INVESTIGATING THE IMPACT OF FLIPPED LEARNING ON COMPUTER SCIENCE STUDENTS' ACHIEVEMENTS, MOTIVATION, ENGAGEMENT, AND LEARNING AUTONOMY IN SAUDI ARABIA HIGH SCHOOLS

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Abstract

Global Educational Technology is a rapidly changing field within this century, and an increasing number of organisations and private learning institutions are attempting to integrate technology into educational practices. Over the last decade, technology in educational settings within Saudi Arabia has started to attract enthusiastic attention from professionals who are attempting to implement higher levels of technology-based learning activities into teaching through blended learning, MOOCs, and flipped learning. The field of education in Saudi Arabia has an ambition that concurs with the Saudi 2030 Vision and two of the main aims of education, which are to integrate technology in education and encourage teachers to apply the student-centred approach, such as through flipped learning.

This study applies a concurrent embedded mixed-method approach to examine the impact of flipped learning on Computer Science students' achievements and identify the effects of flipped learning on their motivation, engagement and learning autonomy. This includes a quasi-experimental design with 74 first-year Computer Science high school students, and data collected through pre/post-tests, questionnaires, semi-structured interviews and focus groups by comparing flipped learning students' achievements and experiences against those of non-flipped learning students. The findings suggest that flipped learning could impact positively upon students' achievement, motivation, engagement and learning autonomy. The result of the pre-and post-test showed that there was an overall increase in the students' scores in flipped learning compared to non-flipped learning.

The qualitative findings show that the flipped learning also provides experiences both in and out of the classroom for Computer Science students, which were found to enhance their achievements. However, certain students would find flipped learning challenging at times, especially in relation to online discussion participation. In addition, students' learning autonomy was shown to increase following a flipped learning environment. The qualitative findings demonstrated that the students in flipped learning hold a positive attitude toward their autonomous learning skills.

Overall, it was concluded that flipped learning should be suggested as one of the possible pedagogical approaches to improve students' learning experiences. However, the studies in the Saudi context remain limited, and require additional investigations into flipped learning, and particularly in Saudi female schools. The current study presents theoretical and practical implications arising from it, limitations, recommendations for improvement, and suggestions for future research.

Dedication

Effort is required in order to accomplish all of life's challenges, together with the support of those people closest to us.

My humble effort I dedicate to:
Soul of My Grandfather
My Father: Salem Alwaqdani
My Mother: Sara Alwaqdani
My Wife: Asrar Altwairqi
My Children: Khalid and Hoor
My Brothers: Majed and Abdul-Aziz
My Sisters: Ahad, Shahed, Amjad, Wed and Jood

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Author’s Declaration

Declaration

I declare this thesis to be original work undertaken solely by myself, apart from any quotations and citations, which have duly acknowledged and cited correctly. I also declare that this thesis has not been submitted to any other university for the award of any degree or published any time previously.

Mohammed Alwaqdani

Some parts of this thesis were used at the international conferences as follows.

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Chapter One – Introduction

The first chapter of this thesis aims to introduce the research and present a concise background of the study, which includes the overview of Computer Science education, the overview of the flipped learning approach, the motivation of the research, and aims addressed by the study. In addition, this chapter briefly discusses the study's context, the significance of the study, purpose and objectives of the study, and research questions. At the end of this chapter the structure of the research will also be presented.

1.1 Background of the Study

1.1.1 Overview of Teaching Computer Science

Computer Science is considered one of the disciplines that aims to prepare the students for the future in terms of knowledge and skills and encompasses areas of study including digital skills and computational thinking skills (CTSs). The acquisition of digital skills is no longer regarded as merely a positive additional aspect in the education of students, as it is now viewed to be a right of all students with 92% of all future jobs believe to require digital based skills (Google & Canvas8, 2019). Indeed, Computer Science is included in the formal curricula in many different nations throughout the world, and many techniques are implemented that use modern technological tools (Balanskat & Engelhardt, 2014; Fluck et al., 2016, Hubwieser et al., 2014). Nevertheless, Computer Science is potentially challenging for teachers as technological advances quickly change the requirements in the subject (Sentance and Csizmadia, 2017). These rapid advancements have resulted in developments in curricula that require adaptations by teachers, as new information and changes could result in students possessing more knowledge than the teachers on certain subjects (Bender et al., 2015; Korkmaz et al., 2017).

In addition, computational thinking is required to be taught by teachers of Computer Science to enable students to learn CTs in their Computer Science courses (Yadav et al., 2016). Wing (2006) emphasised that CTSs are one of the daily life skills that everyone needs, rather than just being a programming skill used only by Computer scientists. Various formats have been used to implement computational thinking into K-12 classrooms, with these skills deemed to be vital in the modern world (Yadav et al., 2016). Specifically, students should learn computational thinking skills within the field of Computer Science, together with programming environments, even though computational thinking ideas have been defined as cross-disciplinary subject areas (ibid). Institutional recommendations that are currently present, as have been used in Europe, the USA and Canada, demonstrate that CTSs via coding are beneficial in early-stage learning, such as in primary schools, as well as into the following stages of education (Arfe et al., 2020). Additionally, programming skills are vital to the development of employability and adaptability skills in the modern world (Yildiz-Durak, 2018). Indeed, programming helps to advance many different concepts and skills that correlate with CTSs and the subject of Computer Science, which include resourcefulness, the ability to solve problems, abstractions, and algorithmic thinking, among others (Florez et al., 2017). The students in the process of programming are engaged to achieve the essence of computational thinking skills by experiencing the steps of analysing the problem in sub-problems, as well as planning to solve these sub-problems via writing algorithms. This leads to the possibility to understand the function of each programming commands, and then be involved in the code writing processes to examine the final programme. Computational thinking involves compartmentalising complex issues into sub-issues that are easier to manage through a sequence of stages (algorithms) that help to overcome the challenges, as well as to review the potential solutions to different issues, which is shown through abstraction; and automation which helps to determine whether a Computer can efficiently solve these specific challenges (Yadav et al., 2016).

However, a particular issue in the teaching of Computer Science relates to teachers being required to possess technical and pedagogical knowledge, which in this subject requires continuous additional information due to modernisation (Hubwieser et al., 2014). Computer Science is often difficult to teach, as it includes many different concepts, which require teachers to apply further effort in the development of relevant teaching approaches that enable students to learn the subject better, which is achieved through adequate working space to practise the concepts and skill such as CTs (Bender et al., 2016). It is also a vital that there is a successful transfer of both theoretical points and relevant skills, which can include computational and mathematical concepts, as well as creative problem-solving that more traditional pedagogical approaches are unable to be achieve (Pirker et al., 2014). In addition, different challenges have arisen in regards to the teaching process of programming, including the vast spectrum of students' backgrounds and knowledge, whether students are sufficiently motivated to learn this form, and whether students are engaged and take the surface approach to learning (Chen, 2014, Bosse and Gerosa, 2017). Therefore, many teachers of Computer Science are faced with the challenge of advancing their students in the classroom, even though the traditional approaches often restrict this process.

The traditional approaches, alongside fixed instructional designs often result in both teaching and learning of Computer Science being a challenge to teachers and students (Isong, 2014). In particular, it has been shown by Koul et al. (2018) that autonomous learning is not advanced through traditional lecture teaching. Indeed, it is difficult for Computer Science students to engage in a teaching approach that has always been traditionally lecture-based, which has not changed, as Computer technology and curriculum have undergone changes; thus, it is difficult for the students to understand basic programming concepts (Rolandsson, 2013; Buitrago Flórez et al., 2017). The traditional approach functions around the concept that a teacher is the central point of knowledge for students, which is contradictory to the progress in Computer Science, as numerous concepts and skills need to be improved by the students in order to advance. Consequently, as technology advances rapidly, which often enables students to be better informed than their teacher, it is not possible to consider a teacher as the only source of knowledge for students (Crawford, 2000). What is more, Schilling and Klamma (2010) state that teaching through the use of traditional methods in Computer Science fails to prepare the students for professional practice in the future. As a result, it is imperative that teaching methods are changed in order to engage students to learn Computer Science curriculum (Silva et al., 2019). It can be said that teachers of Computer Science are required to be flexible and qualified to teach Computer related subjects with dynamic teaching methods ensuring that students become engaged in the learning process in order to achieve the aim of teaching Computer Science.

Caceffo et al. (2018) found that some students of Computer Science gain motivation in problem-based learning more than from lecture forms, while the open-question opinions demonstrated that the lecture-based classroom setting induced fatigue and made comprehension more challenging, which is why more interactive and dynamic classes are required. In general, it has been found that students prefer to work together with peers, and thus, Computer Programming classes are appealing to many students (Kavitha et al., 2018). Therefore, a Computer Science teacher may need to implement teaching methods that focus on students as active learners and develop a more student-centred approach. Additionally, active learning settings help to stimulate discussions, which enable the entire class to improve in learning Computer Science (Hao et al., 2018; Greer et al., 2019). A more student-centred approach could motive students to learn.

In addition, a review undertaken by Hsu et al. (2018) applied problem-based learning and collaborative learning strategies in the Computer Science course, including programming as the most suitable strategy used to teach computational thinking. The reason for this could be the potential for problem-based learning and collaborative learning to involve the students in the learning process that enables them to discuss the problem and find the appropriate algorithm to solve it, before evaluating their programming code. Thus, teachers of Computer Science could apply a new approach, such as flipped learning, which is able to provide teachers with technological tools that help to learn technology and to develop a more student-centred setting in the classroom. Flipped learning could enable a teacher to better use classroom time by moving part of the learning content to be online to prepare the students well for classroom activities, and then use the classroom for more problem-based learning and collaborative learning, which could acquire the students' Computer Science knowledge and skills, such as computational thinking and coding. The flipped learning approach could motivate the students to engage in learning Computer science subjects, such as programming, which students usually find difficult.

The Saudi Arabian Ministry of Education (MoE) has placed Computer Science as a priority subject over the previous 30 years and has begun to implement at various education levels in the country. In 1985, the MoE made it mandatory to teach a certain level of Computers skills in high schools, with the main concepts being: Computer structures, programming, and software application (Al-Oteawi, 2002). Moreover, Computer Science was made into its own individual subject in high school, which enables students to gain more Computer experience and focus on their potential future careers in this field. Computer Science has subsequently been implemented as a subject in both intermediate and secondary schools in the country (Alghamdi et al., 2018). Specifically, the K7-9 curriculum has the intention of developing students' general knowledge regarding Computer Science and its application; while for K10-12 it is based on the standards set by the Computer Science Teachers Association (CSTA K-12), which comprises three central concepts: contemporary applications, programming, and digital citizen.

Saudi Arabia has started in recent years to place great importance on Computer Science in formal education, which is why there are now in excess of 12,000 teachers for the subject. Even though there have been marked improvements in the educational system in the country, and particularly in relation to Computer skills, teaching approaches still require additional improvements and to become more student-centred, as this will focus more on the overall subject content and students' personal needs. A qualitative research study was undertaken by Alghamdi et al. (2018), which demonstrated that there remains limitations in professional development of Computer Science teachers in regards to their teaching approaches, with challenges occurring due to the rapid development in Computer Science combined with the need to progress teaching techniques. It seems the Saudi Arabian Computer Science teachers face many challenges, and one of the challenges relates to the teaching methods, and thus, the current study aims to examine the flipped learning approach, in order to ascertain evidence on its effects upon teaching Computer Science in the Saudi context.

Therefore, it should be a requisite for Saudi teachers to start contemplating new directions and guidelines for teaching practices that are geared towards and centred upon students, such as flipped learning. Bou Aishah (2018) stated that the experts working in Computer education have combined to develop qualifications for Computer teachers through different teaching methods which focus on a student-centred approach. Flipped learning might contribute to the provision of effective learning and play a key role in the development of Saudi educational practices. At the very least, it may be the case that teachers engage in critical reflection concerning the mechanisms and rationales by which they teach. Encouraging the teacher to apply the innovative pedagogies, such as flipped learning, and to engage them in critical evaluation of its potentials, might help them to increase the quality of their educational practices.

1.1.2 The Overview of Flipped Learning

Modern technology during the past 10 years has helped to transform learning for students around the world. There is an increasing number of organisations and private learning institutions are asking to integrate technology into educational practices, the world has moved from thinking about the just existence of ICT tools in schools to also utilising digital tools to shape the learning and teaching process. However, the changes that have occurred through technology in education are not comparative to the advancements that have occurred in business or other sectors. OECD has produced a report that states how Computer/ technology utilisation fails to connect with the improvements to students' performance levels in learning (OECD, 2015). It was also shown through the report that schools and education systems are generally not at the stage to introduce these new forms of technology adequately. Further, there is a lack of the use innovative pedagogies which explained why EdTech did not achieve what anticipated accomplishments (ibid). Therefore, it has been possible recently to observe an increase in the utilisation of innovative pedagogies that are based on the concept of learning enhanced forms of technology worldwide, such as Massive Open Online Courses (MOOCs), social media, different forms of virtual reality, collaborative technology, open educational resources, online, adaptive forms, and mobile learning (Martin et al., 2020). What is more, a blended learning approach has been implemented in various institutions around the globe since 2012 (Means et al., 2013; Poon, 2013; López-Pérez et al., 2011); and MOOCs originating from universities in the USA and their partnerships with private sector organisations that include Silicon Valley start-up Coursera in 2012.

In addition, flipped learning, which is the focus of the current study, has been considered as one of the educational trends that is receiving popularity among educators around the world. Flipped learning has also been mentioned in different educational reports, such as NMC Horizon Reports, which list flipped learning as an effective digital strategy (Johnson et al., 2015). It can be said that the countries worldwide seeking to utilise the technological advancements to improve their education system. Specifically, technology in Saudi Arabia has started to attract enthusiastic attention from professionals who are attempting to implement higher levels of technology-based learning activities into teaching. In conjunction with this interest, there has been an increase in implementing new trends in educational technology in the Saudi context, such as MOOCs, BYOD, and flipped learning, which requires support by studies investigating the potential of them in the Saudi education context.

Flipped learning attempts to modify and make a learning environment have significant ubiquity. The number of studies which have discussed the benefit and the potentiality of flipped learning in various disciplines: Math (Clark, 2015; Muir & Geiger, 2016; Sun & Xie, 2020); Computer Science (Johnson & Renner, 2012; Wang, 2017); English (Sung, 2015; Challob, 2021), and Nursing (Gilboy et al., 2015), have increased in the past years. The studies were conducted in higher education contexts and during pre-university levels (Graziano & Hall, 2017, Shaffner & Hyland, 2017) and across the worldwide, including developed countries, such as the USA and Australia. According to a review undertaken by Hwang et al. (2019), the main five individual countries that comprise studies that focus on analysing flipped learning are: the United States of America (USA), China, Taiwan, Australia, and South Korea. This can be an indicator toward suggesting that alternative pedagogical practices to the traditional ones are emergent and increasingly significant for educators. Indeed, many studies have highlighted the negative issues associated with the traditional way of learning in terms of not improving the students' learning and the fact of making students as passive learners (Gewertz, 2008; King, 2012) where flipped learning supposed to allow for applying active learning that improves students learning experience (Jamaludin & Osman, 2014; Strelan et al., 2020).

In addition, there is an element of flipped learning which seems to meet the students' expectations, namely, using technology in their learning. In flipped learning, the educational materials are often available for students on online platforms. Thus, the students often use their devices for entertainment purposes; thus, it seems to be of more worth to encourage them to use their devices for educational purposes, which might lead them to engage positively with the educational content and increase their motivation toward learning. It seems that the learning experience in flipped learning, be it in-classroom or out-of-classroom, could contribute to the enhancement of students' motivation towards learning (Davies et al., 2013) and more effective engagement in the learning process (Chiang & Wang, 2015).

Furthermore, another claim is that the students in flipped learning assume responsibility for their learning. They are expected to prepare themselves by accessing educational content as homework. They are also expected to play a major role in their discussions and activities in the classroom. This kind of experience might also enable high school students' to be responsible individuals and promote their autonomy learning skills (Chiang & Wang, 2015), which can help them in their future. In addition, this experience for students stands in contrast to the traditional classroom, which could also mean that the students enjoy in flipped learning more than any other approach (Ferreri & O'Connor, 2013; Kurt, 2017). What is more, the focus of the learning process in flipped learning is based on a concept or an approach that is student-centred (Bergmann & Sams, 2012). According to previous studies which show that students are more engaged with the flipped learning (Davies et al., 2013; Smith, 2015; Wang, 2017), the students' achievement can be influenced positively by applying flipped learning (Ruddick, 2012; Wiginton, 2013; Chao et al., 2015; Baris, 2017; Lo, 2018, Polat & Karabatak , 2021). Potentially Saudi schools are found wanting in terms of this kind of learning approaches that place more emphasis on students and might allow them to practise skills in keeping with the requirements of the 21st century and enhanced the student learning experience. However, there is a lack of evidence to support the effect of flipped learning on high school students, particularly in Saudi schools, which can make the current study valuable for those who are interested in innovative pedagogy and professionalism in Computer education

Flipped learning has become one of the most common but still under-researched concepts among teachers as a new way of teaching and learning, and as an alternative to traditional methods. It is considered as a pedagogical practice that is utilising the advancement of technology and employing active learning. Although it is considered as a new pedagogical practice, flipped learning has gained a rapid popularity and ubiquity amongst teachers and higher educators alike (van Alten et al., 2019). This common use can be due to the change that flipped learning has impacted the way of learning and teaching, which is opposite to the traditional method. Flipped learning also promises the teachers that it is a 'fix' that will somehow provide a different approach for students' success which put pressures on teachers to integrate this approach into their teaching practices. Although there is no clear and consensual agreement about the exact nature of flipped learning, it generally aims to move what usually occurs in the classroom to be done as homework and what is used to be as homework is asked to be done in the classroom (Bergmann & Sams, 2012).

A teacher changes in this process from developing the learning materials into a learning guide within the setting of the classroom. It has also been shown that teachers in these situations must utilise relevant learning content in order to develop a flipped learning setting. The creation of digital learning materials, nevertheless, is often a significant obstacle in the process of flipped learning, as teachers may not have the necessary skills required. However, numerous online resources can be utilised by teachers to help them, as teachers are important in the creation of online resources, which are commonly adapted from previous formats and used to improve the flipped learning approach. Also, flipped learning requires educators to advance from dispensing information to guiding students throughout the learning process (Becker et al., 2017). The aforementioned points show that the learning process of students changed in the flipped learning approach, and that the teachers practice also shifted.

Even though rigorous and empirically well-grounded studies currently seem to be rare in the research on flipped learning (Lundine, 2017, Akçayır & Akçayır, 2018), there has been some level of criticism about the potential of flipped learning. For instance, flipped learning from various research studies has been presented as an alternative to merely improving students' overall learning, although flipped learning has not been detailed comprehensively in relation to incorporated technology utilisation, and learning theories and activities (Lundine, 2017). However, Li Cheng (2018) added that most research studies have failed to provide sufficient details regarding the ways that flipped learning settings are implemented, as the focus has generally been on the consequences of students' learning during flipped learning and not based on the pedagogy and learning design, including focus on which instructional strategies have been employed during face-to-face and digital interactions (ibid).Hence, it is difficult to claim that flipped learning is effective when the concept of flipped learning is not described sufficiently; and this is one of the criticisms toward flipped learning. Furthermore, there have been studies that have determined that flipped learning does not result in higher learning gain compared to non-flipped (Chen, 2016; Jensen et al., 2015). Also, one review in K-12 found that despite the benefit of flipped learning, there was the challenge that could affect negatively, such as skipping pre-class activities, the workload of students and faculty time investment (Lo & Hew, 2017). However, it can be observed that there is still a need to understand the concept of flipped learning and its potential in terms of improving the students' learning experience.

In general, there are only minimal studies that focus on flipped learning interventions (i.e. Bond, 2020, Tsai et al., 2020, Akçayır and Akçayır, 2018). Separately, Turan and Akdag-Cimen (2020) conducted a systematic review and determined the requirement to undertaken further experimental studies that analyse the effects of flipped classrooms. Additionally, a content analysis of different research papers that focused on flipped learning was conducted by Prevalla Etemi et al., (2021), which showed the amount of published papers on Computer Science (34) and Engineering to be low. What is more, there was a mixed flipped learning effect size in the previous studies; with Hinojo Lucena et al. (2020), for instance, presenting the size effect of flipped learning as moderate in regards to the factors of motivation (r=0.40) and learning autonomy (r=0.47). An action study was also carried out by Kostaris et al. (2017) at a 2nd grade of junior high school, with the aim of determining how flipped learning impacts upon student outcomes, motivation levels, and engagement in Computer Science. The results from that study highlight the size effect of the 1st assessment of outcomes (r=0.58) and the 2nd assessment (r=0.90) with a high level size effect of engagement (r=0.65). From a different study, the effect size of intrinsic motivation was moderate (r=0.40) for males students (Ferriz-Valero et al., 2022); while a meta-analysis by Zheng et al. (2020) demonstrated a moderate effect size (r=0.661) in the process of learning motivation. The inference of the difference in the effect size, though, may potentially provide an explanation into the effects that may correlate with the form of implemented educational practice, which can include details of a teacher's role and the utilisation of technology.

1.2 Research Aims and Motivation

This study aims to investigate flipped learning in order to develop a comprehensive understanding of its impact on high school Computer Science students' achievements, motivation, engagement, and autonomous learning. The study's context is based on high schools in Saudi Arabia. Furthermore, this mixed-methods research aims to investigate whether flipped learning can be adopted as an impactful innovation in education, and to ascertain whether it can contribute positively to Saudi Computer Science students' learning experience.

Flipped learning has potentially become one of the most influential educational approaches in the education sector, as another option besides traditional teaching. After the publication of Bergmann and Sams' book "*Flip Your Classroom: Reach Every Student in Every Class Every Day*" in 2012, this approach has since been seen as popular trend in teaching innovations world-wide. The authors of this publication tried to explain how to apply flipped learning, as well as point out to the positive impacts of flipped learning on students learning by drawing on writers' various experiences as classroom instructors (Bergmann & Sams, 2012), yet in the absence of detailed and systematic research evidence. As a result, flipped learning has been frequently mentioned in the reports associated with the education field such as NFER (Straw et al., 2015) and The NMC Horizon reports (Johnson et al., 2015) despite extremely limited and valid empirical justification. Given this huge popularity, many teachers claim to have found a magic tool to improve students' learning and many schools are encouraging teachers to follow this practice (Bergmann & Sams, 2012; Yarbro et al., 2014). However, there is little agreement within the research as to whether this indeed is the case, and in addition, there is still scarce theorisation concerning the construction of the process and its dynamics.

Furthermore, although flipped learning is considered as an innovation and despite its popularity among educators, such popularity is not enough to guarantee that this strategy will promote student learning howsoever defined of course. Watkins (2007) for example stated that certain strategies are offered to schools with the promise to improve learning and that the last three decades of educational innovation is replete with examples of supposed learning improvement that have never been established in empirical research. Furthermore, it might not be effective to apply specific strategies in different contexts (ibid). Watkins' perspective is to clarify for what we see about flipped learning, and where it has been offered to teachers as an effective instruction. The evidence of the effect of flipped learning has almost been centred on self-report (Milman, 2012; Caligaris et al., 2016), and has often been shared on social media and reached a critical mass of generally held opinion rather than properly examined concept. This point could explain the source that teachers rely on to use this innovation. In addition, it should be pointed out, however, that there is a lack of rigorous studies regarding this field (Hamdan et al., 2013; Butt, 2014; Akçayır & Akçayır, 2018; Tasi ,2019; Turan & Akdag-Cimen 2020); which calls for a deeper understanding of the concept and the effect of flipped learning, due to this upsurge in interest and application. A recent review by Turan and Akdag-Cimen (2020) provided findings that show a requirement for additional experimental studies to be conducted into the method of flipped classrooms. It was also found in the review by Senali et al. (2022) that further investigations need to focus on how students become motivated through different levels of flipped classroom experiences. Meanwhile, Tsai (2019) stated that more research should aim to determine the impact of flipped learning on academic performance over a variety of fields. Accordingly, the current study will focus specifically on improving this empirical and conceptual gap.

In addition, it can also be argued that while there is dearth of studies about flipped learning, the research methods of flipped learning studies have mostly been limited to quantitative data, along with a scarcity in richly representational qualitative research (e.g. Karabulut-Ilgu et al., 2017, Bond, 2020). In particular, Bond (2020) demonstrated that additional investigations are required into flipped learning and its correlation with student engagement levels, which should be undertaken by ascertaining qualitative data, including focus groups.Furthermore, the majority of studies have been carried out on the undergraduate stage (e.g. Bishop & Verleger, 2013a; Butt, 2014; Chetcuti et al., 2014; Bernard, 2015; Chen Hsieh et al., 2017; Guo, 2019), which leads one to assume that there is an empirical gap in the literature. Correspondingly, additional K-12 research is needed, as shown following the systemic review by Akçayır and Akçayır (2018). Likewise, only two studies have been conducted that have focused on compulsory education in Saudi Arabia (Najmi, 2020; Al-Harbi & Alshumaimeri, 2016). Al-Harbi and Alshumaimeri (2016) specifically analysed high school students' performance levels following flipped learning interventions and their attitudes towards it. Hence, there is more need for empirical studies using mixed-methods concerning the flipped learning, more particularly the use of flipped learning approach on students' learning in high schools. This empirical research will address this gap in the field. Not only will the researcher highlight the lack of rigorous investigation of flipped learning in High School context, but he will also focus on the field of Computer Science field within Saudi Arabia as an example of where this type of research in education field is still unexplored and in need to be taken into consideration in terms of new directions of teaching. Presently, there is a strong inclination to enhance all educational aspects in Saudi Arabia, including teaching approaches, which education decision-makers should consider and develop. As such, this area needs to be investigated in more depth in order to address this contextual gap and to provide useful insights for Saudi decision-makers rather than just making decisions based on adopted experiences from developed countries that differ in both context and culture.

