the learning activities are ineffective (Ekici, 2021). For example, Hanus and Fox (2015) conducted a longitudinal study utilising these elements to support students' achievement and learning empowerment over time. They found that students in a gamified class attained lower exam scores than their peers in a non-gamified class. The study concluded that students' achievement tended to be influenced by their motivation levels, suggesting that care should be taken when combining gamification mechanisms into educational environments. After analysing the pre- and post-test data, Gündüz and Akkoyunlu (2020) found that gamification increased the potential of a flipped learning environment by positively affecting students' learning achievement. Despite that, they emphasised that caution should be taken when designing such a learning approach, as the lack of preparation may cause confusion and stress among students. Based on this, it can be said that the integration of gamification mechanisms can be a double-edged sword for both staff and students alike (Sailer & Sailer, 2020; Zainuddin, Chu, *et al.*, 2020); therefore, it should be utilised purposively and wisely, with a clear understanding of its functions (Huang & Hew, 2018; Ofosu-Ampong, 2020). This suggestion is supported by Groening and Binnewie (2019), who stressed that the effectiveness of

gamification is highly dependent on its design, which can impact students' performance and motivation, either directly or indirectly.

In sum, this section has addressed research question 1, with the quantitative findings indicating that integrating SDT-based gamification into an active learning environment, such as online flipped learning, tended to positively impact students' learning achievement, as well as their performance. Adopting gamified pre-class activities in the current study, including instructional videos, might enhance students' preparation by encouraging them to complete these tasks, possibly improving their overall achievement and performance scores in the online flipped CS course. In addition, it seemed that the gamified FVC not only involved students in the active learning process but also provided a more flexible learning approach in which they experienced a sense of choice and competition via team-based activities. Although both groups (i.e., the gamified FVC and the non-gamified FVC) participated in the online flipped learning settings, the SDT-based gamification mechanisms integrated into the experimental group's practice seemed to engender better learning achievement results. Based on the current study's findings, an explanation can be provided that the CS students in the gamified FVC were possibly motivated to complete the pre-class tasks. This preparation might have helped them understand the basic concepts in a way that supported their abilities to construct new knowledge during the in-class activities, thus leading to better performance and achievement scores. In contrast, the participants in the non-gamified FVC, who might have found the learning activities unattractive and uninteresting, were likely to be less motivated to prepare before attending the online sessions, which might have negatively affected their ability to absorb the theoretical and practical knowledge associated with the course. A study by Zainuddin and Halili (2016) concluded that students might find pre-class tasks tedious to do outside class time and not sufficiently interesting or attention-grabbing. Accordingly, during the course design phase of flipped learning, instructors should ensure that these activities render the instructional content as interesting as possible. This will be more likely to encourage students to perform the tasks effectively (Galway & Cameron, 2020; Zainuddin *et al.*, 2021), which can impact their overall learning achievement.

Designing quality pre-class activities is one of the most commonly reported challenges that instructors often encounter (Rasheed *et al.*, 2020). Adams *et al.* (2015) found that some students

in the conventional flipped-class environment did not watch the assigned pre-class videos, leading to their low learning achievement. In the present study, using formative assessments (e.g., quizzes without gamification) seemed insufficient to foster students' desire to complete the pre-session tasks. This concurs with Brunsell and Horejsi's (2013) finding that merely assigning video quizzes to students in an experimental group did not necessarily make these learning activities interesting to them and that doing so, may be confusing and dissatisfying to students at worst. However, combining an SDT-based gamification design with flipped learning was likely to reduce the negative effect of such an issue observed in the conventional online flipped learning approach that was applied to the control group. The findings suggest that such gamified tasks can potentially facilitate knowledge construction among students. This might be achieved when the gamified system can motivate them to actively engage with the instructional materials before class to acquire the foundational concepts and then provide scaffolding and supportive feedback based on personalised progress reports in the online sessions in which the knowledge is constructed and expanded, leading to a deeper understanding of CS concepts and better learning achievement. SDT-based gamification elements, including different forms of gamified tasks, optimal challenges, and team-based activities, might provide a practical framework that can play a vital role in enhancing learning achievement in online computer science courses by making the instructional materials more appealing in a way that encourages students to put more time and efforts into their learning progression. The impact of gamification on students' performance in learning activities might be mediated by the extent to which they are self-motivated to engage in the learning process.

Indeed, research has shown that gamification elements can produce both positive and negative effects on students' learning, depending on their design (Hanus & Fox, 2015; Koivisto & Hamari, 2019). The present research contributes to the field by suggesting how gamification elements can be provided as effective practices that may make online flipped learning environments more engaging, which may result in improving students' achievement. It offers a practical framework for instructors to design engaging activities that are likely to enhance the effectiveness of such environments, leading to better learning outcomes. It also contributes to

the field by empirically examining the effectiveness of SDT-based gamification in addressing low student performance in online flipped learning environments.

5.3 Impact of Integrating Gamification into FVC on Autonomous Motivation

This section discusses the key results related to the second research question: *To what extent did the integration of gamification into FVC affect students' autonomous learning motivation in Saudi higher-education CS?* Quantitative data were collected from pre- and post-questionnaires that helped the researcher determine the possible significant changes and differences in students' autonomous learning motivation between the gamified FVC and the non-gamified FVC. Furthermore, qualitative data were obtained from semi-structured interviews to deepen the understanding of the SDT-based gamification implementation process and its potential effect on students' autonomous motivation.

To investigate the autonomous learning motivation variable, four relevant indicators were assessed in both groups of students via four questionnaire sections: autonomy, competence, relatedness and interest/enjoyment. Section one (autonomy dimension) aimed to assess the perceived autonomy within the learning process of CS by comparing this variable within and between the gamified FVC and the non-gamified FVC. The second section (competence dimension) aimed to provide measurements of the extent to which students felt competent when performing the learning activities. The third section (relatedness dimension) assessed the students' feelings of social relatedness and belonging, and the fourth section (interest/enjoyment dimension) evaluated the extent to which the students perceived the learning tasks as interesting and/or enjoyable. The following sub-sections discuss these autonomous motivation components and their association with intrinsic motivation, along with the relevant quantitative and qualitative findings.

5.3.1 Autonomous Learning

Supporting the autonomous learning of students has been shown to be essential for the delivery of higher education globally, including in Saudi universities, especially during and after the Covid-19 pandemic (Alghamdi & Alghamdi, 2021; Zainuddin *et al.*, 2021; Khaldi *et al.*, 2023). Therefore, it is vital to ensure that higher education environments are able to support

autonomous learning skills, specifically when applying learner-centred methods, such as online flipped learning (Rasheed *et al.*, 2020), where students are often required to be autonomous learners and responsible for their own education (e.g., accessing VLEs on a regular basis and completing assigned tasks) (*ibid*; Wang, 2019). Autonomy-supportive teaching and learning approaches emphasise the importance of designing learning activities in which students experience a sense of volition and choice (Reeve & Jang, 2006); these factors, according to SDT, can boost the autonomous types of motivation (Ryan & Deci, 2017). Based on this reasoning, the current study assessed students' autonomous learning as one of the main indicators of autonomous motivation.

The data analysis of the questionnaires and semi-structured interviews generally suggested that students in the gamified FVC environment were more autonomous when engaging in the learning activities than their peers in the non-gamified FVC setting. The overall quantitative findings of the autonomy dimension revealed a statistically significant difference, with $t = 6.25$, $p = 0.001$, and $p < 0.05$. This difference's effect size was also found to be large (Cohen's $d = -1.54$), according to Cohen's guidance (1988) for effect size, the most widely used in research to measure the size of the difference. The finding shows a substantial difference between the mean of the two groups and suggests that by combining SDT-based gamification elements with the online flipped learning environment, students tended to be more autonomous in their learning compared to those who followed a conventional flipped learning approach. In addition, the qualitative data analysis of students' perceptions of the gamified FVC generally showed positive attitudes towards their learning experiences; they felt more autonomous in performing the flipped-class activities. These results concur with previous studies reporting that the merging of gamification elements and flipped learning can provide autonomy-supportive learning situations (e.g., Zainuddin, 2018; Awidi & Paynter, 2019; Zainuddin, Shujahat, *et al.*, 2019; Parra-González *et al.*, 2020), with a significant positive effect size (Segura-Robles *et al.*, 2020).

Although the general notion of the flipped-class pedagogical approach is to create a flexible learning environment in which students can complete out-of-class activities based on their respective levels of pacing and ability (Kong, 2014; Zainuddin, 2018), the quantitative findings of the current study reported that the participants in the conventional flipped learning

environment experienced a low sense of freedom and choice when completing the assigned learning tasks compared to those in the gamified FVC group, who reported more autonomous learning (see Section 4.1.4.1). One possible justification for this difference is that the students in the SDT-based gamified group experienced a degree of choice in deciding what to complete in the pre-class activities based on different gamification forms. They might also feel the initiative and desire to compete and collect points and badges whenever they choose before attending their online class compared to peers in the control group. This finding was supported by the qualitative results, which reported that allowing students to choose what suited their interests and abilities from the available forms of challenges and tasks stimulated their desire to complete more of these activities, which might have reflected positively on their overall autonomous learning. This effect was described by some students as follows:

“I was free to choose what I wanted to complete from the activities ... So, I think that providing more forms of activities is much better than having only one type for each task.” (BSTD3)

“I felt that I had the chance to choose between the available activities ...” (BSTD22)

“... giving me the freedom to choose what to perform from options of learning activities was a good thing that motivated me to be more creative ...” (BSTD28)

However, the results relevant to the control group do not fully support the previous research by Zainuddin and Perera (2018) and Lindeiner-Stráský *et al.* (2020), who concluded that a conventional flipped classroom can create an autonomy-supportive environment by providing students with feedback and flexibility in timing and pacing when completing out-of-class learning activities. This might be partially true since students are able to progress and complete these tasks based on their own availability of time; nonetheless, flexibility in learning environments does not necessarily fulfil their psychological need for autonomy or fully describe the state of autonomy (Ryan & Deci, 2017). To illustrate, students may experience flexibility in completing out-of-class tasks, however, they may do this non-autonomously to get high grades or to satisfy their parents or teachers. In such cases, they are likely to feel controlled or forced by external factors. The role of autonomous behaviour was alluded to by three students (BSTD28, BSTD22, BSTD3) in the experimental group. For example, student BSTD22 stated, *“The provision of these activities in a non-compulsory and free manner increased my desire to complete more learning activities and*

exercises.” In line with this perspective, BSTD11 attributed his motivation to his sense of choice and asserted:

“I felt that I did not have to choose the same type of activity because there was more than one option, and this motivated me more to compete with my team and earn points in more than one way.”

This suggests that in order to augment students’ autonomy in engaging in activities, it is vital to minimise the effect of external regulations (Deci & Ryan, 2000) and increase the possibility that their actions will be driven by their own decisions to willingly choose and pursue the tasks or challenges (Huang *et al.*, 2019). In accordance with this finding, Ryan *et al.* (2006) stated that supporting students’ freedom to choose what to do in the gamified tasks might enhance their autonomous actions. In addition, Reeve and Jang (2006) reported that when students feel controlled, their behaviours may stem from an external locus of causality, such as assignment pressure and tension. Although the students in the conventional flipped learning class were provided with a certain degree of flexibility over time, as well as strategies when performing the out-of-class activities, they were required to complete specific tasks without having any choice, which is often a main attribute in such settings (He *et al.*, 2016). Consequently, they might have felt controlled or coerced by external factors, negatively affecting their need for autonomy (Ryan & Deci, 2017). The current study found that providing flexibility around time and asking students to complete specific tasks (i.e., without choices) seemed insufficient to create an autonomy-supportive learning environment. Student BSTD27 explained that most university instructional modules do not offer options or alternatives for assigned tasks, so students may have only one choice for each required task. The current study will provide practical guidance for educators who may wish to support the effectiveness of flipped learning through the provision of flexibility and meaningful choices in the learning activities and aim to stimulate a sense of autonomous learning among students.

In relation, it is crucial to consider that providing students with choices in learning tasks does not guarantee a positive effect on their experience of autonomy. Choices can be meaningless when accompanied by subtle pressures or when students are not interested in or do not understand the value of the activities (Ryan & Deci, 2020). Therefore, autonomous learners

should be supported to willingly accept the value of, or have an interest in, completing the learning tasks without feeling pressured or forced to choose a task. The overall findings of the present study revealed that students in the gamified FVC group were more interested in completing the learning activities, as these reflected what they wanted to do, in comparison with their peers in the conventional FVC group. The students in the former group implied that when doing the pre-session tasks, their actions were driven by their desire to learn and apply new knowledge related to computer science (BSTD3, BSTD11, BSTD22, BSTD21). For instance, in the context of the CS module, some students might seek to understand how a specific computer app, digital tool, or programming language code works because they find it useful learning for upcoming university studies. One interviewee commented, “... *to benefit from the information related to the course that we were studying ...*” (BSTD3). Another student reported:

“I wanted to learn more about computers and acquire computer-related skills, and the method of presenting information helped me a lot because it was similar to entertaining learning applications.” (BSTD21)

These combined quantitative and qualitative results reflect those of Páez-Quinde *et al.*'s study (2021), which concluded that to promote students' autonomous motivation when implementing a gamification design, rather than use its mechanisms for its own sake, without clear goals or purpose, the design should be aimed at students perceiving the gamified learning activities to be useful. This suggests that when designing gamified flipped-class activities, demonstrating the rationale or usefulness of the topic and its relevance to the student's future goals should be emphasised (Wang, 2019), along with providing choices when assigning these activities. Based on this finding, the study contributes to the field by emphasising that the provision of choices and flexibility in the pre-class tasks might not be enough to stimulate a sense of autonomy, but rather, these should be perceived by students as meaningful or engaging.

Another finding in the current study is that—although a slight statistical difference in mean scores was reported between the experimental and control groups in terms of the extent to which the students felt able to express their ideas to others when doing the activities—students in the gamified FVC environment felt more enabled to share their opinions than their peers in the conventional online flipped class. Based on this, it appears that the flipped learning

strategy utilised in both groups mainly provided the students with opportunities to express their perspectives regarding the knowledge acquired from completing the pre-class activities. Although there might be a positive effect of the non-gamified FVC, the moderate effect size of the difference (Cohen's $d = -0.56$) indicates that the integration of gamification into this instructional setting might, to some extent, facilitate the knowledge-sharing process and further support the effectiveness of conventional flipped learning (Cohen, 1988). However, this result also indicates a moderate increase in students' ability to express their opinions to others, which means that further research might be required to explore this aspect. In parallel with this finding, Zainuddin (2018) and Zainuddin, Chu, *et al.* (2020) found that students in the gamified flipped classroom felt confident when sharing and discussing their opinions in a group discussion. According to Reeve and Jang (2006), instructional behaviours, such as offering pressure-free opportunities for students to talk as well as paying attention to their opinions, might positively impact students' feelings of autonomous learning.

Additionally, several contributing factors may affect autonomous learners: the extent to which they feel able to control the learning environment and how taking responsibility for their own learning is perceived, for example. Reiners and Wood (2015) argued that if the aim is to magnify students' autonomy, they should be provided with considerable control over learning activities, which might stimulate their autonomous motivation. The current study's quantitative results show that students in the gamified FVC group felt more able to control the process of completing the pre-class tasks and manage their learning speed and time than those in the non-gamified FVC group. This finding matched the qualitative data result, which indicated that most students in the experimental group were able to answer the gamified pre-class quizzes assigned on the online learning platform often without the teacher's help. As one student expressed, most of the instructional tasks "*... could be answered through the information available on Blackboard*" (BSTD21). Student BSTD22 added that the embedded gamified quizzes could be answered by focusing on the content presented in the videos. Furthermore, interviewee BSTD27 mentioned that to earn points, he attempted to watch and rewatch some of the pre-class videos to find the correct answers for the embedded gamified quizzes independently. This implies that students were able to independently set their goals to progress through their learning and prepare for competitive online in-class activities by completing the pre-class tasks, as demonstrated by

student BSTD11. In fact, because the online flipped learning approach components were applied to both groups (i.e., the gamified FVC and the non-gamified FVC) as foundational learning settings, the students in the two groups were required to take responsibility for their learning and prepare independently before attending the online sessions (Kim *et al.*, 2017; Chen & Hwang, 2018). However, the present findings revealed that students in the gamified group were more likely to accept responsibility for their learning process than their peers in the non-gamified group.

It seems possible that these results are because the students in the SDT-based gamified flipped learning class perceived their responsibility for learning along with a sense of choice and in a meaningful and non-controlling manner, rather than being forced to tackle specific learning tasks. For example, some students implied that their desire to complete the learning activities was due to the provision of these tasks as various forms of challenges (BSTD22, BSTD11, BSTD28). This justification is supported by a number of studies (e.g., Deci & Ryan, 2000; Reeve & Jang, 2006; Lo & Hew, 2020), suggesting that emphasising meaningful choice rather than control can play a vital role in facilitating the internalisation of responsibility among students. This suggestion seems to be consistent with the present findings, which stress that allowing students to take responsibility for their learning does not necessarily conflict with the internalisation process of their motivation. Based on this, it can be assumed that a student might willingly accept responsibility for their own learning when directing this based on their desired goals and when the provided gamified learning tasks are in line with what they want to do or achieve. Thus, these tasks might be perceived as internally motivating.

Although the optional gamified pre-class activities involved deadlines (i.e., submitting the task before attending the online sessions to be counted in the gamified system), this did not seem to control students' autonomous learning. They reported that they were able to watch the gamified pre-class videos and answer the embedded quizzes at any time before the sessions without limitations in time or attempts (BSTD27, BSTD25, BSTD3). The findings also revealed that some students in the gamified FVC group wanted to do the CS activities because they understood their usefulness in the in-session application and in their future practices. In addition, they were motivated to participate in the competition by completing as many tasks as possible to collect points and badges for their teams. For example, three students mentioned the following reasons:

"... One of the reasons why I completed the activities was because I wanted to learn and apply new skills." (BSTD22)

"... we were excitedly trying to get 2nd and then 1st." (BSTD3)

"... when the goal was to earn 2,000 points and reach a high level on the leader board, my group had to challenge the other groups while collecting the desired points." (BSTD28)

It appears that the students in the experimental group had their own goals for completing the gamified pre-session tasks, which included, for example, benefiting from the instructional CS content, contributing effectively to the team's success, and competing to level up the team's position on the leaderboard. This finding supports the evidence from previous research (e.g., Amabile *et al.*, 1976; Chia *et al.*, 2016), suggesting that learning tasks that are bound by deadlines can be controlling when they cause students to perceive the impetus for their behaviours as highly external. This might occur when demands are imposed on students to complete a learning activity, leading to their feeling pressured or obligated to others, and thus losing interest in the task (Sheldon & Filak, 2008). Deadlines can be perceived as controlling or non-controlling targets or goals, depending on the extent to which they represent the reasons for pursuing desired goals (Ryan & Deci, 2017). In other words, the context in which the deadline is provided can positively or negatively affect students' autonomy. When autonomous students are given a deadline for a task, they are basically being advised to set a goal for themselves (Amabile *et al.*, 1976). For example, although the two situations involve deadline-based tasks, the context in which students are provided with the freedom to choose what to complete from optional forms of pre-session learning activities based on their own desire and volition might have a different effect on their motivation compared to the context in which students are asked to do tasks without meaningful choices. This is in line with Benita *et al.* (2014), who emphasised that submission deadline goals in autonomy-supportive situations might positively impact students' emotional experiences, interests, and engagement compared to goals introduced in controlling-based settings. Reeve and Jang (2006) concluded that deadlines and other external factors can be autonomously motivating when presented as opportunities for choice and self-determination rather than as mere demands or constraints. Hence, goals (including deadlines) may support motivation when they are achievable and set in autonomous, engaging, and non-controlling ways based on clear rationales

that reflect usefulness, self-endorsed values, and interests (Deci & Ryan, 2000). Internalising the 'why' component of goal pursuits, such as a task's deadline, might be the key to shifting students' perceived locus of causality from external to internal, which is epitomised by the SDT's taxonomy concept of controlled versus autonomous regulations (Ryan & Deci, 2017). Autonomy-supportive gamification seemed to tailor students' learning experiences to their individual needs and preferences in flipped learning. Although different students may have different expectations and preferences, which are often challenging, if not impossible, to satisfy among all students, the provision of choices might give them room to choose what may interest them (Zou, 2020) to submit before the given deadline. Based on this discussion, the current study suggests a practical gamified framework that tended to allow students to endorse the task's deadline and to willingly accept responsibility for choosing their own learning path when completing the pre-session activities in a way that could help them overcome challenges they might find in a single option or task form, thus supporting their autonomous learning progress. The relationships between the autonomy factor and other learning outcomes are discussed in sections 5.3.5 and 5.5.

5.3.2 Competence

Competence refers to the feeling of effectiveness and mastery when performing an activity, interacting with an environment, or participating in a situation (Deci & Ryan, 1985). In the learning context, this basic psychological need is often associated with students' perceptions of their ability to transcend challenges or obstacles; thus, they feel capable of progressing in their learning and acquiring new skills and concepts (Jones *et al.*, 2022). In the relevant literature, this factor has been reported as a strong indicator of autonomous motivation (Ryan & Deci, 2000a; Tamborini *et al.*, 2010). Since the second question in the current research was to investigate the impact of incorporating SDT-based gamification in FVC on students' autonomous motivation, it was crucial to assess the extent to which they felt competent (i.e., perceived competence) when performing the online flipped class activities and how this affected their motivation to learn autonomously. The data associated with the competence variable were collected from the second dimension of the pre-post questionnaire and the semi-structured interviews. Overall, the quantitative data analysis results of the gain scores implied that the students in the gamified FVC group ($M = 1.60$, $SD = 0.68$) felt more competent than their peers in the non-gamified FVC group

($M = -0.04$, $SD = 0.74$), with $t = 9.34$, $p = 0.001$, $p < 0.05$. The overall effect size of this significant difference was also found to be large (Cohen's $d = -2.31$), according to Cohen's d criteria of measuring the difference between the means of the two groups. This suggests that online flipped learning with SDT-based gamification activities would be more likely to support and enlarge students' perceived competence compared to an online flipped class without gamification (see Section 4.1.4.2).