From the researcher's personal experience as a Computer Science teacher in Saudi Arabia, it was difficult to dedicate the classroom time for activities or discussions due to concerns over the delivery of all content before the end of the class. At that time, the researcher attempted to overcome this challenge by asking the students to prepare for the classroom, although it was found that most of these students did not prepare themselves for the classroom activities, which again forced the use of a lecture method to ensure that the lesson was covered. Deep down, there was a feeling that this learning process would not attract the new generation of students and motivate them into the learning process. The reason could be the students did not have the motivation to learn or the researcher's way of teaching was not attractive for students. It could be that the researcher lacked certain skills to be applied in a variety of teaching methods from a good lecture to more student-centred activities. Subsequently, the researcher applied the lecture method alone, although this does not enable students to engage in Computer Science classes, and does not involve them in different skills, such as collaboration, interaction, critical thinking and creative participation, as it relies on teachers as the sole transferors of information. In fact, it would be a major challenge for any teacher to motivate and engage their students by using just conventional methods, especially in Saudi Arabia. According to Al-Rowais (2014), conventional instruction is the dominant educational method in Saudi schools.

The researcher observed that the students enjoyed practical classes, such as in programming classes where they worked together. One explanation for this level of enjoyment could be that the students need space to work to make meaning of what they learn, and they might enjoy more if student-centred activities were utilised in theoretical lessons where the concept of Computer Science is explained. The choice of teaching methods in Computer Science classes is vital in the process of students learning, which can make the learning experience attractive and could improve students' achievements. Similarly, some Computer Science students has low level attainment levels in Saudi Arabian high schools, as teaching methods normally focus on conformity, instead of innovative collaboration (Bou Aishah, 2018). Therefore, the current study is concerned with determining the potential of flipped learning on teaching Computer Science, which could provide recommendations for teachers of the subject, particularly in Saudi Arabia.

1.3 The Saudi Arabian Education System

Saudi Arabia covers an area of 2,149,790km^2, making it one of the largest nations in the Middle Eastern region. The nation was established as Saudi Arabia in 1932 by King Abdul Aziz Al Saud, with Riyadh declared as the capital city. The Saudi government has made it clear that education is a vital part of the country's development, as shown by the increased budgets set for national education (Allmnakrah & Evers, 2020). In general, the Saudi Educational System is centralised in how it makes decisions, with a clear 'top-bottom' hierarchical structure, which often results in schools unable to act autonomously with high levels of bureaucracy (Alzaidi, 2008). The Ministry of Education (MoE) in Saudi Arabia was previously responsible for supervising schools and for all forms of education prior to higher education (both public and private); with the Ministry of Higher Education focusing on universities, colleges, and any form of Saudi students who had gained scholarships to study in different countries. In 2015, though, the government amalgamated both ministries into a singular central MoE. Hence, this resulted in a significant change to educational protocol in the country and has proven more beneficial in rectifying certain issues through better active management and less ambiguous educational policies and guidelines. This change was one of many reforms in the different departments in the Saudi government with the aim to unify the efforts to improve the outcomes of the education system. One of the benefits of this amalgamated process was to produce a roadmap, including the policies, orientations, strategies, methods and curricula of the students' studies to achieve the vision of education by supervision of all students from nursery to their graduations from university. In the last five years, there has been a massive change in the curriculum, which has included a spotlight on teachers' professional development, and changes in pre-service teacher education. Even though these can show the intention of the MoE to improve the education system, the outcomes of all this change have hitherto not appeared.

Education in Saudi Arabia is separated into four individual levels (MoE, 2019). Nursery/Kindergarten comprises the initial stage, which are renowned for providing a soft approach to learning based on guidance. The following stage is in Primary, which provides a base for children to prepare for future scenarios in life. This stage is centred on developing beliefs, attitudes and behaviour, experiences, together with skills and knowledge. The third stage then moves into the Intermediate Level, which is seen to be a cultural stage, with the purpose of providing students with total Islamic education that improves the mind, body and behaviours. High School Level is then Stage Four, which focuses on students' ages and concepts of growth, which requires greater levels of advanced guidance in order to prepare the students for adulthood. Within the fourth stage, intermediate certificate holders are included into different systems that are devised by relevant authorities.

Teachers in Saudi Arabia have been trained in courses that focus on various methods and strategies of teaching, although traditional approaches are commonly still utilised in classroom settings (Al-Nassar, 2011). The more traditional content of the taught courses include traditional lectures and PowerPoint presentations directed at teachers (Gashan, 2015). As a result, many teachers use the same form of approaches, which has arguably the consequence of diminishing creativity and critical thinking on the part of the students (Allmnakrah & Evers, 2020, Al-Nassar, 2011). Autonomous learning environments have still not been implemented throughout the country, and thus, Saudi public schools commonly create a detrimental effect upon students' abilities and development (Alebaikan, 2010). The typical classroom environment in Saudi Arabia is very formal, teacher-centred and lacks learner autonomy and individual personality, which can be termed as 'high-power distance' learning (Elyas & Picard, 2018).

From a cultural perspective, as the nation of Saudi Arabia has an Islamic monarchy, Islamic Holy (Shari'a) Law forms the base of all laws and customs in the country. Islamic local tradition and culture are the primary sources from which society in Saudi Arabia take their values and ideas (Alhamid et al., 2009). As a result, Islamic education is compulsory in public education (ibid). The education system in the country has developed over time with developments from katateeb (i.e. a physical location/school, where the Holy Quran was taught with Islamic teachings that included writing, reading, and basic mathematics (Alhebsi 201".) to the creation of 42 Universities throughout the Saudi Arabia with a variety of study programmes offered over in different academic areas. Certain educational practices, however, remain such as the dependence on teachers as the main source of knowledge, which was generally conducted through a process of memorisation. With significant financial input, training and exchange programmes, the Saudi government has started to advance the country's education system, although certain detrimental aspects of the traditional system remain (Al Thowaini, 2015). Different parts from the old system have remained unquestioned or unaddressed, such as centralisation of decisions, memorization as a learning technique followed by assessments (ibid). Following the Saudi Vision 2030, which was implemented in 2016, however, the education system has started to decrease its reliance on the traditional practices, and to focus on the eradication of any inappropriate system that may prove negative towards students' educational development.

As a result of the global Covid-19 pandemic, the use of technology has increased in the field of education, with Saudi Arabia no exception, as learning has moved more online with remote teaching starting in approximately the middle of 2020. The Covid-19 pandemic has, indeed, resulted in increased and more rapid efforts by the Saudi MoE to improve education output and results. This has helped to produce a national online platform known as, Madrasati, with teachers also increasing their utilisation of technology in their practices. These advancements may potentially help to reduce any form of resistance to change and assist in integrating technology into students' educational practices. Following the re-opening of the schools, there has continued to be a noted drive to maintain this encouragement for teachers to use technology when delivering educational practices, such as through the process of blended learning.

Saudi Arabia can be viewed in the same educational manner as other traditional Asian societies, including those in Singapore, Malaysia, and South Korea, although it has been determined that Singapore and South Korea produce students who are more competent at Maths and Science, as well as advancing more knowledgeable societies and knowledge-based economies (Mullis et al., 2020). Consequently, it has recently been stated that educational reform is required in Saudi Arabia, and particularly in relation to the Economic Vision 2030 for the nation, which requires improved education. Vision 2030 is an ambitious project that includes focuses on technology in education and a more student-centred approach to learning (MOE, 2019). It can be said that this situation applies in Gulf countries, where the policies of Saudi Arabia are consistent with the policies of Gulf nations including the orientations in education; and there are educational representatives of each country that work together to draw the policies of education in the region. Hence, there is the exchange of experiences in relation to teaching methods, educational technology and innovation, in either the cooperation between the universities or via the conferences organised by the Gulf comparative education society.

Accordingly, educational transformation programmes in Saudi have started to follow different aims, which include the stimulation of students' creativity and innovation through more dynamic learning settings (Alghamdi et al., 2018). Additionally, it is also vital together with this process to advance the curricula and teaching strategies throughout the country via the organisation of many workshops, training courses and significant efforts to reform the curricular. Recently, there has been interest to promote critical thinking in teachers' practices, which would enable the teachers to evaluate the pedagogy they have applied. This might ensure that teachers improve their educational practices and enhance their ability to determine the best teaching methods for their students. In addition, in 2020 the MOE approved to introduce a curriculum of critical thinking and philosophy to high schools, which would initially require teachers to be able to think critically about their educational practices and then determine which method and activities could promote their students' critical thinking skills.

In addition, the MoE in Saudi Arabia has, hitherto, established protocol that works on the importance of implementing technology into education as a means of quality improvement concerning both learning and teaching. It is vital that the benefits of technology are capitalised upon, as most Saudi Arabians use some form of technology in everyday life that could help education. Accordingly, the Saudi Communication and Information Technology Commission presented data that shows how 93.3% of all 10–74-year-olds in the country use the internet (CITC, 2018). Therefore, it seems that the aim of integrating technology into education might not face resistance. It is also worth stating that the crises of COVID-19 have accelerated the plan of using technology in education, where the whole learning process in Saudi Arabia has transferred to become emergency remote teaching for almost 18 months. This has provided an insight into the future of Saudi education, where students and teachers will have to become familiar with the use of technology in their education.

Furthermore, various protocols have been set up which aim to advance education in Saudi Arabia with the focus on technology to achieve the goals of the Vision 2030, such as the ‘Future Gate’. This effectively utilises information technology, in order to develop teachers’ capabilities and advance more beneficial pedagogical strategies in order to reform learning and teaching in all different parts in the country (TETCO, 2020). It is also important to adapt to the utilisation of digital technology in the process of training teachers, together with other modern educational concepts within the scope of digital skills, such as improving the overall pedagogy and curriculum (ibid).

1.4 Significance of the Study

There is limited research to date that focuses specifically on flipped learning and its impacts upon Computer Science in high schools in worldwide context and particularly Saudi context. Most studies in regards to flipped learning in this context, as well as in relation to pre-universities have focused on Maths (Bond, 2020, Lo & Hew, 2017). Nevertheless, there are currently no studies based in Saudi Arabia that analyse flipped learning and its impacts on high school students’ engagement, motivation and autonomy to learn in general. Furthermore, it has been stated that research should focus on investigating flipped learning in the setting of Computer Science with key analysis on learning outcomes (Maher et al., 2015). In accordance with that study, Abeysekera and Dawson (2015) stated investigations need to be undertaken to determine the changes in students’ levels of motivation, and particularly in relation to flipped learning through the analysis of qualitative data based on learning experiences. Correspondingly, the present mixed method study aims to present important findings in relation to flipped learning and how it impacts upon the levels of achievement, engagement, and motivation attained by students, together with an evaluation of the benefits to autonomous learning. The findings will hopefully present innovative knowledge on Saudi Arabian Computer Science students, which will potentially be used to advance high school Computer Science courses through the implementation of flipped learning.

1.5 Purpose and Objectives of the Study

This research investigates whether flipped learning can be adopted as one of fresh directions in education, and how it can contribute positively to Saudi Arabian students' learning experiences. Furthermore, the aim is to investigate in more detail the flipped learning approach in order to gain a comprehensive understanding of its impact upon students' achievements, motivation, engagement, and autonomous learning. Previous studies show that students are more engaged with flipped learning approach (Davies et al., 2013; Smith, 2015); and students' achievement levels can be influenced positively by applying flipped learning (Ruddick, 2012; Wiginton, 2013; Huang & Hong, 2016; Abdelrahman et al, 2017). In terms of the flipped learning design, the researcher aims to provide suggestions, including how teachers can successfully implement flipped learning. Considering the findings from schools in Saudi Arabia, it will be possible to make the appropriate recommendations to improve the approach to teach in Saudi Arabian schools, and to also inform future research. The following objectives are defined for this study:

- To examine the impact of flipped learning on Computer Science students' grade-related achievement
- To identify the effects of flipped learning on Computer Science students' motivation
- To examine the impact of flipped learning on Computer Science students' engagement
- To examine the impact of flipped learning on Computer Science students' learning autonomy
- To explore the benefits of the flipped learning approach for Saudi high school students' educational and learning experiences.

1.6 Research Questions

1) To what extent did Flipped Learning affect Saudi students' achievement in the first-year high school in the Computer science subject?

   $H_{0:}$ There is no significant difference in terms of students' scores between the flipped learning approach and the non-flipped learning approach

H_1: There is a significant difference in terms of students' scores between the flipped learning approach and the non-flipped learning approach

2) To what extent did Flipped Learning affect Saudi students' motivation in the first-year high school in the Computer science subject?

   H_0: There is no significant difference in terms of students' motivation between the flipped learning approach and the non-flipped learning approach

   H_1: There is a significant difference in terms of students' motivation between the flipped learning approach and the non-flipped learning approach

3) To what extent did Flipped Learning affect Saudi students' academic engagement in the first-year high school in the Computer science subject?

   H_0: There is no significant difference in terms of students' academic engagement between the flipped learning approach and the non-flipped approach.

   H_1: There is a significant difference in terms of students' academic engagement between the flipped learning approach and the non-flipped approach.

4) To what extent did Flipped Learning affect Saudi students' autonomous learning in the first-year high school in the Computer science subject?

   H_0: There is no significant difference in terms of students' autonomous learning between the flipped learning approach and the non-flipped learning approach

   H_1: There is a significant difference in terms of students' autonomous learning between the flipped learning approach and the non-flipped learning approach

5) How did the Saudi high school students perceive their learning experience in flipped learning approach and non-flipped learning approach?

The current study implemented a quasi-experimental design with the utilisation of a mixed-method approach, which helped to achieve the objectives and focus on the set research questions. This included two specific groups under analysis: the experimental (flipped learning group - FLG) and the comparison group (non-flipped learning group - NFLG).

The different proposed tools from this method were a pre-post-test, a questionnaire, semi-structured interviews, and a focus group, which were all used in order to ascertain their stated objectives. The quantitative findings also functioned to determine how students' achievement levels, motivation, engagement and learning autonomy would alter based on the implementation of the experiment. Additionally, the qualitative findings helped to provide a greater level of comprehension of teaching approaches and their effects upon students' achievements, motivation, engagement and learning autonomy in Saudi Arabian schools. This was also used to analyse the students' opinions of the contrasting teaching styles.

1.7 Structure of the Thesis

A total of seven chapters comprise the current research. The first chapter presents an introduction, together with a study background, which also defines the objectives, aims, set research questions for the study. Chapter One also provides a description of the study's context and requirement. The following chapter provides a literature review based on flipped learning, which highlights the current literature's limitations regarding the subject. Chapter Three then presents the research design and methodology, before Chapter Four shows the quantitative findings from the pre-post-test and questionnaire; and Chapter Five showed the qualitative findings from the focus group and semi-structured interviews. Subsequently, in the final two chapters, the findings are presented and critiqued with comparisons drawn to different studies in Chapter Six; while Chapter Seven focuses on the main findings with a conclusion, as well as determining the contributions and limitations from the study, together with recommendations for additional studies in the future.

Definitions of Terms

For the purpose of this thesis, I will adopt two definitions that appear to be commonly used and referred to when discussing Flipped Learning

Flipped learning: "*Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator* *guides students as they apply concepts and engage creatively in the subject matter*" (Network, 2014).

Non-Flipped learning: Traditional or Conventional Learning, which is also termed as Classical Learning takes places in the classroom with a teacher and students all present with the setting functioning on complete reliance from the teacher to transfer knowledge in regards to the subject (Tularam, 2018). In the current study, nonetheless, non-flipped learning (NFL) is the term that will be used throughout to refer to this method.

Chapter Two – Literature Review

2.1 Flipped Learning History

The use of technology in education has been in practice for a long time, with interested parties in the education field and teachers always attempting to integrate technological tools into the learning environment for the promotion of learning and teaching approaches. Several technologies have shaped the way classroom content is delivered, such as projectors, which evolved into using Computers to facilitate the learning process in the classroom. However, a host of learning approaches have emerged since Web.2, namely and predominantly mobile learning, blended learning, and MOOCs. Flipped learning is considered to be one of the most innovative learning approaches that have recently been promoted. The terms of "flipped learning" or "flipped classroom" have gained popularity since two chemistry teachers, Bergman and Sams, in the United States of America (USA) published their book in 2012 that was based on their own experiences, as they started using the flipped learning model in their classrooms at Woodland Park High School in 2006.

Prior to Bergmann and Sams, a method for teaching known as "inverted classrooms" was promoted at Miami University (Lage, 2000). That research used video and PowerPoint lectures to encourage students to learn about the content topics prior to the classes, in order to become engaged in relevant discussions, whilst they were also able to access materials in the Computer lab or review material at home. From this process, the instructors would begin each class by asking the students whether they had any questions based on the lectures and material. When a student failed to comprehend something from learning material, the start of the class enabled the opportunity for students to gain further understanding, which often resulted in mini lectures (an average of 10 minutes). Following the students' questions, group discussions would generally start that would apply the principles they learned, which is the basis of the current flipped learning approach as shown by Bergmann and Sams (2012). The story behind current flipped learning was that many students were reported to have absenteeism issues as a result of extra-curricular school activities; thus, the flipped learning enabled the learners to watch the teacher's lectures in a digital format (Bergmann & Sams, 2012). There was frustration on the part of both teachers as their students found it hard to render course material and basic objectives from lectures into beneficial information, especially for more complex uses like labs, group projects, and discussions (Bergmann & Sams, 2012). One of the contributing factors behind the design of flipped learning was to allow these teachers to check the progress and catch up with students who had not attended for sporting reasons or because of other events taking place during typical school hours. They would then observe how such students performed. The main contrast between inverted classrooms and flipped learning is that the latter concept promotes the easy accessibility of digital and online media in learning (Bates 2013).

Essentially, with the application of a flipped learning, it would be possible for teachers to dedicate more time by acting as instructional coaches and aiding students and giving guidance with difficult projects, lab work, research materials and resources, and practical steps to enable students to gain autonomy and ownership of their own learning (Hamdan et al., 2013). Although flipped learning has only been part of the educational armoury for a short period of time, it has increased in popularity because of the benefits associated with using social learning and technology, which seems to have an impact on the learning process.

A number of research studies and reports shed light on the factors that led to the growing popularity of flipped learning and Hwang et al. (2015) summarised these factors. Firstly, it is important for teachers to make good use of the multimedia technology so that learners are provided with the most relevant teaching materials, which allows them to learn without any time or space restrictions. In this way, students are shown how to gather information before class and are required to be actively engaged in the learning process and in charge of their own learning. Secondly, using the teaching videos makes it easy for students to review and preview so that they are well-equipped and knowledgeable enough about the content before class, in addition to giving the opportunity for absent students to catch up. Thirdly, it is easy to save, manage, revise, and impart multimedia digital teaching materials. Fourthly, it is possible for instructors to check when putting together flipped learning that the curriculum is followed in order to improve the overall content of teaching and advance the design of the activities. Fifthly, having sufficient prior knowledge gives students the opportunity to carry out higher level tasks and deal with more sophisticated questions.

In addition, there is more scope for teachers to offer individualised assessment and personalised learning, which could work well for students with learning difficulties, as well as enabling these educators to gain better insights into the learning status of their students. Another factor refers to the activities within the classroom, together with peer/teacher discussions, as these can improve the connections developed between teacher and students, as well as among students. Ultimately, this often results in better levels of students' motivation to learn, and as a result of peer pressure, the learning impacts would be maximised. Additionally, alternative teaching approaches have been focused on in this process, such as learning through projects-based and problem-solving activities, as these instil higher order thinking skills in accordance with the students' abilities and requirements (ibid).

2.2 The Concept of Flipped Learning

The misconception associated with the aim of flipped learning is that it is only concerned with employing technology to provide online materials (Bishop, 2013); whereas the aim of flipped learning is to make students active in the learning process, either by using pre-classroom materials or being immersed in in-classroom activities. Thus, technology has the capacity to create virtual learning environments in flipped learning, especially outside of the classroom. This way enables teachers to deliver all the content in a classroom on an online platform, while the students should engage in pre-classroom activities to prepare themselves. Following this phase, students should engage in active learning activities in the classroom; it can be noticed that the students in flipped learning are the centre of the learning process (Kurt, 2017; Gilboy et al., 2015). This indicates that flipped learning is oriented towards utilising the advantages of student-centred instruction. Bergmann and Sams (2012) explained that instructors in flipped learning provide opportunities for students to learn independently and to learn from each other in the classroom. In addition, flipped learning offers opportunities for students who have different learning styles to gain more personalised choices in how to learn the concepts under study (Enfield, 2013). Flipped learning, at least in theory, seems to reach all learner types, due to different varieties of using technological tools and allowing them to engage in numerous activities in the classroom.

Furthermore, it seems that flipped learning attempts to make students develop into active learners when compared to certain traditional learning approaches, where the students might be passive and mainly just receive information. Flipped learning develops a more interactive and student-driven learning environment where activities can easily be developed to accommodate different levels of learning ability and skills (Altemueller & Lindquist, 2017). It can be noted that flipped learning can be one of the pedagogical approaches that can reform learning environments by utilising the advantage of technology to engage the students in pre-classroom tasks, and then encourage them to be involved in active learning opportunities in the classroom (Strayer, 2012, Mehring, 2018, Bergmann & Sams, 2012). Indeed, this practice may overcome the pressure that faces teachers when attempting to apply active learning in the classroom. Many studies have stated that the adoption of active learning in the classroom is hindered by the pressure to cover a wide variety of topics in an already packed curriculum which results in leaving little room for innovative practices (Bishop & Verleger, 2013b; Dove, 2013). This could potentially be the reason for the popularity of flipped learning as an approach to facilitate the application of active learning. One of the first reports about flipped learning was published by (Hamdan et al., 2014), which outlined four pillars to apply the concept of flipped learning in the right way that are as follows:

1) Flexible environment: Teachers commonly rearrange the learning space within the classroom around specific lessons and/or units, as a flipped learning environment allows for numerous learning modes.

2) A shift in learning culture: flipped learning facilitates learning experiences through pedagogies that engage students in in-class active learning activities with intense interaction among students and the teacher.

(3) Intentional content: content is redesigned intentionally and deliberately so that students can be prepared before coming to class to take part in various active learning activities.

(4) Professional educators: educators observe their students and give them relevant feedback continuously.

In the concept of flipped learning, the role of students and the teacher are different compared to other teaching strategies. Students who learn through a flipped learning model utilise autonomous learning methods outside of the classroom that incorporate digital instruments, which include Edmodo, YouTube, Google Apps, Dropbox (Ahmed, 2016). This contrasts with traditional methods, where students would have to complete paper-based homework. Students in flipped learning methods prepare for the classroom using different learning materials, which enable them to participate in discussions and teamwork within the classroom environment, as they are able to learn at their own speed, while maintaining interactions with their teacher and peers that develops a continuous cycle of feedback and improvement (Ozdamli & Asiksoy, 2016). Students, consequently, become active learners and start to work collaboratively instead of using a teacher as their main facilitator of knowledge (Altemueller & Lindquist, 2017). Hence, a vital part of flipped learning is in the process of developing students' abilities on how to learn correctly and more efficiently (Espada et al., 2020).

However, the shift in the role of students might face resistance from them which could potentially lead to failure in applying flipped learning. Indeed, resistance from students was an issue that certain instructors faced when attempting to implement flipped learning, as the more conservative approach had directed their entire previous education, which consequently made them apprehensive about a more active learning format (Karabulut-Ilgu et al., 2018). As a result, the students could often be unwilling to participate and be responsible, particularly in achieving pre-classroom activities, which is the foundation of in-classroom learning in the flipped learning approach. It has also been stated that many students failed to become familiar with flipped learning and would fail to accomplish pre-class activities (Lo & Hew, 2017). Therefore, the role of the teacher is to prepare students for the shift in the role and understand their attitude before any changes, in order to avoid such failure. A teacher can potentially resolve any resistance issues by communicating with the students and responding to relevant concerns through the provision of guidance on the course (Baker & Hill, 2017).

Furthermore, the concept of flipped also changes the role of the teacher compared to direct instructions. The teacher in flipped learning is required to create and provide online materials for students, such as instructional videos, podcasts and online quizzes, which seem to require digital skills. In addition, flipped learning enables a teacher to become a learning coach and facilitator (Bergmann & Sams, 2012; Altemueller & Lindquist, 2017), as teachers can gain clearer insights into the difficulties and learning styles of individual students when they are able to concentrate on the students' learning process, which compares with training sessions for athletes (Altemueller & Lindquist, 2017). Hence, the teacher has time to be able to correct and assess the students immediately during classroom activities. In flipped learning, the role of the teacher is vital where there is a shift in the teaching paradigm from 'performance' to 'guide'. Flipped learning develops a setting for learning that is based on active learning, rather than the transference of direct knowledge (Bergmann & Sams, 2012). It allows for misunderstandings to be corrected with clarification provided when required (Bergmann & Sams, 2012; Jeong & González-Gómez, 2016, Khanova et al., 2015); it also enables increased student participation levels (Strelan et al., 2020). Further, Hamdan et al. (2013) added that teachers in flipped learning settings observe, provide feedback, and assess in order to provide guidance to learners, which stems in procedure from the Socratic Method. Accordingly, students receive greater levels of effective feedback and innovative instructions from their teachers during the process of flipped learning. Even though the role of a teacher in flipped learning seems divergent and the concept of flipped learning requires the teacher to provide online resources and become a facilitator of learning in the classroom, due to the differences in the design of flipped learning and its method of implementation.

Subsequently, when engaged in the flipped learning process, students must assume the role of active learners and seize the opportunity of being guided to learn through the help and encouragement provided by professionals to clarify the relevant points in the curricular content. In so doing, teachers are become more facilitators and mentors than mere instructors. In general, it seems that the role of the teacher in flipped learning should include the provision of assistance for students to be able to think and discuss. Flipped learning seems to provide teachers with the space to be creative to encourage their students to show their best in the classroom. The aforementioned details can be summarised in the definition of flipped learning, which is:

> "*Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter*" (Network, 2014).

The final points in this section clarify the misconception in regard to flipped learning and flipped classrooms. According to the flipped learning leaders (Network, 2014a), there is also a clear distinction between a flipped classroom and flipped learning; hence, the two terms are not identical. While it is true that flipping a class can precipitate flipped learning, this is not always the case. In fact, it is possible for several teachers to flip their classes when they make their students undertake some out-of-class activities, such as reading a text, watching supplementary videos, or solving further problems; however, when flipped learning is applied, teachers must integrate the following four pillars into their practice, which have been mentioned above (see Figure 2.1).

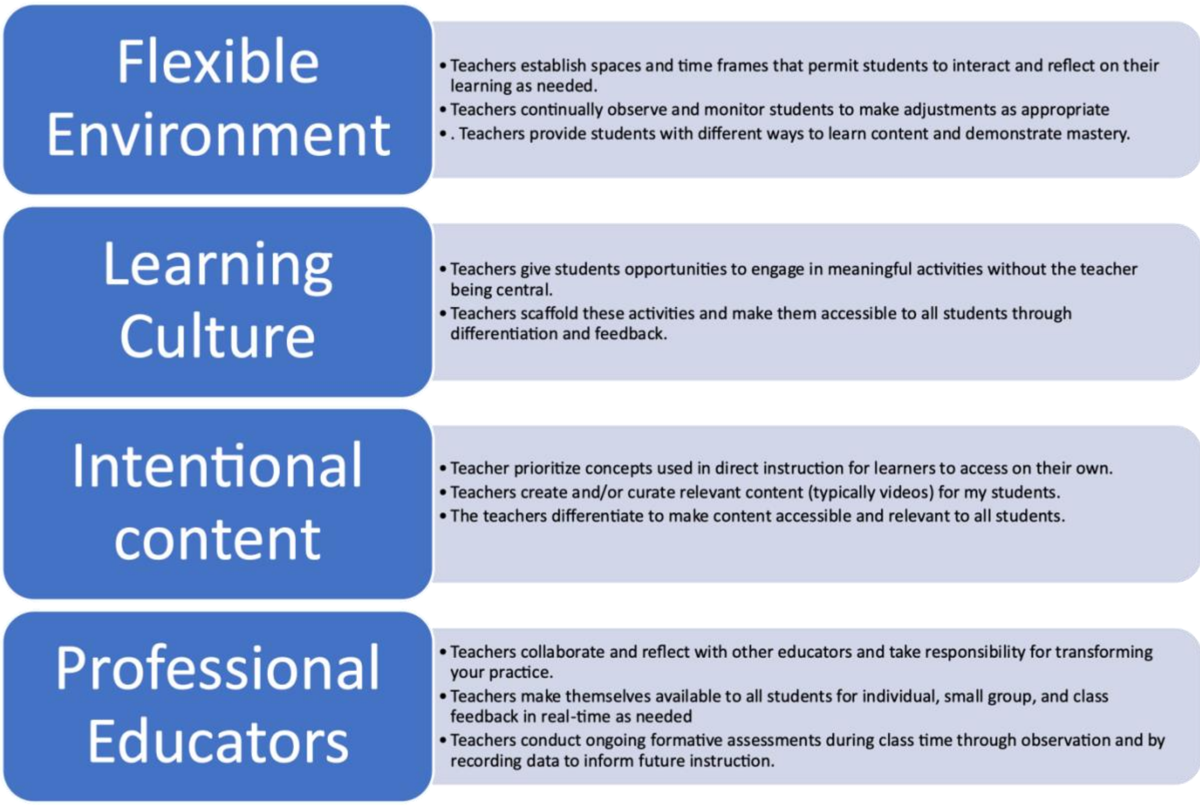


Figure 2.1: The Four Pillars Applied in the Flipped Learning Approach (Network, 2014a)

2.3 Integration Technology in Flipped Learning

Flipped learning aims to exploit the features of advanced technology to provide rich educational environment by including various learning activities such as video, e-text, quiz, online forum … etc. Indeed, Learning Management Systems (LMS) (Baris, 2017; Lo et al., 2018, Winter, 2018; Wang, 2017); Google classroom (Strydom, 2017, Shaffner & Hyland, 2017); ALEKS (Strayer, 2012); Moodle (Butt, 2014, Sergis et al., 2018, Louhab et al., 2020); and

MyLabIT (Davies et al., 2013) were often used by many studies in flipped learning. These technologies are easy to navigate, which is an important feature that might keep students engaged. These technologies have typically the same features by offering tools to enrich educational environments as illustrated in Figure 2.2 below (Coates et al., 2005).

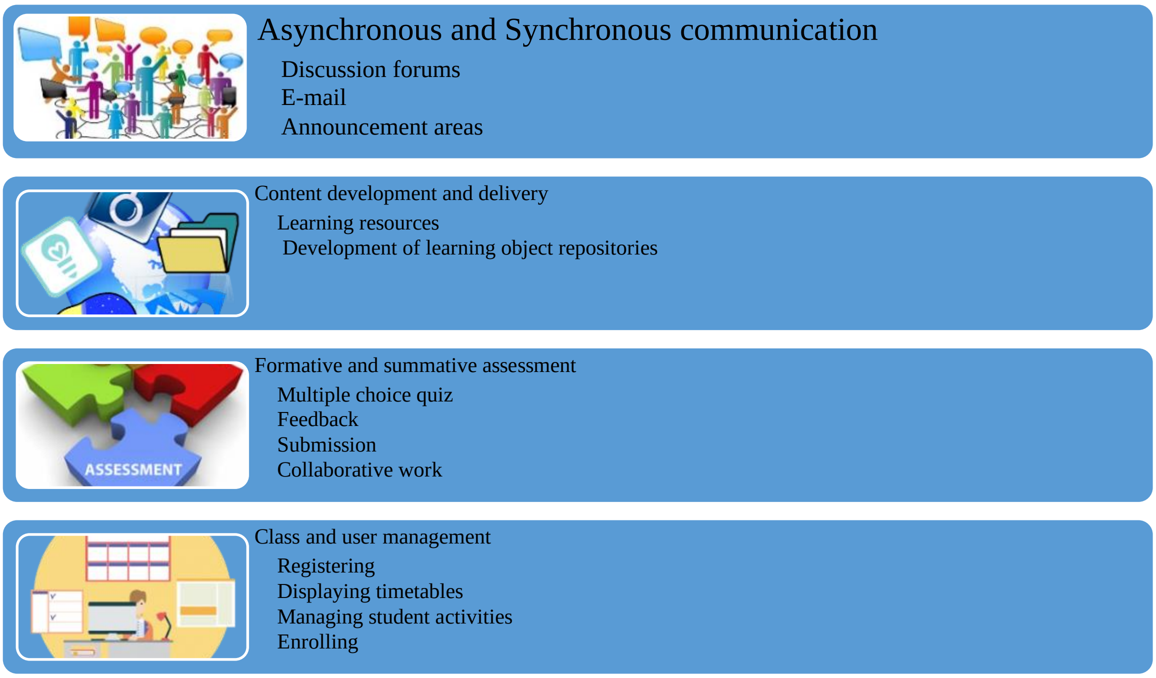


Figure 2.2: Tools in Technology that Improve Educational Settings

Furthermore, YouTube is used as a tool to upload instructional videos (Chao et al., 2015; Hao, 2016; Karaca & Ocak, 2017). In addition, there are e-platforms, such as Khan Academy (Kirvan et al., 2015; Tawfik & Lilly, 2015; Weiss III, 2018) and Edmodo (Kurt, 2017; Santikarn & Wichadee, 2018) which enables teachers to provide E-texts, quizzes and online discussion. Accordingly, the development of technology has offered practitioners multiple options to apply flipped learning and particularly to create educational environments outside of the classroom. Nevertheless, each online platform has different features. Therefore, choosing the tool can be based on how the teachers would design their learning environment. In most cases, instructional video is used in the design of flipped learning, and that is to provide explanations of certain concepts to students. The teachers can produce instructional videos by software to record the lecture (Schultz et al., 2014) or to record their voices over the PowerPoint slides (Peterson, 2016). Even though teachers who do not have high technology skills, they can utilise online platforms such as Khan Academy (Kirvan et al., 2015), TED Ed (Sohrabi & Iraj, 2016), which provide such ready-made instructional videos. To sum up, there is a variety of technology tools available for the teacher to implement the flipped learning approach, and it does not matter if the teacher is expert in using technology or a complete beginner. The teacher can either produce the learning materials from scratch or basically utilise the ready-made learning materials, which are easy to find on the internet.

2.4 Learning Theory of Flipped Learning

2.4.1 Social Constructivism Theory

The general concept of flipped learning implies that the learning process and its environment is based on the concept of students-centred approach. On one hand, it is contended that the theory behind flipped learning is the constructivist theory (Bishop & Verleger, 2013b; Sohrabi & Iraj, 2016). In constructivist perspectives, learning occurs when the learners construct knowledge by following minimal instruction and integrating a new experience with prior knowledge (Marlowe & Page, 2005). In this sense, flipped learning incorporates the constructivist learning by allowing the students to be exposed to basic knowledge before going to classroom, while they use their time in classroom to explore the learning concept more in depth and build their knowledge constructively. However, constructivist learning has received criticism over the principle of the learning process, where there is no evidence based on controlled studies that support this view (Kirschner et al., 2006).

In addition, this approach of learning may be regarded as less effective and negative because the students lack guidance, or they may be subject to misunderstanding and lacking the full picture of what they have been given (ibid). Thus, flipped learning may lose its reliability when constructivist theory is implemented in this approach. In other words, when teachers are in the process of designing lessons via flipped learning approach, they should pay extra attention to provide ample opportunities of guidance (Scaffolding) and make concepts clear for students in the pre-classroom phase. Indeed, leaving students to deal with new information without guidance may affect the progress of their learning. On the other hand, social constructivism theory (SCT) is claimed to be employed in flipped learning (Tong, 2014; Ng, 2014, Wen et al., 2016; Chen, 2016; Rahman et al., 2018; Mehring, 2018). These research studies used social constructivism theory to develop the base of flipped learning, as it is believed that collaborative learning produces more benefits than when undertaken individually. As a result, flipped learning develops group-based learning, where students learn through peer assistance and feedback. The social constructivists believe that students learn by social activities. They also define learning as an active process of construction of meaning. Learning is best achieved when undertaken as a social engagement with peers, and not where one only develops passively to external stimulus (McMahon, 1997). Students need to learn by autonomously discovering principles in the subject, different concepts and knowledge, which results in becoming motivated to progress intuitive thinking, as stimulated by the teacher (Brown et al., 1989).

Vygotsky (1978) explained that learning occurs through social interaction. He emphasised that children could learn when teacher or/and peers offer scaffolding when learning. According to social constructivists, any meaningful learning takes place whilst people are involved in social behaviours like interactional and collaborative activities (Amineh & Asl, 2015). This theory is incorporated within flipped learning by making classroom time rich with excessive collaborative activities. A social constructivist theoretical dynamic set into flipped learning helps to facilitate a student-centred approach (Green, 2015). It has also been stated that the flipped learning instructor is able to develop the learning time in the classroom based on social constructivist activities which enhance learning outcomes (Mehring, 2018). Students work together with classmates during the process of flipped learning, as they engage in discussions and develop their content comprehension (ibid).

One of the basic claims of flipped learning is that it encourages students to work together and shifts the role of the teacher to act as a facilitator in the classroom (Bergmann & Sams, 2012). Perhaps employing the social constructivism theory in flipped learning design may add value on to the learning environment where there are opportunities to enrich the learning environment by applying several of activities such as discussion, debate and collaboration inside the classroom, and before that, which would expose the students to prior knowledge and enable them for online discussions, which consequently accentuates the principle of the theory. Social constructivism theory incorporates various forms of cognitive constructivism that focus on collaboration in learning that could be potentially applied to group work and discussions tasks inside the classroom and through online discussion between students and their teacher (Wen et al. 2016). Therefore, it can be determined that social constructivism should be integrated into a flipped learning setting in order to improve its effectiveness (ibid).

The Zone of Proximal Development (ZPD) and scaffolding or a more knowledgeable person (MAK) are key concepts of social constructivism. ZPD is defined by Vygotsky and Cole (1978, p.86), "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers". Hence, ZPD relates to an individual who can complete tasks unaided in a self-regulatory manner and can achieve more with the aid of more knowledgeable people (MKP). ZPD, in the current research, involves determining how learners can undertake their tasks during periods of teacher guidance and through peer interaction in the classroom. Moreover, ZPD has shown that a less knowledgeable individual starts to become more engaged when they are able to have increased levels of interaction with more knowledgeable people (MKP), including mentors, teachers, teachers, observers, etc. (Shabani, 2016).

The concept of ZPD can be applicable in flipped learning; for example, it is possible for students to engage in classroom activities where they are all able to work in groups. In these groups, both novice students and expert students (MKP) can be included together, with the teacher assuming the expert's role when assigning group tasks. Similarly, when engaged in a class activity, there is a sense of fluidity and fluctuation in the novice and expert roles; in other words, it is possible for the novice peer to become an expert upon contributing some of the knowledge to another learner, even if he or she does so intermittently. As stated by Lantolf and Pavlenko (1995), "individuals, none of whom qualifies as an expert, can often come together in a collaborative posture and jointly construct a ZPD, in which each person contributes something to, and takes something away from, the interaction" (p.116); this is something worth considering and acquiring when designing classroom activities in the flipped learning approach. Vygotsky (1978) claims that students can complete tasks from current performance to potential performance after receiving support through scaffolding.

Scaffolding is also beneficial as an education-specific concept to determine the most beneficial practices in pedagogy, which ensure that learners are adequately supported in their process of learning in order to improve their knowledge levels on the subject content (Green, 2015). It can be assumed that the concept of scaffolding is initially applied in flipped learning in the pre-classroom phase, where the teacher provides the students with advice, guidelines, instructional videos, online quizzes and/or online discussions (Jeong et al., 2017). In addition, the role of the teacher in-classroom phase can achieve the concept of scaffolding when the role is as a facilitator.

In general, the foundation of flipped learning in the current study can build upon the principle of social constructivism, which has been implemented in some previous studies (Jarvis et al., 2014; Caverly, 2017; Mehring, 2018; Joseph & Joy, 2019). Scaffolding in the process of flipped learning provides support to students through pre-classroom guidelines, videos, and online discussion with their peer students. Moreover, there are also online quizzes that are often used in modern teaching, which help students to better understand their own weaknesses in order to clarify different concepts. In this learning process, the ZPD concept considers how learners achieve their tasks while being guided by pre-classroom materials. A teacher who applies flipped learning can apply the principle of scaffolding through classroom activities by providing instructions of problem-solving activities, identifying the role of expert peers in the group, and being a facilitator during the in-classroom learning. In addition, the students can engage into social interaction via online discussions, and then come to the classroom to construct knowledge by being involved in collaborative and cooperative learning activities, and social interaction with peers and teachers. Social constructivists believe that students learn by social and communal activities. They also define learning as an active process of meaning construction.

Gree (2015) implemented the concept of social constructivism theory with flipped learning in a research study together with the introduction of technologies that would facilitate video-recorded lecture content before a class, where students would be able to autonomously learn in the manner that best suited them. This form of autonomous learning functioning alongside group work inside the classroom has the potential to be a successful educational model for the population of any country, as students attend classes in a more prepared manner, with students gaining motivation from the knowledge that class time will revolve around interactive discussions, problem-based activities, active group work, and positive activities that function through a social constructivist method of learning.

2.5 Design of Flipped Learning

Most of the studies have not explained the rationality of their implemented design of flipped learning. Even though the approach of flipped learning has been promoted in recent years, there remains ambiguity regarding the best approach and in the most beneficial form of implementation (Jenkins et al., 2017). In addition, the development of a practical design framework is more important, as flipped learning continues to grow in popularity (Jenkins et al., 2017). In this section, the researcher first attempted to survey flipped learning designs in the previous studies, whilst also aiming to explain the principle of design of flipped learning that is applied in the study.

It can be stated that the concept of flipped learning design has two phases: the first phase is the out-classroom; and the second phase is in the classroom. The learning in this design occurs, not just in school, it starts from students' preparation at home. In addition, when examining the design of flipped learning in previous studies, it could be noticed that it is based on the hierarchy of the revised version of Bloom's taxonomy model (see Figure 2.3). The pre-classroom phase focuses on the base of the hierarchy, as well as remembering and understanding, while the in-classroom phase concentrates on the higher levels, the application, analysis, evaluation and creation. This perception has been aligned with reports about the design of flipped learning (McLaughlin et al., 2014; Gilboy et al., 2015; See & Conry, 2014; Eppard & Rochdi, 2017). It was stated that the initial two levels of remembering and understanding were aimed to be achieved via an online learning environment using instructional videos, digital textbooks, and podcasts. Hence, the process of learning would happen outside of the classroom, which would be directed without any supervision by a teacher, where the students would autonomously direct their own learning by selecting their own strategies, such as watching videos as many times as required (Eppard & Rochdi, 2017).

Contrastingly, the higher levels are achieved in in-classroom activities, where the students could apply the concepts by involving in-peer instructions, such as group discussions, collaborative tasks, and problem-solving activities. The role of a teacher within the setting of the classroom develops to facilitate learning, instead of instructing it, whilst also advancing problem-solving techniques through in-class discussions, collaborative learning, guidance, and different methods that function to augment students' self-reflection on their own abilities, as this will help them to achieve greater levels of cognitive learning behaviour, which are attained through application, analysis, and evaluation (Hwang et al., 2015). Specifically, Bloom's Taxonomy corresponds with flipped learning, as it focuses on the development and transmittance of information through learning, which students obtain outside of the classroom in an independent manner, while information assimilation happens in the class setting under an instructor's/ mentor's guidance. It has even been added that flipped learning enables the progression and accomplishment of all the levels to Bloom's Taxonomy (Uzunboylu & Karagozlu, 2015).

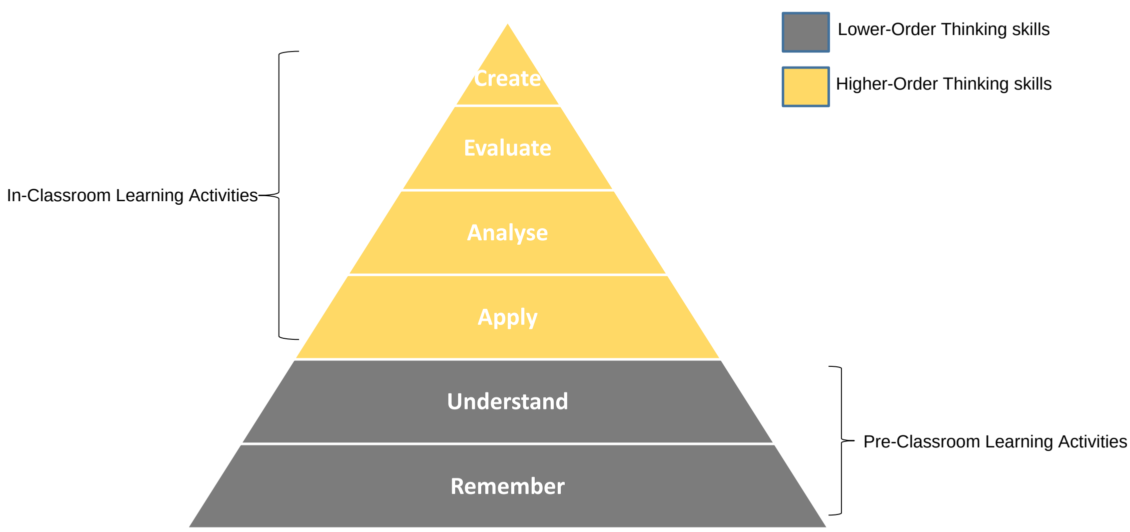


Figure 2.3: Taxonomy for flipped learning based on bloom's taxonomy

In addition, the features of the flipped learning design seem similar to those already suggested by a number of scholars (e.g. Abeysekera & Dawson 2014; Kim et al., 2014; Lee et al., 2017; Yildiz-Durak, 2018). The design of flipped learning in most studies generally depended on some elements, either in the pre-classroom phase (a Computer-based student preparation), or during the in-classroom phase (an interactive group-based learning environment). The common element used in the pre-classroom phase was the instructional video and it was used either as the only resource for the students' preparation (Strayer, 2012; Schultz et al., 2014; Bhagat et al., 2016; Chen, 2016; Slemmons et al., 2018) or with other additional resources (Chao et al., 2015; Muir & Geiger, 2016; Karaca & Ocak, 2017; Kim, 2017). The usage of videos is beneficial and can be viewed as a value-added feature in this phase, as it increases the students' motivation, enhances learner autonomy and learning experiences (Willmot et al., 2012); and has the potentiality for deeper learning of the subject. Further, the students might become motived to learn via videos, where they have control to watch, and re-watch based on their own pace rhythm of learning. Generally, as stated by Hung (2015), teachers who implement flipped learning into their way of teaching can improve traditional face-to-face lectures and develop them into PowerPoints, videos, and instructive digital material, as well as to select previously produced educational videos from different platforms. As a result, the time in the classroom can be utilised to improve the learning environment, and thus, students become better prepared to participate in higher level interactive activities, including solving problems and debates (Sohrabi & Iraj, 2016, Lai & Hwang, 2016).

However, some studies used short videos, which are about 5 to 15 minutes as a part of students' preparation (Mason et al., 2013; Hodkiewicz, 2014; Bhagat et al., 2016). Then, adding extra learning resources such as digital texts to read and discover concepts further via websites (Kirvan et al., 2015; Baris, 2017; Kim, 2017; Kurt, 2017; Yildiz-Durak, 2020). This practice seems to be appropriate and beneficial in this phase as it allows students to have comprehensive understanding. Furthermore, quizzes were employed in pre-classroom in some studies. This is either to test the students' knowledge or to guarantee that students prepare themselves for the classroom activities (Seitan et al., 2020; Bates & Ludwig, 2020; Jensen et al., 2015; Hao, 2016; Yough et al., 2017). The importance of the quizzes appears in determining the level of the students' understanding and ensuring that teachers have an insight about the students' understanding so they can intervene efficiently during classroom time. Furthermore, the unavailability of the teacher can be seen as a criticism against flipped learning, especially in the pre-classroom phase (Schultz et al., 2014). Thus, few studies attempted to utilise the potential of asynchronous discussion (Kim, 2017; Chen Hsieh et al., 2017; Aidinopoulou & Sampson, 2017; Challob, 2021) in a way to overcome the absence of teacher. Employing asynchronous discussion in flipped learning design can enrich the learning environment in the pre-classroom phase as well as add value for flipped learning design. Indeed, the students can have the opportunity to experience virtual interactions with the teacher or peers via asynchronous discussion.

Moving to in-classroom phase which should be complementary to the first phase in order to create a successful flipped learning experience (Strayer, 2012; Mason et al., 2013). Most studies agree with engaging students with active learning and this by applying the collaborative learning (Chao et al., 2015; Hao, 2016; Aidinopoulou & Sampson, 2017; Kim, 2017; Kostaris et al., 2017; Kurt, 2017; Wang, 2017). This, in fact, can be one of the aims of flipped learning as mentioned by (Bergmann & Sams, 2012). The type of these activities focused on encouraging the students to mostly work in-group to solve higher order-thinking activities such as problem solving, think–pair– share and small-group discussion (Chao et al., 2015; Jensen et al., 2015; Kirvan et al., 2015; Kurt, 2017; Al-Zahrani, 2015; Ugwuanyi et al., 2020, Roach, 2014). Hence, flipped learning attempts to make the learning environment more social and richer and more valuable in terms of enhancing students' knowledge and skills, such as in communication, collaboration and critical thinking. Moreover, some studies stressed on the importance of making the beginning of class an activity of questioning and answering (Lage et al., 2000; Schultz et al., 2014; Chao et al., 2015; Chen, 2016; Aidinopoulou & Sampson, 2017; Wang, 2017). This kind of strategy can allow the teacher to provide immediate feedback for any misconceptions or gaps in students' knowledge, and then empower the students before engaging them with higher order thinking activities.