Most students in the gamified group believed that they performed well in the assigned learning tasks. This is based on the overall quantitative findings, which revealed that the students in this group felt satisfied with their performance in the out-of-class tasks, while those in the conventional flipped learning class generally reported no significant changes in their perceived satisfaction, according to the gain scores analysis. This outcome is contrary to previous studies by Hung (2015) and Xi and Hamari (2019), which emphasised that in flipped learning environments, students often have the opportunity to prepare and complete pre-class tasks, and this preparation may engender positive attitudes towards their learning and promote feelings of mastery when participating in in-class activities. However, when implementing the flipped learning approach, providing students with out-of-class tasks to be completed may not be sufficient to build their sense of competence in performing these tasks (Ekici, 2021). Huang and Hew (2018) concluded that the desirable impacts of flipped-class activities may only be achieved when they are motivating. The current study's overall findings suggest that, unlike their peers in the gamified FVC group, most students in the non-gamified FVC group did not feel empowered to complete the assigned out-of-class tasks. Both groups were provided with pre-class quizzes, yet on their own, these tended to fail to motivate the students to consistently complete the activities before attending the online sessions. This significant finding broadly supports the studies by Zainuddin (2018) and Eyupoglu and Nietfeld (2019), who reported that online gamification quizzes motivated students to watch pre-class instructional videos but that such pre-class tasks were not the main factor associated with the increase in students' competence and learning motivation. In the present study, since the only difference between the two online quiz designs was that those used in the experimental group integrated SDT-based gamification elements, it can be assumed that this integration might be used to increase the effectiveness of FVC in improving students' perceptions of their competence in completing the pre-session quizzes.

Moreover, the qualitative results of this study showed that students in the gamified FVC group desired to take on more challenging tasks. Some students reported that they wanted to watch the gamified pre-class videos without missing any parts or skipping any embedded quizzes (BSTD3, BSTD11, BSTD21, BSTD22). For example, student BSTD11 explained, *“I felt the opportunity and much desire to complete all the tasks without skipping any activity.”* One possible factor that might have boosted their desire and motivation to take the initiative to progress is that they had the opportunity to try out different forms of game-like tasks to discover those they could best complete. Thus, they were more likely to progress along different challenging paths and experience a sense of mastery. This was expressed by student BSTD25, who mentioned that this provision of forms *“... took into account [his] interests and what suited [him] in terms of the difficulty levels ...”* Student BSTD3 also stated that these task options made him feel capable to take on more tasks, while student BSTD11 highlighted that offering choices was better than having only one option for pre-class tasks, which might be difficult for some students. Indeed, providing different gamified activity forms allowed the students to choose what they believed they would be able to master. For instance, student BSTD28 stated, *“The availability of gamified activities in different formats means that there is something suitable for everyone...”*

The notion of allowing students to take control of their own path in playful learning situations is supported by Ryan *et al.* (2006), who emphasised that this can enhance students' preferences and facilitate their sense of competence. Another contributing factor in students' desire to progress may perhaps be the safe competition they experienced when performing the gamified FVC tasks. Some students pointed out that they strived to compete and take on more challenging learning tasks as they felt able to contribute positively to the group's ranking on the leaderboard by earning as many points and badges as possible (BSTD3, BSTD11, BSTD22, BSTD28). For instance, one student expressed, *“... when you see the total points go up on the leaderboard after finishing each learning activity ... these things are awesome”* (BSTD11). Student BSTD3 also said that he desired to complete the gamified tasks to support the team, since winning the competition relied heavily on the achievement and accomplishment of each team member. Providing students with team-based competitive learning activities and fostering their desire to participate seemed to contribute positively to the satisfaction of their psychological need for competence. One student reported that taking part in the competition was based on *“... [his]*

personal desire without any force on [him] ... this method was useful and made the course more competitive ..." (BSTD22). In accordance with these results, previous studies (e.g., Fülöp, 2009; Rigby & Ryan, 2011; Ding, 2019) have described such competitive situations as constructive competition in which students do not feel pressured to participate because of the non-controlling nature of the competition. This finding suggests that to design competence-supportive flipped learning, instructors may consider utilising gamification mechanisms, such as points, badges, and leaderboards, based on SDT, and this may enrich such teaching approaches with a good-natured competition that might allow students to demonstrate their competence in safe learning environments fine-tuned by trial and error.

However, this suggestion is contrary to the findings of Hanus and Fox (2015), who argued that leaderboards create a form of destructive competition because they display others' progress and announce a single winner, thus increasing negative social comparisons among students. The current study's findings indicate that the impact of a competitive gamification mechanism on students' competence might differ depending on the sense of community, mutual support, and how students perceive each other and conceptualise winning and losing. In the semi-structured interviews, students in the gamified FVC acknowledged that the team-based gamification aspect contributed to boosting collaborative competition and allowed them to engage socially in performing the learning tasks and to demonstrate social competence (BSTD3, BSTD11, BSTD22, BSTD28). Student BSTD3, for instance, mentioned that his team's ranking on the leaderboard was third, and his groupmates were enthusiastically competing to achieve higher positions by earning more points and badges. Such behaviour is often associated with students' feelings of effectiveness and mastery when performing activities (Fong *et al.*, 2019). Based on this, it can be assumed that a competence-supportive gamified instructional intervention provides ample opportunities for students to engage in constructive competition and make better progress in their learning than their peers in an FVC without gamification.

Another finding that stands out from the overall quantitative results is that students in the gamified group felt able to master most complex out-of-class CS tasks, while those in the control group experienced diminished confidence in their ability to complete such activities successfully. A possible justification for this significant difference between the two groups can be induced from

the qualitative data analysis, which revealed that harnessing points, badges, and leaderboards to provide progression-supportive feedback on students' performance tended to facilitate their sense of progress in completing tasks (Huang & Hew, 2018). Some students indicated that the gamification components were used to acknowledge every accomplishment throughout the course, so they were able to see their points accumulating as they progressed. For example, one student remarked about earning points, "*... I felt a sense of achievement and progression ... increasing our enthusiasm for progressing in the course ...*" (BSTD3). Students BSTD11 and BSTD22 also mentioned that this gamified method helped them and increased their desire to progress and take on extra tasks. The accumulation of points displayed on the leaderboard seemed likely to help some students continuously self-evaluate their progress, as revealed by student BSTD25's statement, "*... the feedback on my progress was important in keeping me on track. I was confident that I would be able to learn from my mistakes, so I was not afraid to make them and to try again...*"

On the other hand, according to the relevant quantitative results, the evaluation system used to assess students' performance in conventional FVC tasks might be perceived by some students as controlling, which would negatively affect their feelings of competence over time. Reflecting on his experience in previous online flipped learning courses, student BSTD28 suggested that using gamification elements instead of course grades can offer "*... feedback on the level [he] reached throughout the course in a much deeper and more detailed way than the official grades do, which often depend only on overall performance in exams ...*" Another student thought that these elements would facilitate the consolidation of the CS information (BSTD21). Although assessing students' performance using grades or formal evaluations can reinforce participation, some negative consequences (e.g., pressure, tension, and anxiety) may affect students' sense of competence and self-motivation when completing flipped learning tasks outside of online session times. This interpretation is consistent with the findings of Kim *et al.* (2014), Marcum and Perry (2015), and Sajid *et al.* (2016), which indicated that students disliked being evaluated by formal grades, as this caused them to focus on their exam grades and decreased their interest in the course tasks. These results provide further support for the hypothesis that to foster feelings of competence and mastery among students, they should be allowed to self-evaluate their performance and progress without formal judgment or controlling consequences. According to

Hung (2017), inherently motivated students often have less need for external motivators (e.g., grades) since their motivation is driven by the task itself. This suggests supporting an internal rather than external perceived locus of evaluation and not presenting the gamification elements (i.e., points, badges, progress bars, and leaderboards) entirely as formal or direct evaluation in judging students' performance by the instructor. Instead, for example, these elements can be used to encourage self-monitoring and may enable the instructor to monitor students' progress in the pre-session activities and provide personalised supportive feedback toward mastering the desired learning objectives. This finding contributes to the relevant field by informing instructors who adopt online flipped learning to consider the importance of allowing students to track their own progress and the understanding of an actively, which may reduce the feeling of pressure and encourage them to take ownership of their learning and thus enable them to progress based on their abilities and feel a sense of accomplishment and competence.

However, the study's findings also revealed that extrinsic motivators, such as formal scoring systems, might be preferred by some students (i.e., BSTD27, BSTD25), who reported low autonomous motivation and whose motivation was more likely to be driven by the final course grade. Although grades are widely considered extrinsic motivators, according to Ding (2019), this might help some students establish a sense of self-competence to begin performing an activity. This notion is consistent with Deci and Ryan (2000) and Gopalan *et al.* (2017), who stressed that students may begin engaging in learning activities because they feel extrinsically motivated. In this study, it was possible that the gamification mechanisms, including points, badges, and leaderboards, were perceived by some students as extrinsic rewards or goals that might encourage them to start participating in the flipped class learning tasks. Nevertheless, the internalisation of extrinsic motivators seemed to be dependent on the context and how students experienced them (van Roy & Zaman, 2018). Ryan and Deci (2000a) concluded that students' adoption and internalisation of a goal will more likely be supported when they understand the reason for it and believe in their ability to succeed, thus boosting their psychological need for competence.

One possible way to facilitate the internalisation process is by gradually moving the perceived locus of causality of students' actions from external to more internal so that they

choose to perform the learning activities because they find them useful, valuable, interesting, and/or enjoyable; thus, they may choose to act based on self-endorsement of their internal reasons (Ryan & Deci, 2000a). Indeed, most students in the gamified FVC group seemed to be affected by the extent to which they were able to progress towards their desired goals, as illustrated by the following quotes from the interviews:

“... and reach a high level on the leaderboard ... I did not feel pressured ... there was a specific goal, which was to get as many points as possible ...” (BSTD28)

“It was also exciting to see my team's name going up on the leaderboard so quickly.” (BSTD22)

“... I did not aim to win as much as I desired to challenge myself ...” (BSTD21)

These results suggest that some students understood what was to be achieved while using the earned points as feedback on how much they had progressed and how many points they needed to reach the desired goal. Overall, the findings agree with those reported by several previous studies (e.g., Reeve & Jang, 2006; Ryan *et al.*, 2006; Vansteenkiste & Ryan, 2013; Fong *et al.*, 2019), emphasising that students' feelings of competence are likely to be supported by encouraging self-evaluation rather than formal grading to reduce stressful situations or threatening demands, offering progress-supportive feedback, providing convincing rationales for engaging in the learning activities, articulating why the undertaking is important or useful, emphasising choice, and allowing room for trial and error instead of imposing controlling instructions. According to the SDT principles, these elements can be theorised as conducive to internalising extrinsic rewards (i.e., using points and badges for self-evaluation).

The qualitative findings indicate that simply designing challenging activities was not adequate to support students in mastering them and achieving their desired goals. Designers of instructional tasks should consider minimising the gap between students' abilities and difficulty levels. Although some students in this study regarded the out-of-class activities as *“challenging”* (BSTD11, BSTD21, BSTD27), they were able to compete collaboratively with others to collect points and progress. For example, student BSTD11, who achieved high points for his team, mentioned that some activities *“... needed more effort to be answered; earning points through some of them was not easy.”* Another student emphasised that the pre-class activities were *“quite*

balanced” in terms of their difficulty levels, and most of them can be answered by “... *focusing on them enough* ...” (BSTD22).

These findings concur with those of some studies reported in the literature, supporting the notion that providing students with competitive learning activities and optimal challenges (Nakamura & Csikszentmihalyi, 2009; Rigby & Ryan, 2011) and allowing them to complete these activities based on their own choices or goals (Thiebes *et al.*, 2014), along with providing progression-supportive feedback to acknowledge students’ improvement, may stimulate their sense of mastery, progression, and effectiveness (Reeve & Jang, 2006). The current study's findings suggest practical implications instructors or online course designers can utilise to create a competence-supportive gamified FVC. Supporting the setting of clear and challenging goals in tandem with offering constructive and supportive feedback can contribute to students’ sense of competency and progress towards achieving the desired goals (e.g., high points, specific badges, top ranking on leaderboards, or skills acquisition), which can play an effective role in stimulating autonomous learning motivation.

5.3.3 Relatedness

The need for social relatedness concerns the feelings of connection with and attachment to a group (Ryan & Deci, 2017). In gamified learning settings, this is theorised to be achieved when students believe that their actions or contributions are important and influential for their team’s progress and when they feel respected and cared for by the teacher and other team members (Sailer *et al.*, 2017). The social relatedness factor has been reported in the relevant literature as one of the autonomous motivation indicators (Deci & Ryan, 2004; Ryan *et al.*, 2006; Reiners & Wood, 2015). The current study sought to answer the second research question, which concerns the impact of gamified FVC on students’ autonomous motivation when performing an activity. Therefore, it was essential to investigate the extent to which students experienced a sense of social relatedness and how this might affect their motivation to learn autonomously.

The quantitative data relevant to the relatedness variable were gathered from the third dimension of the questionnaire, while the qualitative data were collected from the semi-structured interviews. The overall quantitative results of the gain scores statistical analysis indicated that the students in the gamified FVC group ($M = 1.56$, $SD = 0.57$) felt more connected

with peers than those in the non-gamified FVC group ($M = 0.27$, $SD = 0.79$), with $t = 7.61$, $p = 0.001$, $p < 0.05$. The effect size of the detected significant difference was calculated and found to be large (Cohen's $d = -1.87$), based on Cohen's guidance (1988). This means that the improvement in students' relatedness might be attributed to gamification intervention more than flipped learning since the d -value implies a large difference between the means of the two groups. This finding generally suggests that the impact of the online flipped-class approach on students' feelings of belonging and social relatedness might be enhanced when SDT-based gamification design is integrated into this approach.

Although there was a small positive change in their overall responses between the pre- and post-questionnaires (i.e., gain scores), the mean gain score result reflects that most students in the conventional FVC group disagreed with the statement that they felt close to their groupmates and were able to interact with them in and out of class time. Even though they had the chance to collaborate with each other through online discussions as part of the applied flipped learning approach, the overall quantitative data analysis of the gain scores revealed that they found it difficult to develop a sense of belonging and connection to their peers. Thus, their perceived social relatedness was not significantly enhanced. However, this finding is not supported by Akçayır and Akçayır (2018), Al-Samarraie *et al.* (2020), and Zainuddin *et al.* (2019), who observed that flipped learning tended to promote students' peer interactions, since it freed up class time for social interaction and provided ample opportunities to exchange ideas through in-class activities (e.g., group discussions, case studies, and project presentations). In fact, students in flipped learning environments are often allowed to use in-class time to work together and engage in collaborative learning. However, dedicating time to peer interactions may not necessarily encourage students to participate in collaborative activities willingly. Some students may be discouraged from working or interacting with their groupmates for several possible reasons, such as disinterest or a lack of preparation or prior knowledge required to understand the concepts being discussed in the class (Lopes *et al.*, 2024). The quantitative analysis results of the current study provide *prima facie* support for this claim, as a moderate positive linear relationship was found between the completion rate of pre-class activities and students' feelings of belonging and connection with others (see Table 4.15). This is in accordance with the study by Burke and Fedorek (2017), which stressed that in-class participation often relies on the agency of

students to attend classes prepared and ready to work collaboratively with their groups after completing the required pre-class tasks.

However, although preparation might contribute to students' participation in collaborative online sessions, supporting their interests in such learning activities might also be essential to maintaining their active participation and promoting positive interdependence (Páez-Quinde *et al.*, 2021). One possible way to achieve this is by creating a competitive and collaborative learning environment that fosters enjoyable teamwork. This notion was highlighted by some students in the gamified FVC group. For instance, student BSTD3 reported, *"... I think we enjoyed working together as a team ..."*, while student BSTD22 commented, *"... I enjoyed working with my group because we were cooperative and aware ..."* Similarly, student BSTD11 mentioned, *"... I enjoyed doing these collaborative activities ..."* This finding aligns with existing evidence (e.g., Chen, 2019; Al-Samarraie *et al.*, 2020; Lopes *et al.*, 2024), suggesting that participating collaboratively in intergroup or team-based competition might have a significant positive effect on students' interest in the learning progress and the value they ascribe to it. Lopes *et al.* (2024) found that about 60% of the students in their study favoured team-based learning in which they collaborated as teams to complete given tasks. Thus, it seems that integrating SDT-based gamified competition contributed to promoting their role as active team members. A possible explanation for this effect, according to Chen and Hwang (2018), is that encouraging students to work on shared goals (e.g., winning badges or points) in teams might play a vital role in boosting their interdependence.

The current study used a team-based leaderboard element as part of the gamification system to display the group's positions and the accumulated total points and badges. The students reported that they tracked and monitored other groups' progress on the leaderboard and tried to level up their team's position by targeting top rankings (BSTD3, BSTD11, BSTD21). Some students actively supported and helped their teammates to achieve the team's goal or target (e.g., BSTD3, BSTD22), implying that gamified instruction can encourage students to interact. The leaderboard, utilised in the gamified FVC setting, tended to produce shareable team goals, which the students might achieve through collaboration and competition for the sake of the team, as indicated by some interviewees (e.g., BSTD3, BSTD11, BSTD28). This observation is

in line with previous studies by Sailer *et al.* (2017) and Páez-Quinde *et al.* (2021), who asserted that some gamification elements would best be designed to support the socialisation of achievement through team-based gamified tasks or shared targets. This team approach creates opportunities for students to collaborate and interact with their peers and learn from each other, which might, in turn, promote their sense of connection and belonging. Based on this, when implementing online flipped learning, instructors should consider the importance of encouraging students to identify and work on achieving shared goals through team-based activities, stimulating the factor of social relatedness among them.

Furthermore, fostering feelings of team loyalty in the gamified FVC group was also likely to enhance social relatedness among the students, which in turn tended to affect the extent of positive outcomes of competition. The qualitative results imply that students would be able to develop a sense of interdependence by relying on each other's abilities and strengths to successfully complete the challenges. Student BSTD22 mentioned that, unlike working individually, each team member strove to contribute to the success of the team by helping each other progress. According to another interviewee, this helping behaviour was aimed at supporting the team to win the competition (BSTD21). However, these findings are contradicted by the claim that the collaborative and cooperative aspects of interdependence may potentially undermine students' autonomy and agency, since they may limit individual control and decision-making over the learning process (Markus & Kitayama, 1991; Gelfand *et al.*, 1996). This argument is perhaps echoed by the notion that autonomy is equivalent to individualism and antagonistic to social relatedness, since autonomous students may lack concern for others and become too focused on their own needs and desired goals, possibly leading to social disharmony. This implies that applying SDT-based instructional design in a team-based learning environment may result in a contradiction between autonomy and collaborative learning orientation in this context. However, Chirkov *et al.* (2003) emphasised the importance of precision in defining autonomy in SDT and concluded that there is no equivalence between autonomy and individualism, as well as no opposition between autonomy and collectivism. It is claimed that students can be autonomously individualistic when they prioritise the value of self (e.g., ego involvement) over the group's or team's goal value. In addition, they may be autonomously collectivistic when prioritising the

group's value (e.g., shared goals) over the self when engaging with others or managing the learning environment (Ryan & Deci, 2017; Segura-Robles *et al.*, 2020).

In this sense, there can be both heteronomous collectivistic and/or autonomous collectivistic participants in collectivistic learning contexts. Swiatczak (2021) indicated that students are more likely to accept and internalise the external value of group goals when they feel a sense of social relatedness and belonging to the group. This aligns with what some interviewees highlighted in the current study, which was that they were competing to achieve various team goals, including earning a specific number of points (e.g., BSTD28), achieving a higher ranking for their team on the leaderboard (e.g., BSTD3), and understanding the instructional materials to be able to help their peers in the team progress, thus contributing to the overall team results (e.g., BSTD22). Students can be forced into heteronomous collectivistic situations, for example, when they obey a group's or leader's rules for reasons related to social control, such as the fear of being rejected or isolated or merely to receive good formal grades or evaluation from the instructor. They might also experience autonomous collectivistic actions when they willingly and individually contribute to or internally value the group's decisions, roles, plans, and shared goals or targets, and they, therefore, act and compete for the sake of the group (i.e., the team's loyalty) (Chirkov *et al.*, 2003; Swiatczak, 2021). Based on this finding, the present study contributes to the relevant research field by emphasising that the need for autonomy can be fulfilled even in collaborative-supportive flipped learning environments, particularly when students fully concur with and endorse the group norms as autonomous and volitional. This assumption is echoed by Zhong (2021), who concluded that well-designed collaborative instructional activities might be the key to boosting the interdependent dimension of autonomous learning and group autonomy. As a result, supporting a sense of belonging to a team is likely to have a positive effect on students' autonomous motivation (Ryan & Deci, 2020).

The quantitative results of the present research also revealed that most students in the gamified FVC group reported that their teams helped them understand the instructional materials and stimulated their critical thinking skills, compared to those in the non-gamified FVC group. Motivating students to engage in team-based activities might provide opportunities for them to learn from diverse opinions and assumptions by exchanging and expanding ideas, knowledge, and

experiences (Nicholson, 2012a). This is in line with social constructivism and other relevant concepts explained in the literature review chapter, including the Zone of Proximal Development (ZPD), More Knowledgeable Person (MKP), and scaffolding. All these approaches emphasise the active role of social interaction and the assistance of the instructor or more capable peers in helping students progress and maximise their potential in constructing their knowledge and allowing for movement within their ZPD cycle (Vygotsky & Cole, 1978) through individual pre-class tasks and collaborative in-class activities. While student BSTD22 stated that “[He] liked to help [his] colleagues in [his] group whenever [he] was able to do so ...”, some students mentioned that teamwork helped them understand and complete the gamified flipped-class tasks (e.g., BSTD3, BSTD21), as they were motivated to discuss and share with their groupmates the knowledge that they acquired from the pre-class activities (BSTD11). This seemed to provide them with guidance for refining their thinking processes, thus supporting their knowledge construction and possibly enhancing their critical thinking skills, as they were encouraged to evaluate different perspectives. It can be assumed that integrating SDT-based gamification instructional settings into pre-class tasks enabled students to grasp the gist of the topic and prepared them for critical questions during in-class sessions in a supportive learning atmosphere in which they felt unstressed when seeking help or feedback from their groupmates and the instructor. In line with a conclusion by Huang *et al.* (2019), the findings of the current study can inform instructors by suggesting that including social interaction-supportive gamification into challenging teamwork and online peer discussions as part of a gamified FVC environment in which students feel cared about and respected by their peers and the teacher may produce a sense of relatedness, mutual support, and well-being.

5.3.4 Interest/Enjoyment

Interest and enjoyment, as defined by the SDT, are psychological states that reflect autonomous intrinsic motivation (Deci *et al.*, 1996; Deci & Ryan, 2000). In other words, students’ feelings of inherent interest or enjoyment towards an instructional course are thought to play a vital role in their natural propensity to learn or complete an activity. Therefore, besides autonomy, competence, and relatedness factors, the interest/enjoyment factor has been considered in the literature as a strong predictor of a high level of autonomous motivation and

psychological needs satisfaction, as well as a measure of intrinsic motivation (Ryan *et al.*, 2006; Tamborini *et al.*, 2010; Eyupoglu & Nietfeld, 2019; Ryan, 2019). The present study attempted to answer the second research question by investigating the effect of gamification elements on students' autonomous learning motivation towards the CS course. Hence, it was crucial to examine the extent to which students enjoyed or were interested in this online flipped course within the gamified and the non-gamified FVC. To achieve this, the participants in both groups were asked to respond to eight questionnaire statements at the end of the intervention. Furthermore, it was essential to understand how the combination of SDT-based gamification and online flipped learning might potentially impact students' autonomous motivation to learn. This was facilitated by conducting semi-structured interviews with those in the experimental group (gamified FVC).