Therefore, the current study will use a design in maintaining what has already been mentioned in the literature review (see Figure 2.3). The researcher followed the recommendations by Giannakos et al. (2018) which detail that flipped learning requires clear information of the specific materials used, together with the pedagogical strategies; in Computer Science this is particularly relevant, as technology is a central point of both content and the form of usage. The design of current flipped learning, as clarified by integrating Bloom's taxonomy and social constructivism theory in the design of flipped learning (see Figure 2.4). Eppard and Rochdi (2017) noted that Bloom's taxonomy is important, as it demonstrates different learning stages, as well as the forms of learning that are present through each stage, although it does not provide any explanation to the most productive practices to utilise each level in specific contexts.

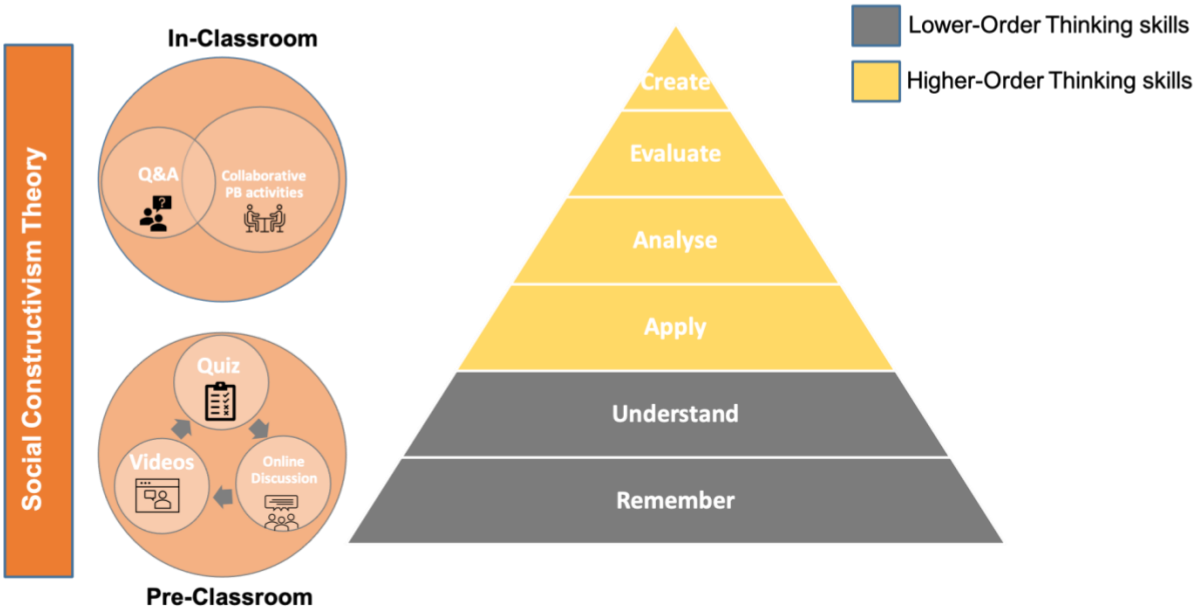


Figure 2.4: Adopted Design of Flipped Learning on the Current Study

Specifically, the design of flipped learning in the current study has two phases, with the pre-classroom phase including instructional videos to allow the students to understand the concepts (Hew & Lo, 2018, Seitan et al., 2020). This use of videos and digital texts aim to help the students grasp the concepts of Computer Science subjects that are included in the experiment, such as the concept of multimedia. The students could be able to re-watch the videos based on their needs and take notes when they require it, as well as to explore the lesson textbooks that are explained in the videos. This could achieve the lower order thinking which is based on remembering and understanding. In addition, the students offer an opportunity to examine their understanding via online quizzes to determine whether they are ready for the classroom (Turner & Webster, 2017). The use of quizzes also helps teachers to see where the students struggled to address that at the beginning of the classroom. This could ensure that the students are ready to be involved in classroom activities. Online discussions will also be used to enable student engagement, which will help the students with less comprehension to gain knowledge from their peers.

The concepts of social constructivism theory (zone of proximal development) are applied in the pre-classroom stage; this allows fast learning learners to skip video content, as they already understand the subject material (Chen, 2016). Comparatively, slow learners will be able to pause the videos when required in order to review the content, which is beneficial as many students might be embarrassed or actively encouraged not to ask their teacher to repeat certain points. As a result, slow students can learn instructional contents at their own pace in flipped learning. Moreover, flipped learning is structured to enhance levels of support to students, which is achieved through pre-classroom guidelines, videos, and online discussions with peers. Additionally, online quizzes also help, which modern teaching practices often incorporate, as greater levels of understanding are advanced through this process, as students can learn their own weaknesses, and thus, better determine and improve different concepts. Through this process of learning, the concept of ZPD concept focuses on the ways that learners can complete their tasks in an adequate manner, while pre-classroom materials guide the overall process.

Moving to the in-classroom phase, the teacher asks the students to become involved in classroom activities, such as collaborative, problem-based and debate activities. The design of this phase and the classroom activities are based on the aim of each lesson. The role of the teacher is to facilitate by walking around and intervening at the optimum time, where they implement the process of scaffolding which is structured through the provision of explanations for different activities. The teacher also needs to identify which students are the most knowledgeable in the groups, and then work as a facilitator for the students within the in-classroom activities. Additionally, the students will gain the opportunity for social interaction as they develop knowledge prior to the class and then work collaboratively with peers and teachers inside the classroom. Social constructivists believe that students learn through social activities and that learning is an active process to construct meaning (Kim, 2001). In addition, the flipped learning design aims for the students to experience activities that engage them in higher-order thinking during in-classroom activities when they use and apply the information that they are exposed to outside the classroom to help them during classroom activities. They also work with classmates to analyse and connect ideas to solve the task and justify their solutions. In some lessons during the current study, the students have activities that require them to create new work, such as videos and blogs.

However, there is a lack of studies that explain the underpinning theory behind the design of flipped learning, and this can be seen as a gap in research in the field of flipped learning. The ubiquity of applying flipped learning in many disciplines should be accompanied by the knowledge of how to implement and evaluate this way of learning, which can be based on a strong underpinning theory. Hence, the current research has attempted to use the flipped learning design based on Bloom's taxonomy and social constructivism theory as the underpinning of the design. In addition, Bloom’s taxonomy has functioned as part of the educational development of Computer Science regarding design and evaluation structure, as well as to better structure assessments and compare different levels of cognitive difficulty for the courses (Thompson et al., 2008). What is more, the use of social constructivism theory is the foundation of the design to achieve the aim of flipped learning, which is to offer a social learning experience for the learners and make them active learners.

2.6 Students’ Motivation

Human behaviour involves two highly multifaceted aspects, namely learning and motivation. While people do often learn from their mistakes and experiences, their disposition to learn is influenced by several factors. In an educational context, one of the most persistent apprehensions for teachers is how to keep students motivated, and thus feel not prepared enough to deal with this issue (Turner et al., 2011). The links between motivating factors and learning have occupied a central position as a research topic in the educational field (Lynch, 2006). Motivation is vital to a student’s learning process and is impactful upon their levels of achievement (Lynch, 2006, Liu et al., 2009, Goodman et al., 2011), which is more evident in the case of learning in a hands-on discipline, including Computer Forte information technology. Better levels of motivation and continuous engagement in Computer Science have resulted in reduced anxiety levels and augmented interest in the subject, and thus, improved achievement levels (Forte & Guzdial, 2005). Engagement and commitment to continuous practice would not be achieved without maintaining the level of motivation and encouragement to succeed (Jenkins, 2001).

The current study assumed that motivation levels are enhanced by applying a flipped learning approach, which might lead to better achievement and engagement by students. In fact, keeping students motivated can increase the students in confidence and engage them in more classroom activities, as well as enable them to grasp the course content more easily (Giesbers et al., 2013). As defined by Cole et al. (2004), the motivation to learn refers to 'the willingness to attend and learn material in a development program'. Arguably, it is true that ability and intellect can have an influence on what students can do; however, it is the degree of motivation that can impact on their focus and the effort exerted on a particular learning task.

2.6.1 Self-determined Motivation Theory

In the present study, the factor of students' motivation will be examined based on self-determination theory (SDT), as proposed in the 1980s (Deci & Ryan, 2004). The major focus of SDT is on a person's capability of making decisions and sustaining their communication and interactional relationship with their respective surroundings (Jones et al., 2009). According to the SDT approach, extrinsic and intrinsic motivation account for the overall concept of motivation, with both contributing a great deal into the encouragement of students' commitment and academic achievement (Abeysekera & Dawson, 2015). In extrinsic motivation, one is simply striving to gain a reward, while refraining from being critiqued or penalised, which can lead to low perceived autonomy. In addition, extrinsic motivation refers to being involved in an activity as it results in a specific outcome. One can mention an obvious example of extrinsically motivated behaviours in those carried out to achieve a physical reward or to avert being penalised (Deci & Ryan, 2008a). On the other hand, intrinsic motivation, refers to engaging in a type of behaviour because the person is interested in the activity itself and takes a great deal of satisfaction from taking part in it (Deci & Ryan, 2008a). Having an intrinsic motivation enables people to carry out activities because of the positive vibes they can gain from the activities themselves not the other external variables associated with them like promotion or financial rewards (ibid).

According to Deci and Ryan (2008), apart from showing keenness in what they are doing, intrinsically motivated people are usually curious. In addition, they also attempt to learn about or identify new stimuli, as well as striving to master challenging tasks. As such, it can be said that the way the teachers teach, and the learners learn can have an impact on students' motivation either intrinsically or extrinsically or both. In the case of flipped learning, it does not only depend on utilising technology, which might be obvious as it is of interest to the current generation, but also on in-classroom activities, which depends on a student-centred paradigm that might improve student motivation. It has been proven that student-centred learning settings can have a considerable influence that can reflect positively on students' motivation (Baeten et al., 2013). The process in flipped learning tends to support student autonomy, which as suggested by Hanrahan (1998), relates not only to enhanced intrinsic motivation, but also to time and energy dedicated to the topic.

Giesbers et al. (2013) stated that students with higher levels of motivation learn autonomously, as they can engage in their own learning process due to increased levels of interest and enjoyment in the subject and lessons. In this case, the students do their homework without waiting for external rewards; in other words, they do it because it is enjoyable (Noels et al., 2000). Pintrich et al. (2008) also support this view by maintaining that intrinsically motivated students take part in an activity for pleasure, i.e., they find their work enjoyable or interesting. Furthermore, they tend to look for novel ideas and challenging tasks, which allows them to explore, learn, and expand their knowledge and put their skills into practice (Ryan & Deci, 2000). On the opposite, external rewards are the driving force for extrinsically motivated students. As described by Reiss (2012), this category of learners is inherently dependent, as they may go to school for other motives, such as the need to achieve good marks or in avoidance of being punished. In addition, extrinsically motivated learners carry out tasks to be able to achieve something, as in gaining rewards like good scores or physical rewards.

As shown in recent research, it is possible to view intrinsic and extrinsic motivation as two separate dimensions, each varying between high and low, where a learner may be high on both, low on both, and any mixture in between (Schunk, Pintrich & Meece 2008). As described by Noels et al. (2000), intrinsic motivation refers to the willingness to commit to an activity because it gives the person performing it a great deal of satisfaction. Similarly, extrinsic motivation refers to an activity undertaken in order to attain certain rewards, which can include gaining a physical prize or a renumeration of some kind, or simply to avert being punished. Flipped learning might improve students' motivation levels when the teacher provides the type of activities on the flipped learning design that are novel and challenging for students. Intrinsic motivation will only take place for those learning activities that are innovative, thought-provoking or offer an appealing value for learners (Ryan & Deci, 2000 A). In addition, one must remember that in order for students to be intrinsically motivated, they have to see taking part in a particular learning activity an inherently source of satisfaction for them. Intrinsic motivation has been stated by to be driven by three psychological needs for all individuals: autonomy through personal ownership of one's own actions; competence and the ability to create set aims and outcomes; and relatedness, which enables the ability to connect an individual to other people (Ryan & Deci, 2000A; Niemiec & Ryan, 2009).

As well as the intrinsic and extrinsic motivation dimensions, Ryan and Deci (2000) also referred to the concept of *amotivation*, which can be simply defined as a state of being where a person fails in linking his or her actions to the implications of these actions, as a result of circumstances that are out of their control (ibid). When it comes to *amotivated* learners, they are typically totally passive and do not feel any desire to do anything. According to Ryan (1995), there are three different reasons that can result in such behaviour, including lack of competence, failure to attain the expected aims of a task, and devaluing an activity. Overall, based on what has been mentioned in this section, which showed the importance of students' motivation levels on their learning experiences, the current study will attempt to examine the impact of flipped learning on enhancing students' motivation levels.

2.7 Autonomous Learning

One of the aims of education across the world in general and in Saudi Arabia is to cultivate the autonomous learning of learners in and out of school. The outcomes of school should include acquisition of autonomous learning skills as a result of demand in the workplace (Luna Scott, 2015). In addition, the importance of independent learning can be seen as a factor of success at the university level (Field et al., 2014). Autonomous learning helps students to develop skills on how to learn correctly that can be used throughout their lives, as they become more responsible in learning management and engagement, as well as increase motivation levels, as the true value of their learning is demonstrated through real situations, which subsequently increases their analytical skills (Thomas et al., 2015).

Autonomous learning also advances a person's self-governing capabilities, which can often result in higher levels of achievement due to augmented motivation (Sert, 2006).

In the literature, the three terms used interchangeably include 'Independent learning', 'self-directed learning' and 'autonomous learning', and these terms have similar descriptions of themes and processes (Vázquez, 2016). In the current study, the researcher used the term autonomous learning. One of the definitions of autonomous learning is self-regulated learning (Meyer, 2010). The students in autonomous learning understand their learning process, and the motivation to hold the responsibility for their learning, as well as being involved with the teacher to structure the learning environment (ibid). Furthermore, autonomous learning means that the students are able and willing to take charge of their learning (Little, 1995; Benson & Voller, 1997).

Autonomous learning is a central point of educational reforms and policies throughout the world (Wiśniewska, 2017, Vázquez, 2015). Recently, these autonomous learning skills have been vital for students during the Covid-19 pandemic, as many schools had to remain closed to students for substantial periods, which have resulted in learning being undertaken at home remotely. Hence, education sectors in many countries have had to adapt, while people's perceptions on the delivery of learning have changed. Correspondingly, (Hodges et al., 2020) states that emergency remote teaching (ERT) has occurred in many different educational settings, which has required developments in teaching delivery through alternative methods.

The literature suggested that there are internal and external factors to achieve autonomous learning (Mayer, 2010). There are contributing external factors, such as the creation of a strong bond between teachers and learners and the provision of an 'enabling environment', in which technology has an integral role to play as an external factor (Mayer, 2010). In this sense, flipped learning might be seen as a learning approach that fosters teacher-student relationship by allowing more interaction in the classroom and by also allowing technology to play a part in the learning environment. Also, there is a wide array of literature shedding light on the significance of ICT for autonomous learning (Meyer, 2010). Moving to internal factors which are cognitive, metacognitive and affective skills that individual pupils must acquire (ibid). Classifying these skills, there are affective skills that are confined to emotions and feelings (Meyer, 2010). In addition, as revealed by Meyer motivation is considered most affective skills that are linked to growing ability to engage in autonomous learning. The self-determination theory is a motivational theory that provides certain requirements to enhance a learner’s sense of autonomy, which is encouraged by the so-called intrinsic motivation, which is the internal determinant of motivation (Ryan, 2006). Furthermore, autonomous learning can be a source of motivation (Malone & Smith, 1996; Neber & Schommer-Aikins, 2002; Zimmerman, 2002; Bishop, 2006 cited in Meyer, 2010) because the students in an autonomous learning environment are extra motivated to engage in learning. Garcia and Pintrich (1996) have stated that students’ opinions of autonomy, in general, have proven beneficial upon intrinsic motivation. Moreover, of the skills that are considered cognitive, memory, attention and problem-solving are the ones most significant (Meyer, 2010). As for metacognitive skills, they are related to the idea of how learning is taking place, as in the learners’ ability to demonstrate their learning and identify who can assist them with their learning (Malone & Smith, 1996).

There are more and more efforts to change the teacher’s role and put into practice teaching styles that place autonomous learning skills at the heart of the learning process to enhance students’ academic performance. As shown in the review of literature, learners cannot be autonomous if they are supported by the teacher (Meyer, 2010). As such, teachers should strive to encourage students’ autonomous learning by providing guidance for students on ways to conduct such learning. As opposed to the role of the teacher in traditional teaching methods, autonomous learning focuses on the learner and learning process whereby the teacher is not the centre of attention, but more of a facilitator. In so doing, he/she can keep learners actively engaged in the learning process, which can impact positively on their creative and academic performance (Bolhuis & Voeten, 2001).

It is common to note that some teachers find it difficult to promote autonomous learning and to transfer learning responsibility to the students themselves, when they find it challenging to adapt from the traditional form of merely providing information to students (Blau & Presser, 2013; Peled, Blau & Grinberg, 2015). Teachers are often required to completely redefine their pedagogical methods from passive knowledge consumption and information reproduction into a student-centred form, where learners are able to study in both individual and collaborative ways, whilst simultaneously taking responsibility for their learning through the advancement of autonomous learning skills (Vázquez, 2016). In general, settings that are more teacher-centred produce teachers who fail to promote independent and autonomous learning (Weimer, 2002, p.15).

It is asserted that traditional learning and teaching methods frequently do not seem to be aligned with the aim of autonomous learning given that most of the responsibility is on the teacher's shoulder and whereby the students act as passive learners. Indeed, in autonomous learning, there is a shift of responsibility throughout the learning process from the teacher to the learners (Meyer, 2010). Hence, an imperative part of teaching is to help students develop their independence and to become more autonomous learners (Shahsavari, 2014);which makes the teachers always search for teaching methods and strategies in their professional development courses. Thus, the teaching methods that apply the concept of active learning and students-centred learning seem to be closed options to autonomous learning (Dickinson, 1995; Meyer, 2010). It is crucial then for the teachers to rethink how they apply the teaching methods, while at the same time pursuing the learning environment that ensures that students acquire the most appropriate autonomous learning skills. In this study, it is assumed that flipped learning is a teaching approach that is based on the application of the student-centred and active learning element that can instil in learners the most relevant autonomous learning skills.

It is possible to consider the students in a traditional learning setting as dependent; in other words, they are passive recipients of information. Therefore, those who seem to take the teacher as the expert in the learning process and content delivery think of themselves and their position as subsidiary or dependent in the learning process (Meyer, 2010). Separately, students who feel that teacher-directed methods demotivate them and perceive teachers to be authority figures are not as likely to become autonomous than individuals who view teachers to be facilitators who motivate and help to advance the learning process (Cotterall, 1995). In this sense, the teacher-centred approach is often applied, which indicates that the outcomes of students in terms of autonomy learning would be unskilled. In contrast, the students-centred approach can help the students to be more independent learners (Thomas et al., 2015).

It is important that independent students are actively engaged in the direction and management of their own learning and that they are experts in learning as such (Meyer, 2010). They also need to be able to unravel information processed and information processing with no assistance from the teacher, which will then distinguish them from the rest; those are passive/dependent learners. Thus, independent or autonomous learning skills can be offered as part of educational practice, such as the flipped learning approach, with the students using their experiences in access, such as on online platforms, to prepare themselves for the classroom following the outline and objectives of lessons provided by the teacher on online platforms. Also, in a classroom setting, they can play a major role in collaborative learning and problem-based activities; these types of classroom activities can play a vital role. In order to develop independence, students require learning space (Healey, 2014); which seems one of the potentials of the flipped learning approach. Vygotsky's influence on autonomous learning, as stated by Vázquez (2015), focuses on the concept of collaboration as a vital factor in the progression of autonomy, which intends to develop learning communities where students are all able to focus on their own learning while absorbing from their peers. This aim could be achieved in the a learning environment that adapts flipped learning, particularly inside the classroom (Tsai, 2019).

There has only been minimal research conducted into learning autonomy based in Saudi Arabia (Al Asmari, 2013; Alrabai, 2017; Alonazi, 2017). Nevertheless, the study by Sajid et al. (2016) focused on students' perceptions toward both flipped and blended learning, and it was determined that technology-based teaching approaches help to motivate students' independence levels and increase engagement, which improves upon traditional lecture techniques that commonly produce greater levels of passivity among students. Moreover, it has been stated by Srisupawong et al. (2018) that research into Computer Science has shown that teaching generally remains directed by traditional methods (i.e. lectures), which fails to progress autonomous learning; thus, more innovative learning methods have been suggested, which include online interaction in a collaborative manner, and problem based activities, as these help to promote greater levels of independence. Indeed, flipped learning is one approach that might improve Computer Science students' learning autonomy. Correspondingly, the current study aims to address this research gap by examining learner autonomy in flipped learning in Saudi Arabian education.

2.8 Student Engagement

Students' engagement is an important factor that affects students' learning experiences, which leads teachers to attempt to ensure that students engage in their learning processes. This factor is continuously growing in the perception that it improves educational achievements, increases learning quality, and develops active learning in class work (Henrie et al., 2015; Fredricks et al., 2004; Miranda-Zapata et al., 2018; Bond et al., 2020; Sinatra et al., 2015). Moreover, engagement has been recently viewed to be a factor in improving students' interest levels in a subject, to improve motivation and increase the likelihood that students will engage in school-related activities, which will consequently result in higher achievement levels (Fredricks et al., 2004). As the current research aims to examine the impact of flipped learning on students' achievements, it also aims to measure students' engagement levels in flipped learning, due to its impact on students' learning experiences. There is currently no set singular definition or research project that has managed to examine and detail all the different constructs of student engagement, and thus, research needs to be conducted that always presents a clear definition in relation to its own form and perception (Bond et al., 2020). In the current research, for instance, student engagement has been used to mean meaningful student involvement within the learning setting, whether inside or outside of the classroom (Reeve, 2012; Martin & Torres, 2016). Hence, a student's involvement in academic tasks or activities is reflected in their levels of academic engagement (Reeve et al., 2004). Overall, engagement is deemed to be multi-dimensional, which consists of cognitive, behavioural, and emotional aspects (i.e. management of academic tasks); while simultaneously producing academic behavioural disaffection, which are influential when combined upon students' levels of engagement (Martin et al. 2021).

The central definition, nevertheless, in most studies on this topic state is that motivation increases engagement levels, which conditions one's behaviour and is not physically visible, whereas engagement is an action that can be observed (Saeed & Zyngier, 2012; Bond et al., 2020). Engagement and motivation commonly function together with students increasing their levels of motivation when activities engage them, which increases higher levels of autonomous effort by students and active learning (Chen & Kent, 2020). Likewise, it has been noted by Ryan and Deci (2009) that engagement correlates with motivation in students, which is initiated by feeling motivated to learn. Both these concepts are imperative to improvements in students' learning outcomes at all levels (Saeed & Zyngier, 2012).

Therefore, the teachers and policymakers pay more attention to engage students in learning processes, as they are linked to important academic outcomes, such as performance (Krause & Coates, 2008; McMahon & Portelli, 2004). Teaching methods often play a vital role in improving students' engagement levels. Learning through more interactive techniques and activities help to engage students (Hampden-Thompson & Bennett 2013; Evans et al., 2015). Positive involvement by students in programmes through active participation and interaction in the classroom really increases engagement levels (Evans et al., 2015); which is improved through the implementation of project-based tasks that are relevant across different subject areas, which results in increased motivation levels, as it becomes more interesting (Skinner & Pitzer, 2012). Students normally have higher levels of engagement when they perceive encouragement in their learning in the process of knowledge acquisition, interaction with and assistance from classmates, as well as when their own ideas and opinions are given respect, together with support provided by their teacher (Ryan & Patrick, 2001).

When teachers are viewed as offering support, students more frequently adhere to the aims and objectives set by the teacher, which include learning activity engagement (Virtanen et al., 2015). A teacher needs to present unambiguous expectations to students, as well as effective behaviour management, a variety of learning methods with organisational support, together with teaching forms that instil better analytical skills (Virtanen et al., 2015). Hence, it can be said that the teaching methods based on the teacher-centred approach seem not to help in enhancing students' engagement levels, which is why the teachers are trained to apply a variety of teaching methods, and the teachers attempt to find interactive teaching methods. Therefore, there is a requirement to apply a more student-centred approach to provide more opportunities to gain engagement in their learning. Indeed, when a lesson is more student-centred it has been shown to be noticeably more engaging than traditional methods (Severiens et al., 2015).

In addition, integrating technology into learning and teaching could play a role in terms of enhancing students' engagement levels, particularly in the modern age, as there are a variety of teaching methods that are shaped by technology, such as blended learning and flipped learning. Accordingly, education is developing in conjunction with technological advances, which have proven to be effectual upon all different parts of the students' experience (Lai & Bower, 2019). It has also been demonstrated in previous research that a positive correlation exists between technology in learning and increased engagement levels by students (Chen et al., 2010; Rashid & Asghar, 2016; Henderson et al., 2017; Hunsu et al., 2016; Ibanez et al., 2014). There are a variety of digital tools that are used in the learning process, which aim to improve students' learning experiences, especially nowadays, as students live with technology in every aspect of life. Bond et al. (2020) determined that technology was used in discussion forums, videos, and recorded lectures, which all improved students' engagement levels. These digital tools usually help to innovate teaching approaches, such as blended learning and flipped learning. In fact, the report published by OECD stated that flipped learning is one of the promising teaching approaches to bring technology more into the classroom (OECD, 2018, p.77); this could enhance students' academic engagement. Flipped learning utilises the student-centred approach, which requires students to be active learners and pay more attention to learning in their home, and to prepare for the classroom, in order to become more involved in classroom activities (Bergmann & Sams, 2012).

It has been stated by Finn and Zimmer (2012) that students from all different age groups achieve higher levels of academic engagement when they have better attention, complete their homework more frequently, are prepared for their classes, and participate in the set activities. Thus, it is important to examine students' engagement in flipped learning and to understand how flipped learning could enhance it. Even though flipped learning was found to be a positive effect on overall engagement (Akçayır & Akçayır, 2018), the review requires more evidence in regards to the impact of flipped learning on students' engagement due to the limitations of the studies that focus on students' engagement levels, particularly in the Saudi context. Bond et al. (2020) noted that additional studies need to be conducted in order to determine the ways that technology in education is effectual upon student engagement levels within different areas, with qualitative methods seen as more beneficial in ascertaining better results. In addition, examining students' engagement levels in the current study is important, as the current study aims to examine the different variables related to engagement, such as motivation and achievement. Student motivation is imperative in the development of student engagement within the scope of learning (Maulana et al. 2016).

2.9 Studies Regarding Flipped Learning

A close examination of the literature, including theses and journal articles, showed that most studies have been conducted in the undergraduate level, while only few studies focused on schools. This section will attempt to clarify the concept and design of flipped learning, and then highlight the main findings about the impact of flipped learning on students' achievement and engagement.

Flipped learning is regarded as one of the most important innovations resulting from the recent developments in educational technology. Despite the novelty and the comparative lack of research on many aspects and contexts of flipped learning, it seems that there is an emerging common consensus among researchers and educators on its general concept. Flipped learning could be considered as an instructional method or a strategy that is utilising the advancement of technology and applying the student-centred pedagogy (Bishop & Verleger, 2013b). According to Love et al. (2014), the teacher in a flipped learning shifts the content of the lesson from classroom to be out of it, while classroom time is mainly used for learning activities. To simplify this even more, in this way, the content of lectures in terms of resources should be available online such as videos and textbooks (Bergmann & Sams, 2012). In contrast, the classroom time should be devoted to student-centred activities (ibid). Therefore, flipped learning is basically composed of two main components. Firstly, students should acquire new knowledge via pre-classroom tasks such as reading some materials or being exposed to instructional videos. Secondly, students should involve in classroom activities to construct and consolidate their knowledge in a greater depth.

Dozens of reports in specialized websites, journals, and papers presented in conferences in the field of education have proposed that flipped learning is a valuable educational practice (Enfield, 2013; Flipped Learning Network, 2014; Schmidt & Ralph, 2016; Challob, 2021; Seitan et al., 2020; Bates & Ludwig, 2020; Zainuddin, 2018; Winter, 2018). This is the case across all subjects and all ages, for example, information system (Mok, 2014), Economy (Lage et al., 2000; Roach,2014), Engineering (Everett et al., 2014; Chao et al., 2015, Chiang & Wang, 2015, Battaglia & Kaya, 2015), Nursing (Bernard, 2015, Geist et al., 2015), Education (Kurt, 2017), Computer Science (Huang & Hong, 2016; (Kostaris et al., 2017; Lo et al., 2018); Math (Chen et al., 2016; Sun & Xie, 2020; Hew & Lo, 2018; Hwang & Lai, 2017). In addition, as can be noticed in the literature, the studies concerned with the flipped learning have increased in recent years (Jarvis et al., 2014; Hung, 2015; Jensen et al., 2015; Bhagat et al., 2016; Brown et al., 2016; Caligaris et al., 2016; Aidinopoulou & Sampson, 2017; Baris, 2017; Chen Hsieh et al., 2017; Graziano & Hall, 2017; Kim, 2017; Kostaris et al., 2017). Although, the popular implementation of flipped learning on general education schools (Hamdan et al., 2013), the majority of studies examined flipped learning carried out on university level (Davies et al., 2013; Hodkiewicz, 2014; Jensen et al., 2015; Sung, 2015; Hao, 2016; Sohrabi & Iraj, 2016; Karaca & Ocak, 2017; Guo, 2019; Sun & Xie, 2020; Challob, 2021). Therefore, the value and impact of flipped learning for high school students is still under investigation and need more studies to prove evidence and explanation balancing with the popularity of applying flipped learning. Akçayır and Akçayır (2018) stated that additional K-12 research is required, as was determined following a systemic review.

2.9.1 Students' Achievements in Flipped Learning

Having a close examination of the previous studies, there is no consensus regarding the result of flipped learning influence on students' achievement. While some studies found a positive impact of flipped learning and in different subjects, Science course (Baris, 2017), Engineering course (Chao et al., 2015), Algorithms and Programming Education (Karaca & Ocak, 2017), Chemistry (Schultz et al., 2014) and English (Huang & Hong, 2016; Abdelrahman et al., 2017), Math (Katsa et al., 2016). Comparatively, some studies found that there was insignificant difference on the students' achievement between flipped learning and the traditional one (Clark, 2015; Chen, 2016; Jensen et al., 2015; Al-Harbi & Alshumaimeri, 2016; Chen, 2016; Esperanza et al., 2016; Lo, 2018). In addition, others found that the effect was on the students with low performance, while there was no difference on those of high performance in flipped learning and traditional learning (Bhagat et al., 2016; Kostaris et al., 2017). However, despite the lack of clarity of flipped learning impact on students' achievement, some of these studies had limitations, which can affect the reliability and validity of the results.

Schultz et al. (2014) measured the impact of flipped learning on students' achievements by comparing the scores of the control group who enrolled in the academic year 2011-2012, and the experimental group who enrolled in 2012-2013. The collection of the students' scores was made in different periods of time, which appears to affect the validity and reliability of these results. Hence, data collection in different periods of time was the first limitation (e.g., Schultz et al., 2014; Peterson, 2016). Moreover, the duration of study was also noted as a limitation. Meanwhile, some studies were conducted for short period of time, such as for two weeks (Baris, 2017; Caverly, 2017); three weeks (Chen, 2016; Çetinkaya, 2017); four weeks (Abdelrahman et al., 2017) and six weeks (Bhagat et al., 2016), and these may not demonstrate the real impact of the intervention, as if it were to be applied for a long time. Indeed, it has been stated that durations that are not long enough are unable to provide validity to flipped learning' overall effectiveness (Zheng et al., 2020). The results may be affected by the novelty of flipped learning on students. In addition, the bias of being a researcher and an instructor simultaneously could be a limitation that can affect the results (Mason et al., 2013; Jensen et al., 2015; Yough et al., 2017; Winter, 2018). Indeed, the result of these studies might be affected by the bias of the students to their teacher.

Polat and Karabatak (2021) undertook a quantitative study with the aim of analysing the effects of flipped learning on undergraduate participants in Turkey and their consequential academic achievements and satisfaction levels. The findings showed that the experimental group using the flipped learning method demonstrated the largest increase in academic achievements. Similarly, an experimental study was undertaken by Wei et al. (2020) in China Middle Schools. It was determined from this study that those who participated in flipped learning attained a better level of learning compared with the students who had worked in a more traditional learning environment. Both current studies agreed that the learning process in flipped learning include the students' preparation before face-to-face sessions and the in-class learning environment, where the students have more time to interact with their peers, which makes learning more effective and enhances the students' performance.

However, a meta-analysis has shown minimal effect on learning outcomes from flipped learning approaches in classrooms (van Alten et al., 2019); while a scoping review by (O'Flaherty & Phillips, 2015) showed that there is only limited evidence to support improved levels of engagement and/or learning outcomes. Further, a meta-analysis was undertaken by Cheng et al. (2019) to determine how the flipped learning instructional strategy affects the different learning outcomes for students. It was determined that the flipped learning method functioned more productively than a traditional form in both K-12 ($g=0.216$, $p=.032$) and undergraduate students ($g=0.212$, $p<.001$). Based on the aforementioned, there are debates regarding whether flipped learning produces positive or negative effects on students' achievements. Therefore, there is a need for more rigorous studies (Lo et al., 2017) to examine the impact of flipped learning on the students' achievement.

2.9.2 Students' Engagement

According to Kuh, Cruce et al. (2008), a widely used definition of student engagement refers to the time and energy learners exert when engaged in academically focused tasks. Flipped learning aims to engage students into active learning process (Bergmann & Sams, 2012, Roehl et al., 2013). The previous studies showed that students are engaged more in flipped learning, and they acquired value for flipped learning as an innovation (Strayer, 2012; Kirvan et al., 2015; Chen Hsieh et al., 2017; Kim, 2017). Additionally, flipped learning has been shown to be positive in increasing students' engagement, as found in a systemic review conducted by (Zainuddin et al., 2019). Two studies also found after observing students that they engaged more in flipped learning than the traditional classroom (Strayer, 2012; Chen Hsieh et al., 2017). It seems that the shift in classroom environment from teacher-centred to students-centred learning allows students to engage with learning process.

Furthermore, flipped learning seems to offer time in classroom for teachers to provide a variety of activities, which might lead to increase the students' engagement. What is more, a recent systematic review (Bond, 2020) on flipped learning within the K-12 context found that flipped learning helps to provide support to advance student engagement. Moreover, flipped learning design and the pre-classroom phase allows the students to have a good knowledge about what they will do in classroom activities which may impact positively on their engagement in classroom. Some studies confirmed this point and showed that engaging students with pre-classroom materials enhances the students' engagement in classroom (Hodkiewicz, 2014; Tawfik & Lilly, 2015; Clark, 2015; Hung, 2015; Wang, 2017). It is worth to mention that the measurements of the students' engagement in pre-classroom, in some of these studies, were based merely on the students' online behaviour (Hodkiewicz, 2014; Hung, 2015; Wang, 2017). It could also be valuable to determine the students' perspectives on their engagement, particularly in the pre-classroom phase, in order to see how they engage in this phase. This can be initiated by inviting the students to interview that allow them to express their perspectives.

However, these findings could offer insight into the importance of engaging students in the pre-classroom phase. It assumes that designing flipped learning and the pre-classroom materials are vital in enhancing the students' engagement in the flipped learning environment. In an action study by Clark (2015), students in interviews claimed that they engaged actively in flipped learning. Moreover, they stated that using technology enhanced their engagement in flipped learning (ibid). The researcher used technology in pre-classroom phase to provide a variety of resources to students such as videos, podcasts, online articles, personations and questions on the subject area to be studied. It can be claimed that this usage of variety of technology tools may meet the students' needs which might enhance their engagement. However, there was a study found that the students' engagement was not affected by applying flipped learning and the result showed that the students had a negative attitude towards using technology (Jensen et al., 2015). That said, this confirms the importance of the students' engagement in the pre-classroom phase, which can reflect their engagement in-classroom activities. Furthermore, students' engagement can not only be improved by just applying flipped learning, but it needs a careful design of flipped learning environment that meets the students' needs and abilities in cognitive, technological and cultural levels. Nevertheless, there remains the requirement to investigate students' engagement by employing qualitative data, such as through focus groups, which are rare to use (Bond, 2020). There is a recommendation to undertake the study with multiple means of data collection, which is strongly advised, including the use of qualitative methods in research regarding flipped learning and students' engagement (ibid).

2.9.3 Students' Motivation

This section attempted to examine the impact of flipped learning on the students' motivation levels. Specifically, Lundin et al. (2018) conducted a study that helped to determine the improvements in student motivation following the implementation of flipped learning. Similarly, Zainuddin et al. (2019) conducted a systematic review and determined that flipped learning has a positive effect on students' motivation levels. A meta-analysis conducted by (Zheng et al., 2020) highlighted a moderate effect size of 0.661 for learning motivation. In addition, the past studies attempted to determine the impact of flipped learning on students' motivation; they showed that there is a positive impact on students' motivation levels (Chao et al., 2015; Bhagat et al., 2016; Muir & Geiger, 2016; Chen Hsieh et al., 2017; Lam et al., 2020). For example, Chen Hsieh et al. (2017) measured the students' motivation in Taiwanese higher education by using a 5-point Likert scale questionnaire, which found that flipped learning promoted students' motivation, as it allowed for various ways of instruction, which means that each student can learn in their own pace and time.

Flipped learning can satisfy students by learning in a better way and with enjoyment, as well as providing the opportunity to learn at their own pace during the pre-classroom phase (Kurt, 2017). In that study, students were motivated, as they enjoyed watching the videos. Therefore, it can be concluded that flipped learning seems to have a positive effect on students' motivation and intrinsic motivation. According to the self-determination theory, it divided motivation into two types: intrinsic and extrinsic (Abeysekera & Dawson, 2015). Intrinsic refers to individuals who do things that are perceived as exciting and enjoyable, while extrinsic motivation refers to individuals who do things as they attempt to pursue rewards or avoid punishment (Deci & Ryan, 2008b).

The utilisation of videos in flipped learning has been stated by Chao et al. (2015) to help to improve students' motivation levels. In addition, the type of video can prove effectual on the students' motivation; a video that is created by the teacher can motive students more than external examples (Muir & Geiger, 2016). These findings determined the students' motivation associated with flipped learning in pre-classroom phase which is online learning. What is more, Yilmaz (2017) showed that e-learning preparation and engagement by students could help to predict their motivation levels during flipped learning. Likewise, Kaur and Abas (2004) noted that e-learning readiness is when a person can use technological resources and multimedia to advance learning quality. Therefore, it appears that the impact of preparing the students to learn online prior to the application of flipped learning ensures that flipped learning could enhance students' motivation levels. However, Clark (2015) found that students' motivation is promoted in flipped learning environment due to the type of collaborative activities. It is also found that flipped learning contributed to change the classroom environment which consequently can promote students' motivation (Tawfik & Lilly, 2015).

Applying flipped learning makes a shift in the classroom environment from acquiring the concepts gained from the use of the traditional way to practising such concepts. As a result, this can play an important role to improve the students' motivation in the learning process. A pre-test – post-test quasi-experimental study was conducted by Lam et al. (2020), which showed that in-class active learning activities, including video presentations, encouraged undergraduate students to interact with their fellow students. However, there was one study which found that there was no difference in the students' motivation between the two ways of learning, the flipped and the traditional (Yough et al., 2017). Finally, Aidinopoulou and Sampson (2017) observed that the students were not motivated towards flipped learning as they were unprepared, and this reflected on their engagement in classroom activities. This can mean that flipped learning may not be applicable in certain contexts. This study, in fact, was conducted in a primary school and it can be assumed that flipped learning might need to be applied among students to make them aware of their responsibilities towards their own learning. Overall, the previous studies measured motivation and found positive impacts of flipped learning; however, there is still the need for studies to measure how flipped learning can improve motivation in terms of both intrinsic and extrinsic motivation.

2.9.4 Autonomy Learning in Flipped Learning

Previous studies have shown that only minimal research has been carried on investigating the learning autonomy of students in flipped learning (Zainuddin & Perera, 2017; Tsai, 2019; van Alten et al., 2020; Challob, 2021; Lubis, 2021). Likewise, flipped learning helps to develop students' autonomy and increase their levels of awareness of potential autonomous learning skills (Tsai, 2019; Challob, 2021; Lubis, 2021; van Alten et al., 2020; Zainuddin & Perera, 2017). This is achieved by enabling students to advance individually and to function as their own guides, as they develop the ability to assess their own learning improvements (McLaughlin et al., 2013; Tsai, 2019). What is more, flipped learning enables an instructor's guidance and process of scaffolding to combine with continuous communication and collaboration among students, which would improve independent learning (Blau & Shamir-Inbal, 2017). However, it can also be observed that most of the studies that examine autonomous learning in flipped learning were conducted in the field of EFL.

Tsai (2019) conducted a study that used two linguistics classes, which were separated into experimental and control groups. The comparisons between the research questionnaires based on learner autonomy highlighted that there is a noticeable statistical difference between these groups. Moreover, the study analysed how the students participated online through various activities, and it was found that there was a positive correlation between online activities and the perception of students regarding their learning autonomy. Tsai (2019) also added that technology provides a learning setting that is flexible, with freedom and customised, which enables better levels of independent learning through flipped learning. They also stated that augmented levels of learner confidence and independence were evident in the students undertaking flipped learning, as they could work at their own pace and rhythm and select the materials and methods of learning that best suited them.

Furthermore, a different study focused on the impact of flipped learning in the subject of mathematics, and it was determined that students would become more motivated and interested in this form of setting, as they would normally prefer virtual environments in comparison to traditional ones (Fernández-Martín et al., 2020). The same study added that flipped learning enhances students' levels of autonomy by increasing motivation to learn, combined with the direction of improved structure to guide learning to learn. Fernández-Martín et al. (2020) also noted that allowing students to work outside of the classroom prior to a lesson helps in the promotion of self-regulation and autonomy in their own learning. It might be stated that these studies prove how the pre-classroom phase of flipped learning would play a role to promote students' learning autonomy.

Even though most of the studies focus on learning autonomy, and that flipped learning was a higher education context, there has been a study conducted in a pre-university context by Hinojo et al. (2020), where the participants comprised of sixth year primary education students and fourth year secondary education students. The main objective of that study was to provide an analysis of flipped learning and to compare its effectiveness against traditional methods. The results obtained from the questionnaire demonstrate that flipped learning received more positive evaluations in regard to academic indicators, as well as providing positive motivational factors and autonomy. Meanwhile, better results were shown in relation to education following students' interaction with flipped learning, which was shown to be effective in both primary and secondary education, with learning autonomy particularly noted in secondary education. However, et al. (2020) did not explain the ways that flipped learning helps students to become more autonomous in learning during secondary education. An improvement could have been made by utilising qualitative methods, such as interviews, which would have helped the researcher to develop better understanding of flipped learning and its overall impact.

Challob (2021) conducted a study based in Iraq, which aimed to analyse how flipped learning would be effectual upon students' writing performance in English language, as well as their levels of autonomy and motivation in progressing their learning. Triangulation was utilised that incorporated a variety of data collection instruments, which included both pre- and post-study writing tasks, interviews, diaries for learning, and observations. Overall, the findings showed that flipped learning helps in the classroom to advance students' English writing autonomy, and most of the participating students stated that it helped to motivate them to write better in English writing classes and to work autonomously whilst also combining group collaboration with peers. The flipped learning environment also included an online aspect, which encouraged students to develop their own learning strategies outside of the classroom, as they were able to use different digital platforms, such as Google Classroom, which also included assistance from the teacher online when required. The interactive setting of the learning environment, together with its flexible structure, also advanced students' motivation levels and autonomy, as they could work more freely with their time, location, feedback, and different learning resources. However, the criticism of this study stems from the sample size (15 males and 15 females), as it is a limitation to the process of generalising the results, at least in a Middle Eastern context.

The aforementioned research studies have presented numerous positive aspects of flipped learning in the development of autonomy learning; nevertheless, Bouwmeester et al. (2019) produced results that showed the less positive effects of flipped learning. That study was undertaken on medical students through the use of observations and a questionnaire, and subsequently, it was determined that perceived autonomy was merely compared as similar to students who would learn in a traditional setting. It can be concluded, however, that certain studies have stated that students' learning autonomy skills can potentially be improved through flipped learning. There is a requirement, though, for additional research to be undertaken that will focus on students' learning autonomy within flipped learning, and especially in regard to the subject of Computer Science in Saudi Arabia, where studies have yet to be conducted that focus on this issue.

2.9.5 Critics and Challenges

Flipped learning is considered a major innovation in the field of education and applying it may present certain challenges for students and/or teachers. In addition, flipped learning has received criticism regarding the challenges accompanied with its implementation. This section highlights some of these challenges and criticism that are associated with flipped learning.

Firstly, the pre-classroom phase seems to be a big challenge for students, as it is perceived as a form of workload and described as a time-consuming task (Hodkiewicz, 2014; Hao, 2016; Zhang et al., 2016; Kim, 2017 Schultz et al., 2014; Lo et al., 2017; Wang, 2017). The students identified several issues: the process of taking notes is hard (Zhang et al., 2016); the amount of content is abundant (Hodkiewicz, 2014 & Schultz et al., 2014); the content itself is complex (Hao, 2016); and it is difficult to ask questions during these phases, together with a lack of prompt feedback. These challenges may threaten the success of flipped learning because students may come to the classroom unprepared, which leads to difficulties to be engaged in classroom activities. These challenges faced by students in the pre-classroom phase are one criticism of flipped learning and depend on its success. Indeed, the students might resist the application of flipped learning because of these challenges, which threatens the successful implementation of flipped learning. Specifically, flipped learning has been criticised on the basis that students often to resist the pre-classroom learning process, which can result in poor preparation (Herreid & Wright, 2014). Consequently, the teacher must re-teach the concepts to the students, which can lead to the failure of implementing flipped learning. This can be the reason why some students prefer traditional classrooms over this way of learning (Hao, 2016; Kim, 2017; Yough et al., 2017). The reason for this resistance could be attributed to the learning environment shift from the traditional to flipped learning, which entails the movement between two different pedagogy paradigms: the teacher-centred and the student-centred.

However, these challenges can be the result of students' unfamiliarity with flipped learning, as found in the critical review by Lo and Hew (2017). Therefore, teachers might minimise this issue by carefully designing the pre-classroom phase and by considering their students' abilities. In addition, the teachers could conduct a workshop explaining the flipped learning approach and its advantages, while the students could become aware of the shift in their role. The teacher may resort to prepare their students by introducing flipped learning, explaining the expectation of learning and the process. McLaughlin et al. (2014) showed how students need to be provided with a clear explanation of the process in order to encourage them to engage with flipped learning. This may contribute to overcome the challenges or at least reduce the students' objections for such a shift. The teacher could also ensure the students' motivation toward the flipped learning approach, which is particularly beneficial for students to receive encouragement to work autonomously, as well as to work collaboratively with their peers in the classroom (Gündüz & Akkoyunlu, 2019). Nevertheless, studies also have revealed that students take time to adjust to the flipped learning environment (Chen, 2016; Kim, 2017; Mason et al., 2013). Hence, it can be assumed that any shift in the teaching approach or learning environment needs time, and it seems the resistance of flipped learning is normal initially.

Furthermore, literature has shown that some students find difficulty in the preparation stage. This is when being exposed to the instructional videos as the delivery was in their second language and not in their mother tongue (Kim, 2017); the instructional video has been described as too long (Schultz et al., 2014, Tütüncü & Aksu, 2018, Lo et al., 2018); and the quality of videos (Akçayır & Akçayır, 2018). The criticism here is that flipped learning may affect negatively upon the students' understanding of important concepts in their learning if teachers do not consider carefully the design and use of videos to deliver the content. Nonetheless, it can be proposed that using the instructional video is essential in the design of flipped learning. However, teachers can overcome this by creating instructional video and keeping the length as short as possible (approximately 10-15 minutes) and segment the length of the videos if possible, to deliver it in parts (Schmidt & Ralph, 2016). Due to the importance of using videos in flipped learning, there is still a requirement to discover the best ways to employ this kind of media in flipped learning.

Another criticism is that flipped learning requires a hard work from the teachers. Indeed, teachers may encounter some difficulties when applying flipped learning; for example, according to Chen (2016), teachers are confronted with the problem of providing effective pre-classroom materials. The teachers who are used to prepare offline materials and deliver the content in the traditional way could face some difficulties when they attempt to shift the content to be online while aiming to ensure the quality of the content. The shift from the lecture in front of students to create a series of instructional videos seems to require effort from the teachers. Accordingly, it has been stated that the progression and implementation of flipped classes are challenging for teachers and require technological skills (Gündüz & Akkoyunlu, 2019), which is an important issue to work with when flipped learning is needed in the classroom. It is also relevant that the production of instructional videos has been noted as time-consuming, which creates extra work for teachers (Mason et al., 2013; Bäcklund & Hugo, 2018). This high level of workload in the creation of content and materials for flipped learning has been shown to be another limitation of flipped learning (Akçayır & Akçayır, 2018; Gündüz & Akkoyunlu, 2019). The teachers, however, could utilise the learning materials that are available on online platform, such as Khan Academy, although time is required from teacher to select the correct resources. It might be argued, though, that these challenges will decrease, especially after the teachers design their videos and build their library of resources, together with gaining the experience of applying flipped learning.

In addition, what concerns teachers is the fact that students may come to classroom unprepared (Chen, 2016; Kim, 2017; Aidinopoulou & Sampson 2017). This can affect the learning process negatively because the students will not be able to engage in classroom activities. Teachers, however, can encourage the students to prepare and this is by making the quiz mandatory and make this activity as a part of the final mark as suggested by (Hodkiewicz, 2014). This may ensure that students come to classroom well-prepare. There is another way used by Bergmann and Sams that could help the teachers to ensure most of students come to classroom well-prepared. They checked students' notes every day from video watching and each student were required brought a question based on video to class (Roehl et al., 2013). Finally, flipped learning in practise requires the use of technology which some students may not have access to it. Sohrabi and Iraj (2016) found that students, in pre-classroom phase, faced some technical problems such as poor connection or access to the internet. This challenge was found also in some (e.g. Akçayır & Akçayır, 2018; Tütüncü & Aksu, 2018). Nevertheless, this problem might be solved and that is by providing the materials for students in the form of DVDs or flash disks (Clark, 2014).