The overall quantitative gain score analysis results revealed that the gamified FVC group ($M = 2.39$, $SD = 0.65$) had higher self-reported interest/enjoyment levels than those in the non-gamified FVC environment ($M = 0.16$, $SD = 0.69$) when performing the learning tasks, with $t = 14.54$, $p = 0.001$, and $p < 0.05$. In addition, the effect size of this significant difference was gauged and found to be large (Cohen's $d = -3.33$) (Cohen, 1988). Accordingly, this d -value provides statistically positive evidence that gamification intervention can be an effective strategy for increasing students' perceived interest and enjoyment based on comparing the two groups and assessing the difference between their means. This result generally implies that integrating gamification mechanisms into flipped learning based on SDT would perhaps contribute to enhancing students' feelings of interest and enjoyment (See Section 4.1.4.4).

Most students in the conventional FVC group disagreed with the questionnaire statement describing their experience of performing the given pre-session tasks as enjoyable. These negative responses were also emphasised in the statistical results of another questionnaire item about the extent to which students found these activities fun. Moreover, the students in the control group demonstrated their emotions towards the online flipped course by reporting a sense of boredom when performing the pre-class tasks. This finding contradicts Jeong *et al.* (2016), who assessed students' perceptions and emotions when flipped learning was utilised as an instructional methodology, revealing high scores for positive emotions (i.e., fun and

enthusiasm) and low scores for negative emotions (i.e., boredom and fear). However, their study used two groups of participants with patently different educational backgrounds and majors (i.e., a social sciences and arts group and a science and technology group). Thus, the possible effect of this confounding difference on students' perceptions of the flipped learning approach might not have been considered. The study acknowledged that the design of the instruction methodology and teaching strategies might have critical effects on students' emotions, and it was found that certain features, such as the possibility to rewatch and rewind the pre-class videos, were what the participants mostly found fun. In fact, several studies (e.g., Zainuddin & Halili, 2016; Long *et al.*, 2017; Zainuddin, 2018) have stressed that pre-class activities need to be designed in a way that attracts and motivates students to complete them; otherwise, they may find them too tedious to complete. The current study, therefore, attempted to understand how the flipped-class activity can be provided to students as motivation-supportive learning materials.

On the other hand, the study's quantitative findings revealed that when those instructional activities were designed by integrating SDT-based gamification elements, most students reported that they enjoyed them. Viewed through the SDT lens, it seems that students often have a high level of autonomous motivation to complete an instructional task when they experience a sense of enjoyment, interest, or inherent satisfaction (Ryan & Deci, 2020; Jones *et al.*, 2022). The participants in the current study self-reported feelings of enjoyment, which were further explained and justified in the data analysis of the semi-structured interviews. The qualitative results revealed that the participants in the gamified FVC group found the team-based competition fun and challenging, especially regarding the accumulation of points when completing the gamified tasks. As interviewee BSTD11 expressed, *"... collecting points through doing the learning activities and competition between groups was really fun and challenging."* Another student related this feeling of enjoyment to the design of the gamified pre-class videos, stating, *"... some of the gamified videos were quite fun ..."* (BSTD27), while BSTD28 described them as *"...creative and fun ..."* Although the pre-session videos were similar in length, content, and quizzes in both groups, unlike the gamified FVC group, the conventional FVC group showed insignificant changes between the pre-questionnaire and the post-questionnaire overall results, indicating that this conventional method did not significantly boost their perceived enjoyment.

The qualitative results of a study by Zainuddin *et al.* (2021), in which the participants in an online flipped learning environment were interviewed, revealed that the length of the pre-class videos should be considered and the instructional materials should be appealing in a way that contributes positively to students' enjoyment and engagement. Students with a high level of autonomous motivation commonly seek innovative learning and willingly accept tasks that challenge them in an enjoyable manner. In this process, they are likely to acquire the targeted knowledge and skills, as well as expand their learning in new ways (Ryan & Deci, 2000b). In other words, intrinsically motivating tasks challenge students to stretch their learning while experiencing inherent enjoyment in engaging with the instructional material. Although several studies have reported positive results regarding students' satisfaction and opinions when gamification elements were merged with learning environments (e.g., Segura-Robles *et al.*, 2020; Sprint & Fox, 2020; Tarhan & Öztürk, 2022), negative findings have also been reported in other studies (e.g., Koivisto & Hamari, 2014; Hanus & Fox, 2015), which contradict the present study's results. In Hanus and Fox's study (2015), two instructional courses were compared: one involved a gamified curriculum in which a leaderboard and badges were utilised, and the other used a non-gamified curriculum with the same educational content. The study revealed a negative impact of using gamification mechanisms on students' satisfaction and motivation, suggesting the need for gamification instructional design to be carefully considered. In line with this result, Koivisto and Hamari (2014) concluded that after integrating gamification elements into a learning environment, students' enjoyment and engagement declined over the course period.

A possible explanation for such effects is that some gamification designs might produce negative consequences instead of enjoyable learning experiences, particularly when students individually compare their performance with those who achieved high positions on the leaderboard (Molleman *et al.*, 2007). Indeed, the nature of the competition (i.e., controlling or autonomous) can play a vital role in the generated effect of enjoyment (Fülöp, 2009; Alabbasi, 2018; Chen, 2019). Furthermore, the competition aspect of gamified learning settings, such as points and badges, would perhaps be perceived as controlling, which might reduce students' enjoyment when engaging with the gamified instructional materials (Marcum & Perry, 2015; Sajid *et al.*, 2016; Ekici, 2021). However, it has been debated whether those external rewards can also be powerful motivators despite their potential short-term effects (Zainuddin *et al.*, 2020; Jones

et al., 2022). Although external motivators may propel students with low motivation to begin participating in an instructional activity, it is crucial to consider that this may also produce some side effects, such as feelings of stress or anxiety about their learning progression (Marcum & Perry, 2015). Therefore, while gamification elements can be used as external motivators to engender low levels of autonomous motivation, carefully applying these elements is strongly advised to gradually instil and maintain internalised motivation in students (Richter *et al.*, 2015).

In this light, in the current study, gamification mechanisms were integrated into flipped learning based on a non-controlling, team-based system in which students were free to try and try again when doing an activity. They were also encouraged to support each other to progress as a team, which might engender a sense of belonging among them in a friendly learning atmosphere. Some students reported this notion in the semi-structured interviews, indicating their enjoyment in a competition that stimulated team loyalty and peer interaction behaviours when performing teamwork (e.g., BSTD3, BSTD11, BSTD22). Based on this, it can be assumed that such factors may help reduce stressful situations, particularly those resulting from individual-based competition or formal evaluation, as indicated by student BSTD28. This corroborates the study's results and coincides with what has been demonstrated in other investigations (Chen, 2019; Sprint & Fox, 2020; Tarhan & Öztürk, 2022). In particular, the research undertaken by Tarhan and Öztürk (2022) revealed positive opinions of students who were taught using flipped learning and gamification methods. The students stated that they were able to learn the instructional content from the flipped learning videos, while the gamified tasks added enjoyable interaction to the flipped learning method. This result was also found in the present qualitative results (e.g., BSTD21, BSTD27). The overall findings suggest that merging SDT-based gamification elements with an online flipped learning setting can potentially promote students' enjoyment and support their autonomous motivation to learn. The implications of these findings will be discussed further at the end of this subsection.

Furthermore, combining gamification and FVC seemed to increase students' interest and attention towards the instructional CS content. The quantitative findings revealed that most students in the gamified FVC group responded positively to a negative questionnaire item (i.e., *"The provided activities did not hold my attention."*) compared to their peers in the non-gamified

FVC group. In addition, the gamified tasks were likely to focus students' attention on the concepts embedded in the instructional videos, which were provided by the instructor before the online sessions (BSTD3, BSTD11, BSTD21). For example, student BSTD21 mentioned that he was motivated to prepare for the online in-class activities and to attend the class after earning several points from the gamified quizzes, which relied heavily on his watching the pre-class videos and understanding the included concepts. These concepts were essential for considering students' CS knowledge and skills when applied and employed in the online sessions. Students in the conventional flipped learning environment might have found it challenging to maintain their attention when watching the pre-class videos, even though the non-gamified quizzes were embedded in them. These results are consistent with Brunsell and Horejsi (2013), who emphasised that integrating conventional quizzes into pre-class videos did not adequately hold students' attention in watching them before class. Since the success of the flipped learning approach often relies heavily on such activities (Long *et al.*, 2017; Lee & Choi, 2019), students who are not interested in doing out-of-class activities are likely to perceive them as extra workloads (Yang, 2017; Phillips & O'Flaherty, 2019), which may explain why they often do not complete these tasks or drop out of courses (Páez-Quinde *et al.*, 2021). The current findings expand upon the existing literature by providing additional evidence for the importance of designing pre-class activities that can hold students' attention and maintain their interest.

Another questionnaire item in the current study sought to evaluate the extent to which students in the gamified FVC and non-gamified FVC groups found the instructional activities more valuable than the final course grade. Although each group showed a small improvement according to the calculated gain scores for this particular item, the quantitative results indicated an insignificant difference between the two groups, as most of the students' responses were situated between "Neutral" and "Agree" based on the 5-Likert scale used in the questionnaire (i.e., gamified FVC group: Mean = 3.91, M = 1.18; non-gamified FVC group: Mean = 3.78, M = 0.91, $t = 0.92$, $p = 0.363$, $p > 0.05$). This finding suggests, to some extent, that students in both groups might value the CS instructional tasks. However, it may also indicate that some students in the two groups might be more concerned about the formal course grade when compared to the course value, since it officially represents their success in the CS course. Those students might, therefore, prioritise the final course grade as it reflects their final academic achievement.

Although students in both classes were informed and assured that their performance evaluation in the online instructional activities would not affect their final course scores, one reason might be that the prevailing educational culture within the Saudi educational context, in which positive recognition from instructors, parents, and peers is often associated with achieving good grades. This belief might have affected some of the students' responses. Thus, it might be possible that some students tended to prioritise their grades over the value of the instructional content. While those students might not find the CS content as personally valuable, it is also possible that the increase in interest and enjoyment observed in the gamified FVC group might serve to compensate for this limitation and play a vital role in stimulating their autonomous motivation, which coincides with the findings from other investigations (e.g., Reeve, 2006; Ryan & Deci, 2017) and is demonstrated in the SDT continuum (See Figure 2.4). Accordingly, while a student's valuing a task indicates autonomous motivation (i.e., identified regulation), perceiving this activity as enjoyable and interesting may represent a high level of autonomous motivation (i.e., intrinsic motivation). Based on this finding, practical advice can be provided for instructors and instructional designers that balancing external and internal rewards and demonstrating the rationale for each task along with integrating enjoyable and interesting game mechanisms can be effective in internalising and maintaining students' engagement in the pre-class activities and these two factors (i.e., understanding the task value and enjoyment) may compensate for the limitation of each other.

Moreover, the qualitative results provided further insights, as some students revealed their understanding of the importance and usefulness of the presented CS knowledge for their future practice and overall self-development (e.g., BSTD3, BSTD11, BSTD21, BSTD22). Indeed, the way in which the instructional content rationale is presented and justified can play a vital role in motivation (Reeve, 2006; Huang & Soman, 2013). In the Saudi higher education context, an attempt has been made to create motivating online learning environments in which instructors are encouraged to keep abreast of new autonomous learning methods and multiple studies have recommended using flipped learning as a pedagogical approach to teaching computer and technology skills (ALRowais, 2014; Al-Zahrani, 2015; Malik *et al.*, 2018). However, several challenges have been associated with the implementation of such a student-centred learning approach; students can be uninterested in and demotivated to engage with the flipped-class

materials used to prepare them for attending their classes (Al-Zahrani, 2015; El Miedany, 2019). Although there has been a notable dearth of studies that investigate using flipped learning in a fully online learning context (Candel *et al.*, 2023; Khaldi *et al.*, 2023), it can be deduced that the online instructional activities should be designed to motivate students autonomously and encourage them to perform the tasks; otherwise, they may perceive these as overwhelming work.

In sum, the merging of SDT-based gamification with flipped learning appears to lead to an increase in students' perceived autonomous motivation, as both the quantitative and qualitative findings generally revealed positive changes in their perceived autonomy, competence, relatedness, and interest/enjoyment, all factors that have been considered strong indicators for autonomous motivation in the literature. The study's findings are in line with the SDT reported by Deci and Ryan (2000), affirming the importance of such factors as innate psychological needs that reflect students' autonomous learning motivation. Specifically, the current study showed that the autonomy factor was likely to be supported among students in the gamified FVC environment by encouraging them to choose what to complete from optional forms of gamified learning tasks. Each task had a different number of points and different types of badges to be targeted and collected by the students in a friendly, competitive, and collaborative learning atmosphere. It might be true that utilising flipped learning can offer more time for self-directed learning than teacher-led lecturing; however, this might not sufficiently satisfy the students' need for autonomy, since independent learning is not equivalent to autonomous learning and does not fully reflect that basic psychological need for autonomy satisfaction is met (Chirkov *et al.*, 2003; Ryan & Deci, 2017). The present study's findings emphasise that SDT-based gamification elements tended to support students' sense of accomplishment and boost their confidence in progressing through challenging activities by providing progression-supportive feedback that was meaningful and free of formal evaluation or performance judgment (Reeve & Jang, 2006). In addition, utilising points, badges, and leaderboards to acknowledge signs of improvement appears to engender a sense of progress and competence in students.

Advocates may claim that the conventional flipped learning approach allows time for students to prepare for their classes by completing pre-class activities that build their confidence and enthusiasm for performing in-class tasks, which may, in turn, stimulate their sense of

competence (Hung, 2015; Zainuddin & Perera, 2018, 2019). However, the present study's findings revealed that the provision of these flipped-class tasks can play a vital role in either satisfying or frustrating students' needs for competence and, thus, their autonomous motivation. Students may perceive those activities as an extra workload or as controlling tasks by which their performance is judged by the teacher, engendering a sense of tension or worry about their study progress. Previous research (e.g., Hwang *et al.*, 2017; Ge, 2018) suggests that learning anxiety and performance pressure that may result from utilising a grading system might potentially urge some students to put more time and effort into completing pre-class activities and learning from those tasks. However, it is argued that this scenario tends to negatively affect the self-determined type of motivation, since the reason for doing an activity in this context is associated more with external regulation (Ryan & Deci, 2000b; Jones *et al.*, 2022). The findings of the present study emphasise the necessity of designing a flipped-class environment in which extrinsic and intrinsic motivators are carefully balanced. At the beginning of students' engagement with the gamified activities, it was possible that the points and badges were perceived by some students as extrinsic motivators, especially when doing a task because of internal pressure or expectations (e.g., ego involvement, approval from self and others, or personal feelings of guilt or shame) (See Figure 2.4). In fact, this might pertain to how these gamification mechanisms are presented throughout the instructional CS course. For instance, gamification may naturally incur anxiety as a result of competition with others (Ge, 2018). Nevertheless, these extrinsic motivating elements are likely to be internalised when students work together as teams to achieve desired shared team goals (e.g., a certain number of group points, team badges, and a higher level on the leaderboard) in parallel with the provision of clear instructions, rationales, and non-formal, progression-supportive feedback. As a result, most gamified FVC students in the current study tended to feel more autonomous in contributing to the progression of their teams. Indeed, after the instructional intervention, the findings revealed that some students found that the SDT-based gamification design produced an enjoyable team-based learning atmosphere, which might have contributed positively to minimising the possible influence of individual performance anxiety. Hence, it can be deduced that creating such a learning environment might arguably be achieved by incorporating gamified activity into online flipped learning to support students' inherent needs

for autonomy, competence, and social relatedness, resulting in autonomously motivating learning rather than producing stressful and controlling learning situations.

Based on the above discussion, while the three basic psychological needs can be supported, to some extent, in flipped learning without gamification (e.g., Abeysekera & Dawson, 2015; Stöhr *et al.*, 2020), the present study findings showed that the addition of game mechanisms into such instructional environments was likely to inject a layer of meaningful collaboration and enjoyable engagement among students which might significantly contribute to enhancing their experience in the course. To reiterate, although autonomous learning may be promoted in flipped-class settings without gamification through emphasising choice and flexibility in time and pace, these factors can be more effective when presented with gamified tasks. In such tasks, students can choose not only what to accomplish but also what challenging paths they should take based on their abilities and how many points are needed to support their team's progression in the competition. Moreover, the flipped-class instructor might provide students with feedback that might boost their feelings of competence (Awidi & Paynter, 2019; Zainuddin, Haruna, *et al.*, 2019); however, gamification elements such as progress bars and points can tangibly represent the instant learning progress of each student, thus facilitating self-monitoring and offering immediate support for their feeling of progression. Flipped learning can also bring students together to work in groups, which may stimulate a sense of relatedness (Abeysekera & Dawson, 2015). Nonetheless, the findings revealed that when gamifying these groups by adding team-based gamification elements, students tended to work together towards achieving shared goals (e.g., specific badges or team positions) and compete with other groups even during out-of-class time. Thus, they may be more motivated to help each other and achieve the team goals towards winning the competitions. When the team members see the immediate effects of their individual contributions to the overall team progression, this is likely to be more supportive of their psychological needs for competence and social relatedness compared to a learning environment with the absence of gamification. The relationships within and between autonomy, competence, relatedness factors and overall autonomous motivation are discussed further in the following sections by synthesising the quantitative and qualitative results and then correlating these findings with the relevant literature.

5.3.5 Correlations Between Autonomy, Competence, Relatedness, and Overall Autonomous Motivation

It has been claimed that the three psychological needs for autonomy, competence, and social relatedness can reflect the extent to which students are autonomously motivated and that enjoyment and interest factors can also indicate a high level of this type of motivation (Deci & Ryan, 2000). It is important, therefore, to investigate the direction and strength of the potential correlations between these variables in order to expand our understanding of the effectiveness of the SDT-based gamified FVC, as a teaching and learning approach. In addition, one aim of the present research is to determine the extent to which it might impact CS students' autonomous learning motivation at the Saudi higher education level. As mentioned previously, the SDT principles have been examined and regarded by many studies as significant indicators of autonomous motivation. However, to the best of the researcher's knowledge, the current research has been the first attempt to examine the potential relationship between these autonomous motivation indicators, particularly in this online flipped-class context, contributing to both gamification and flipped learning literature. In this regard, further discussion is provided in the following sub-sections.

5.3.5.1 Autonomy and Autonomous Motivation

It is theorised that the satisfaction of each of the three inner needs can be facilitated through the provision of autonomy-supportive instructional situations (Ryan & Deci, 2017). The SDT suggests that when students perceive a sense of autonomy in their actions, their autonomous motivation will be more stimulated. Although some students' actions may be driven by external regulations, it is argued that these can then be internalised and proceed through more autonomous levels of motivation when the psychological need for autonomy is supported in the learning environment (Deci & Ryan, 2000; Reeve, 2006). Therefore, the strength and direction of the correlation between the autonomy variable and autonomous intrinsic motivation (i.e., interest/enjoyment) were statistically assessed in the current study as an attempt to understand the nature of the potential relationship between them. The collective results revealed a strong positive correlation ($r = 0.69$, $r^2 = 0.48$ $p = 0.001$) between these two variables, indicating that students' perceived autonomy can statistically explain 48% of the variation in their autonomous

motivation (Humble, 2020). This is compatible with several additional studies (e.g., Reeve & Jang, 2006; Vansteenkiste *et al.*, 2012; Zainuddin, 2018), implying a positive relationship between autonomy-supportive contexts and students' autonomous motivation. For example, Reeve and Jang (2006) conducted a correlation analysis to assess the association between students' perceived autonomy and their feelings of interest and enjoyment during the learning activities and reported relatively similar results ($r = 0.56, p < 0.01$). Therefore, it is claimed that such learning situations will likely produce a high level of basic psychological needs satisfaction since autonomy, in particular, can be the best indicator of the autonomous type of motivation, along with competence and relatedness (Ryan & Deci, 2017). However, Sweet *et al.* (2012) argue that although the autonomy factor tended to have a significant relationship with this type of motivation, it is crucial to independently satisfy each of these basic needs, as the frustration of any of those needs, in many cases, may affect the facilitation process of the other. For instance, for the instructor's behaviour to be autonomy-supportive, it was important to pay attention to students' perspectives, listen and respond to them, acknowledge their contributions to the competition, and provide help and guidance to support their progression and expand their understanding so they might feel cared for, attached and related to others (Reeve, 2006). This is not to imply that autonomy is more critical for autonomous intrinsic motivation than the other needs of competence and social relatedness, but rather, each of those may emerge to drive the satisfaction of the other, depending on the context or situation (Ryan & Deci, 2017).

The results of the current investigation appear to support this notion by emphasising the possibility that some SDT factors (i.e., interest and enjoyment) might produce motivation-supportive situations despite the low effect of other aspects (i.e., value), as a strong correlation coefficient was statistically found between the interest/enjoyment variable and the three components of self-determined motivation ($r = 0.92, r^2 = 0.85, p = 0.001$). This indicates that 85% of the changes in overall autonomous motivation might be related to perceived interest/enjoyment. Another important finding that stands out from the qualitative results is that some students in the gamified FVC implied that they were able to collaboratively make decisions on the shared goals, working together as a team to accomplish the tasks (e.g., BSTD3, BSTD11, BSTD22, BSTD28), so each member of the team might accept responsibility for their given roles. In parallel, the quantitative data analysis revealed a strong positive correlation ($r = 0.67, r^2 = 0.45$,

$p = 0.001$) between autonomy and relatedness. These triangulated findings suggest that the satisfaction of autonomy needs might be a socially situated construct. This justification is supported by Zhong (2021), who conducted a study to examine how group autonomy was stimulated and evolved during the collaborative learning process; the study concluded that boosting this factor through well-designed team-based activities was likely to engender a feeling of connection and relatedness among the group members by supporting each other cognitively and emotionally toward collective achievement. The study also mentioned that autonomy might well be stimulated individually and in groups depending on the learning environment as well as the teacher's behaviour. In the current research, the findings implied that the SDT-based gamification elements, integrated into the FVC, allowed the students to collaboratively decide on the total number of points that their team needed to compete for against other teams, and how many points each team member had to collect through completing the gamified pre-class activities. Based on this scenario, it is conceivable that the students might experience a sense of autonomy both individually (e.g., by choosing which tasks to complete based on the targeted number of points) and collectively (e.g., by deciding on the total number of points needed for the team as a whole). Hence, while the feelings of autonomy and relatedness are independently fundamental for the students' autonomous motivation to learn the CS instructions, both factors seemed interconnected and mutually reinforcing in the gamified FVC context. This finding suggests that instructors and educational designers of flipped-class models should aim to support each of these needs to create autonomously motivating learning environments.