It can be concluded that the flipped learning receives validation and praise as well as criticism, it can claim that flipped learning as any teaching approach has challenges in practice such as considerable investment required from instructors in the beginning of the implementation of flipped learning, students' unreceptiveness to flipped learning, and digital issues. It could be said that these challenges minimise when the teachers become more confident in how to implement flipped learning and creating the learning resources and when the students become familiar with the flipped learning approach. Successful flipped learning require motivated and confident teachers, who also require appropriate levels of time, resources, and support to develop a flipped model (Strelan et al., 2020).

2.9.6 Flipped learning in Computer Science

The flipped learning approach might be used in Computer Science to promote students' learning experiences. Also, the use of flipped learning could change the learning practice by intergrading the technology into the instruction of Computer Science and by providing active learning in a student-centred learning environment. There were a few studies that have examined the impact of flipped learning on Computer Science (e.g. Chen, 2014; Maher et al., 2015; Chyr et al., 2017; Karaca & Ocak, 2017; Tugun et al., 2017; Kostaris et al., 2017; Cukurbasi & Kiyici, 2018; Yildiz-Durak, 2018; Seitan et al., 2020; Yildiz-Durak, 2020). Some of these studies were conducted on compulsory education (e.g. Tugun et al., 2017; Kostaris et al., 2017; Chyr et al., 2017; Yildiz-Durak, 2018; Cukurbasi & Kiyici, 2018). These studies agreed that flipped learning is considered an effective approach for teaching Computer Science.

Kostaris et al. (2017) conducted an action study to find the impact of flipped learning on students' outcomes, motivation, and engagement in Computer Science at the 2nd grade of junior high school. The results of the study found that the incorporation of flipped learning in the teaching and learning process led to a statistically significant increase in the cognitive learning outcomes of students. In addition, they found that flipped learning enhanced the low performing students more. These results can be attributed to flipped learning through collaborative activities, which enabled students through face-to-face sessions to gain formative feedback and scaffolding, both from their teacher and classmates. In addtion, the findings from the survey showed the positive impact of flipped learning motivation, where the result was statistically significant to increase their motivation levels. This finding signifies that students' satisfaction and interest levels in the ICT course were enhanced and, moreover, that students were able to link the learning process to their own interests and improve their sense of accomplishment.

Regarding students' engagement, the results indicated that flipped learning provided two main benefits: firstly, the students were significantly more engaged throughout the course with a continuously increasing trend; and secondly that the experimental group showed that low performers improved the most in engagement levels, whilst student motivation was shown to be largely attributed to more productive face-to-face sessions through flipped learning. This study also focused on face-to-face sessions and how they were used for each group; and evaluated whether flipped learning can actually facilitate teachers to promote more student-centred practices. The analysis of the delivered types of teaching and learning activities indicated that flipped learning allowed the teachers to primarily focus on competence-building "hands-on" activities and formative feedback provision when compared to non-flipped learning, where teachers' lectures were the primary learning activities. Indeed, this is expected as all new learning content was delivered by the teacher in the class. In addition, student-student collaboration; however, received a very low-frequency percentage, which can be considered a significant shortcoming in the non-flipped learning approach. This quantitative study could show the potential of flipped learning to allow the Computer teacher to expose the students to new content in their home and utilise more classroom time for "hands-on" activities and formative feedback, which would enhance the students' performance, engagement and motivation. However, this study did not use qualitative methods, which could help to provide understanding of how the flipped learning process affects students' motivation and engagement, as well as comprehension of the pedagogical practices that enhance students' learning experiences in flipped learning environments.

In addition, the most previous studies examined the implemented flipped learning approach in programming as a specific area of Computer Science (e.g. Chen, 2014; Karaca & Ocak, 2017; Psycharis & Kallia, 2017; Tugun et al., 2017; Yildiz-Durak, 2018). These studies produced data that show the potential that students' learning is advanced through flipped learning. In addition, Yildiz-Durak (2018) conducted a study in middle school with 371 students, and the data provided evidence that the engagement in lessons, together with the students' self-efficacy levels, had developed during the flipped learning model programme. In another study, Tugun et al. (2017) examined the effect of flipped learning on programming, using a sample of 52 9^{th} Computer course learners and used a pre-test – post-test research model with experimental and control groups, which was conducted in Cyprus. Following eight weeks of flipped learning the results showed that the average grades of the students had increased (86.96), which contrasted from students who had studied in the traditional method (67.29). The analysis from this study showed that a noticeable difference could be seen that proved the benefit of flipped learning. Meanwhile, the study also detailed how flipped learning helped students to better understand programming skills, as students specifically noted that the array of applications utilised in the classroom assisted in implementing practical solutions within their study processes. Moreover, they started to enjoy their learning more and began to develop a greater level of understanding following the combination of working more at home with various materials and resources.

However, there were students who mentioned certain challenges, as it was shown that some students were not fully comfortable with new applications that they were unfamiliar with, although these feelings dissipated once a teacher would explain the process and they were given time at home to develop their skills for the courses. Some students also mentioned technology issues, such as losing internet connection and not owning a Computer to study at home, and thus, the Computer teacher should consider these challenges before applying flipped learning. It was added by Yildiz-Durak (2020) that flipped learning helps to advance the learning of programming, as it creates a greater scope of instructional time and interaction that helps in the teaching of abstract concepts within the subject. It is also possible for teachers to provide support and/or feedback to their students through online platforms and discussions. Flipped learning within programming courses functions in the development of different learning activities, as teachers are enabled to implement teaching methods that are more relevant to their classes and topic. Similarly, students develop more autonomous responsibility in a flipped learning setting, which develops more productive preparation for the course. Even though the above studies showed how flipped learning could be beneficial in some areas of Computer Science, no explicit focus has yet been placed on the evaluation of flipped learning in the context of high school ICT teaching (Kostaris et al., 2017), particularly in the context of Saudi Arabia. A flipped learning approach, therefore, can potentially benefit the development of Computer Science course, which is analysed in more detail later in the study.

2.9.7 Flipped Learning in the Saudi Context

There remain minimal studies that focus on flipped learning in Saudi Arabia, whether that is on the Saudi Digital Library (SDL), Scopus database or Google Scholar. However, most studies that have been conducted have been based on higher education (i.e. Al-Rowais, 2014; Al-Zahrani, 2015; Alharbi, 2015; Alsowat, 2016; Sajid et al., 2016; Elmaadaway, 2017; Al-Ghamdi & Al-Bargi, 2017; Jdaitawi, 2020; Alsmari, 2020; Alamri, 2019; Rawas et al., 2020; Alnuhayt, 2018) (see Appendix A). Nonetheless, this section will review and discuss the most recent studies that have been produced in relation to this topic. For instance, one of the earlier studies was conducted by Al-Zahrani (2015), who investigated how flipped learning helped to promote students' creative thinking in higher education. The findings show that, even though it promoted creative thinking, certain challenges were found for students in the process of adapting to flipped learning, as there was ill-preparation from students for the classroom. The main issue with this study is that it was conducted with a duration of four weeks, which seems short to examine the impact of an intervention. Furthermore, Alharbi (2015) undertook a qualitative study on undergraduate students and produced results that showed all students concurring that flipped learning was beneficial in the process of developing understanding, as it was structured in a more interactive and collaborative learning setting. Comparatively, Alharbi (2015) also stated that flipped learning has certain limitations, as it can increase the workload on the teacher, while students can sometimes be faced with Internet connection problems and others may not feel technologically capable. Meanwhile, the sample size of this study could be considered as a limitation; the sample size was 14 undergraduate students.

In terms of students' engagement, there were two studies that examined the students' engagement (Alsowat, 2016; Elmaadaway, 2017). Alsowat (2016) conducted a quasi-experimental study in Saudi Arabia on 67 undergraduate students. The study found that there was a statistically significant difference between the mean scores of the pre- and post-experiment students' engagement. The way of examining the students' engagement could be considered as a limitation of this study. Indeed, the researcher assessed the impact of flipped learning on students' engagement by assessing the differences between student engagement both before and after the intervention on the experimental group only. It can also be assumed that the students' engagement in the non-flipped learning group also improved. Hence, it seems more valuable if the researcher examined the flipped learning by comparing between the control group and experimental group. In addition, Elmaadaway (2017) aimed to examine students' engagement levels by using a quasi-experimental design that compared the students' classroom engagement. The analysis of the questionnaire showed that students in flipped learning achieved higher scores than their traditional counterparts. However, in terms of achievement, there were studies that examined the students' achievement (Al-Rowais, 2014; Alamri, 2019; Najmi, 2020); these studies found statistically significant differences in students' academic performance for the flipped learning group. Nevertheless, it can be observed that there is no study that investigates students' motivation levels and learning autonomy in a flipped learning context in Saudi Arabia.

Even though there is a low rate of flipped learning studies in the Saudi Arabian context, most of them have been conducted in the field of EFL (6 studies), with no focus on Computer Science at the pre-university level. Based on the forms of methodologies that recent studies have implemented in research based in Saudi Arabia, quantitative approaches have been generally used to examine flipped learning (Alnuhayt, 2018; Alsmari, 2020; Jdaitawi, 2020). However, there was one mixed-methods study undertaken by Alamri (2019), who attempted to examine the impact of flipped learning on undergraduate students' achievements and levels of satisfaction. The findings by Alamri (2019) showed that there is a noticeable difference in students' academic performance levels in flipped learning, while most students gained high satisfaction levels from this method, and generally enjoyed the activities and setting. However, in the context of compulsory education, there were only two studies (Najmi, 2020; Al-Harbi & Alshumaimeri, 2016). Specifically, the study by Al-Harbi and Alshumaimeri (2016) was only one of the flipped learning studies conducted in a high school, which aimed to analyse the performance of the students from the intervention of flipped learning and their attitudes regarding it. This was a quasi-experimental study that found that students' English performance in the flipped learning group was not significantly higher than in the traditional group. In addition, the students' perspectives regarding flipped learning were positive. They claimed that flipped learning can promote their communication and encourage their self-learning.

However, there is still a need for additional studies in the context of Saudi Arabia, particularly in high schools, in order to understand to what extent flipped learning can benefit from this. Therefore, the current study will be unique in terms of undertaking a long-term study and focusing on Computer Science students' achievements, motivation, learning autonomy and engagement. In addition, there are recommendations to apply mixed-methods studies in the Saudi Arabian context (Jdaitawi, 2020; Al-Ghamdi & Al-Bargi, 2017); while the current study will be the first to use this design to produce a comprehensive understanding of flipped learning and its effects in regard to Saudi high schools.

2.10 Conceptual Framework of the Study

The method of flipped learning redirects education from a teacher-centred approach, such as lecturing, to a more student-centred approach, which includes more active learning for students. This modern pedagogical approach enables students to gain pre-class learning in order for the class time to focus on the application and development of these concepts. In theory, flipped learning has its base in social constructivism, which presents learning as more attainable through social engagement, and not through passive development with external motivation (McMahon, 1997). Accordingly, collaborative learning helps students to gain more benefits than when purely learning alone. Indeed, social constructivism develops flipped learning to produce more student-centred pedagogies that increase student engagement (Green, 2015). Student-centred approaches, which include problem-based learning (PBL) and CL are focused on the same learning-centred principles as included in flipped learning. The social constructivism theory, though, stresses that the process of "scaffolding" is vital in the implementation of social interactions between peers in flipped learning, which involves experts providing guidance and structure during the learning process.

Flipped learning includes two phases: pre-classroom, which is based on technology; and in-classroom, which is based on a student-centred approach. The pre-classroom learning guides "(i.e. scaffolding) the students to learn independently, and in the classroom engages the students to learn through social interaction based on students-centred activities. Based on the design of flipped learning, the students do not depend on the teacher, the role of the teacher as an expert encourages the students to learn autonomously by providing guidance, which includes (pre-classroom learning materials and lesson plans, including aims and objectives). In this sense, is it useful for the current study to understand the learning autonomy in the context of a flipped learning environment. Autonomous learning is when a student gains the capability to direct and guide his/her own learning (Littlemore, 2001). It is believed that different concepts and factors may help to increase learning autonomy skills, which include the establishment of a conducive setting through the use of relevant technology, flexibility, and an appropriate physical environment (Meyer, 2010). The utilisation of technology tools in flipped learning in the pre-classroom could be considered as enabling environments to provide students with guidance to develop rich experiences to learn autonomously. In addition, the creation of a strong relationship between teacher-students is considered to be a factor to enhance student autonomy, which could be provided by making a classroom more social and allowing for more interactions, where a teacher could play a vital role by encouraging and supporting students.

However, the social constructivism theory requires students to be engaged and in social interaction through students-centred activities and to have motivation for that, as well as to have motivation to follow a teacher's guidelines (scaffolding) that help them to learn that reflects upon their overall learning. Moreover, engagement is perpetually developing to improve educational achievements, together with enhancing the quality of learning, and developing active learning and engagement with class work (Henrie et al., 2015; Fredricks et al., 2004; Miranda-Zapata et al., 2018; Bond et al., 2020, Sinatra et al., 2015). Additionally, engagement has been shown to contribute to the improvement in students' interest in subjects, as well as to increase motivation levels and the likelihood of students participating in activities connected to their school life, which will help to improve levels of achievement (Fredricks et al., 2004). Further, motivation and engagement is able to augment interest levels in Computer Science subjects, which has also resulted in lower anxiety levels and increased interest in respective subjects, which subsequently also improves attainment levels (Forte & Guzdial, 2005). Hence, it has been beneficial to understand students' motivation and engagement levels within the context of flipped learning in the current study, which examines the impact of flipped learning on Saudi high school students' academic achievements, motivation, engagement and learning autonomy. In conjunction with this, the current researcher has drawn up a conceptual framework that shows the importance to determine how flipped learning influences motivation, engagement, learning autonomy and achievement.

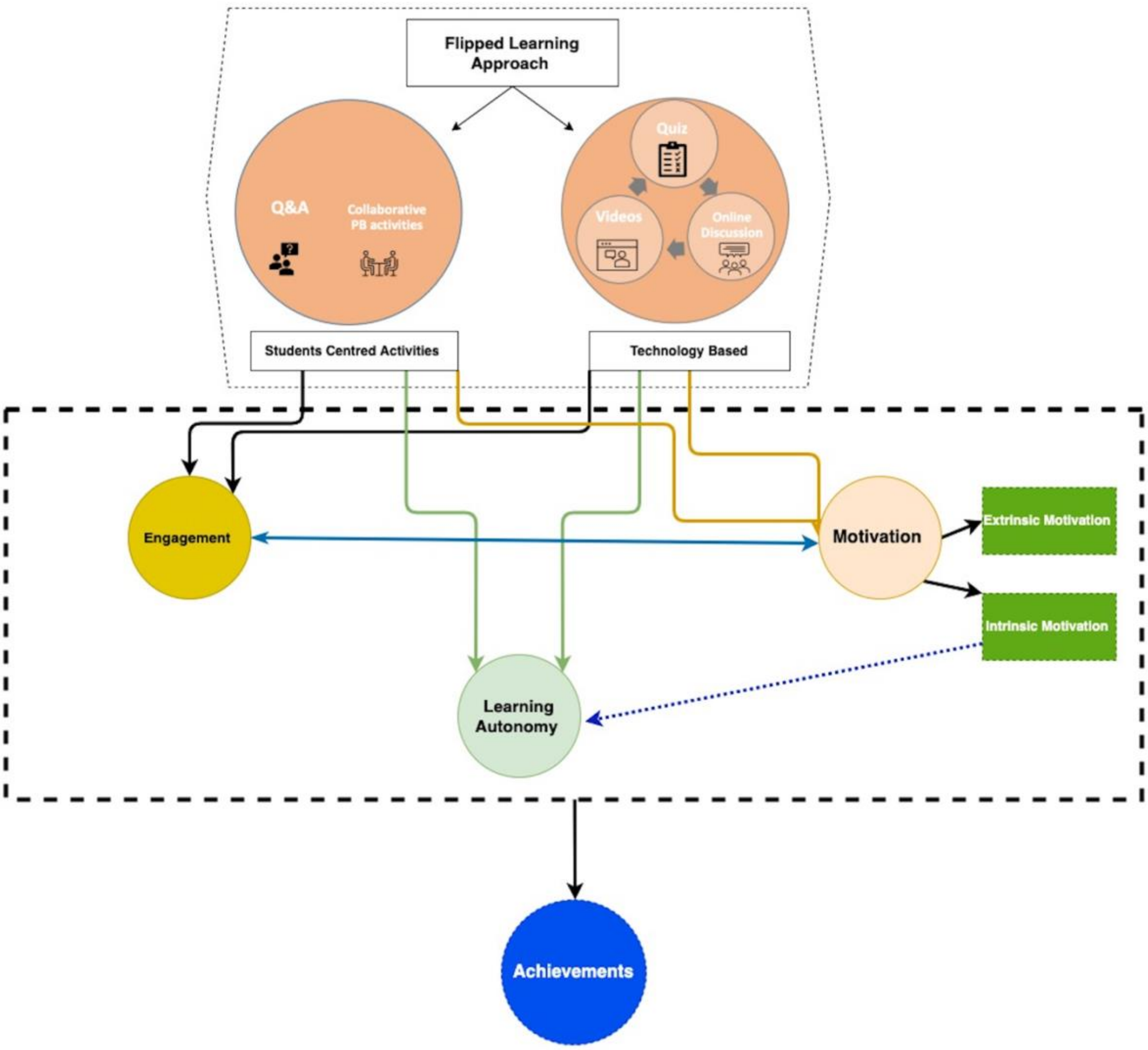


Figure 2.5 Conceptual Framework of the Study

2.10 Summary

This chapter has reviewed flipped learning, including the history of this phenomenon, which is one of the new innovative forms that is one of the outcomes of the breakthrough of educational technology. The concept of flipped learning has been covered in this chapter, as well as how the technology is integrated into this approach. The design of flipped learning was reviewed to clarify which design of flipped learning will be used in the current study. This section has also focused on Computer Science, which is one of the fields that aims to develop new innovative teaching approaches to overcome the challenge of teaching the subject. In addition, the variables of the current study were reviewed, whilst also focusing on motivation, engagement, and learning autonomy. That often proves to be affected positively following the implementation of flipped learning.

The review of the literature on flipped learning seems to be promising in terms of promoting students' achievement, motivation, engagement and learning autonomy. However, the variation of the findings and the lack of rigorous studies, especially in high schools, may render this study critical in educational development. Indeed, it can be noticed that despite the limitation of studies concerning the impact and the benefit of flipped learning on students' learning, most studies were undertaken in a higher-level context. However, students' high school achievements, motivation, engagement and learning autonomy have not been extensively studied; thus, the impact of flipped learning on students' learning still requires some robust research. One study such as this present one, should focus on Saudi Arabia, as there is limited attention to the use of new innovations in educational technology, despite the availability and wide access to an array of technological forms. In addition, the study focuses on the impact of flipped learning in Computer Science. Subsequently, the following chapter presents the study's research design and method that have been utilised in the process of following the research aims.

Chapter Three – Methodology

The aim of this study was to investigate the impact of flipped learning on Saudi high school students' academic achievement, motivation, engagement and learning autonomy. In order to achieve this aim, two classroom environments were selected: one for the flipped learning implementation and the other for the non-flipped learning application. The researcher carried out mixed method research to explore the impact of both types of environments, broadly defined. The purpose of this study was five-fold:

- To examine the impact of flipped learning on Computer Science students' grade-related achievement
- To identify the effects of flipped learning on Computer Science students' motivation
- To examine the impact of flipped learning on Computer Science students' engagement
- To examine the impact of flipped learning on Computer Science students' learning autonomy
- To explore the benefits of the flipped learning approach for Saudi high school students' educational and learning experiences.

As a result, this study sought to address the questions below:

1) *To what extent did Flipped Learning affect Saudi students' achievement in the first-year high school in the Computer science subject?*

   $H_{0:}$ There is no significant difference in terms of students' scores between the flipped learning classroom and the non-flipped classroom

   $H_{1:}$ There is a significant difference in terms of students' scores between the flipped learning and the non-flipped classroom

2) *To what extent did Flipped Learning affect Saudi students' motivation in the first-year high school in the Computer science subject?*

$H_{0:}$ There is no significant difference in terms of students' motivation between the flipped learning classroom and the non-flipped learning classroom

$H_{1:}$ There is a significant difference in terms of students' motivation between the flipped learning classroom and the non-flipped learning classroom

3) *To what extent did Flipped Learning affect Saudi students' academic engagement in the first-year high school in the Computer science subject?*

   $H_{0:}$ There is no significant difference in terms of students' academic engagement between the flipped learning classroom and the non-flipped classroom

   $H_{1:}$ There is a significant difference in terms of students' academic engagement between the flipped learning and the non-flipped classroom.

4) *To what extent did Flipped Learning affect Saudi students' autonomous learning in the first-year high school in the Computer science subject?*

   $H_{0:}$ There is no significant difference in terms of students' autonomous learning between the flipped learning classroom and the non-flipped learning classroom

   $H_{1:}$ There is a significant difference in terms of students' autonomous learning between the flipped learning classroom and the non-flipped learning classroom

5) *How did the Saudi high school students perceive their learning experience in flipped learning classroom and non-flipped learning classroom?*

To address these research questions the researcher applied an embedded mixed method approach and adopted the pragmatism paradigm. A non-equivalent control group pre-test-post-test quasi-experimental design was embedded in the current study to find out the impact of flipped learning on students' achievement, academic engagement, motivation, and learning autonomy. To clarify, the non-equivalent groups' design presents participants who have not been randomly assigned to conditions. In this chapter, the researcher will explain: (a) the reasons behind selecting the mixed-methods design for this research; (b) a review of the mixed-methods design; and (3) how this design can best address the research questions. Furthermore, this chapter will present the quantitative and the qualitative methods, and tools used to investigate the research questions and the appropriate procedures to collect and analyse the data collected. This chapter will also consider the setting, sample, ethical issues and reliability and validity of this study.

3.1 The Research Design

Flipped learning is a recent development in the field of education; therefore, it needs to be both given attention and to be opened to scrutiny in order to gain further insights and a comprehensive understanding of such phenomenon. The term is referred to as phenomenon here because of the relatively sudden and arguably surprising popularity it has gained during the last seven years and especially since Bergmann and Simon shared their experience in their book "*Flip Your Classroom: Reach Every Student in Every Class Every Day* (Bergmann & Sams, 2012). One of the most important aspects of flipped learning is the overwhelming belief that 'social learning' is a very effective form of learning, and that it is this element of learning that makes the critical difference to learning. This learning is learning from peers, learning through observation and copying, learning through vicarious means. When coupled with technology, flipped learning seems purportedly to have the magic touch, so it is perhaps not surprising that this has happened. Social media in addition, seems to have encouraged the take-up of flipped learning amongst groups of teachers world-wide. As a form of social learning that has spread teachers' ideas around the world, this movement therefore has been particularly strong, but without any research evidence. In fact, the teachers seem to have suffered from Fear of missing out (FOMO) syndrome – teachers try to develop their way of teaching from the web and from social media propagated ideas, but without any evidence from educational authentic research, because of FOMO. The teachers do not want to miss any suggestions raised or highlighted related to the improvement of their job and to their outcomes, and they fear to someone experiencing a new way of teaching that they wish they were adopting. They also fear that their students' miss such experience and desire that any intervention that can possibly improve their students' learning experiences as well as their outcomes, cannot possibly be ignored. All the aforementioned studies explained why flipped learning has gained popularity among teachers. One can also observe the reasons for the spread of implementation of flipped learning across the various disciplines and levels of education.

Although the number of studies investigating flipped learning has been on the increase, such studies seem to be confined to quantitative data. In addition, they are not only characterised by their small size (Tawfik & Lilly, 2015; Muir & Geiger, 2016; Sohrabi & Iraj, 2016), but also by not being longitudinal (Chen, 2016) and lacking in rigour (Davies et al., 2013; Gough et al., 2017), while there is dearth of qualitative research (Karabulut-Ilgu et al., 2018). Previous studies employed just quantitative data such as survey (Zhang et al., 2016), exam scores (Chiang & Wang, 2015), system-logged online data (Schmidt, 2014). All the data in the studies were used to measure the students' motivation, outcomes and academic engagement in order to investigate the impact of flipped learning. Adding qualitative data, however, can also be valuable in terms of interpreting these quantitative results to gain a holistic view about the phenomenon. Combining quantitative and qualitative data can be more productive than depending on one or the other (Maxwell & Loomis, 2003). The researcher and readers can see the statistical evidence of the impact of flipped learning and understand the perspectives of students towards the learning process in two different learning environments. The limitation of the previous studies reminds the researcher to consider the implementation of the methodology that can examine the complexity of flipped learning.

Considering that the general design of flipped learning involves two phases; namely pre-classroom and in-classroom (Abeysekera & Dawson, 2015; Akçayır & Akçayır, 2018), the use of only one single data source may not thus give the researcher opportunity to gain a comprehensive understanding about the complexity of flipped learning. Indeed, flipped learning as a teaching approach that integrates social learning and utilising technology seems to make a particular change in the learning process. This shift in the learning process might influence students' learning experiences. Therefore, while investigating the efficacy of flipped learning on students' motivation and learning autonomy, this research also aims to examine the impact of flipped learning on students' outcomes. As already mentioned, current research has five questions focused on achievement, academic engagement, motivation, learning autonomy and students' perceptions. Thus, one method is not sufficient to respond to the research questions, which is another rationale for employing a mixed method in the current research. According to Creswell and Clark (2011), when this is the case, i.e., a single method is not sufficient to answer the research questions, the mixed-methods design should be chosen.