5.3.5.2 Competence and Autonomous Motivation

Several studies presented in the literature review chapter reported the role of competence as a psychological need for students' autonomous learning motivation (e.g., Deci & Ryan, 2004; Ryan *et al.*, 2006; Sheldon & Filak, 2008). Students feel competent when they are able to master a task or believe that their contribution can make a difference in a challenging instructional situation (Vansteenkiste & Ryan, 2013; Nicholson, 2015). It has been claimed that the satisfaction of the competence need may also support the facilitation of other psychological needs for autonomy and social relatedness independently (Ryan & Deci, 2017); thus, the autonomous type of motivation is stimulated (Deci & Ryan, 2000). Therefore, in the present study,

the relationships between competence and the other indicators (i.e., autonomy, relatedness, and interest/enjoyment) were statistically assessed in order to add an in-depth explanation to the obtained findings. The Pearson correlation coefficient test revealed positive relationships between the perceived competence and autonomy among the students ($r = 0.71$, $p = 0.001$), as well as their perceived interest/enjoyment ($r = 0.80$, $p = 0.001$). Similar results were also reported by prior studies mentioned in the literature, revealing significant positive moderate relationships between these variables (e.g., Ryan *et al.*, 2006; Rigby & Ryan, 2011; Mekler *et al.*, 2017). It seems plausible that the autonomy support (e.g., freedom to choose) offered to the students was associated with their feeling of competence since they had more opportunities to find what they believed they could complete (e.g., BSTD11, BSTD27, BSTD28). This might, in turn, help them feel effective in their actions and capable of progressing in their learning, which is consistent with the SDT principle. Autonomy-supportive practices, such as providing options, accompanied by progress-supportive feedback and allowing decision-making on shared goals, might encourage students to take on more challenging gamified tasks; as long as they progress through these tasks, they are more likely to feel competent (Ryan & Deci, 2020). These results reflect those of Levesque *et al.* (2004) concerning the role of students' autonomy and competence in German and American university contexts and the relationship effect of autonomy on well-being through competence. The study concluded that when students feel competent in a particular task, they might experience, to some extent, autonomy-supportive learning situations when doing that task; thus, they are likely to develop the skills and abilities required for their progression. As a result, they may feel more capable of accepting the mission and making their own decisions to choose what suits their abilities, positively impacting their overall autonomous motivation. The significant association between the competence factor and autonomous motivation emphasises the effective role of integrating competence-supportive gamification elements into flipped learning design when aiming to motivate students autonomously to learn.

5.3.5.3 Social Relatedness and Autonomous Motivation

The current study also delves into the possible correlation between perceived relatedness and autonomous intrinsic motivation (i.e., interest/enjoyment) in an attempt to understand the impact of integrating SDT-based gamification into the FVC context on students' autonomous

motivation to learn. The feeling of social relatedness reflects not only a sense of belonging and connection but also the situation in which students feel effective or significant team members (Ryan & Deci, 2017). In the present research, the aim was to facilitate this factor among the students in the gamified FVC group by encouraging them to work, compete, and progress through team-based gamified tasks and friendly competitions. The quantitative results indicated a positive correlation between students' perceived social relatedness and the extent to which they found the gamified activities interesting and enjoyable ($r = 0.75$, $p = 0.001$). This positive relationship was also reported in some previous studies in the relevant literature (e.g., Tamborini *et al.*, 2010; Eyupoglu & Nietfeld, 2019). A possible explanation for this association is that the students experienced peer interactions and supportive relationship opportunities when performing team-based gamified activities in a competitive and collaborative learning environment. For instance, some interviewees alluded to the notion that team-based gamification increased their enjoyment and that earning and accumulating points for the sake of their team account was enjoyable and motivating (BSTD3, BSTD11, BSTD22). Based on the results of this study, encouraging team loyalty among students appeared to play a vital role in perceiving the activities as enjoyable teamwork rather than individual workload.

Consistent with prior research (e.g., Ryan *et al.*, 2006; Lafrenière *et al.*, 2012), the present research found that the relatedness factor tended to have a positive correlation with competence. Facilitating the satisfaction of social relatedness might be ascribed to stimulating students' feelings of competence when participating in an activity (Wilson & Rogers, 2008). To illustrate, when students in the gamified FVC group were earning points and badges for their team by completing individual pre-class tasks, this might have made them perceive themselves as effective team members, possibly due to their ability to earn points and badges and contribute to the team's winning or position on the leaderboard. Fitting with this discussion, Ryan and Moller (2017) imply that the feeling of effectiveness in one's interaction within a group or team may well facilitate the satisfaction of competence needs. This emphasises that the relatedness and competence factors can be positively correlated depending on the instructional situation.

Overall, it appears from the discussion above that supporting autonomy, competence, and social relatedness factors contributed to stimulating and maintaining students' autonomous

motivation (Eyupoglu & Nietfeld, 2019). Although it is important to provide sufficient support for each of these psychological needs, as demonstrated by the SDT continuum, some learning situations may be less supportive of one of those needs while greater support is provided for the others. In other words, depending on the situational conditions and how students perceive the reasons behind their actions, these three needs can function as complements or facilitators for each other (Wilson & Rogers, 2008; Ryan & Deci, 2017); the satisfaction in each of them is essential for stimulating students' autonomous motivation.

5.4 Impact of Gamified FVC on Completion Rate of Pre-session Tasks

The completion rate of pre-class activities has been one of the most challenging problems when applying flipped learning approaches, as demonstrated previously in the literature review chapter (see Chapter Two, Section 2.3). It is crucial, therefore, to suggest practical solutions to such challenges. This section discusses the findings concerning the third research question: *"To what extent did the integration of gamification into FVC affect students' completion rate of pre-session activities in Saudi higher-education CS?"* To address this question, the relevant quantitative data were gathered from the VLE statistical reports of the gamified FVC group and non-gamified FVC throughout eight weeks/topics to gauge the differences in student completion rates of the provided online pre-session tasks between those two groups. Although the overall result of the applied Mann-Whitney *U* test and descriptive statistics indicated that students in the gamified FVC group completed more instructional tasks than their peers in the non-gamified FVC class, the findings related to the pre-class tasks of topics 1 and 2 revealed no significant differences between the experimental and control groups. This suggests that there was no significant effect of integrating SDT-based gamification into the online flipped learning condition in the short-term two-week period, as a negligible effect size was found in the results of the first two topics ($r = 0.06$ and $r = 0.08$, respectively). According to Cohen (1988) and Pallant (2020), an *r*-value below 0.11 indicates an insignificant difference between the experimental and control groups. It also shows a minimal to no impact of the independent variable (i.e., gamification) on students' completion rate, as a dependent variable, in the initial stages. Based on Cohen's guidance, it can be said that the observed difference between the two groups in the first two weeks was unrelated to the gamification intervention, emphasising the need for further studies

to explore the effects of other possible factors, particularly at the initial stage. However, a statistical difference and significant change in the completion rate pattern throughout the longer-term eight-week course can be observed from the third week. The completion rates variable of the non-gamified FVC group started to decrease from 55.3% to 43.3%, while the gamified FVC maintained a rate above 60%, although a moderate effect size was reported ($r = 0.24$). Similarly, in topic 4, students in the gamified FVC group completed more of the assigned tasks (73.1%) than their peers in the non-FVC group (38.3%), with a moderately large effect size ($r = .55$). An interesting trend regarding the completion rate of the gamified FVC group can be seen as the participants showed a continuous increase in their completion percentage as time went on; however, this was not the case for the non-gamified FVC group (see Figure 4.21). The effect size results also parallel this observation, indicating an increase in the r -value from moderately large to large effect sizes, which might reflect the increasing impact of the gamification intervention on students' completion rate of pre-session activities.

This result is broadly consistent with the work of other research (e.g., Long *et al.*, 2017; Huang & Hew, 2018; Tang *et al.*, 2020), alluding to the issue that the low completion rate of pre-class activities is one of the common criticisms of the flipped learning pedagogical approach despite its fast growth. An empirical study by Huang and Hew (2018), for instance, investigated whether there was a statistically significant difference in pre-class task completion between a gamified flipped classroom and a conventional flipped classroom. Consistent with the current study, their finding indicates that students in the gamified class completed significantly more pre-class tasks than in the non-gamified class. Huang *et al.* (2019) also reported no significant difference in these activities related to the first topic between the gamified and non-gamified groups; nonetheless, a significant difference was then detected from the second topic. These findings suggest that integrating SDT-based gamification into online flipped learning can be a possible intervention to facilitate the completion rate of the pre-session instructional activities and, thus, boost the students' preparation, particularly in the long run, compared to the conventional online flipped learning format.

However, when it comes to completing out-of-class activities in flipped learning environments, there has been a debate that they may only suit independent students and that

those who are more dependent on the teacher's guidance will likely encounter progression-related learning difficulties; thus, they may not be able to develop self-efficacy in their learning (Fisher *et al.*, 2017; Zainuddin & Perera, 2018; Halili *et al.*, 2019). In other words, independent students are likely to show confidence when completing out-of-class tasks, while dependent students may need feedback and guidance from the instructor. In fact, the flipped-class instructor had ample opportunities to monitor the student's learning progress, whether through the individual points earned from completing the pre-session activities or the VLE statistical reports included in the online learning platforms; thus, he was able to informally evaluate and support independent students by providing scaffolding, while helping dependent students by offering progression-supportive feedback. Most students in the current study emphasised this notion by mentioning that the information and feedback provided via the Blackboard enabled them to progress and complete the online pre-class tasks (e.g., BSTD3, BSTD11, BSTD21, BSTD22, BSTD25). It is possible that employing flipped learning, whether with or without gamification, can facilitate independent learning during the CS course. Some interviewees stated that they wanted to do the pre-class tasks and prepare for the online sessions before attending them to help them understand the in-session instructional content and activities (e.g., BSTD3, BSTD11, BSTD21).

In the topics from weeks three to eight, it seemed that merging SDT-based gamification with flipped learning not only helped students to manage their independent learning but also increased, or at least maintained, their desire to complete more pre-class activities. This integration can be, therefore, a key solution toward the successful completion of those activities. There are several factors which may have driven students' desire in the gamified FVC group to complete the pre-session activities. These potentially encompass the desire to collect specific types of badges (e.g., early birds and star of the week) that are worth extra points (e.g., +80XP, +150XP, *etc.*), which the group members might perceive as shared goals that helped the team win the competition. This is consistent with the notion that setting shared goals can be vital in directing students' attention to goal-relevant tasks and may boost their desire to complete those activities (Locke & Latham, 2002; Huang *et al.*, 2019). Another possible factor is that the dynamic aspect of gamification (e.g., removing two incorrect answers from a total of four) and the points earned by completing each gamified task led to progression-supportive feedback, thus promoting students' persistence to progress through their learning. This parallels a study by Mekler *et al.*

(2017), who found that points, levels, and leaderboard feedback were impactful in improving performance quantity in instructional tasks. It is, therefore, suggested that a careful alignment of learning objectives and gamification elements might enhance the potential of flipped learning tasks when utilised in the context of CS higher education.

Due to the lack of previous studies that investigated the effect of combining SDT-based gamification and flipped learning in a fully online learning setting on students' completion rate (Candel *et al.*, 2023), the current study may provide a valuable first step in this important research direction. In addition to filling this research gap, it contributes to the field by offering practical guidance for instructors regarding how to develop an online flipped learning environment that integrates autonomous motivation-supportive gamification mechanisms, particularly for those in the Saudi higher CS education context. Although flipped learning can be effective in supporting students; autonomy, competence, and social relatedness, this approach has been found, in many studies, not sufficient to create engaging pre-class activities that can motivate students to complete them (e.g., Long *et al.*, 2017; Huang & Hew, 2018; Phillips & O'Flaherty, 2019; Tang *et al.*, 2020). The present research enriches the understanding of specific gamified practices that can potentially satisfy the three psychological needs and how these practices are related to each foundational need and the completion rate variable. Understanding the effectiveness of these gamified practices can contribute to enhancing students' preparation in flipped learning as one of its main challenges. This will be explained further in the following section.

5.5 Correlation Between Autonomous Motivation and Completion Rate of Pre-session Tasks

The completion rate of pre-class activity is considered an essential element of the flipped learning pedagogical approach. Research has shown that if these activities are not perceived as attractive, interesting, valuable, or enjoyable, students tend to find them less engaging and tedious extra workloads (Burke & Fedorek, 2017; Phillips & O'Flaherty, 2019). In contrast, more interesting or enjoyable instructional experiences can motivate them towards a better completion rate as a result of catalysing their self-motivation (Reiners & Wood, 2015). Based on this, it has been argued that students should be self-motivated to maximise the purported benefits of such student-centred learning environments (Huang *et al.*, 2019; Ekici, 2021). The current study has, therefore, investigated the autonomous motivation variable and its possible

correlation with the extent to which students complete pre-class tasks before attending the online sessions as an attempt to answer the fourth research question:

“To what extent did the students’ autonomous motivation correlate with their pre-session task completion rate when gamification was integrated into FVC?”

This section discusses the findings concerning the correlation between the research variables associated with students’ autonomous motivation (i.e., autonomy, competence, relatedness, and interest/enjoyment) and the completion rate variable. Two different sets of pre-class activities are compared: one included SDT-based gamification mechanisms, and the other was introduced based on a conventional flipped learning setting without gamification. Students in the gamified FVC group and non-gamified FVC group followed similar instructional content and procedures; however, the former (i.e., experimental group) was given choices of different gamified pre-class task forms and the freedom to decide what to complete from those gamified choices. Unlike the non-gamified FVC group, which was evaluated for completion or non-completion of the pre-class activities using a grading system separated from the final formal course grade, the SDT-based gamification elements (e.g., points, badges, and progress bar) were used with the gamified FVC group instead of the grading system. However, integrating autonomy-supportive actions into the online flipped learning environment, such as paying attention to students’ perspectives about the competition and incorporating rationale in the instructions of each gamified task, might positively influence the overall completion rate of those instructional activities (Reeve & Jang, 2006; Ryan & Deci, 2020). This claim is supported by the present findings, which indicate a positive moderate correlation ($r_s = 0.37$, $r^2 = 0.14$, $p = 0.002$) between the autonomy and completion rate variables. This result suggests that there was a discernible relationship between the extent to which students felt autonomous in their learning and the rate of completing the assigned pre-class activities.

Besides, the qualitative findings revealed that most students in the semi-structured interviews reported a sense of freedom and choice when completing the instructional activities, which might boost their desire to complete more learning tasks (e.g., BSTD3, BSTD11, BSTD22, BSTD28). This suggests that, to some extent, there was a predictive power of the autonomy variable for the completion rate, yet this does not necessarily imply a causal effect (Cohen *et al.*,

2018). A potential interpretation for such a positive correlation is that when students were provided with different gamified task forms, this facilitated finding what interested them, compared to an instructional situation in which students are required to complete assignments without choices, and their performance is often evaluated without paying attention to their concerns, abilities and interests. This is in parallel with a point from a study by Jones *et al.* (2022), implying that students' perceived autonomy can be diminished when they are compelled to complete every task without options, since their behaviour is likely to become more externally regulated. It is therefore suggested that students' choices and voices should be supported when designing a gamified learning environment in order to engender a sense of autonomous learning (Ryan *et al.*, 2006). This, in turn, might contribute to encouraging students to complete the pre-class tasks and demonstrate greater engagement with them (Jones *et al.*, 2022). An assumption can be made that in the gamified FVC context, students' completion rate of pre-session activities increased when they were allowed to choose what form and how many gamified tasks to complete, and were provided with instructions regarding the usefulness of each task (Reeve, 2006). This is in addition to offering cumulative points and different types of badges that are considered one of the most common forms of feedback patterns in gamified settings (Richter *et al.*, 2015).

According to SDT, students' competence factor is another indicator of being autonomously motivated to progress in learning. It is crucial, therefore, to determine the possible relationship between this variable and the completion rate of pre-class activities. In this light, the quantitative findings of the current study reported a correlation coefficient of 0.47 with a *p*-value of 0.001, which is generally considered a moderate positive correlation. Students in the gamified FVC group seemed more likely to feel competent and effective when provided with optimal challenges accompanied by progression-supportive feedback to enable them to master the given gamified pre-session tasks. Indeed, some students stated that those tasks were balanced in their difficulty level, and most of them could be completed by focusing enough on the instructional content and feedback provided via the Blackboard (BSTD11, BSTD22, BSTD25). For example, student BSTD21 mentioned that the pre-class videos were distinctive and easy to complete, thus earning more points through finishing them. Another interviewee stated, "*The competition to collect points was exciting for me to reach my goals and collect as many points as possible...it was*

up to my personal desire without any force on me” (BSTD22). This explains the positive association between students’ feelings of competence in their abilities to progress and their desire to earn extra points by completing the gamified pre-class activities. Students were able to choose to participate in team-based competitions, including challenging pre-class tasks; thus, they earned points that were eventually added to their team’s account. This contribution to the team's progression, position, and winning might potentially encourage them to undertake more gamified instructional tasks; the more they feel as effective and competent team members, the more activities they complete, as implied by student BSTD3. These results reflect those of Reeve and Jang (2006), Sailer *et al.* (2017), and Zainuddin, Shujahat, *et al.* (2019), which stress that enabling students to progress and master the available competitive tasks by providing meaningful feedback that is supportive rather than merely evaluative or controlling might be associated positively with the way that students perceive those gamified pre-class tasks. For instance, gamification elements such as points, badges, and performance bars can be utilised to provide students with progression-supportive feedback in a way that reflects their progress, levels, and performance (Zainuddin, Shujahat, *et al.*, 2019). These gamified flipped-class elements can also be used by the instructor to identify those who are behind or more dependent learners who need more help to catch up, even before attending their online session, and thus, provide rich feedback through scaffolded tasks (Ding, 2019; Lindeiner-Stráský *et al.*, 2020). Typically, when students are supported in gaining essential knowledge or understanding through completing the pre-class activities, this will likely engender a sense of mastery among them when performing the in-class tasks. One student reported that “...[the pre-session activities] helped [him] to consolidate the acquired information and concepts as [he] needed to remember them...”; as a result, this motivated him “...towards completing the existing activities.” (BSTD21). Another student commented, “...[he] felt a sense of achievement and progression...” which contributed to “...increasing [his] enthusiasm for progressing in the course...” (BSTD3). Consistent with the prior research by Rigby and Ryan (2011), the present study revealed that the feedback aspect of gamification integrated into flipped-class settings might contribute to the satisfaction of competence needs among students, which was found to be positively associated with the completion rate of pre-class activities.

Furthermore, the correlation between the feeling of social relatedness and the rate of pre-class completion was also examined in the current study. The relatedness factor is an important element of the SDT. The present findings have shown that this factor can potentially be supported among students by encouraging them to participate in team-based activities in which they experience a sense of team loyalty, connection, and belonging as team members. The statistical analysis reported a moderate positive correlation coefficient ($r = 0.34$, $p = 0.005$, $p < 0.05$) between the relatedness and completion rate variables. This suggests, to some extent, that when students in the gamified FVC group experienced a sense of social relatedness, such as feeling supported by other team members and the instructor, they tended to feel motivated and committed to completing more pre-session tasks. A possible interpretation for such an association between these two variables is that when students take part in a team-based competition, they might feel a sense of social accountability and responsibility to their teammates because of their desire to contribute positively to the team position on the leaderboard, as reported by student BSTD28. Therefore, they tended to work together and help each other as a team to win the competition. One student commented that *“Working in [his] group was great as it helped motivate [him] to complete the activities...”* (BSTD3), while student BSTD22 implied his positive attitude towards helping his groupmates in the team-based tasks.

Moreover, most students highlighted the important role of their contribution in completing the available learning tasks and, thus, supporting their team to progress and gain higher positions (e.g., BSTD3, BSTD11, BSTD21, BSTD28). This suggests that those who felt that their roles were influential as active team members tended to devote significant time to accomplish the gamified instructional activities and thus achieve the group's shared goals. In line with this finding, a study by Chen and Hwang (2018) reported that team-based competitive activities are likely to encourage students to focus on their individual roles as team members and strive to complete those tasks. Indeed, when students feel accepted, cared for, and connected to each other and their instructor, they are more likely to seek help or guidance when they need it, to take on more gamified instructional tasks and progress toward the shared goals. Hence, it can be said that when designing online flipped learning, supporting the feeling of relatedness among students through SDT-based gamified competition might be positively associated with their completion rate of the pre-class activities.

Finally, the current study revealed a strong positive correlation coefficient ($r_s = 0.54$, $r^2 = 0.29$, $p = 0.001$) between the interest/enjoyment variable (a factor of autonomous intrinsic motivation) and the completion rate variable. This suggests that 29% of the change in students' completion rates can be explained by the perceived feeling of interest and enjoyment, while 71% of the variance is statistically unexplained and might be attributed to other factors. In line with this result, Katz *et al.* (2014) reported the important role of the type of autonomous motivation in students' involvement in completing their homework. Zainuddin *et al.* (2021) also found that students' enthusiasm appears to be associated with their desire to take up more challenging gamified quizzes with their peers. The qualitative findings in the current study also support this notion, as some students indicated that they were keen and interested in completing the gamified tasks as they found them fun (BSTD3, BSTD22) and did not feel bored (BSTD11, BSTD28).

Overall, there seem to be positive correlations (ranging from moderate to strong) between the autonomous motivation indicators and the extent to which students completed the gamified pre-session activities. This suggests that stimulating students' psychological needs for autonomy, competence, relatedness, interest and enjoyment might motivate them autonomously to prepare before attending their online classes, participating in the team-based competition to earn as many points and badges as possible, and contributing to the team's position on the leaderboard. Supporting students so they feel like they are making progress as effective and important team members in a safe, non-controlling, enjoyable, and competitive learning environment was found to be positively associated with the completion rate of pre-session activities in this study. The finding offers suggestions to university instructors who are considering applying the flipped learning models to their online courses. It provides practical implications for instructors seeking to enhance students' preparation before attending in-session activities in online flipped learning courses, minimising the possible effect of students' disengagement in pre-session tasks as a frequently reported problem when using such an approach.

5.6 Students' Perception of Gamified FVC

One of the current study's aims was to understand the students' perceptions of their learning experience in the gamified FVC environment to shed light on the application and implication of integrating SDT-based gamification into online flipped learning in CS higher

education. This relates to the fifth research question: *“How did the Saudi university students perceive their gamified FVC experiences?”* This qualitative research question was attempted to be addressed by analysing the semi-structured interview content using data-driven thematic analysis. The current section discusses the CS students’ perceptions of their gamified learning experience, including the relevant potentials and challenges they encountered while applying this gamified FVC method.

To understand the CS students’ experiences, students’ viewpoints were explored. This step was crucial to facilitate the identification of the effective implementation and relevant practices of this online learning method, based on students’ perceptions. The participants were subjected to gamified FVC through online pre-session videos to explain various topics and key points; quizzes to check their comprehension and provide feedback; discussions, and other gamified learning activities involving SDT-based competitive and collaborative learning situations. The results of the present analysis of the semi-structured interviews implied that the students’ views regarding their experiences of the gamified method were generally positive in the online CS course (see Section 4.2.7). This has also been found in several previous studies related to different discipline contexts, including physics, mathematics, and public administration (i.e. Aşıksoy, 2017; Lo & Hew, 2020; Zainuddin *et al.*, 2021).

5.6.1 Computer Science Students’ Experiences in Gamified FVC

The gamified FVC students reported that adding gamification elements to flipped-class learning activities provided a useful learning experience and made the course more interesting, appropriate, and distinctive (BSTD11, BSTD21, BSTD22, BSTD27). For example, student BSTD22 mentioned, *“...the experience was interesting, useful and motivating for me and my groupmates...”*, while another student expressed: *“...I think this method is appropriate and I consider it an awesome experience...”* (BSTD11). This was also demonstrated by student BSTD27, who stated, *“...Honestly, the experience was good...”*. This finding indicates that most students in the gamified FVC seemed to be interested in the integration of the SDT-based gamification elements into the CS instructional content and learning materials. In addition, the preference for using instructional videos that included gamified quizzes was revealed by student BSTD27, who commented, *“...there were embedded quizzes after every short time when watching each video*

and thus earn points while watching...the way that the videos were provided was generally interesting."

In fact, creating engaging online learning activities (e.g., pre-session tasks) has been reported as a crucial factor that flipped-class instructors should consider, particularly when applied entirely remotely in online flipped learning environments (Zainuddin & Halili, 2016; Rasheed *et al.*, 2020). Uninteresting pre-session activities and instructional materials might be one factor behind students missing them or dropping out (Páez-Quinde *et al.*, 2021). Gamification mechanisms, such as points, badges, progress bars, leaderboards, and team-based competitions, might make those CS learning tasks more interesting for the students. This concurs with a study by Turan and Göktaş (2018), in which students reported that such a learning atmosphere motivated them to engage interestingly with the provided instructional tasks. The study concluded that gamification activities (i.e., Kahoot) and group work can be added to the course as motivating factors that are likely to increase students' interest in this course.

In the current study, some students relate their positive opinions to the team's achievements and how they strived to win the competition by supporting each other (e.g., BSTD3, BSTD22, BSTD28). This is in line with the findings by Tarhan and Öztürk (2022), reporting that students not only learned the subject from the pre-class videos and prepared for the class but also found integrating gamification into the learning environment interesting, instructive and enjoyable, according to the interview analysis. One possible explanation for the positive perception of gamification is that its elements included some targeted badges (e.g., early-bird badges and the star of the week) that were linked with cumulative points and bonuses, were perceived by students as specific goal signifiers for which they actively competed with their peers while completing the gamified tasks before the deadline. This notion is explained further in the following sub-sections.

5.6.2 Setting Desirable Goals

When students perceive the gamification elements as desirable goals and are supported to achieve them, they will likely feel more interested and competent (Locke & Latham, 2002); thus, they may volitionally seek to participate in competitive online activities (Huang & Hew, 2018). Indeed, in the current study, some students were trying with their peers to target higher

positions on the team-based leaderboard by earning badges and a specific number of points (e.g., BSTD3, BSTD11, BSTD21, BSTD28). For instance, student BSTD28 eluded to this notion and mentioned, *"...my group had to challenge the other groups while collecting the desired points."* Student BSTD21 also believed that pursuing other teams on the leaderboard was challenging; however, their enthusiasm was behind achieving their shared goals; as a result, student BSTD3 commented, *"I felt a sense of achievement and progression..."*. Although this goal might be considered somewhat extrinsic, the internalisation of such extrinsic rewards might potentially be facilitated by utilising autonomy-supportive gamification settings in a way that may stimulate students' enjoyment, interest, and perceived value, thus, fostering self-determined motivation.

As the qualitative results suggest, most students reported a sense of enjoyment when participating in the team-based competition by earning points and badges (e.g., BSTD3, BSTD11, BSTD21, BSTD27, BSTD28). For example, student BSTD3 said, *"The points and working in a group also encouraged me a lot and increased my enjoyment of working as a team..."*; while another student highlighted specific learning activities and mentioned, *"...the educational video activities were distinctive, easy and more fun..."* (BSTD21). Indeed, such a feeling of enjoyment has been considered a significant indicator of the internalisation of a task and a proxy for autonomous intrinsic motivation (Ryan & Deci, 2017). One possible reason behind this perceived feeling is that the gamified learning tasks were provided in a non-controlling form of competition (i.e., optional gamified forms), which might contribute to reducing the pressure of *'must do'*. As student BSTD28 implied that although they were challenging, *"...[he] did not feel pressured to complete the learning activities..."*. This justification parallels a discussion by Ge (2018), suggesting that when competition anxiety and pressure decrease, students' learning motivation tends to increase or vice versa.

In addition, another way to foster the internalisation process of the gamified flipped-class activity, according to Reeve and Jang (2006), is by presenting it with a meaningful rationale to explain why it is important to be completed. In the current study, each learning task included learning objectives and outcomes to demonstrate its usefulness and importance. As a result, students might perceive the value of each gamified learning activity differently. To illustrate, some students expressed their desire and goal to benefit from the presented new CS knowledge

for different reasons, including activity value or usefulness (e.g., BSTD22) and actively competing with others by targeting and accumulating points and badges (e.g., BSTD3, BSTD27, BSTD28). In line with previous research (e.g., Jo *et al.*, 2018; Gómez-Carrasco *et al.*, 2020; Zainuddin *et al.*, 2021), the present discussion implies that various reasons might drive students' desires to engage in learning. These included the extent to which they understand the importance of the CS knowledge and how they perceive the gamified challenges through competition (i.e., as interesting or enjoyable without feeling pressured or forced to complete those activities). According to the SDT continuum, such reasons for students' behaviours may reflect the internalised type of autonomous motivation (Ryan & Deci, 2000b) and the extent to which their actions were driven by a sense of "wantivation" rather than "mustivation" (Visser, 2017).

This finding contributes significantly to the research field by providing effective practices that can guide educators and researchers in designing internalisation-supportive activities that may engender positive competition among students. Persuasive goals may differ from one student to another depending on how they perceive these goals. The finding suggests that instructors in gamified FVC should be more flexible in supporting these goals since they can take different forms, as explained in the discussion above.

5.6.3 Gamified Choices for Self-Preparation

A learning environment that provides students with options of gamified task forms to choose from so that they are allowed to complete and compete in their own way is thought to be supportive of establishing a sense of self-determined motivation (Ryan *et al.*, 2006). In this regard, the gamified FVC attempted to deliver optional forms of pre-session resources to practice and from which to learn. Students seemed able to opt for the type and method of the gamified learning tasks based on their interests and capabilities, which might be essential in developing a sense of autonomous learning (Saputro *et al.*, 2019). The semi-structured interviews indicated that self-preparation before attending the online sessions tended to encourage involvement in the in-session tasks and deepen students' understanding of new concepts. Student BSTD21, for example, demonstrated that the pre-class task forms facilitated the acquisition and retention of information and concepts. In parallel with this perspective, student BSTD28 explained, "*...every student has his own interests and preferences when doing any activities; these interests and*

preferences often differ from student to student...So, in my opinion, the freedom to choose between the activities was very important in this course." As a result, student BSTD3 emphasised, *"I could attend the session knowing in advance the educational content required..."* Although the fact that providing pre-class activities is generally an essential characteristic of the flipped learning approach, the primary findings of the conventional FVC (control group) revealed no significant improvement regarding the completion rates of these tasks, which might be attributed to several factors discussed previously in this chapter (see sections 5.4 and 5.5). It is worth noting that the provision of meaningful choices and forms of gamified tasks was one of the distinguishing elements between the SDT-based gamified FVC and the conventional FVC. This might allow greater opportunity for the students to experience autonomous learning when performing a task, which student BSTD22 indicated as *"...a non-compulsory and free manner..."* that could increase the desire to complete extra instructional activities (BSTD11).

This result suggests that the integration of these gamified forms into pre-session activities was likely to encourage the students to preview and review the CS instructional content by completing what they might find useful, valuable, interesting, or enjoyable based on their own time and pace. This corresponds to the recommended gamification design by Nicholson (2015), emphasising the importance of introducing various gamified forms in a way that can put the student in control of how to engage with the task based on their own decisions and interests, which may motivate them autonomously to complete more learning activities. This finding also confirms the result discussed previously in this chapter, indicating a positive relationship between autonomy-supportive learning situations (e.g., choices) and the completion rate of pre-class tasks. The current study offers practical implications for students in online flipped learning environments by offering different forms of gamified pre-session activities that may suit a wider range of students' preferences. Those who may find one form of gamified task unappealing might find another more engaging. This provision of choices can contribute to increasing the completion rates and maintaining overall motivation throughout the online flipped course.

5.6.4 Team-based Challenging Tasks

Students in the gamified FVC reported that they had benefited from working collaboratively as a team, which facilitated the accomplishment of the assigned challenging tasks,

and might also foster the development of competence and relatedness feelings, since individual goals are more related to team achievement (Reiners & Wood, 2015). In the current study, one student mentioned, *"The teamwork could make the activities more enjoyable because the achievement was not for one member or individually, but it was the responsibility of everyone in the group."* (BSTD28). Another participant stated, *"...we could help each other and that also contributed to the success of our team...this method, I think, is better than working individually..."* (BSTD22). Other perspectives indicated that working together to earn points encouraged students to take on the activities in an enjoyable and collaborative learning atmosphere. For example, student BSTD11 revealed, *"...I tried to win and contribute with them [his team] to earning more points..."*. Although most of the gamified pre-session tasks required students to perform them individually, the points and badges earned from completing those tasks were eventually added to the total team account, which seemed to give the student a sense of contribution to the team's progression as an effective member, as indicated by some students (e.g., BSTD3, BSTD22).

The implementation of this notion is at the heart of SDT and in line with what was found in a study by Sailer and Sailer (2020), emphasising that a constructive culture of competition can occur when augmented with a sense of peer collaboration through gamification, including points and team leaderboards in a way that may foster cohesion within teams and competitive situations between them. In the present study, it seemed that integrating the social aspect of SDT-based gamification into flipped learning brought the class together to enjoy the team-based competition, as explicitly demonstrated by students BSTD3, BSTD21, BSTD22, and BSTD28. A possible explanation for these perspectives is that when students engage in competitive learning situations through gamification-based teamwork in a safe, non-controlling, and friendly atmosphere, they might be encouraged to willingly accept their individual roles as team members and thus want to collect as many points and badges as possible by completing the available instructional activities and go that extra mile (Chen & Hwang, 2018; Swiatczak, 2021). These findings suggest that by the inclusion of team-based learning activities and emphasising a sense of team loyalty and shared goals (e.g., accumulating points and obtaining badges for the sake of the team) as part of the gamified FVC, the perceived competence and social relatedness were likely to be supported among students.

5.6.5 Difficulties in the Gamified FVC Experience

Despite the students' positive perceptions reported and discussed above regarding the gamified FVC experiences, some students in the semi-structured interviews raised various points related to the challenges and difficulties they encountered in the CS lessons. Some might struggle with time limitations due to doing homework or tasks for other courses, while also wanting to complete and review the assigned pre-session activities associated with the CS course. This might result in mental and cognitive overload (Keong & Jimei, 2024), leading some students to attend the online sessions without sufficient preparation, possibly negatively affecting the overall group's performance and contributions. In relation to out-of-class tasks, some students implied that they could not complete some tasks effectively due to the lack of time and personal circumstances. For example, student BSTD28 mentioned, *"...I was the leader of my group, and because of my family circumstances and lack of time, I felt that I negatively affected the overall performance of my group..."* As a result, student BSTD25 said, *"...sometimes, we did not have enough cooperation when we needed to do some in-class activities..."*

Indeed, various factors might influence students' engagement and interaction with the activities, including personal circumstances or commitments, part-time jobs, exams, or, generally, time constraints (Do *et al.*, 2023). In other words, some students may struggle to prioritise completing the pre-session activities if these are unachievable and not received as important or interesting. For instance, when students feel overwhelmed by the workload due to the compulsory homework of other courses, they may allocate more time and effort to those pressing instructional tasks (Stöhr *et al.*, 2020). This was emphasised by student BSTD22, who justified his non-completion of one pre-class video by saying, *"...I was quite busy throughout some weeks."* Such challenges would likely impact students' completion rate of the pre-session activities, possibly resulting in a low level of understanding of the in-class instructional content. This is parallel with a previous study by Hao (2016), who emphasised that a lack of students' preparation before attending the class might lead to a failure in the flipped learning approach. Similarly, Fisher *et al.* (2017) found that flipped-class activities could cause some students to attend their classes unprepared, while the instructor expected that they were ready for in-class tasks and to construct more in-depth concepts based on the priorly acquired knowledge. It is suggested, therefore, that

such activities should be designed based on a robust motivation theory in a way that can attract students to perform them. In addition, it is crucial to ensure they have enough time for out-of-class activities by considering other work they may have to do associated with other instructional courses or personal commitments (Ding *et al.*, 2018). Indeed, it is also vital to monitor students' performances and progression in the pre-class activities to ensure that they have at least the essential knowledge required for the in-session activities (Long *et al.*, 2017). This might be achieved by harnessing the progression-monitoring aspect of gamification elements (e.g., progress bars) that allow the instructor to identify students who need help, and thus, meaningful feedback could be offered.

Another difficulty implied by two students was that the design of some gamified pre-session instructional videos was not attractive. For example, some gamified quizzes in those videos were assigned in the middle of points or information that a student described as easy, so they wanted to skip and accelerate the videos. In the meantime, they needed to ensure that they did not skip any gamified quiz attempting to earn all the points available in those videos despite the non-compulsory form of the embedded gamified quizzes. One interviewee mentioned, *"I was also not able to skip certain parts of some videos because of the embedded quizzes...so, in order to collect all the points, I felt I was forced to watch the entire video as I could not skip some unimportant information."* (BSTD25). While an opposite opinion was reported by student BSTD21, *"I did not want to speed up the video or skip some parts because most of the videos were interesting..."*.

This may suggest that some students could easily understand some parts of the instructional content presented in the pre-session videos, so they might want to speed up or skip some parts when watching, while other students might find those parts interesting. Nonetheless, in both cases, they arguably did not want to miss any of the gamified quizzes in order to collect as many points as possible. This may also indicate that some students were more interested in earning points and badges than the instructional content itself, which may explain the small change (between the pre-and post-questionnaires) regarding the students' overall responses to a questionnaire item asked about the extent to which they found the CS instructions valuable. Although the quantitative findings showed that most students were interested in completing the

gamified learning activities, it is possible that some students might be interested in the gamified competition and, meanwhile, not perceive the CS instructions as valuable. This emphasises the importance of the activity design and advises the flipped-class instructor to consider the provision of a convincing rationale for completing each learning task to explain its usefulness and value. In this regard, one student commented, *“I think the video should be creatively designed so that the information in it should be linked with daily life.”* (BSTD28), while another indicated, *“...the embedded quizzes were asked at some points of the video and neglected some other parts of the instructional content.”* (BSTD3).

This is in parallel with the findings by Reeve and Jang (2006) and Neufeld (2021), which revealed that the instructor should put effort into explaining why a particular task might be useful in order to help students build an integrated value. Hence, besides the emphasis on the tasks' value, it is crucial to investigate and understand how the gamified learning activities are designed, particularly in the pre-session phase. The findings of the current study suggest that these tasks need to be perceived by students as interesting, so those who might not sufficiently see the importance, value, or usefulness of an activity might find the gamified competition an interesting or enjoyable experience; thus, their overall autonomous motivation might potentially be stimulated (Ryan & Deci, 2017). It can be said that SDT-based gamification that incorporates collaborative activities and challenging tasks accompanied by the provision of meaningful rationale for each task can enhance the effectiveness of flipped learning and instil a sense of autonomous learning.

This discussion intended to highlight some advantages and challenges based on students' experiences and perceptions of the gamified FVC. These will allow instructors who apply online flipped learning to consider the positive practices, and the relevant challenges mentioned above to create more supportive and engaging online courses, contributing valuable insights to the field and guiding future research. More studies might use this finding as a starting point to explore and examine these aspects to provide more effective implementation practices. Several adoption and design considerations related to the implementation of the gamified FVC should be addressed. These will be further discussed in the following section.

5.7 Key Adoption and Design Considerations in Gamified FVC Implementation

Several behavioural and motivational process theories, including, for example, self-determination theory, self-efficacy theory, flow theory, social comparison theory, reinforcement theory, and goal-setting theory (Cook & Artino, 2016; Benke, 2019), have been suggested for different gamification designs and implementations in various teaching and learning environments. However, the gamified FVC method used in the present research was mainly based on the principles of the theory of self-determination for many reasons previously explained in detail in the literature review chapter (see Chapter Two, Section 2.5). One of the present study's aims was to provide key considerations and suggestions regarding the incorporation of SDT-based gamification into the FVC, considering the practical experience and an examination of this method based on students' perceptions as well as the existing literature review. The SDT-based gamification mechanisms were integrated into online flipped-class content elements, including educational videos, online quizzes and discussions, and team-based tasks. These elements have indeed been utilised in several studies (e.g., Jo *et al.*, 2018; Huang *et al.*, 2019; Lo & Hew, 2020; Zainuddin *et al.*, 2021); however, to the best of the author's knowledge, there has been a lack of research that investigates the effect of gamifying those elements with the flipped learning approach in a fully online instructional course on students' autonomous motivation; while also assessing the extent to which the indicators of this variable related to the completion rate of pre-session activities (Phillips & O'Flaherty, 2019; Xiao & Hew, 2023). The procedures for the gamified FVC method, implemented in the current study, are explained in detail in Chapter Three, Section 3.2.5.

The present research collected data via semi-structured interviews to address the sixth research question (i.e., *What are the key adoption and design considerations that need to be addressed when implementing the gamified FVC method for autonomously motivating learning?*) to evaluate this method and understand the students' views considering its potential, which might help to provide useful suggestions for future implementations. According to the qualitative findings, several points were raised by the interviewees concerning the instructional videos, the gamified quizzes, and the team-based tasks that were utilised in the gamified FVC.

First, one of the key elements often used in the flipped-class modules is instructional

videos (i.e., pre-session videos), which facilitate the provision of the essential instructional content required as a base for students to enable them to construct more advanced levels of knowledge and skills through in-session activities (Bergmann & Sams, 2012). In the current study, the interviewees raised some suggestions to maximise the benefits of such gamified videos and potentially produce more attractive and interesting online learning materials, which may encourage students' engagement and preparation. In this regard, some students reported:

"...the content in some videos was explained in clear informal language and the information was not provided directly but was presented in indirect but interesting ways at the same time..." (BSTD3).

"...the definitions of some terms, the function of particular devices or parts of the computer, or certain software commands that were shown in the pre-class videos were easy to be understood and answered and thus gaining more points..." (BSTD11).

"I liked the integrated videos and quizzes more than other types of learning activities...because they presented the information in an interesting way, in the form of gamified videos..." (BSTD22).

In addition, student BSTD11 added that those videos were preferable because they presented concepts and content *"...were very clear and understandable..."* These perspectives indicate that when watching the instructional videos, the simple and straightforward language (i.e., Arabic slang) used to deliver the CS concepts and embedded gamified quizzes made them more gameful as well as understandable for some students than those using formal academic language, which might be a barrier to understanding and did not reflect the playful atmosphere, as mentioned by student BSTD3, who added, *"...some of the videos were explained in formal and academic language I think it was quite unclear."* It seems that using easy, everyday language to explain some concepts in the pre-session videos and embedded gamified quizzes created joyful situations and encouraged some students to engage in their learning; whereas other instructional videos that used more academic language might negatively affect out-of-class engagement.

This is consistent with other studies (e.g., Huang & Hew, 2018; Turan & Göktaş, 2018) emphasising that in pre-class CS activities, although students are often expected to learn basic concepts, definitions, and functions of certain software and programming orders and codes before performing or applying them in class or in the computer lab, dealing with the difficulty of some complex or unclear concepts out-of-class time may lead to a decrease in students' learning

motivation. Therefore, instructors are advised to strike a balance between using formal and informal language and ensure that the instructional content and gamified quizzes included in the pre-session videos are suitable for the gameful learning atmosphere and presented clearly and understandably to maximise their vital role in the preparation process.

Another relevant observation reported in the semi-structured interviews is that before doing a gamified task or watching an instructional video, students often look first at their titles and lengths, which might influence their decision to engage in these tasks. Related to this design issue, two students emphasised:

"The title of the video is also important in attracting attention...the title should be more attractive and not just a title that reflects the lesson content. For example, in a lesson "Using MS Excel", the title should not be as simple and boring as this, but rather, it should be more attractive." (BSTD28).

"In my opinion, there were some negatives in the length and quality of some educational videos. I think some of them were excellent and some were not..." (BSTD3).

In addition to the video title, the researcher asked the interviewees about their perceptions and preferences of the gamified instructional video to gain insights into its design. Some participants noted that the length of those videos was generally acceptable, approximately 10–15 minutes, as exemplified in the following statements:

"...I think they [the videos] were clear and not very long or boring...if the videos were long (for example, more than 15 minutes), I would not be able to focus and I would therefore miss some of the information in those videos and I would not be able to complete the quizzes properly...So I think the length of the videos is very important." (BSTD28).

"...one of the videos was a bit long, but the other videos were not that long...I think that the length of each video should be between ten to fifteen minutes." (BSTD11).

One possible effect of the pre-session video duration on its completion rate was revealed by student BSTD21, implying that since most of the videos were interesting short-length clips, *"...[he] did not want to speed up the video or skip some parts..."*. Indeed, the video length can be vital in affecting students' interest in such learning materials (He *et al.*, 2016; Al-Samarraie *et al.*, 2020), engagement levels, and cognitive load (Brame, 2016). Some students might compare the

length of the video with the number of points they were able to earn from watching it before they decide to engage in the task. In line with this finding, Wagner *et al.* (2013) found that many students disliked watching a long pre-class instructional video. Giuliano and Moser (2016) also found a negative relationship between the length of the videos and the rate of watching these videos by students. Therefore, it was suggested that in order to maximise its potential, a long video-based lecture should be posted on the online platform as a series of short-length videos (Battaglia & Kaya, 2015; El Miedany, 2019). The current study recommends that a flipped-class instructor should carefully consider the title and length of gamified pre-session videos as well as the total points and badges that can be earned from watching those videos, since they can potentially contribute to the students' first impression of an instructional video. This might also influence their decision to engage and build interest in watching it.