When a study combines quantitative and qualitative data, one can safely say that "we have a very powerful mix" (as cited in Creswell, 2012, p.535). The current research seeks to examine the effect of flipped learning on students' achievement, performance, academic engagement, motivation, and autonomous learning in the form of quantitative data. In addition, the researcher needs to hear from participants to understand how the change in the learning process has had an impact on students' learning experience in form of qualitative data. Mixing these two types of data methods might help the researcher to draw a clear picture of flipped learning impacts. It is clear that the researcher was looking to employ two types of data for completeness, which is the reason for choosing a mixed-methods design, as Bryman (2016) stated. Moreover, in the literature, there is clear recommendation to carry out further research by employing qualitative and quantitative data. Bishop and Verleger (2013a) indicated the need for more mixed-methods studies to understand what flipped learning entails and how it can support student learning. Since that time, not many rigorous mixed-methods have been carried out. Even though the reviewed studies have been carried out in a number of data collection forms, including students' perceptions and learning, there was a shortage of explanations and triangulation between the various kinds of the gathered information (Giannakos et al., 2014). As stated by DeLozier and Rhodes (2017), there is not much in terms of research on flipped learning because it is still in an embryonic phase, although case studies are emerging regularly over the last few years. In addition, this study aimed to find out the impact of flipped learning in Saudi high school students' achievement, academic engagement, motivation, and autonomous learning when studying a Computer related subject.

There is a consensus about flipped learning in that it is a result of advancement in the integration of technology in education (Davies et al., 2013; Voronina et al., 2017; Shyr & Chen, 2018). This consensus could be regarding the essence of the role that technology is playing in flipped learning, particularly in the pre-classroom phase. Indeed, technology can potentially contribute to and enrich the teaching practice. In addition, there are many technological tools that allow application of the general concept of flipped learning, such as LMS, CMS, and social media. By taking advantage of this advancement, the teachers can apply the concept of active learning, and student based learning (Akçayır & Akçayır, 2018). This believe towards flipped learning is extracted from the popular concept of it, which is direct instruction is delivered through technological tools such as instructional videos and other media; while the time of classroom time is designed for engaging students in collaborative activities and problem solving (Bergmann & Sams, 2012; Flipped Learning Network, 2014). In this sense, flipped learning seems suited for an education system such as that of Saudi Arabia, where the aim is to focus on involving students in learning by applying a student-centred approach. Recently, the Saudi Ministry of Education came to the realisation that schools are still dependent on curricular materials produced in the late 19th century. Such materials place teachers at the heart of the teaching and learning process and consider them as the only source of knowledge. In 2016, the Saudi government released the *Saudi Vision 2030*, with the Ministry of Education as one of the sectors included in the areas of interest to be invested in. Two major aims of the educational vision include allowing students to lead the learning activities and facilitating the process of integrating technology in education (Mitchell & Alfuraih, 2018). In fact, as stated earlier, flipped learning combines these two key objectives in learning. Suggesting a teaching practice, such as flipped learning, for the Saudi education system can be aligned with the requirements of *Vision 2030* for enhancing the Kingdom's education sector. Thus, there is a reason for utilising the advantage of mixed method design, which is to provide a rich and complete picture about the research problem to allow the researcher to draw a credible recommendation in keeping with the *Saudi Vision 2030*.

Flipped learning might be one of the currently most important areas in educational research that needs significantly more investigation. The number of studies on flipped learning has multiplied over the years and there are now regularly papers with diverse research designs in some of the highest-ranking journals in the field of education (Chen et al., 2017; Karabulut-Ilgu et al., 2018). Some of these studies mentioned the positive impacts on some learning aspects, such as students' interaction (Kim, 2017), students' motivation (Strayer, 2012; Davies et al., 2013; Chen Hsieh et al., 2017), students' perception (Tawfik & Lilly, 2015), and students' engagement (Hodkiewicz, 2014; Hung, 2015). However, it is obvious that the focus of most studies in the literature review has been on higher education contexts even though many schools have expressed their interest in flipped learning. Even though there were several studies conducted in pre-tertiary education to understand the impact of flipped learning, these studies showed a major limitation in that they were inconsistent about the effect of flipped learning on students' achievement (Clark, 2015; Chen, 2016; Chen et al., 2016; Huang & Hong, 2016). Nevertheless, they found a positive effect on students' motivation (Chao et al., 2015; Baris, 2017), responsibility (Muir & Geiger, 2016), satisfaction (Bhagat et al., 2016) and engagement (Jarvis et al., 2014; Gilboy et al., 2015; Alsowat, 2016; Elmaadaway, 2017). The field of flipped learning is still in need for further evidence about the impact on students' experience, especially in pre-tertiary education. The current study aimed to find out about the impact of the change in the learning process that occurs by applying flipped learning on the various aspects of students' learning experience, including achievement, performance, academic engagement, motivation and learning autonomy.

As a result, this research study used the mixed-methods design to address the aims and objectives of the research. According to Creswell (2002), mixed-methods design allows the researcher to gain better insights into the research questions. Mixed-methods research has two or more types of qualitative and quantitative data that can integrate the results to provide a better understanding of the phenomenon. Similarly, as given its usefulness in terms of bridging the gap between various ways of seeing, understanding and knowing (Greene, 2007), the mixed-methods approach was selected for this study. In addition, employing a mixed method design can enhance the integrity of the findings (Creswell & Clark, 2011). Therefore, the current study employed the quantitative and qualitative methods as they could allow the researcher to gain further insights into the impact of flipped learning on students' achievement, academic engagement, motivation, autonomous learning through different types of data collection; namely pre-post-test, questionnaires, interviews and focus groups.

One of the key advantages of the mixed-methods design is that it allows the researcher to draw on the strengths of the quantitative and qualitative research methods (Creswell, 2009). In this study, the purpose of using the quantitative method is to accurately measure and compare data (Maxwell & Loomis, 2003) and to examine of the effects of the learning environment. The quantitative data was employed to determine the extent to which flipped learning influences students' performance by comparing students' grades in two different groups. Also, the students' performance, achievement, academic engagement, motivation, learning autonomy, and perceptions were examined by a set of questions in the form of a questionnaire. Similarly, the purpose of using the qualitative methods was to understand the phenomenon under study and discover the influences (ibid). Hence, the qualitative data was employed to gain an in-depth understanding of the phenomenon from the participants themselves by means of face-to-face interviews and focus groups. Once the quantitative results were obtained from the sample, there was a follow-up with some of the participants to explain those results in more detail (Creswell, 2012).

3.2 The Research Paradigm

According to Mackenzie and Knipe (2006), research may be defined as an inquiry into an educational or psychological phenomenon by means of data collection, analysis and description, as well as prediction or control. Research into the educational sector, which is seen as a complex social science field, has attracted several contrasting viewpoints from social science scholars and practitioners (Cohen, 2018). For example, Walter (2009) sees social science research as an inquiry on and with real people in real world. As such, the research process should aim for precise findings to gain a holistic view regarding the research problem. In fact, determining the paradigm of the research can be useful in terms of understanding the reasons behind the researcher’s selection of the research design (Creswell 2009). One can thus say that a paradigm is a mutual worldview that epitomises the opinions and principles in a discipline and that signposts how to resolve problems (Schwandt, 2014). Furthermore, it is possible to define a paradigm as a perspective that shapes views, opinions, belief systems and practices into a rational whole in order to inform the research design. The research questions are usually useful when deciding the paradigms. As explained by Guba (1990),there are a number of characteristics for the research paradigms, including (1) ontology, which looks into reality and the nature of “knowable”; (2) epistemology, which investigates the nature of the relationship between the knower and the known and how to know something; and (3) methodology, which seeks to determine how a knower goes about finding out knowledge and what methods they should adopt in the process of finding it out.

Broadly speaking, one can categorise paradigms into positivism, post-positivism and inter-positivism (Guba, 1990). The quantitative methodology is the primary methodology adopted in positivism and post-positivism even though qualitative methods may also be utilised within such paradigms (Mackenzie & Knipe, 2006). In positivism, reality is seen as the only tangible notion, which indicates that reality is detached and independent (Chilisa & Preece, 2005). In the meantime, as concurred by post-positivists, reality exists; however, they hold that it can only be identified in an imperfect way given the human limitations and shortcomings of the researcher (ibid). As stated by Guba (1990), in post-positivism, there appears to be a broad, multifaceted and dynamic approach to comprehending knowledge; in other words, there are multiple realities, as opposed to one base reality (Cohen, 2011). Comparatively, qualitative methods frequently correlate with interpretivist paradigm (Goldkuhl, 2012). This is referred to by Basit (2010) as the 'constructivist' or 'naturalistic' paradigm, as it provides in-depth insights into the human behaviour. According to this paradigm, reality is socially construed (Creswell & Clark 2011; Mackenzie & Knipe 2006). With reference to the research questions and aim, the current study combined quantitative and qualitative data, and considering the brief description of the paradigms, the study drew from both the positivist and interpretivist paradigms. Thus said, there is a paradigm that may be relevant for the current study design, namely the pragmatic paradigm. Even though pragmatism is not related to a single philosophy or base of reality, pragmatist researchers try to pay attention to the 'what' and 'how' of the research problem (Creswell & Clark, 2011). In fact, the pragmatic paradigm has at its core "the research problem" by applying all approaches to comprehend the issue (ibid). As such, the present research sought to identify the effect of a phenomenon, i.e., the educational approach known as flipped learning, on the students' achievement, academic engagement, motivation, learning autonomy, and perceptions.

The previous studies examining flipped learning depended on quantitative data (Abeysekera & Dawson, 2015; Hodkiewicz, 2014; Karaca & Ocak, 2017; Kurt, 2017; Zhang et al., 2016), which seemed to come from a positivist view. Several studies sought to explore students' motivation, achievement, and academic engagement in flipped learning by employing quantitative data, including questionnaire and pre-post-test (Zhang et al., 2016; Chao et al., 2015; Karaca & Ocak, 2017; Wang, 2017). Although these tools might allow the researcher to examine the impact of flipped learning in statistical form, which would be easily observed and differentiated, it may lead to a restricted scope in terms of exploring the phenomenon. In other words, it could be a barrier to a deeper understanding of the phenomenon, which could occur by allowing the participants to express their views in the form of qualitative data. In so doing, the researcher requires numerical data and the participants' views and perceptions in order to construct a comprehensive idea about the impact of flipped learning on students' achievement, performance, academic engagement, motivation, autonomous learning. In short, the application of the pragmatic paradigm enables researchers to choose methods, techniques, and procedures to suit their specific requirements and purposes, as well as answer the research questions (Creswell & Clark, 2011).

3.3 Research Design in Practice

In order to succeed, students are increasingly required to develop the skills and knowledge they acquire on a regular basis at school. Such urgency can be explained by the interconnectedness of our global economy, ecosystem, and political systems according to which students have to learn to interact, work together, and deal with problems with other people all over the world (Saavedra & Opfer, 2012). Indeed, the teachers have a duty to provide a rich learning environment and attempt to keep their students motivated and engaged. According to Marope et al. (2018), the teachers are responsible for creating learning environments that inspire active learning and instil engagement through several meaningful and increasingly challenging tasks that can be stimulating to the learners' thought processes. In addition, prompting autonomous learning skills can create a supportive learning environment (Nguyen, 2012). As a result of the demands of the 21st century, traditional teaching seems to be an inappropriate option for teachers and learners alike.

Furthermore, educational research supports giving the learners more of a role to play in the learning process and encourage the teacher to be more of a facilitator than a deliverer (Freeman et al., 2014; Higgs & McCarthy, 2005; Knight & Wood, 2005). Beside the development of technology and the requirement to integrate technology in learning, there are continued efforts in the education field to apply new approaches of learning and teaching, including attempts to integrate technology-based approaches. In the report of innovation in education, it can be seen how technology can shape the new educational practice, particularly in learning and teaching (Johnson et al., 2015). It can be agreed that the popularity of flipped learning stems from the desire of teachers to meet the requirements of effective education that has as a key aim the promotion of students to be ready for future work by receiving the appropriate knowledge and skills (O'Flaherty & Phillips, 2015). An interesting points to be raised in previous studies are teachers reporting that flipped learning can pose some challenges for them, such as being time-consuming and teachers being overworked (Chen, 2016; Kim, 2017; Mason et al., 2013) and the student's disengagement with pre-classroom task (He et al., 2016). Despite these challenges, it was reported the flipped learning is still used among teachers. It can also be noted that there is an online community for teachers interested in flipped learning, which could be ascribed to the fact that flipped learning is promisingly thought of as having a positive impact on students' learning experiences.

Thus said, it is important to understand why flipped learning is still recommended despite the findings in the literature being inconsistent in terms of achievement and the teachers' reports of challenges in the implementation of flipped learning. As such, the pragmatic approach in combination with the right methods was adopted to address the research questions. The researcher applied this approach due to its appropriateness to the research problem and questions as it allows the researcher to collect both quantitative and qualitative data. According to Johnson et al. (2007) and Teddlie and Tashakkori (2009), the mixed-methods research is the kind of research in which aspects of qualitative and quantitative research approaches are combined by the researcher, such as the adoption of perspectives, data collection, analyses, and inference methods from both strategies in order to gain a broad and deep understanding and rationale and blend and mix together a wide range of philosophical worldviews.

In the current research, the first questions needed to be addressed statistically by employing pre-test and post-test to collect test scores of students from flipped learning environment and non-flipped learning environment then compared. After that, the students from the two groups responded to a set of questions in the form of questionnaire. The second, third and fourth questions were addressed in a statistical form followed by qualitative data to gain an in-depth understanding of the complexity of flipped learning. The last question was addressed using qualitative data since it was a "How" question. It focused on finding out about the students' experiences in their learning environment (both flipped learning and non-flipped learning). In the literature review, there were studies attempting to utilise the value of mixed method to examine flipped learning (e.g. Yang et al. 2016; Baris, 2017; Chen Hsieh & Kim, 2017). Certain limitations, nevertheless, as shown by Schultz et al. (2014), can prove to be effectual upon validity, which can include data collated over different time period; there have been specific research studies that have focused on short time periods (Chen, 2016;

Baris, 2017). Separately, a different limitation can be found in regard to bias, as certain researchers and/or instructors can potentially affect the results of a study (Kim, 2017).

As noticed in the previous studies, the implementation of the flipped learning approach can influence the nature of learning practices, such as the role of teacher and students, as well as the importance of pre-classroom learning and its effect on in-classroom learning. In addition, flipped learning requires extra efforts from students who need to have internet access at home in order to explore the educational materials and then come prepared to their respective classes and get involved in the learning activities (Karaca & Ocak, 2017, Kostaris et al., 2017). The impact this can have on how teaching is conducted and the integration of technology in the learning process should be considered when examining flipped learning. There is a variety of learning activities and a noted change in terms of the students' role in learning, which means that the mixed-methods could be an appropriate tool to address the research aims and better understand the phenomenon of flipped learning. Mixed-methods can yield insights into, and an explanation of the processes and multiple views of the issue (Creswell & Clark, 2011). Therefore, to understand the complexity of flipped learning and its impact on the learning process, the researcher needs to cover all the different layers in this educational research. According to Yvonne Feilzer (2010), the mixed method approach can help the researcher in terms of measuring and observing phenomena with different layers using quantitative methods to measure some aspects of the phenomenon in question and qualitative methods for others.

Bryman (2016) confirmed that the incorporation of two approaches can be seen as an effective step to help offer general and intuitive understandings of the results from the quantitative data and yield more insights into the issue by also employing qualitative data. To put it differently, several kinds of data are examined as a whole to produce knowledge, which seems to be a positive factor in terms of the consistency and validity of the study. Indeed, the current research employed quantitative data to examine the effect of flipped learning on students' scores compared to students in a non-flipped group to identify if flipped learning can contribute to term of students' achievement. Also, the quantitative data would be useful in terms of ascertaining the impact of using such trend innovation in education and its effect on students' achievement, performance, motivation, academic engagement and learning autonomy by carrying out a questionnaire. The researcher also believes that using qualitative data could help when attempting to understand the phenomenon of flipped learning by listening to participants' experience and their views in the form of interviews. As the research paradigm is pragmatism, the researcher employed the data tools that can ensure a deeper and richer understanding of flipped learning and its potential to promote students learning experiences, as well as fulfilling the aspirations of society and policymakers in education. Morgan (2007) terms pragmatism as a paradigm of choices, as there are many complex choices available to integrate the strengths of the qualitative and quantitative methods based on the nature of research.

The deductive research adopts a quantitative paradigm, whereby the researcher can reach some theoretical conclusions by gathering evidence based on numerical measures. The model can be beneficial in terms of studying the link between variables and making predictive inferences. In the current study, this approach can inform the researcher if there is any impact of the dependent variable, which is the learning environment, on the independent variables, i.e. students' outcomes, academic engagement, motivation and learning autonomy, which carried out in the form of methods mentioned early. On the other hand, the inductive research adopts a qualitative paradigm, whereby meaning is produced to be construed from the participants' viewpoint (Rauscher and Greenfield, 2009). This approach was applied to the current study in order to understand how students could be motivated and engaged whilst experiencing two different learning environments. Moreover, it was necessary to comprehend how they perceived their achievements and autonomous learning. These were achieved by inviting students to share their experiences and perspectives of the two different learning environments, which serves to give more explanation about the results of quantitative data in terms of testing the impact of the intervention. Hence, this mixed method strategy was the most beneficial form for the current study, as it helped to determine the how flipped learning approach is effectual upon the overall learning process and the learners' views regarding their learning setting. The research design is illustrated in Table 3.1.

Table 3.1: The Research Design of the Current Study: Concurrent Embedded Mixed-methods Design

Research Questions	Type of Data	Methods and research instruments	Data Analysis	Finding	Result

Q1	QUANT	Pre-post Test Questionnaire	SPSS	Test hypotheses	The impact of flipped learning on Saudi high school students
Q2	QUANT and QUAL	Questionnaire Semi-structure interview Focus group	QUANT: SPSS QUAL: thematic analysis	Test hypotheses And answer Q2	
Q3	QUANT and QUAL	Questionnaire Semi-structure interview Focus group	QUANT: SPSS QUAL: thematic analysis	Test hypotheses And answer Q3	
Q4	QUANT and QUAL	Questionnaire Semi-structure interview Focus group	QUANT: SPSS QUAL: thematic analysis	Test hypotheses And answer Q4	
Q5	QUAL	Semi-structure interview Focus group	Thematic Analysis	Answer Q5	

3.3.1 The Type of Mixed-methods Adopted in this Research Study

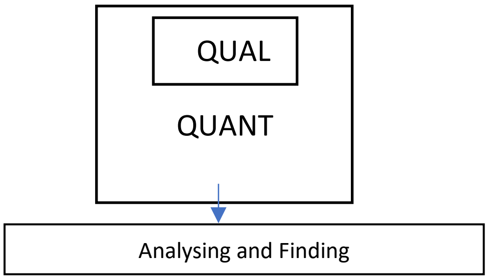
Furthermore, including both quantitative and qualitative methods without explicitly mixing the data derived from each is not a mixed method; it is just a collection of multiple methods (Creswell & Clark, 2007). A strong mixed method design serves to effectively explain the strategy of how to mix the data in terms of timing and weighting (ibid). Indeed, the aspects that influence mixed-methods research are timing, weighting, and mixing (Creswell, 2009; Creswell & Clark, 2011). The design of procedures of mixed method approach is based firstly on the timing of the quantitative and qualitative data collection, which can sometimes be in phases (i.e., sequential) or when gathered simultaneously (i.e., concurrent). Additionally, the mixed method design is changed by the different phases of both quantitative and qualitative data that depend on the weight or priority of the design. The researcher and the audience used for the purpose of the study, and what the researcher seeks to highlight in the study are all factors that determine the weight or priority for one type of data (Creswell & Clark, 2011). Thirdly, mixing refers to when two types are connected, which occurs when the quantitative and qualitative methods are connected between the first phase when data is analysed and data collection in the second phase. Mixing can also refer to whether two data types are integrated or embedded (Creswell & Clark, 2011). The last aspect of the design is the perspective theorising or transforming in terms of whether the study is guided by a theoretical perspective and whether it is explicit or implicit. The design of this study applied these aspects to find out an appropriate design of mixed-methods (see Table 3.2). According to Creswell (2009), there are six types of mixed-methods design, including:

1- Sequential Explanatory Design
2- Sequential Exploratory Design
3- Sequential Transformative Design
4- Concurrent Triangulation Design
5- Concurrent Embedded Design
6- Concurrent Transformative Design

Table 3.2: Aspects to Consider in Planning a Mixed-methods Design

Timing	Weighting	Mixing	Theorising
No sequence **Concurrent**	Equal	Embedding	Implicit

Based on the four criteria indicated by Creswell (2009), the researcher applied the concurrent embedded strategy, which is one of six mixed method designs introduced by Creswell (2009). This strategy was used in this study to address different research questions needing different types of data. The concurrent embedded strategy allows the researcher to collect the data concurrently; in other words, the quantitative and qualitative data gathered at the same time. It was difficult for the researcher to revisit the field where the study is carried out a number of times for the purpose of collecting his data. As Creswell mentioned, this option is recommended in case of difficulty to revisit the field for data collection (2009). In addition, the concurrent embedded strategy allows the researcher to embed qualitative data within a larger quantitative framework or to embed quantitative data within a larger qualitative setting (Creswell 2009). In this study, the qualitative method was embedded in the quantitative framework, which was quasi-experimental, in order to address different questions (see Figure 3.1). Comparatively, the qualitative data taken from both the semi-structured interviews and focus group were utilised for the first research question, which functioned in conjunction with the questionnaires' quantitative findings and provided additional points from the students in relation to flipped learning and how it affects their achievement in Computer Science. Additionally, the interview and focus group qualitative data helped to support the quantitative results taken from research questions 2, 3 and 4, which provided additional details of how flipped learning affects students' levels of motivation, engagement and helps them to become autonomous in their learning process. Moreover, the qualitative data helped to determine the perceptions of the students in regard to the flipped learning setting and non-flipped learning settings. In addition, the time for collecting the data was almost the same for both quantitative and qualitative data.



Concurrent Embedded. (Creswell, 2009)

Figure 3.1: The Design of the Current Mixed Method Study QUAN → qual

3.3.2 Quasi-experimental Design

The research design for quantitative method was quasi-experimental design. This design is used because of the difficulties to assign the participants randomly in groups (Cohen, 2018), either for ethical or practical concerns (Stuart & Rubin, 2008). It is difficult for a researcher to ask a school to assign students into groups as the schools have their own strategy of dividing the students into equal groups. The quasi-experimental design was applied given the aim of the study which was to measure the impact of intervention (i.e. flipped learning) on students' learning experiences by comparing between two groups; namely control and experimental. This design also allowed the researcher to utilise different methods to address the research questions; then, the results were collected using different methods in order to be interpreted for the whole study.

There is more than one type of quasi-experimental designs (One-Group Pre-test-Post-test Design, One-Group Post-test-Only Design, The Non-equivalent Control Group Design with Post-test Only and The Non-equivalent Control Group Design with Pre-test and Post-test) (Cohen, 2018). The current study applied a non-equivalent quasi-experimental design Pre-test and Post-test (see Figure 3.2). The non-equivalent control group design with pre-test and post-test has been described as a frequently utilised quasi-experimental design in research within the field of education (Cohen, 2018, p.407). This is commonly relevant, as students are placed into groups (i.e., classes) within their schools and have been shown to share many characteristics (Best & Kahn, 2006). While non-equivalent groups may not be preferable, non-equivalent groups have been described as “better than nothing” (Heiman, 1999, p.320). As matching is often impossible for practical reasons, researchers using non-equivalent groups should select samples from the same population, as well as selecting samples that are as similar as possible (Cohen, 2018). Hence, the researcher included two parallel classrooms. In the quasi-experimental research design, the efficacy of the flipped learning approach was examined by involving two parallel groups of students out of which one belonged to a non-flipped learning setting “controlled group” and the other to a flipped learning setting “experimental group”.

Experimental group	O_1	X	O_2
Controlled Group	O_3		O_4

Figure 3.2: O1: Pre-test O2: Post-test O3: Pre-test O4: Post-test X: Treatment (FL)

The study investigated two learning environments: the flipped learning environment and the non-flipped learning environment. The fact that different groups were chosen in the experiment enhances the analysis, resulting in a better understanding of the efficacy of the flipped learning approach. As aforementioned, the current study used the quasi-experimental design with a pre-and post-test strategy of data collection of students’ performance levels, as implemented by Shapley et al. (2010). This design provided the researcher with the opportunity to determine the impact by analysing the differences between before and after the intervention. In addition, this design allowed the researcher to collect data by employing questionnaire which might help to determine the impact of the intervention on students' achievement, academic engagement, motivation, and learning autonomy. Furthermore, this design enhanced the validity of the study and ensured the two groups were parallel.

The experiment was carried out for almost two months. As shown by Clark and Sugrue (1991), eight weeks, which is equivalent to more than the half of a term, is the duration for the novelty factor to fall to a minimum point. It can also be observed that this novelty may impact on how both students and teachers interact with new technology as time elapses (Chwo, Marek & Wu, 2016). It was also found in previous studies that there were attempts to examine the impact of flipped learning but they were limited to two weeks (Baris, 2017), three weeks (Chen, 2016), and six weeks (Bhagat et al., 2016). In this study, the researcher collected the quantitative data using a pre-and post-test to measure the impact of the learning approach on students' achievement, performance, academic engagement, motivation, and autonomous learning. Also, this use of pre-and post-test instrument might increase the validity of the study (Dimitrov & Rumrill Jr, 2003). In addition, the researcher used questionnaires to explore students' perceptions towards the flipped learning approach.