Second, some students implied that the gamified quizzes helped them to understand the topic's concepts, as shown in these reported statements:

"The quizzes that were embedded into the videos helped me focus on the information presented in these videos..." (BSTD21).

"...this helped me a lot in understanding most of the lessons' points." (BSTD3).

"I liked the quizzes embedded into the videos the most because the instructional content was clear, and the questions were timely." (BSTD11).

These comments indicate the importance of integrating gamified quizzes into flipped learning to maximise its potential. Although quizzes were embedded in both the gamified and non-gamified FVC groups, the findings discussed early in this chapter revealed that, unlike the non-gamified quizzes, basing their design on gamification elements that focus on providing support for students' autonomy, competence, and relatedness tended to stimulate their autonomous motivation to complete them effectively. However, student BSTD3 indicated that the online quizzes focused on some parts of the content and should cover all the information presented in these videos, whereas student BSTD25 stated:

"...I think it would have been better to separate the quizzes and their points from the videos so that we could answer them all together and collect points quickly instead of having to watch the entire video and wait for each quiz to appear."

In fact, these quizzes were created based on specific instructional objectives previously assigned to each lesson in this CS course, to check students' understanding of the relevant main concepts. Considering these objectives in the design of online pre-class tasks, including gamified quizzes, might play a vital role in boosting students' engagement with in-class activities and knowledge construction. This notion is consistent with a conclusion made by Wang (2019), who emphasises that engagement with pre-class tasks can influence the statistical relationship between the extent to which students engage in in-class learning and their achievement of instructional objectives. However, allowing students to choose whether they want the gamified quizzes to appear throughout the video or at the end of each video might be an effective practical design suggestion, and an idea worth considering, particularly in supporting a sense of choice. Therefore, more studies are needed to explore the efficiency of this design suggestion.

Finally, one suggestion was provided by student BSTD25, who highlighted a fundamental issue that needs to be considered by the instructor when dividing students into teams or groups, *"I believe that dividing the students into groups should be done in a balanced way so that there is a kind of performance equality between the groups."* Student BSTD22 emphasised, *"... working in groups depends on how active each team member is..."* This issue was also raised by student BSTD28, who recommended that *"...it is important to divide students into balanced groups based on their abilities rather than creating the groups randomly."* Student BSTD3 also commented, *"Our team was so strong to compete with other teams because all of us were active and wanted to win the competition."* This finding stressed that the overall characteristics of students in the divided groups might influence the level of peer interactions and collaboration when in the flipped learning environment (Chuang *et al.*, 2018). The interviewee BSTD28 then suggested, *"...students' performance should be evaluated before creating groups to have balanced groups."*

It is worth pointing out that the current study strived to reduce the possible effect of this issue by conducting a pre-test and pre-questionnaire to assess students' CS background knowledge and online learning self-regulation skills in both groups, the gamified FVC and non-gamified FVC. Based on their results, students were divided into six groups of five or six members (see Chapter Three, Section 3.2.5). This step might contribute to minimising the potential characteristic variation associated with prior CS knowledge and self-regulation skills between the

groups when engaging in group-based tasks. However, in social science research, it is important to keep in mind the complexity of human behaviour and emotions, other external variables or unexpected personal circumstances which may have an impact in the context of flipped learning, as expressed by students BSTD22 and BSTD28. The findings suggest that evaluating the teams' performances regularly during the course period, and regrouping students when needed based on this evaluation, might increase the collaboration and competition aspects of the gamified FVC method, as indicated by BSTD27. These findings provide practical adoption and design suggestions, based on both students' perspectives and the relevant literature, which will contribute to enhancing the integration of gamification mechanisms into flipped learning for autonomously motivating instructional design. These suggestions will inform the implementation of future gamified FVC, incorporating elements that may resonate with students' preferences.

Overall, the key findings of the current study emphasise the critical roles of instructors and the structure of the learning environment in the effectiveness of gamified FVC. Applying such a student-centred approach requires the instructor to adopt autonomy-supportive practices as a first step towards an autonomous motivating learning style, which was found to be positively correlated with the completion rate of pre-sessional activities. Several flipped learning studies mentioned in the literature review considered providing students with flexibility in time and place when doing pre-class activities as sufficient support for autonomous learning. However, although such flexibility can be an influential component of autonomy-supportive environments, the present investigation has shown that this component was not enough to significantly enhance the autonomy factor among students. This should involve a sense of freedom to choose what goals to pursue and what challenging path to take based on inner interests. Instructors are advised to adopt such practices to maximise the effectiveness of FVC and yield significant enhancements in student outcomes. It is also crucial to consider other factors, including interest/enjoyment, competence, and social relatedness, as these were found to be positively correlated to autonomous learning and motivation. The current study has demonstrated how to integrate SDT-based gamification into FVC to create autonomous motivating learning that may support these factors. This advances the understanding of autonomy in flipped learning by considering and evaluating the effect of various practices related to this factor. Moreover, by isolating the effect of gamification intervention within an FVC context, the study offers substantial

insights into how gamification might influence autonomous learning motivation and pre-class activity completion rate in FVC, contributing individually to both gamification and flipped learning as two separate concepts.

5.8 Summary

The current chapter has discussed the key quantitative and qualitative data analysis results, which were synthesised, explained, correlated, and eventually compared to the findings of previous studies. Integrating SDT-based gamification mechanisms into online flipped learning was reported to be a promising instructional intervention that might positively impact CS students' achievement scores. The findings obtained from the experimental group (i.e., gamified FVC) and the control group (non-gamified FVC) were discussed to demonstrate the extent to which students in the gamified FVC format felt autonomous, competent, and socially related to their peers when engaging in their learning in comparison with the non-gamified FVC setting. These motivational factors have been considered fundamental and supportive components of autonomous motivation; therefore, it was crucial to discuss their role and how they can be stimulated through harnessing SDT-based gamification mechanisms.

Moreover, the correlation coefficient within and between autonomy, competence, relatedness, and interest/enjoyment was statistically assessed and then explained based on both quantitative and qualitative results. This assessment was carried out mainly to provide an in-depth understanding of the detected relationship between autonomous intrinsic motivation (i.e., interest/enjoyment) and the three psychological needs of autonomy, competence, and relatedness. Furthermore, integrating SDT-based gamification into a fully online flipped learning environment was found to minimise the potential effect of one of the most reported problems when implementing flipped learning: students' lack of preparation before attending in-class sessions. This finding has been discussed in this chapter, along with the results of the correlation between the students' perceived autonomous motivation and the extent to which they complete the pre-session activities.

Finally, the last two research questions addressed in this chapter were qualitative and pertained to students' perceptions of incorporating SDT-based gamification into an FVC related to CS learning. From this perspective, several advantages and challenges were highlighted and

discussed concerning the implementation of the gamified FVC, in addition to relevant adoption and design considerations based on students' experiences and an examination of this method. This has enabled the researcher to provide gamification design suggestions for future applications. This study has shown that integrating SDT-based gamification design into an online flipped learning environment can contribute to enhancing students' autonomous motivation, learning achievement, and completion rate of pre-session activities in the Saudi higher education context. The implications of these findings and the study's contributions to conceptual and pedagogical advancement will be discussed further in the following chapter.

Chapter Six – Implications and Conclusions

6.1 Introduction

This chapter aims to briefly discuss the implications of the research findings in relation to the relevant fields of knowledge and research, and how the study might impact students, educators, and policymakers. The chapter also provides conclusions about the key results from the quantitative and qualitative research methods related to the research questions of the current study. Additionally, the chapter will shed light on the contributions of this research regarding the implementation of gamified FVC in the broad literature and, specifically, in the Saudi context. Finally, the present study has limitations that will be reported before providing crucial future research suggestions and recommendations.

6.2 Implications

This section briefly discusses who might benefit from the research findings reported in the current study. The implications are classified into different subsections, as implications for: knowledge, instructors, students, policymakers, and the research field. Additionally, recommendations for effective gamification and online flipped learning implementations are presented.

6.2.1 Implications for Knowledge

Several studies have investigated flipped learning and gamification, producing mixed and inconsistent findings. Many universities worldwide have applied the flipped learning approach to deliver their online courses, even after the Covid-19 pandemic. However, evidence regarding the application of this approach to fully online learning environments is still lacking globally, and particularly in Saudi Arabia. This lack of studies might make it difficult to determine how to develop online flipped learning and how the integration of gamification can possibly take part in this development to maximise its effectiveness. Online flipped learning is a relatively new pedagogical approach, and its theoretical underpinnings remain largely unexplored. Conducting the current study has contributed to refining the SDT, by understanding how to incorporate its principles into online flipped learning through gamification elements to produce motivation-supportive virtual learning environments, in which autonomous learning is emphasised. In

addition, it provides practical insights into bridging the principles of this motivation theory and the social constructivism foundation of flipped learning models.

In the Saudi context, the Vision 2030 project has encouraged the universities in this country to transfer many instructional courses to effective online learning, by harnessing advanced educational technologies in their teaching practices in which learning revolves around the student (Abdullateef *et al.*, 2023). It is crucial, therefore, to support the research community in suggesting effective research-based educational technology and learning design that considers such a developmental orientation and the global direction in online learning. The study can be the starting point for providing evidence regarding the innovative online flipped learning approach and students' autonomous motivation to learn, particularly in computer science (CS), a fundamental field widely demanded in various domains. It also provides evidence-based guidelines for designing and adopting gamification interventions in online flipped learning.

Moreover, the lack of research demonstrates methodological challenges that the current study has attempted to minimise. One of these issues that can affect the validity of the findings in many studies is neglecting the statistical comparability of the data collected from the experimental and control groups. In other words, the potentially significant differences in baseline characteristics (e.g., prior knowledge, online self-regulation skills, initial motivation) between the two groups can make it difficult to attribute the educational outcome changes to the gamified intervention. The current study also assessed autonomous motivation through four dimensions (i.e., autonomy, competence, social relatedness, and interest/enjoyment) that have been considered proxies for this variable. In addition, the relationships between SDT principles and intrinsic motivation were also assessed statistically. This will allow the researchers in this field to deepen their understanding of the phenomena. The qualitative research phase was essential in the current study to understand these statistical analysis results and obtain some findings that quantitative data could not reveal (e.g., the need for extrinsic rewards to begin engagement and the value of gamified tasks can be perceived differently across students). This study provides evidence to scholars in this research field regarding the importance of utilising mixed-method research. Furthermore, it offers methodological guidelines for practical assessments of students'

perceived autonomous learning motivation that future studies may utilise in such gamified online learning contexts.

6.2.2 Implications for the Research Field

The literature review in the current study showed that numerous studies have claimed that the flipped learning approach can stimulate students' learning autonomy since it provides them with flexibility in place and time when requiring them to complete pre-class activities. The present research supports this claim by demonstrating the critical role of flexibility in autonomous learning and the effectiveness of the pre-class tasks in flipped learning. However, the findings revealed that supporting flexibility might not be enough to motivate students autonomously to complete these tasks. The study demonstrated that flexibility is not equivalent to autonomy and provided practical suggestions for supporting autonomous learning motivation by integrating SDT-based gamification to maximise the effectiveness of the flipped learning approach. Although incorporating this method into online flipped learning is relatively new in this research field, the gamified FVC can inspire future research by suggesting an innovative framework that considers certain practices that promote internalisation and motivate students to prepare before attending their classes.

Indeed, most studies focus on the impact of pre-class tasks on performance and achievement, while little research investigates how to motivate students autonomously to do these tasks, especially in fully online flipped learning environments. The current study bridges research areas, including instructional design for such learning environments, educational psychology, and gamification integration. This study may impact the current research direction of flipped learning by inspiring further investigation to focus on how to create gamified pre-sessional activities that are more supportive of autonomous learning motivation. Future research concerning the development of online flipped learning would benefit from the analytical agenda proposed in the current study and may adopt the process of examining and exploring autonomous motivation through four indicators and the interrelationships between them using mixed-method research to better understand the effectiveness of the flipped-class activities used. This is important since autonomous learning has been the core of flipped learning, and rather than focusing merely on the impact of such activities on students' achievement and

performance, considering the potential influence of their design based on different theoretical frameworks is equally crucial.

6.2.3 Implications for Instructors

Students' disengagement in pre-session tasks has frequently been reported as one of the main challenges instructors may encounter when applying flipped learning. This issue has arisen for several possible reasons discussed previously in the literature review chapter. These reasons may include, for example, low motivation, task difficulty, resistance, and procrastination, which can negatively affect students' learning progress in such learner-centred environments. Flipped-class instructors should understand that providing students with pre-class videos or tasks without considering their design and the purpose of each element might not be enough to produce engaging learning activities. These out-of-class tasks should be designed or reviewed in a way that can motivate them autonomously to learn and progress. The literature review revealed that many flipped-class instructors have called for motivating practices that can increase the effectiveness of flipped learning. The current study's findings suggest that integrating SDT-based gamification into the FVC is likely to enhance students' autonomous motivation, particularly when their basic psychological needs for autonomy, competence, and social relatedness are supported, resulting in an improved completion rate of pre-session activities.

Several design elements can play vital roles in stimulating these motivation factors and, in turn, in increasing completion rates. One element to be considered is autonomy-supportive gamification. Giving students a choice about how they might engage with the instructional activities by posting different forms of gamified tasks in the online learning platform was found to be a key factor in engendering a sense of autonomous learning. In addition, emphasising a meaningful rationale for each gamified task by which the usefulness and value are explained, was crucial to promoting volitional actions among students. In the gamified FVC, the task value could vary from one student to another. In other words, while some students may understand the value of a task for future studies or other relevant courses (e.g., the value of learning MS Excel for progressing in a statistics course), other students may more value a gamified task because they want to support their teams and feel like effective contributors in achieving the team's shared goals. Such practices were also found to boost students' competence and social relatedness. The

competence-supportive gamification dynamics, such as accumulating points and progress bars, used in the pre-session tasks may enable instructors to identify students who are behind and need help to progress, and then provide meaningful feedback based on their performance. The gamified FVC allows students to choose their learning pathways based on their abilities and interests, contributing effectively to their feeling of mastery and progression. This process could also engender supportive relatedness practices when maximising students' abilities to support the team's progression, based on their individual differences and preferences; thus, emphasising their role as important team members. This study develops practical guidelines for instructors aiming to develop autonomously motivated learning, essential for effective learner-centred environment design. Indeed, the time constraints some instructors may encounter might make it seem challenging to incorporate gamification into their teaching planning; however, the main aim of SDT-based gamification intervention is to support students to be more autonomous and engaged in their self-learning and to prepare them before attending the online class. As a result, this is expected to reduce lecturing time and free up more time for instructors to plan, assess, and provide individual support for students.

6.2.4 Implications for Students

The present study introduced SDT-based gamified practices that may play a vital role in making learning activities more engaging for students, in comparison to the conventional flipped learning approach. Students reported their interest and enthusiasm when this gamification design was integrated into the FVC and accepted the changes to their online learning environment. The flipped learning approach has been applied worldwide in many online courses, and particularly in Saudi universities. The participants in this study were accustomed to being taught using the flipped learning approach in most online instructional modules, particularly after the Covid-19 pandemic. However, when adding SDT-based gamification to their learning environment, the students showed higher autonomous motivation levels and enhanced engagement rates.

Indeed, this study demonstrates that flipped learning allows students to learn at their own pace through completing asynchronous pre-session activities, such as watching instructional videos and completing quizzes. They can then construct more advanced knowledge through

collaborative in-session activities, including application-based tasks. However, integrating SDT-based gamification design could make these activities more persuasive for students so they might willingly accept responsibility for their learning and progression. Endorsing learning responsibility has been considered fundamental in internalising the reason behind students' actions (e.g., teamwork value or CS knowledge value), reflecting their self-determined motivation to learn. Indeed, goals may differ from student to student; therefore, the gamified FVC emphasises the importance of supporting the diversity of these goals. Furthermore, unlike grading systems in which students' performance is often judged and evaluated in a controlling way, employing the aspect of progression indicators of gamification in a non-controlling manner was an effective tool that helped the students to self-evaluate their progress and developed an internal locus of evaluation, which can reduce the external and internal pressure of "mustivation" (i.e., must do actions).

These SDT-based gamification practices have implications that may well, therefore, enhance students' achievement and autonomous learning. The study found that providing students with collaborative activities might not be sufficient to develop a sense of belonging and social relatedness. Instead, students need to understand the value of teamwork, be interested in participating, and believe that their contributions (e.g., levelling up the team position on the leaderboard) can make a difference and will be acknowledged by the instructor and peers. Team-based activities encourage students to share their knowledge and maximise their zone of proximal development (ZPD) as they are urged to help each other in achieving shared team goals. The study findings suggest that balancing the competition and collaboration aspects of gamification can play an important role in producing constructive or destructive competition among students, depending on how they conceptualise each other and perceive winning and losing. The proposed practices might provide team-based competition that can motivate students autonomously to be well-prepared for online classes, allowing more time for in-class applications and other higher-order thinking skills.

6.2.5 Implications for Policymakers in Education

Since the Covid-19 pandemic, there has been a growing focus in Saudi higher education on developing distance education and transferring many instructional modules to fully online

learning formats, as supported by Vision 2030. However, educational policymakers should understand that providing advanced online learning platforms and digital devices may not be sufficient to enhance learning outcomes in this essential educational sector where autonomy is a critical element of its development. The findings suggest that these platforms can be equipped with gamification elements and guidelines for effective strategies and designs that support the creation and adoption of autonomously motivating instructional practices, which are possibly associated with positive educational outcomes. In addition, Saudi instructors should be encouraged and trained to apply innovative online teaching and learning approaches that revolve around the learner and emphasise autonomous learning skills. This training may include how to employ, or design gamified pre-session activities that can motivate students intrinsically to engage in their learning and prepare for the in-session activities. Indeed, motivation can be the energy that keeps the learning wheel turning; thus, this factor should be considered when designing or adopting such activities. The current study provides suggestions and practical procedures regarding how to design motivation-supportive instructional activities, which can be included in teaching guidelines, training programs, and curricula. Applying effective online teaching and learning approaches, such as the gamified FVC, also requires policymakers to offer instructional video editing platforms and gamified quiz tools (e.g., Edpuzzle and Wordwall) that can spark creativity and curiosity among students. These elements should be incorporated into the university's VLEs (Virtual Learning Environments) to enable the instructors to customise their gamification design to suit their students' learning and educational objectives. It is acknowledged that gamification is not a one-size-fits-all method; however, the present study shows that when the gamified system succeeds in supporting the three psychological needs of autonomy, competence, and social relatedness among students, positive findings related to autonomous learning motivation and educational outcomes can be expected across different disciplines.

6.3 Summary of the Study

The current study aims to contribute to flipped learning and gamification literature by investigating the effect of integrating SDT-based gamification into FVC on students' autonomous motivation, achievement, and completion rate of pre-session activities. The study employed SDT as a theoretical framework for a practical flipped learning approach that is often underpinned by

the foundation of social constructivism. This section summarises the possible impact of the gamified FVC on students studying computer science, compared with utilising the non-gamified FVC, inferring from the findings of this mixed-method study in Saudi higher education. In this context, a promising plan has been supported by the Saudi Vision 2030 project to harness advanced educational technology in transferring many university courses to online learning formats. In addition, computer science teaching and learning has gained much attention from universities worldwide, including Saudi universities, possibly due to the increasing demand for this domain in today's job market. This has motivated the researcher to conduct the current study, particularly in this context.

Moreover, research on the flipped learning approach has reported positive results and is recommended to be utilised in fully online education. However, one of the most frequently reported problems in the relevant literature when applying such student-centred approaches is that many students tend to miss pre-session activities and attend online sessions without preparation, reducing the effectiveness of flipped learning. The literature review in the current study showed that this issue remains unsolved and needs more rigorous investigation, since the pre-class phase is considered a foundational principle in flipped learning that can impact students' knowledge construction and learning process. Many studies have indicated that students in such learning environments need to be motivated to engage in out-of-class activities and put more time and effort into completing them; otherwise, they may perceive these tasks as tedious and disengaging. Hence, this research problem has been central to the current investigation.

Based on this reasoning, this study has investigated how to develop an innovative online flipped learning environment in which students are autonomously motivated to take responsibility for their learning by completing pre-session activities and preparing effectively to progress; thus, enhancing their achievement in a CS course. It has also explored students' perceptions of the integration of gamification into the FVC and the adoption and design considerations that need to be addressed when implementing this combined method. Therefore, explanatory, sequential, mixed-methods research with a quasi-experimental design was utilised to answer the research questions (see Chapter Five, Table 5.1) through a comparison between the experimental and control groups. This was undertaken in a university in the city of Jeddah,

Saudia Arabia, from the 10th of February to the 5th of May 2022, with 34 participants for the gamified FVC group and 32 for the non-gamified FVC group.

A pre- and post- test was conducted to assess learners' achievement before and after the study intervention, while their performance was measured using quizzes and formative assessments. The completion rate variable was also monitored and evaluated, utilising the VLE reports throughout eight weeks. In addition, the researcher employed a pre- and post-questionnaire to assess students' autonomous motivation, by focusing on four dimensions (i.e., autonomy, competence, social relatedness, and interest/enjoyment) that are considered the main components of motivation. Furthermore, the gain score method (post minus pre) was applied to the achievement tests and questionnaires to ensure that only the changes between pre- and post- scores were included in the data analysis. The direction and strength of the correlations within and between the autonomous motivation dimensions and the completion rates of pre-session activities were also assessed. This process helped the researcher identify the interrelationships between the three basic psychological needs and autonomous intrinsic motivation, as well as the extent to which these are correlated with autonomous learning outcomes in this context.

Sequentially, semi-structured interviews were carried out as a qualitative data method, involving seven students from the gamified FVC group, to gain an expanded understanding of the effect of integrating SDT-based gamification into an FVC on Saudi CS students in terms of their autonomous motivation and completion rate, and the relationships between these variables. This data method also aimed to understand students' perceptions of the gamified learning experience and to gain valuable suggestions regarding the adoption and design considerations for autonomously motivated learning. Based on these aims, thematic analysis, including theory-driven and data-driven coding, was applied to analyse the data collected from the interviews.

The quantitative and qualitative findings suggested that integrating SDT-based gamification into FVC improved students' learning achievement and performance, their autonomous motivation, and their completion rates of pre-session tasks. Based on the data analysis of the calculated gain scores, students in the gamified FVC showed higher scores than those in the non-gamified FVC. Similarly, the average score of the eight-week formative

assessments revealed a significant difference between those two groups in their overall performance. Moreover, the perceived autonomous motivation of the students in the gamified FVC group was reported to increase, based on analysing the gain score data obtained from the pre- and post- questionnaires, and compared to their peers in the non-gamified FVC.

Indeed, the qualitative data analysis helped the researcher to identify the possible reasons behind some of the quantitative results. These reasons include, for example, providing students with different forms of gamified pre-class tasks and meaningful rationales to explain the importance and usefulness of each instructional task; allowing students to choose from these tasks based on what suits their abilities, goals, and interests; offering progression-supportive feedback; creating friendly team-based competition in which students help each other to progress; acknowledging each contribution to the team using points and badges, making them feel they are important team members for the team's progression. These practices were found to support students' feelings of autonomy, competence, and social relatedness, which, in turn, contributed to stimulating their autonomous motivation to learn and engage effectively in instructional activities.

Supporting autonomous motivation was found to be positively correlated with the completion rate of pre-session tasks. However, the quantitative results showed no significant differences in this variable between the gamified and non-gamified groups in the first two weeks, which may be attributed to students being unfamiliar with the study intervention. In contrast, the weeks from three to eight reported an increase in the completion rate for the gamified FVC compared to the other group. The findings revealed that autonomously motivated students tended to complete extra pre-class activities.

The study findings indicate that the students' motivation in completing pre-class activities showed a clear pattern. Accordingly, most students in the gamified FVC needed two weeks to fully engage in these competition-based gamified tasks. This emphasises the importance of allowing sufficient time for students to establish engagement and become accustomed to the gamified system while providing optimal challenges to support and sustain students' motivation. Indeed, individual differences in learning style and motivation may influence these results. Therefore, providing flexible choices of gamified tasks and continuously monitoring students'

engagement are crucial elements in the SDT-based gamified FVC that may allow the instructor to optimise the integration of gamification elements into flipped-class activities for a more effective design.

The present research has also attempted to understand students' perceptions of SDT-based gamification intervention according to their experiences. The interviewees mentioned several advantages, challenges, and suggestions regarding the integration of gamification into the FVC. In this gamified environment, students were likely to perceive the gamification elements as desirable shared goals that they worked with their teams to achieve. Indeed, while some students understand the value of the CS concepts and activities, others might see the importance of completing these gamified tasks for the team's progress and position on the leaderboard. Most students stated that the provision of choices and different forms of team-based gamified tasks were crucial factors that motivated them to complete these tasks based on their abilities and interests. However, other factors were reported to influence their motivation to complete these tasks, including personal circumstances or commitments, exams, and time constraints. These factors should be considered by the instructor to minimise their negative effects on students' learning and progression. Furthermore, useful suggestions were provided by students that will contribute to enhancing the implementation of the gamified FVC method. These include, for example: using informal language (i.e., Arabic slang) that represents a game-like atmosphere when presenting the video content as much as possible; dividing lengthy videos into a series of short gamified videos; allowing students to choose the way that they want to take the embedded gamified quizzes (i.e., within the video or at the end of it); and grouping the students into balanced teams based on continuous evaluation of their performance, to maximise the competitive aspect of gamification.

Finally, although the findings indicate the effectiveness of integrating SDT-based gamification into the FVC on the investigated learning outcomes, the complexity of human behaviour in social science research can make it impossible to infer that these gains were attributed entirely to the study's intervention. However, the study showed that when providing gamified educational practices that can support students' basic psychological needs for autonomy, competence, and social relatedness, similar findings can be expected. Hence, it can be

assumed that flipping virtual classrooms using SDT-based gamification intervention contributes to reducing the effect of one of the most reported problems frequently mentioned in the relevant literature: students' non-completion of pre-class activities.

6.4 Research Contributions

The reported mixed-method research findings and the methodology used in the current study make significant contributions to the body of the gamification, flipped learning, and SDT literature globally, and more specifically, in the Saudi context, where there has been a need for conducting studies that investigate how to develop effective, online flipped learning. This need is supported by the desired changes in Saudi education underpinned by the current development orientation in this essential sector.

The present study examined the applicability of SDT in a gamification-based online flipped learning environment for autonomously motivating learning. This will contribute to the existing literature and add to the understanding of SDT applications in such innovative learning settings; a review of the relevant literature revealed that no study has been focusing on students' autonomous motivation in a gamified, online flipped CS learning environment. Supporting the three basic psychological needs for autonomy, competence, and social relatedness in an SDT-based gamified FVC was found to be correlated with autonomous intrinsic motivation and positive learning outcomes. This provides evidence to demonstrate the effectiveness of applying this theoretical framework, presented in SDT theory, in enhancing students' experiences of FVC. Based on this, the present study advocates that the application of SDT-based gamification to such online learner-centred environments can contribute to reducing the negative effect of students' low completion rates of pre-session activities, a frequently reported problem according to the existing literature.

This study, therefore, contributes to filling this gap in the pedagogical literature by suggesting the SDT-based gamified FVC, which seemed promising in terms of enhancing students' autonomous motivation to prepare for their online classes and construct their knowledge effectively. Moreover, learning in the gamified FVC environment is provided as collaborative tasks and team-based applications rather than isolated work. The study showed how supporting team loyalty and the spirit of teamwork through utilising gamification mechanisms can promote a sense

of a learning community among students, which can relate to their feelings of social relatedness. This could play a vital part in making each team member accept their role and endorse the responsibility of completing the gamified tasks and contributing to the team's progress and position on the leaderboard. Although students in the gamified and non-gamified groups experienced group work, integrating SDT-based gamified teamwork was likely to compensate for the limitations of the online flipped learning environment and maximise its effectiveness, where students are autonomously motivated to complete the activities and progress in their learning.

The current study also provides methodological contributions to the existing literature. The autonomous motivation factor was investigated based on four dimensions (i.e., autonomy, competence, social relatedness, and interest/enjoyment), and then the correlation between the satisfaction of the three psychological needs and intrinsic motivation was assessed. The study also applied a gain score method to ensure that only the changes regarding the research variables before and after the implementation of the study intervention were included in the data analysis. This could significantly add to the validity of the data analysis process and, eventually, to the study's findings. Furthermore, a qualitative data phase was conducted to understand the reasons behind the quantitative findings and students' perceptions of the gamified FVC. These procedures will provide a robust research design guideline that can be used by other researchers in future studies.

The literature review showed that previous studies examined the effect of gamifying the flipped classroom on educational outcomes, producing mixed results and inconsistent findings, which may be attributed to the applications of various learning and motivation theories. Moreover, merging gamification into fully online flipped courses for autonomously motivating learning has not yet been investigated sufficiently. The current study, therefore, contributes to clarifying contradictory evidence as well as filling knowledge research gaps. Conducting this study was crucial for the advancement of gamification and flipped learning research fields and can be taken as a starting point for further theoretical and empirical studies that concern designing autonomous motivation-supportive learning environments.

6.5 Research Limitations

The current study has considered the utilisation of an innovative, online flipped-class approach that integrates SDT-based gamification for an autonomously motivating learning environment. This approach has not been widely applied in the present research context, nor is it widespread in the existing relevant literature; more specifically, it has not been applied in online CS courses. Since this study is an initial investigation of the effect of integrating gamification mechanisms into the FVC based on the SDT theory, it has some limitations.

First, the participants in the experimental and control groups came from a convenient sample since the classes were already formed by the university's system; thus, the researcher was unable to assign the students to the two groups randomly. Quasi-experimental research design is often needed in such educational studies, particularly those conducted in teaching and learning environments. One reason for the broad utilisation of quasi-experimental design in the academic field is that random assignment of the participants is often impossible due to institutional constraints. However, the current study strived to reduce the possible effects of this limitation by employing a non-equivalent control group with pre- and post-tests design, which is considered one of the most rigorous research designs commonly used to minimise the possible impact of confounding factors.

Second, the gamification intervention was tested only in one academic term, which may be considered a short-term period, making it challenging to draw conclusions related to the possible long-term effect of its intervention. Nevertheless, the current study conducted semi-structured interviews in a mixed-method research design to: reduce the potential impact of this limitation; provide in-depth insights into the effectiveness of integrating gamification into the FVC; and triangulate the quantitative data obtained in the first phase of the data collection to add more validity to the research conclusion.

Third, all the participants in this research were males because of the gender segregation system in most Saudi universities. Including female participants in the study sample would have enriched the findings with more insights that would support the empirical evidence provided. However, this issue was considered in the current study by maximising the diversity in the qualitative sampling. In other words, the participants interviewed in the qualitative data phase

were selected based on the quantitative results, specifically, their motivation levels (i.e., low, moderate, and high) to ensure data diversity in this main research variable. This could mitigate the limitation of the single-gender sample and provide an in-depth understanding of the phenomena. Although the current study's findings may be more generalisable to gender-separate education systems and can provide valuable knowledge for the currently limited research on similar educational systems, the study provides practical guidance for educational practices that have been evidenced in several previous studies to support students' motivation. Despite this valuable knowledge the study offers, caution should be taken when generalising its findings to other research contexts.

Finally, the aim of conducting semi-structured interviews in this study was to understand why and how the integration of SDT-based gamification into the FVC might affect educational outcomes; therefore, the interviewees were selected from the gamified FVC to achieve this aim, along with other reasons which were listed in Chapter Three, Section 3.5.2. Although interviewing the students in the non-gamified FVC could have provided an understanding of the sole effectiveness of online flipped learning, this was based on the research questions to narrow the study investigation's scope and obtain more concentrated results.

6.6 Future Research

The current study investigated the possible efficacy of a gamification intervention in developing online flipped learning, particularly in a Saudi CS higher education context. However, applying the gamified FVC to different disciplines, contexts, and countries, as well as other student cohorts, is recommended to gain a broader understanding of its effectiveness and validate the potential applicability and transferability of the findings to different contexts. Since a random selection for the study sample was impossible, as assigning students to classes is often based on educational systems, future research may consider validating the findings of this study by using samples that are randomly selected and comparing the effectiveness of the gamified intervention with the results reported in the present study.

Moreover, it is worthwhile to evaluate the long-term impact of integrating SDT-based gamification into FVC by conducting longitudinal studies for more than one academic term, which was difficult to achieve in the current study due to time limitations and university constraints.

Researchers are also advised to consider assessing the possible correlation between external motivation and the three psychological needs for autonomy, competence, and social relatedness to expand the understanding of the interrelationships between these variables. Future studies may also focus on collecting more data through, for example, observing the changes in students' motivation and engagement and the role of the instructor in online class activities throughout the course period; this was not possible in the current study as the head of school and the instructor allowed the researcher to attend only the online sessions of the induction week. In addition, interviewing the non-gamified FVC is also recommended for future research to explain the possible reasons behind students' engagement or disengagement in the conventional online flipped learning condition.

Finally, the gamified FVC requires instructors to choose or design instructional activities based on the desired learning objectives. These activities include pre-session videos, quizzes, and in-session tasks to be effectively applied by the instructor. Hence, further research should be conducted based on instructors' perceptions of the gamified FVC, to gain a different perspective and thus determine the possible potentials, challenges, and considerations for future adoption and design related to SDT-based gamified learning experiences.

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Appendices

Appendix A: Ethical Approval

Ethics approval

Luke Coverdale <luke.coverdale@newcastle.ac.uk>

Thu 20/05/2021 15:46

To: Mohammad Albshry (PGR) <M.A.H.Albshry2@newcastle.ac.uk>

Cc: Caroline Walker-Gleaves <Caroline.Walker-Gleaves@newcastle.ac.uk>

 3 attachments (868 KB)

Ethics Form_Albsbry review2.docx; final_PGRRiskAssessment.pdf; Ethics Form%Albsbry review1.docx;

Ethics Approval: Mohammad Albshry.

Dear Mohammad,

Your ethics form has been reviewed and is now approved.

Many thanks and good luck with your research.

Luke
Luke Coverdale
ECLS Research Support

Appendix B: Outside Study

PGR: Outside study decision made

gradschool@ncl.ac.uk <gradschool@ncl.ac.uk>

Tue 01/02/2022 15:29

To: Mohammad Albshry (PGR) <M.A.H.Albshry2@newcastle.ac.uk>

Cc: Caroline Walker-Gleaves <Caroline.Walker-Gleaves@newcastle.ac.uk>; James Stanfield <james.stanfield@newcastle.ac.uk>; Student Data <student-data@newcastle.ac.uk>; Sponsors / Progress Report Collection <sponsors@newcastle.ac.uk>; Compliance <Compliance@newcastle.ac.uk>; HaSS and SAgE Graduate School <gradschool@newcastle.ac.uk>; Frances Cook <frances.cook@newcastle.ac.uk>

Dear Mohammad Atyah H. Albshry

re: Outside study application <https://postgrad.ncl.ac.uk/forms/display/outsidestudy/student/core-record-42954/>

Your request for an adjustment to your studies has been processed with the following comments:

TZ/180558986

Dear Mohammad,

I hope that you and your family are well and keeping safe during these challenging times.

The Dean of Postgraduate Studies acting on behalf of the Faculty of HASS has acknowledged your application for a period of study outside the University as a result of the ongoing Covid-19 situation.

Please retain the following details of your candidature.

Location of Outside Study:

Saudi Arabia

Supervisory Team:

Caroline Walker-Gleaves

James Stanfield

Outside Study effective from:

14.02.2022

Outside Study end:

14.05.2022

End of Minimum Period of Study

27.09.2023

Latest Submission Date of Thesis:

27.09.2024

You must report any change to the above dates to the HaSS and SAgE Graduate School. You are expected to maintain contact with your supervisor at Newcastle University on a regular basis.

If you are unable to travel back to the UK because of travel restrictions, please contact your supervisor and/or Graduate School so that we can discuss a sensible plan about remote contact/supervision during this period and can extend your outside study period.

Please note that on your return to Newcastle, you should visit the HaSS and SAgE Graduate School Office on Level 6 of The Henry Daysh Building. Our opening hours are 9am to 5pm (Mon-Fri, except Wed 10am-5pm). You should bring your passport and visa, and/or any documents indicating your UK re-entry date and we will take a copy of the documents for our records. Please note that this is dependent upon when the HaSS and SAgE Graduate School Office reopens. Please keep checking the website for details.

Please keep this email as evidence of the outside study period granted.

Should you have any queries regarding this, please do not hesitate to contact the HaSS and SAgE Graduate School at gradschool@ncl.ac.uk.

Yours sincerely,
Tahura Zarrin

Appendix C: Permission from the Host University to Conduct the Study (Arabic)

2684-297-36-f9jK7C-TVQjMFAnEb8ZQQQ—12/29/2021 12:02:39 PM

عمادة الدراسات العليا
Deanship of Graduate Studies

عمادة الدراسات العليا
رقم المعاملة : ٤٣٠٢٢٩٤٧٥
التاريخ : ١٤٤٣/٥/٢٣
مشفوعات : لا توجد مشفوعات

جامعة جدة
University of Jeddah

جامعة جدة
University of Jeddah
12081

2684-297-36-f9jK7C-TVQjMFAnEb8ZQQQ (موافقة تسهيل مهمّة باحث وأجراء دراسة) MFAnEb8ZQQQ—12/29/2021 12:02:39 PM

السلام عليكم ورحمة الله وبركاته ،،،

تهديكم عمادة الدراسات العليا أطيب التحية والتقدير ، بشأن تسهيل مهمّة الباحث / محمد عطية
حمد البشري - طالب الدكتوراه - تخصص (تقنيّة التعليم) ، بأجراء بحث بعنوان (أثر دمج الألعاب في
الصف الافتراضي المقلوب على الدافعيّة الداخليّة والتحصيل الدراسي لطلاب التعليم العالي السعودي)
وعينيّة الدراسة ستشمل العينة شعبيتين فقط من طلاب السنّة التحضيرية - مقرر "مهارات تقنيّة المعلومات" -
(CCIT 100) - مسار الإنساني.

نأمل من سعادتكم التكرم بالاطلاع والموافقة على تسهيل مهمّة الباحث واتخاذ ما ترونه حسب
الأنظمة المتبعّة لديكم.

وتقبلوا أطيب التحية والتقدير ،،،

عميد الدراسات العليا المكلف
د. نايف بن مستور السلمي

2684-297-36-f9jK7C-TVQjMFAnEb8ZQQQ—12/29/2021 12:02:39 PM

المملكة العربية السعودية - وزارة التعليم
Kingdom of Saudi Arabia - Ministry of Education
ص ب 80327 جدة 21589 21589

DgsUJ Dgs@uj.edu.sa Dgs.uj.edu.sa +966 12 2334444

Appendix D: Participant Information Sheet and Informed Consent



Newcastle University
School of Education, Communication & Language Sciences

Participant Information Sheet

PLEASE NOTE: Each piece of research raises a unique set of ethical considerations. Consequently, this list of statements is not intended to be exhaustive, and you should feel free to adapt, add or omit statements according to the needs of your project. For example, if you are working with individuals who have difficulty comprehending English you may need to simplify the language and include pictures. Moreover, if your project involves withholding important information from the participant, you would need a statement explaining why this is the case and how applicants will be debriefed. It is impossible for us to cover all of these eventualities, and therefore you will need to think carefully about the ethical implications for your study.

Your supervisor is there to support you through the ethics process, and they will provide detailed help and guidance where necessary.

You are invited to take part in a research study entitled "*Flipping the Virtual Classroom through Gamification: Investigating Its Effect on Students' Achievement and Motivation in Saudi Higher Education*". Please read this document carefully and ask any questions you may have before agreeing to take part in the study.

The study is conducted by a PhD student from the School of Education, Communication & Language Sciences at Newcastle University.

- This research project is supervised by Professor Caroline Walker-Gleaves (Professor of Education) from the School of Education, Communication & Language Sciences at Newcastle University.
- The purpose of this study is to research the impact of the Gamified Flipped Virtual Classroom (GFVC) model on Saudi higher education students' levels of motivation and achievement.
- You have been invited to take part in this study because you are one of the University of Jeddah's students who will be taught using one of two online learning methods: Gamified Flipped Virtual Classroom (if you are in group one) or non-Gamified Flipped Virtual Classroom (if you are in group two).
- If you agree to take part in this study, you will be asked to follow the learning model instructions provided to you by your teacher including taking an achievement test, filling a questionnaire, and participating in an interview.
- Your participation in this study will take approximately 12 weeks as follows: two weeks pre-test and introduction, eight weeks teaching the content of the course, two weeks post-test, questionnaire, and interviews. Those classes will be held approximately 3 times/week (1-2 hours each).
- Once research has been completed, I will debrief you on the main findings of the research via email or another meeting if you wish. You will also be given a full copy of the research paper that I aim to produce.
- To compensate you for your time, we would like to give you an opportunity to win a gift card as a prize in a raffle. At the end of this course there will be a prize draw to win this valuable card.
- You are free to decide whether or not to participate. If you decide to participate, you are free to withdraw at any time without any negative consequences for you.
- You may decline to answer any questions or withdraw from the study without penalty of any kind.
- All non-identifying information you provide, will be kept in a password-protected electronic database, tagged with an anonymous ID number. Identifying information, e.g. your name, contact details and date of birth will be kept on paper in a locked filing cabinet in my office. This office is kept locked when not in use. This means that any anyone with access to the electronic information

will not be able to identify you as an individual. The only way to identify you as an individual is to access both the electronic records, and the paper records stored in the locked filing cabinet. It is very unlikely that anyone outside of the research team will be able to do this.

- We would like to upload your non-identifying information to a repository (the Open Science Framework) to be shared with other researchers. It is impossible for anyone to identify you as an individual from this information alone.
- Your rights to access, change or move your information are limited, as Newcastle University needs to manage your information in specific ways in order for the research to be reliable and accurate under UK General Data Protection Regulations. If you withdraw from the study, Newcastle University will keep the information about you that has already been obtained. To safeguard your rights, the minimum personally-identifiable information will be used. You can find out more about how Newcastle University uses your information at <http://www.ncl.ac.uk/data.protection/PrivacyNotice> and/or by contacting Newcastle University's Data Protection Officer (Maureen Wilkinson, rec-man@ncl.ac.uk). And by contacting University of Jeddah's Postgraduate Studies and Scientific Research Officer (Khaled Al-Mutairi, malkinani@uj.edu.sa).
- If you have any questions, requests or concerns regarding this research, please contact me via email at: M.a.h.albshry2@newcastle.ac.uk.

This study has been reviewed and approved by the School of Education, Communication & Language Sciences Ethics Committee at Newcastle University (date of approval: Feb. 7, 2021).



Newcastle University
School of Education, Communication & Language Sciences

Declaration of Informed Consent

- I agree to participate in this study, the purpose of which is to research the impact of the Gamified Flipped Virtual Classroom (GFVC) model on Saudi higher education students' levels of motivation and achievement. I will be recruited to one of the following two groups: the first group will be taught using a Gamified Flipped Virtual Classroom, while the other group will be taught using a Flipped Virtual Classroom without gamification.
- I declare that I have understood the nature and purpose of the research.
- I have read the participant information sheet and understand the information provided.
- I have been informed that I may decline to answer any questions or withdraw from the study without penalty of any kind.
- I have been informed that all of my responses will be kept confidential and secure, and that I will not be identified in any report or other publication resulting from this research.
- I have been informed that the researchers may wish to share non-identifying information, e.g. my responses to questions, in a public repository. I understand that it will not be possible to identify me as an individual from this information alone.
- I have been informed that the investigator will answer any questions regarding the study and its procedures. The investigator's email is M.a.h.albshry2@newcastle.ac.uk
- I will be provided with a copy of this form for my records.

Any concerns about this study should be addressed to the School of Education, Communication & Language Sciences Ethics Committee, Newcastle University via email to ecsls.researchteam@newcastle.ac.uk. And to contact University of Jeddah, you can email the University of Jeddah's Postgraduate Studies and Scientific Research Officer (Khaled Al-Mutairi, malkinani@uj.edu.sa).

Date	Participant Name (please print)	Participant Signature

I certify that I have presented the above information to the participant and secured his or her consent.

Date	Signature of Investigator

Appendix E: Pre-Post Test



الإختبار التجريبي الأول

لمقرر المهارات الأساسية في تقنية المعلومات
CCIT 100

* Required

معلومات الطالب الأساسية

1. اسم الطالب

2. الرقم الجامعي

3. رمز الشعبة *

☐ AA1

☐ FHG

أسئلة الإختبار التجريبي وتبدأ من الفقرة رقم 4 إلى الفقرة 43
أجب على جميع الأسئلة التالية بمجموع 40 سؤال

4. (1 Point) توجد داخل وحدة المعالجة المركزية وهي المسؤولة عن تنفيذ العمليات الحسابية.

- ☐ وحدة التخزين
- ☐ وحدة الحساب والمنطق
- ☐ وحدة التحكم
- ☐ وحدة الذاكرة

5. (1 Point) تقاس سرعة وحدة المعالجة المركزية بـ.

- ☐ الميغابايت
- ☐ الميغاهرتز
- ☐ الكيلوبهرتز
- ☐ الجيجابايت

6. (1 Point) من أجهزة الإخراج في الحاسب الآلي.

- ☐ المايكروفون
- ☐ الكاميرا
- ☐ لوحة المفاتيح
- ☐ الطابعة

7. (1 Point) هي ذاكرة مؤقتة متطايرة قصيرة الأجل.

- ☐ الذاكرة الرئيسية
- ☐ التخزين السحابي
- ☐ ذاكرة القراءة فقط
- ☐ القرص الصلب

تستخدم للتخزين طويل الأجل لنظام التشغيل، البرامج، المستندات، والملفات الأخرى، بحيث لا تُمسح. (1 Point) عندما نقوم بإيقاف تشغيل الكمبيوتر أو فصله عن الطاقة

- ☐ ذاكرة القراءة فقط
- ☐ الذاكرة المخزنة
- ☐ الذاكرة الرئيسية
- ☐ القرص الصلب

9. من أنواع القرص الصلب. (1 Point)

- ☐ RAM
- ☐ USB
- ☐ HDD
- ☐ ROM

عندما نلاحظ أن جهاز الكمبيوتر بطيء، أحد الحلول الممكنة لتحسين سرعته وأدائه هو بزيادة حجم الـ 10. (1 Point)

- ☐ RAM
- ☐ ROM
- ☐ DVD
- ☐ USB

هو حلقة الوصل بين جهاز الكمبيوتر ومعداته، وجميع البرمجيات الأخرى، كما أنها أيضاً حلقة الوصل بين 11. المستخدم والكمبيوتر. (1 Point)

- ☐ نظام التشغيل
- ☐ البرمجيات المساعدة
- ☐ المتاح
- ☐ واجهة المستخدم

12. (1 Point) نظام التشغيل الأكثر شيوعاً لأجهزة الحواسيب الشخصية هو .

- ☐ ويندوز
- ☐ لينكس
- ☐ ماك
- ☐ أندرويد

13. من وظائف أنظمة التشغيل الرئيسية. (1 Point)

- ☐ تنفيذ العمليات الحسابية والمنطقية
- ☐ تخزين البيانات والمعلومات
- ☐ طباعة المستندات
- ☐ إدارة الموارد

14. (1 Point) من الأمثلة على أنظمة التشغيل مفتوحة المصدر.

- ☐ لينكس
- ☐ ويندوز
- ☐ ماك
- ☐ Apple iOS

15. عبارة عن مجموعة من أجهزة الكمبيوتر المتصلة ببعضها البعض من خلال الأسلاك أو الألياف الضوئية (1 Point)

- ☐ شبكة الكمبيوتر
- ☐ شبكات الاتصالات الهاتفية
- ☐ شبكات التواصل الإجتماعي
- ☐ أنظمة التشغيل

16. (1 Point) تُعدّ من شبكات الحاسب الأكثر أماناً.

- ☐ شبكة الاتصالات اللاسلكية
- ☐ شبكة المنطقة الحضرية
- ☐ شبكة المنطقة الواسعة
- ☐ شبكة المنطقة المحلية

17. (1 Point) يصعب اكتشاف المشاكل وحلها في.

- ☐ شبكة المنطقة الواسعة
- ☐ شبكة المنطقة المحلية
- ☐ شبكة المنطقة الحضرية
- ☐ شبكة المنطقة الشخصية

18. (1 Point) من أمثلة شبكة المنطقة الشخصية ما يلي

- ☐ الشبكة غير المتصلة
- ☐ الشبكة المتصلة
- ☐ الشبكة الواسعة
- ☐ شبكة المنطقة المحلية

19. تُستخدم للتواصل بين البنوك في المدينة، حجز تذاكر الطيران، في الجامعات داخل المدينة الواحدة، (1 Point) وللأصال في الجيش

- ☐ شبكة المنطقة الشخصية
- ☐ شبكة المنطقة الحضرية
- ☐ شبكة المنطقة الواسعة
- ☐ شبكة المنطقة المحلية

20. (1 Point) من عيوب شبكة الاتصالات اللاسلكية

- ☐ صعوبة التركيب
- ☐ ارتفاع تكلفة التركيب
- ☐ تداخل الإشارات
- ☐ عدم الموثوقية

21. تكون الوسائط المستخدمة فيها موجهة حيث تكون هذه الوسائط عبارة عن مسارات مادية مثل وصلات (1 Point) الألياف البصرية

- ☐ الاتصالات السلكية
- ☐ الاتصالات بالأشعة تحت الحمراء
- ☐ تقنية البلوتوث
- ☐ الاتصالات اللاسلكية

22. (1 Point) أي شبكات الحاسب التالية الأكثر حاجة إلى برامج الحماية ومكافحة الفيروسات عند استخدامها؟

- ☐ الشبكة السلكية
- ☐ الشبكة الشخصية
- ☐ الشبكة الواسعة
- ☐ الشبكة المحلية

23. التقنية التي غالباً ما يتم استخدامها في أجهزة التحكم عن بعد للتلززيونات والسيارات وأجهزة الصوت هي (1 Point)

- ☐ الأقمار الصناعية
- ☐ الأشعة تحت الحمراء
- ☐ البلوتوث
- ☐ الأشعة فوق البنفسجية

24. (1 Point) الفكرة الأساسية التي يقوم عليها الذكاء الاصطناعي هي

- ☐ تشغيل الأجهزة الذكية
- ☐ حل الأنماز
- ☐ فهم دكاء الروبوتات
- ☐ فهم التفكير البشري وعملياته

25. هي تُنظم يتم فيها الاستفادة من المعرفة البشرية بعد تمثيلها في الحاسب بهدف حل المشكلات التي (1 Point) تعتمد عادةً على تلك المعرفة

- ☐ النظم التعليمية الذكية
- ☐ النظم العمرة
- ☐ نظم التشغيل
- ☐ النظم المعلوماتية

26. (1 Point) يمكننا التمييز بين البيانات الضخمة والبيانات التقليدية من خلال

- ☐ حجمها
- ☐ تنوعها
- ☐ جميع ما ذكر
- ☐ سرعة معالجتها

27. من الأمثلة على التقنيات الحديثة التي ستساعد على انتشارها تقنية الجيل الخامس بشكل واسع النطاق (1 Point)

- ☐ تقنية الترجمة الآلية
- ☐ تقنية الواقع الافتراضي
- ☐ تقنية فهم الكلام والصوت
- ☐ تقنية الروبوتات

28. (1 Point) من أهم مجالات تطبيق نظم تعلم الآلة ما يلي

- ☐ التشخيص والعلاج
- ☐ البحث عن مصادر جديدة للطاقة
- ☐ جميع ما ذكر
- ☐ البنوك والاستثمار

29. تخيل أنك متواجد في مجمع تسوق وشاهدت شاشة عرض كبيرة يبدو وكأن هناك أشياء غير واقعية تخرج من تلك الشاشة. فماهي التقنية المستخدمة هنا؟ (1 Point)

- ☐ تقنية الرؤية بالكمبيوتر
- ☐ الواقع المعزز
- ☐ تقنية الجيل الخامس
- ☐ الواقع الافتراضي

30. (1 Point) الفرق بين كل من البروتوكولين: http و https

- ☐ http يستخدم في تشفير البيانات الشبكية
- ☐ https أكثر أماناً في نقل البيانات وتشفيرها
- ☐ https أكثر سرعة في تصفح المواقع العامة
- ☐ لا يوجد فرق بينهما

31. إذا كنت تريد استخدام إحدى التطبيقات السحابية لحماية ملفك من الضياع وإتاحة الوصول إليها من أجهزة أخرى فأيها فإلك ستستخدم (1 Point)

- ☐ Calendar
- ☐ Online Word
- ☐ Outlook
- ☐ OneDrive

32. (1 Point) لكل جهاز متصل على شبكة الإنترنت عنوان فريد يسمى بـ

- ☐ http
- ☐ HTML
- ☐ IP
- ☐ URL

33. (1 Point) من أمثلة محركات البحث الداخلية

- ☐ جميع الإجابات صحيحة
- ☐ محرك بحث جوجل
- ☐ محرك بحث موقع جامعة جدة
- ☐ محرك بحث Bing

34. ...يُعتبر أحد التطبيقات السحابية التي توفر خدمات مثل البريد الإلكتروني، والتقويم، وإدارة المواعيد (1 Point)

- ☐ Calendar
- ☐ Outlook
- ☐ OneDrive
- ☐ Online Word

35. (1 Point) تطبيق يسمح بتخزين وحفظ المستند تلقائياً على مساحات التخزين السحابية

- ☐ Online PowerPoint
- ☐ Online Excel
- ☐ Online Word
- ☐ جميع الإجابات صحيحة

36. جميع المواقع المتوفرة على شبكة الإنترنت معزّمة بعنوان لا يمكن أن يتكرر لموقع إلكتروني آخر وهو ما يسمى (1 Point)

- ☐ مُحدد موقع الموارد URL
- ☐ فقاعة الترشح Filler Bubble
- ☐ بروتوكول http
- ☐ بروتوكول https

37. (1 Point) في حال كنت مُستخدم لخدمة الحوسبة السحابية وكان لديك صلاحية التعديل على ملف، فإنه

- ☐ يمكنك تحديد صلاحيات التعديل على الملف
- ☐ جميع الإجابات صحيحة
- ☐ يمكنك إيقاف مشاركة الملف تماماً
- ☐ يمكنك المشاهدة

38. (1 Point) تُعتبر جملة الاستعلام (مجموعات التسوق في جدة) من

- ☐ استعلامات التنقل Navigational Queries
- ☐ جمع ما سبق
- ☐ استعلامات إعلامية Informational Queries
- ☐ استعلامات المعاملات Transactional Queries

39. هو نظام يملح تطابق الأسماء والعناوين على شبكة الإنترنت: مما يعطي اسماً فريداً لأي جهاز أو خادم أو موقع إلكتروني، ويسمى اختصاراً (1 Point)

- ☐ URL
- ☐ http
- ☐ DNS
- ☐ www

40. (1 Point) أحد الأجهزة التالية يُعتبر وحدة إدخال، وكذلك وحدة إخراج

- ☐ الطابعة
- ☐ السماعات
- ☐ شاشة اللمس
- ☐ الفأرة

41. رتب أنواع الشبكات التالية بدايةً بسحب كل منها لتصبح (نزولاً) من الأعلى إلى الأكبر من حيث المساحة الجغرافية (1 Point)

- شبكة المنطقة الحضرية
- شبكة المنطقة الموسعة
- شبكة المنطقة الشخصية
- شبكة المنطقة المحلية

42. (1 Point) يمكن استخدام البروتونات في

- ☐ العمليات العسكرية
- ☐ العمليات الدراجية
- ☐ جمع الإجابات صحيحة
- ☐ العمليات الصناعية

43. (1 Point) من الأمثلة على البرمجيات التي تستخدم خدمة SaaS

- ☐ محرك بحث جوجل
- ☐ Office 365
- ☐ Bing
- ☐ جمع الإجابات صحيحة

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Appendix F: Pre-Post Questionnaire



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Introduction

Dear participant,

Thank you for agreeing to take part in this research, which is about the effect of online flipped learning with and without gamification intervention on students' motivation, learning achievement, and completion rate of pre-class activities in a computer science higher education. This questionnaire will attempt to assess these aspects in students in the Computer Science and Information Technology course (CCIT-100). Please be assured that all the responses you provide will be strictly confidential and will not be shared with third parties. Your responses will not be used for any formal evaluation associated with this instructional course or any other courses.

Instructions

This questionnaire consists of six sections as follows:

- 1- Biographical information
- 2- Autonomy
- 3- Competence
- 4- Relatedness
- 5- Intrinsic motivation (interest/enjoyment)
- 6- Self-regulation skills

D	N	Questionnaire Items	عناصر الاستبانة	ب
Biographical information	1	Personal questions	أسئلة شخصية عامة	بيانات عامة
	2	Have you ever experienced an online flipped course?	هل سبق وأن جربت استراتيجيات الصف المقلوب قبل هذا المقرر؟	
	3	Have you been taught any course that used gamification?	هل سبق وأن درست مقرر استخدم التلعيب قبل هذا المقرر؟	
	4	Do you have access to the internet from home?	هل يتوفر خدمة الإنترنت في منزلك؟	
	5	Which of these electronic devices do you use when accessing online classes?	أي من هذه الأجهزة الإلكترونية تستخدمها عادة في المقررات الدراسية عن بعد؟	
Autonomy	1	I enjoyed a sense of freedom to choose between the assigned out-of-class activities whenever I was able to perform them.	استمتعت بنوع من حرية الاختيار عند أداء الأنشطة والمهام التعليمية متى ما كنت أستطيع.	الاستقلالية
	2	I felt that the out-of-class activities I had chosen reflected what I really wanted to do.	شعرت بأن التمارين الدراسية خارج الصف التي اخترتها عكست فعلاً ما كنت أريد أن أفعله.	
	3	I felt free to express my ideas and opinions in the group work.	شعرت بحرية التعبير عن أفكارتي ووجهات نظري في مجموعة العمل الطلابية.	



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	4	Outside of the class sessions, I was able to control my learning environment by working when it was convenient for me.	خارج وقت المحاضرات، كنت قادراً على التحكم في بيئتي التعليمية من خلال أداء الأنشطة التعليمية متى ما كنت مرتاحاً.
	5	Outside of the class sessions, I was able to manage my own learning time.	كنت قادراً على إدارة وقت التعلم الخاص بي خارج وقت المحاضرات.
	6	Outside of the class sessions, I was able to control my own learning speed.	كنت قادراً على ضبط سرعة التعلم الخاص بي خارج وقت المحاضرات.
Competence	7	I think I performed well at the activities provided, compared to other students.	أعتقد بأنني قد أدت بشكل جيد الأنشطة التعليمية المقدمة، مقارنة مع باقي زملائي
	8	After working on this activity for a while, I felt competent to achieve my learning goals.	بعد فترة زمنية من العمل على الأنشطة التعليمية، شعرت بشيء من الكفاءة لتحقيق أهداف التعلم الخاصة بي
	9	I was skilled at the out-of-class activities provided.	كنت ماهراً بعض الشيء عند أداء الأنشطة التعليمية المعطاة خارج وقت المحاضرة.
	10	I think I am good at the out-of-class activities provided.	أعتقد أن أدائي للتمارين الدراسية خارج وقت المحاضرة كان جيداً.
	11	I feel I can successfully complete difficult out-of-class tasks in this computer science course.	شعرت أنه بإمكانني إكمال الأنشطة التعليمية الصعبة المتعلقة بمقرر علوم الحاسب خارج أوقات المحاضرة بنجاح
	12	I am satisfied with my performance at the out-of-class activities provided.	أنا راضٍ عن أدائي بخصوص الأنشطة التعليمية خارج وقت المحاضرة.
	13	Outside of the class sessions, I could not do the learning activities well (R).	خارج وقت المحاضرة، لم أتمكن من أداء الأنشطة التعليمية بشكل جيد (ع).
Relatedness	14	I was able to interact with peers during and after class hours.	كنت قادراً على التفاعل مع زملائي خلال وبعد وقت المحاضرات
	15	I had more opportunities to be close to others while doing tasks.	كان لدي الفرصة لأكون قريباً من زملائي عندما كنت أقوم بأداء الأنشطة التعليمية.
	16	I liked the people I worked with during discussion sessions.	أنا حقاً أحببت العمل مع الطلاب في جلسات النقاش
	17	I liked working on the in-class tasks.	أحببت فعلاً العمل على الأنشطة التعليمية خلال وقت المحاضرة
	18	Working in a group helped stimulate my critical thinking skills.	العمل في مجموعة ساعدني على تعزيز مهارات التفكير النقدي لدي
	19	Working in a group seemed to help me understand the material.	يبدو أن العمل في مجموعة ساعدني على فهم الأنشطة التعليمية



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Intrinsic motivation (Interest/enjoyment)	20	I enjoyed doing the provided activities.	استمتعت جداً بأداء الأنشطة التعليمية المقدمة.	الدافعية الذاتية (الاهتمام/الاستمتاع)
	21	The learning activities were fun to do.	إكمال الأنشطة التعليمية المقدمة كان ممتعاً.	
	22	I thought the provided activities were boring (R).	اعتقدت أن الأنشطة التعليمية المقدمة كانت مملة (ع).	
	23	The computer science I learned was more valuable to me than the grade I received.	علوم الحاسب التي أتعلمها هي أكثر قيمة بالنسبة لي من درجة التقويم التي أحصل عليها.	
	24	The provided activities did not hold my attention at all (R).	لم تستحوذ الأنشطة التعليمية المقدمة على انتباهي على الإطلاق (ع).	
	25	While I was doing the provided activities, I was thinking about how much I enjoyed them.	أثناء قيامي بالأنشطة التعليمية المقدمة، كنت أفكر في مدى استمتاعي بها.	
	26	I thought the provided activities were enjoyable.	اعتقدت أن الأنشطة التعليمية المقدمة كانت ممتعة للغاية.	
	27	I would describe these activities as interesting.	أستطيع أن أصف الأنشطة التعليمية في هذا المقرر بأنها مثيرة للاهتمام.	
Self-regulation in terms of time management and learning task strategies	28	I try to schedule the same time every day or week to study.	أحاول أن أقوم بجدولة نفس الوقت كل يوم أو كل أسبوع للمذاكرة.	التنظيم الذاتي إدارة الوقت واستراتيجيات التعلم
	29	I read instructional materials posted online aloud to avoid any distractions.	أنا أقرأ تعليمات الأنشطة التعليمية المطلوب تأديتها بصوت مرتفع قليلاً لتفادي ما يلهي تركيزي.	
	30	I allocate extra studying time for my online learning tasks.	أقوم بتخصيص وقت إضافي لأداء مهام التعلم الخاصة بي عبر الإنترنت.	
	31	I try to take more thorough notes for my online classes.	أحاول تسجيل ملاحظات أكثر شمولاً أثناء وقت المحاضرات عن بعد.	
	32	Outside of the class sessions, I work on extra learning activities in addition to the assigned tasks to master the course content.	خارج وقت المحاضرات، أقوم بأداء أنشطة تعليمية إضافية لإتقان محتوى المقرر.	
	33	I prepare my questions before joining an online session.	أقوم بتجهيز أسئلتني قبل الانضمام إلى المحاضرات عبر الإنترنت.	
	34	Although we do not have to attend daily classes, I still try to organise my studying time evenly across days.	على الرغم من أنه لا يتعين علينا حضور الفصول بشكل يومي، إلا أنني ما زلت أحاول تنظيم وقت دراستي بشكل متساو على مدار الأيام.	

Appendix G: Interview Protocol (Arabic)

☐ رقم الطالب:

☐ تاريخ المقابلة:

☐ مقدمة:

تهدف هذه المقابلة إلى محاولة فهم تجربتك لطريقة التدريس المستخدمة في مقرر علوم الحاسب وتقنية المعلومات والذي قد قمت بكماله مؤخراً. نرجى العلم بأن إجاباتك ومقترحاتك في هذه المقابلة سوف تتقارن بسرية مطلقة وأن يتم مشاركتها مع أطراف ثلاثة بطريقة يتم التعرف فيها على شخصيتك. نرجو منك عزيزي الطالب قراءة التعليمات المرفقة والمرسلة لك بعناية قبل البدء بهذه المقابلة الشخصية والتوقيع بالموافقة أو عدم الموافقة وشكراً.

أُسئلة عامة:

☐ هل تحب ألعاب التحدي وتجميع النقاط؟

☐ هل جربت طريقة النقاط والمجموعات من قبل؟ إذا نعم

☐ كيف كانت تلك التجربة؟

١. COMPETENCE (القدرة على التقدم، توافر مستوى السهولة والصعوبة)

☐ ما رأيك في طريقة النقاط والمنافسة بين المجموعات؟ هل تراها **فعلية** / **غير فعلية** لماذا؟

☐ هل كنت تحاول كسب المزيد من النقاط لماذا؟ (الترتيب، السلبية والمثبة)

☐ هل شعرت بأنك **فاز** / **غير فاز** على الحصول على مركز متقدم في ترتيب المجموعات؟ لماذا؟

☐ كيف كنت ترى أداءك للتكوينات؟

٢. AUTONOMY (حرية، اختياريات)

☐ ما هو شعورك عندما يكون أمامك أكثر من طريقة لكسب النقاط والدرجات؟ (فيديوهات، كوييزات)

☐ كان أمامك على المنصة أنواع مختلفة من الأنشطة التعليمية لأدائها وإكمالها، على سبيل المثال، فيديوهات تعليمية، محتوى للقراءة، وبعض الأنشطة التعليمية الأخرى. ما الذي كنت تشعر به وقتها حيال توفير هذه الخيارات؟

☐ ما الطريقة التي تفضلها من بين هذه الطرق، إذا كان هناك واحدة؟ ولماذا؟ (الاختيارات تجعل الدراسة أكثر متعة؟)

☐ كيف كنت تنظم وقتك لمشاهدة الفيديوهات خارج أوقات المحاضرات؟

٣. RELATEDNESS (التعلق، الترافيق)

☐ ما رأيك في العمل في مجموعات طائفة؟

☐ ما هو شعورك تجاه أفراد مجموعتك الذين عملت معهم؟

☐ كيف ترى التفاعل بين مجموعتك؟

٤. INTRINSIC MOTIVATION (INTEREST/ENJOYMENT) (المتعة، إثارة الاهتمام)

☐ ما الذي **تشجعك** / **لم يشجعك** على مشاهدة مقاطع الفيديو التعليمية وحل الأسئلة القصيرة خارج أوقات المحاضرات؟

☐ هل تعتقد أن طريقة النقاط والمجموعات **ممتعة/مملة**؟ باعتبارك ما الذي كان **ممتعاً** أو **يثير اهتمامك** **ممتعاً** بالنسبة لك؟

☐ هل جذبت انتباهك؟

٥. PERCEPTIONS AND SUGGESTIONS

☐ ما الأسباب التي جعلتك تكمل الأنشطة التعليمية خارج وقت المحاضرة؟ وما الذي لم يعجبك في هذه الأنشطة؟

☐ هل كان مدرس المقرر يقوم بعرض لوحة الصدارة بشكل مستمر أم لا؟ ما هو رأيك في ذلك؟

☐ هل أثرت هذه الطريقة على تحصيلك الدراسي وعلى تملكك بشكل عام؟

☐ بشكل عام، ما رأيك في تجربة التدريس؟

☐ برأيك كيف يمكن تطوير هذه الطريقة؟ هل لديك اقتراحات بخصوص ذلك؟

الختامية:

☐ هل لديك أي استفسار أو فكرة تود إضافتها؟ شكراً لك على المشاركة