3.3.2.1 Applying the Design to the Current Study

In this study, the researcher conducted a quasi-experiment to find out which learning environment- flipped learning or non-flipped learning- is more effective in term of students' achievement, performance, academic engagement, motivation and learning autonomy. The teaching approach was the intervention whereby the flipped learning was applied on the experiential group and the non-flipped learning was applied on the control group. The aim of the current study was therefore to examine this intervention method in order to clarify whether there is a significant difference in students' learning achievements, performance, academic engagement, motivation, and learning autonomy between flipped learning and non-flipped learning. To conduct this, the researcher used the diagram below, according to which group 1 is referred to as the flipped learning environment and group 2 as the non-flipped learning. This pre and post-test non-equivalent groups design was applied to determine which learning environment influences students learning a Computer science course. The students in group 1 experienced flipped learning, whereby they accessed online pre-classroom materials, and then attended the classroom involved in collaborative activities. The students in group 2 exposed to non-flipped learning with the teacher delivering the same materials as their flipped learning counterparts, and then depending on the classroom time, the teacher gave the students certain activities. Also, the students should do their homework before next classroom meeting (see Figure 3.3).

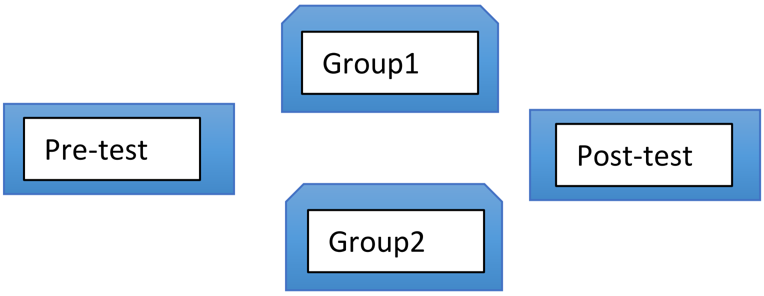


Figure 3.3: The Current Experimental Design

The table below (3.3) shows that two groups were exposed to the same subjects. The independent variables were teaching and learning practice of flipped learning, while the dependent variables included the level of the students' achievements, performance, academic engagement, motivation and autonomous learning.

Table 3.3: Syllabus of the Computer Science Curriculum - Unit 1, 2 and 3

Week	Unit	Flipped Learning	Non-Flipped Learning
1	**Unit 1: Open sources and Linux systems** What are open sources - The concept of open resources and closed resources licenses Advantages of open sources	✓	✓
2	The potential of using open-source software Copyright Plagiarism	✓	✓
3	What is Linux How to install Linux Identify the Linux interface Linux Applications for Office	✓	✓
4	**Unit 2: Multimedia** Introduction to Multimedia	✓	✓

	The concept of multimedia - its importance - its components		
5	Multimedia use areas Production stages Software to create and edit multimedia files	✓	✓
6	**Unit 3: Design and manage website and social media** Introduction to social media Definition of website management software on the Internet	✓	✓
7	Steps to create site management software Advantages of using site management software	✓	✓
8	How to write content through site management software Examples of sites and applications that use site management software (blogging + sharing resources with others)	✓	✓

3.4 The Flipped Learning Design and Implementation

The current research was conducted in the first term of the academic calendar in Saudi Arabia of the academic year 2019, for a period of eight weeks during August to November. The Computer Science course specified in this study is one compulsory subject for high school students and the curriculum designed by the Ministry of Education (MOE). In this course, different concepts and topics of Computer Science are taught and the three units covered in the current study were: Open Sources and Linux Systems; Multimedia and Design; and Manage the Website and social media. In the current research, the main teacher and researcher created the course materials using the course textbook. Further, the course textbook helped to source the different activities, based on the teaching aims from the different weeks. All these materials were assessed by two other Computer Science teachers, as well as two experts, in order to ensure that they covered the aim of each unit.

This section has detailed both the flipped and non-flipped learning formats. Flipped and non-flipped learning are different from each other in relation to how new content is presented to students and in how the activities are undertaken. Flipped learning is not just a different method that provides interactive pre-classroom activities, but it also requires more careful consideration about classroom instructions. It has been noted by Moffett (2015) that a teacher is required to take decisions about the elements taught outside the classroom and what is put into practice within it prior to implementing flipped learning. Indeed, there are both in-class and out-of-class activities within the concept of flipped learning, and thus, students need to be able to use both pre-classroom and in-classroom guidelines to work in a dynamic manner. In the current study, during the pre-classroom phase, each week the teacher provided the students with short instructional videos that explained the concept of the lesson, and the teacher used the online discussion to enable the students for more interaction with classmates and the teacher. Also, the online quizzes were used in the pre-classroom phase; this coincides with Roehling (2017, p.6), which states that a teacher needs to provide students with the possibilities to learn base information outside of a classroom setting, and online quizzes also help to assess students' levels of understanding (ibid). All these online learning materials were uploaded in an online platform titled as "Marefa", which is based on a learning management system.

Moving to the classroom phase, the teacher normally used the first five minutes for Q&A, in order to ensure that the students were clear about the foundation knowledge that could help them to engage in classroom activities. Subsequently, the teacher provided the students with well-defined guidance (i.e., worksheet) for classroom activities. The classroom activities were a form of collaborative and problem-solving activities, and each of them depended on the course textbook, based on the different week's aims. The use of these types of activities helps to apply active learning, which is one of the aims of the flipped learning approach (Bergmann & Sams, 2012; Hamdan et al., 2013; Burke & Fedorek, 2017). The students worked in small groups of 4 or 5 in the Computer lab and each group had access to a Computer. Comparatively, the non-flipped learning group coverer the same units and was based on a traditional lecturer setting that followed the classroom activities with homework outside of the classroom; this is the known as the 'normal' way of a teaching method as used by the teacher involved in the current study. Table 3.4 presents the different components that are found in both FLG and NFLG.

Table 3.4: The Different Components of the Flipped and Non-Flipped Learning

	FL	**NFL**
Course Duration	8 Weeks	8 Weeks
Number of Class Per-week	Three per week (45Mins)	Three per week (45Mins)
Online Learning	Yes	No

Online Discussion	Yes	No
Out-classroom Homework	Studying the online learning materials	Completing pen and paper homework.
Teacher Role	To facilitate, monitor and evaluate the new knowledge	To provide knowledge and evaluate new knowledge
Working with Group	Yes	Yes, practical lessons and to depend on the class time

3.5 Research Instruments

The current research aimed to investigate the impact of applying flipped learning approach on achievements and performance of Saudi high school students in a Computer science subject, and on their academic engagement, motivation and learning autonomy. Thus, based on the research questions, four research instruments were employed. The test instrument was in the Arabic language and the questionnaires, interviews and focus group questions were in both Arabic and English but carried out in the Arabic version. In Figure 3.4, it can be seen how the research instruments answered each research question.

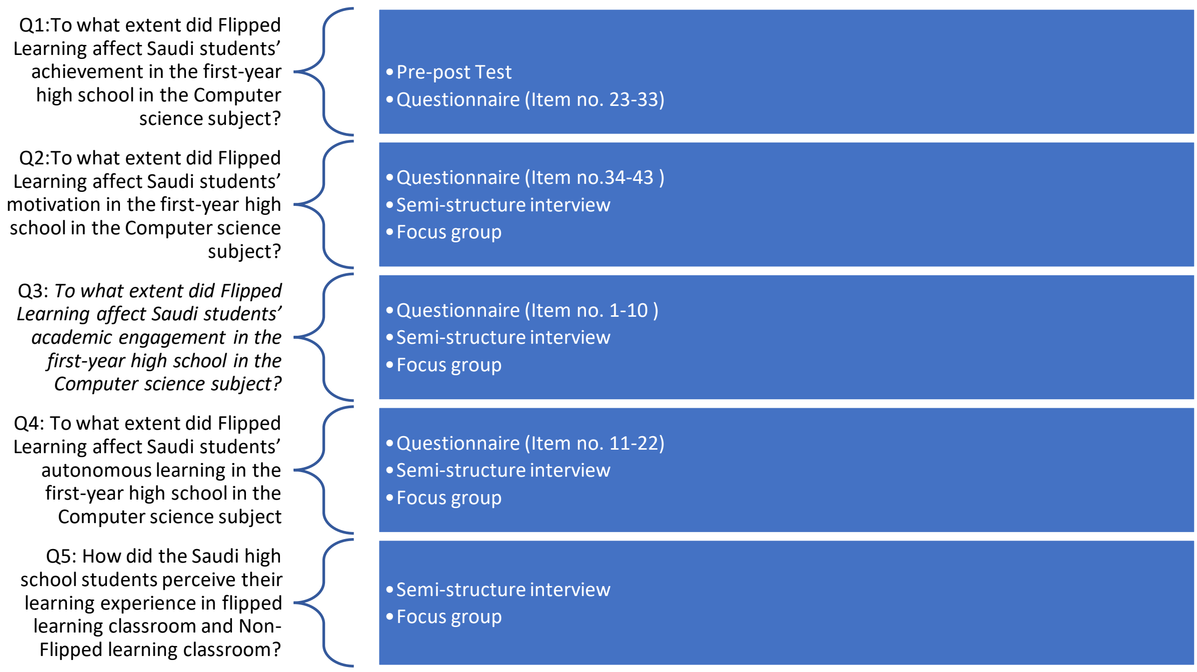


Figure 3.4: Research Instruments

3.5.1 Pre- and Post-Test

The researcher applied the pre-and post-test design approach to a quasi-experimental design. In this instrument, the researcher assigns intact groups the experimental and control treatments, administers a pre-test to both groups, conducts experimental activities with the experimental group only, and then administers a post-test to assess the differences between the two groups (Creswell, 2012). One of the aims of this study was to examine the impact of flipped learning on Saudi high school students' achievement in Computer subjects. The first research question "To what extent did Flipped Learning affect Saudi students' achievement in the first-year high school in the Computer science subject". According to (Cohen, 2018), a researcher can use certain tests to measure student achievement. Thus, the researcher used the pre-and post-test instrument with an experimental group and a control group to identify any differences in student achievement in both groups. In terms of designing the test, the teacher and the researcher attempted to design a comprehensive test that covers the various units of the curriculum during the experiment. They followed a seven-phases process that has been suggested by Buffum et al. (2015) to create a valid and reliable test instrument. The process can be used for a pre-and post-test, addressing the open need in Computer science education research for evaluating the strengths of a given intervention (ibid). The seven phases are as follows:

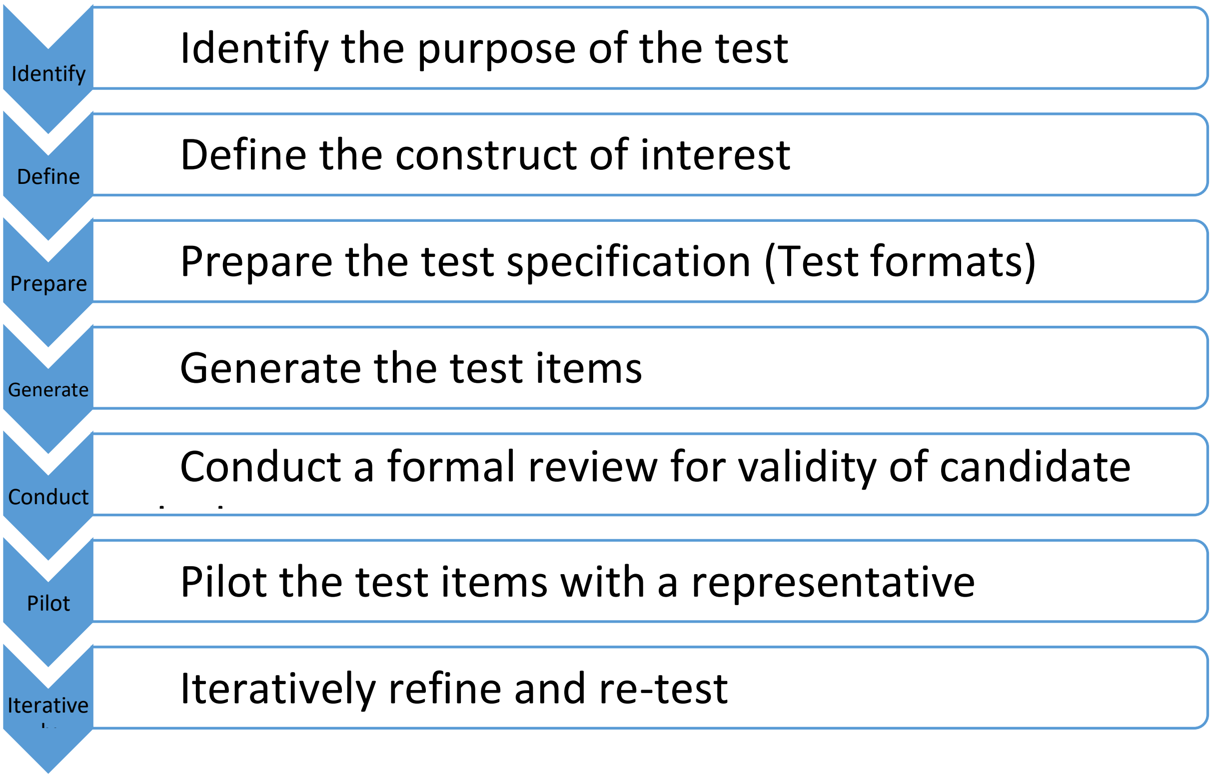


Figure 3.5: A Seven-phases Process to Create a Valid and Reliable Test Instrument suggested by Buffum et al. (2015)

In the first phase, the purpose of using pre-and post-test was to determine whether flipped learning could have an impact on Saudi high school students' achievement in Computer science subjects by observing any perceived differences on the dependent variable, which is the student score in both the experimental and control groups. As for the second phase, the test was constructed based on the learning objectives of the Computer science curriculum. The test covered the concepts and facts taught during the experiment. In the third phase, which involved preparing the test specifications, there are many options in terms of the test formats; thus, the test was built using the multiple-choice format. The multiple-choice test is a straightforward to grade and is scalable to many students (Buffum et al., 2015). Then, the test was generated and conducted using a formal review with five Computer teachers. The researcher conducted a pilot study, and the test items were piloted with a representative sample. As for the last phase, the researcher refined the test by considering the feedback from the experts and pilot phase. The procedure of this instrument entails that the students are given the test at the beginning of the experiment and then have the same test at the end of that experiment (see Appendix F).

3.5.2 Questionnaires

In the current study, the researcher employed the questionnaires to compare the students' perceptions towards their achievements and performance in two learning environments, in order to extend their understanding of the results of the pre- and post-tests to address Research Question One. In addition, the researcher employed the questionnaires to address Research Question Two, Three and Four; these questions aimed to examine the impact of flipped learning on students' academic engagement, motivation and learning autonomy. There is also a section in the questionnaire that addresses student perceptions toward flipped learning approach in both phases, i.e., in-classroom and pre-classroom. The researcher utilised questionnaire because of its potential to assess attitudes and offer practical knowledge about participants' experiences and their opinions (Cohen, 2018). It also provides an impartial way of collecting data that in keeping with the respondents' knowledge, thoughts, perceptions and attitudes (Bryman, 2016). To put it simply, the role of researchers is to gauge various types of characteristics by means of questionnaires (Johnson & Christensen, 2013). Thus, use of the questionnaires allowed the researcher to gain better insights into the impact of flipped learning on students', achievement, performance, academic engagement, motivation and autonomous learning, which investigated further using the qualitative data.

It is possible, however, that questionnaires result in some limitations as in the potential for respondents leaving some questions unanswered, or the probability for a lack of truth in some responses, and the duration that the data analysis may take (Bryman, 2016). Nevertheless, the current study used both quantitative and qualitative data, which means that the data of the questionnaires can be enhanced by interview and focus group data. In addition, the existence of the researcher through all stage of the collecting questionnaires seemed to be reduce the limitation by introduces the important of the questionnaires to students and help them if there are any confusing or unclear questions (see Data collection procedures Section 3.10). Indeed, carrying pilot study and introduction session was helpful.

The questionnaire was used to investigate students' experiences in flipped learning environment and non-flipped learning environment. For the purpose of this study, the researcher adopted a structured questionnaire in order to gain specific data, which proved to be a useful measure in the data analysis process (Cohen, 2019). Overall, some items were adapted from the literature (Arano-Ocuaman, 2010; Feri et al., 2016; Burke & Fedorek, 2017; Zainuddin & Perera, 2017; Zainuddin, 2018), while others were generated for the present study. To start with, the researcher provided a specific review of literature on flipped learning, with the focus being on five related aspects: student's achievement, performance, motivation, academic engagement, and learning autonomy. In addition, based on Cohen et al. (2011), the new generated items were directed in relation to the study's objectives.

3.5.2.1 Questionnaire Design

The aim of the questionnaire was to examine the impact of flipped learning on students' motivation, learning autonomy, achievement and academic engagement by comparing the data from two groups: a flipped learning group and a non-flipped learning group. The questionnaire was divided into five main sections, including general information, motivation, learning autonomy, achievement, performance and academic engagement. However, there were two more sections for the flipped learning group; there were related to students' perceptions towards the flipped learning experience (See Appendix G). The questionnaire mainly consisted of closed questions, which was useful for the current study aims. As stated by Cohen (2019), using this kind of questionnaire allows the researcher to compare across the sampled groups. Furthermore, it makes it easier for the participants to respond at leisure (ibid). In fact, such valuable selection could be the answer for participants like students who may find it difficult to deal with open-ended questions. The questionnaire included 48 items for the two groups: the flipped learning group and the non-flipped learning group. Five sections emanated from these items, including general information, students' motivation, learning autonomy, students' achievements, performance, students' academic engagement.

Section One involved six items, including collection of general information about the students, such as the level of experience in using technology in education and the subjects, accessibility in terms of using the internet, preferences as to which devices to use and the place at which they often use the internet. These items allowed the researcher to gain brief information about equality between students when using the internet, especially for the flipped learning group, where the students needed to use technology and the internet.

Gaining this general information could help the researcher to determine whether issues of access to technology devices and the internet affect the result of the intervention (flipped learning). In previous reviews the difficulty of accessing the technology and internet was mentioned as one of the challenges faced by the students in their flipped learning environment, which could threaten the implementation of a flipped learning design, especially the pre-classroom learning, which is online.

Section Two aimed at examining the students' motivation levels by adopting ten items from the literature. There were ten statements in the form of a 5-point Likert scale (SA-A-N-D-SD). These were divided into five items to measure intrinsic motivation and five for extrinsic motivation. These items were used in the study by Zainuddin and Perera (2017), who measured students' motivation in a flipped learning context. They constructed the motivation scale based on self-determination theory and used five items for intrinsic motivation, including competence, autonomy and relatedness, which are considered to be the base for intrinsic motivation according to self-determination theory (Ryan & Deci 2000). The second part of this section was five items for extrinsic motivation, which were also was designed based on self-determination theory. Furthermore, this scale was discussed with experts, including the supervisor to ensure its validity of it (see Section 3.14.2). The intrinsic and extrinsic motivation were reviewed in-depth (see Section 2.6.1).

Section Three was to examine the students' autonomous learning by adopting 12 items from the literature, which were also in the form of a 5-point Likert scale. Section Four was dedicated to measuring students' perceptions towards their performance and achievement in the Computer science course. This section, along with the other pre and post-test, was intended to assist the researcher to closely observe the students' achievement and performance in the two learning environments. The last main section in the questionnaire attempted to observe the students' academic engagement in the form of a 4-point Likert scale (Very Often- Often- Sometimes- Never). As mentioned above, these were the five main sections for the groups, and they carried out the after the experiment. The other two sections were meant to address the students' perceptions towards flipped learning experiences in both phases, i.e., in-classroom and pre-classroom. They were designed in two forms; the first 12 items were based on the 5-point Likert scale and last question was to rate the most effective element in the design of a flipped learning approach.

3.6 The Qualitative Methods

The qualitative methods were employed to gain an in-depth understanding of the impact of flipped learning on Saudi students in terms of their achievement, performance, academic engagement, motivation and learning autonomy. As mentioned by Giannakos et al. (2018), when it comes to studies carried out on the flipped learning approach, it seems that there is not much attention given to qualitative-oriented studies. In addition, qualitative data can also be used to complement and augment data from quantitative method (Palinkas et al., 2011). Thus, the researcher employed two data tools: namely interviews and focus groups. By applying these qualitative tools, with the interview method as one of the popular methods in social science research (Packer, 2011, p.42), the researcher was able to understand more about the students' learning experiences and provide more depth to the questionnaire research results. The face-to-face interview might allow the researcher to give students more freedom to express their views, while the focus group, given its nature, could allow participants to probe their views. These two research methods can yield very rich data about students' views and practices (Xerri, 2018). In addition, they were employed together with different data instruments in order to perform triangulation and to validate the findings. It seems that these two methods are similar, but the current research employed them so that their advantages could be exploited to obtain richer and more relevant data. According to (O. Nyumba et al., 2018), there seem to be some similarities between focus group and semi-structured interviews in terms of their potential for revealing people's views and beliefs. In contrast, they seem to differ significantly when it comes to the researcher's role or contribution. In the interviews, the researcher assumes the role of the "investigator", which indicates that the researcher is raising queries, dictating the various aspects of the discussion, or interacting with respondents one at a time. In a focus group discussion, however, the role of a "facilitator" or a "moderator" is assumed by the researcher. All in all, both qualitative tools have the potential to yield valuable data.

3.6.1 Interviews

An interview is simply defined as *'a verbal interchange, often face to face, though the telephone may be used, in which an interviewer tries to elicit information, beliefs or opinions from another person*' (Burns, 1997, cited in Kumar, 2011). The key aim of the interviews is to provide richer and more exhaustive qualitative data after completion of the questionnaire process. Interviews are thus preoccupied with exploring issues that have not been covered or answered sufficiently through questionnaires. The researcher employed the interview for various reasons, including gaining an understanding of the students' experiences in two different learning environments, evaluating the value of flipped learning over non-flipped learning or the opposite, and highlighting the differences between students' experiences. As stated by (Creswell, 2012), interview allows for a discussion of the meanings and inferences about the world in which the interviewers and interviewees live. They also allow these participants to voice their own opinions and concerns about certain situations and issues. Using this qualitative data might complement the quantitative data in offering an understanding of the extent to which flipped learning can impact on Saudi students and in gaining a deep understanding of the implications of applying this learning practice with students. This use of different data types on the same phenomenon, which is known as triangulation, could make the investigation more valuable and credible (Creswell & Clark, 2011), which increased the credibility of this study.

3.6.1.1 Semi-structured Interviews

There are five types of interviews, including (i) the structured interview; (ii) the semi-structured interview; (iii) the unstructured interview; (iv) the non-directive interview; and (v) the focused interview and the current research employed semi-structured interview. In this interview, the researcher determines the topics and questions; however, while the questions are open-ended, the wording and sequence are based on each individual respondent and the answers they provide, using prompts and probes. The researcher used the semi-structured interview method that conducted with students from the experiential groups and control groups in order to gather the relevant qualitative data. Indeed, a semi-structured interview allows a researcher to compare between different participants' responses, which benefits from the diversity and flexibility in individual answers (Burns, 2010). Thus, the interviews can help the researcher address the questions about the impact of flipped learning on students' experiences by comparing the students' responses. The interviews were conducted with both the experiential groups and control groups to gain further insights into the experiences and perceptions of the participants. A semi-structured interview allows views and thoughts to be expanded upon during the interview process (Denscombe, 2014).

The semi-structure interview allows the interviewees to ask an interviewer to clarify more, particularly when they do not fully comprehend (ibid). In addition, as stated by Denscombe (2014), it is possible for the interviewer to rearticulate or repeat the question or offer a similar example. Indeed, this type of interview allowed the researcher to ask the students questions and based on their answering ask deep questions. There are four dimensions covered by the interview questions, including academic engagement, motivation, achievement, performance, and autonomous learning. For the purpose of the current study, the research questions were utilised by the researcher so that he could embark on the research interviews. This was done after some extensive discussions with the main supervisor and a research assistant, as the aim had been to remove language ambiguity and to ensure significance was provided towards the main research areas, which proved to be a useful approach to determine and deal with potential problems (see Appendix H).

3.6.2 Focus Group

One of the types of strategy in qualitative research refers to focus groups according to which perceptions, viewpoints or attitudes towards certain ideas, or a topic, product, subject, service or proposal are investigated by means of a free and open dialogue between the different members of a group and the researcher (Kumar, 2018), which, in turn, will be a stimulating factor for several discussions among the group members. Through focus groups, the researcher can attain an understanding about the students' views regarding how they want to learn (Bryman, 2016). Moreover, this is useful for the researcher in terms of comprehending the participant's communication in various contexts (Kitzinger, 1995). Another equally important issue for the researcher was to be able to understand and get close to this type of communication in order to monitor students' responses and reactions towards Computer Science learning experiences when instructed within two different learning environments, as it was hard to formulate a holistic idea about this specific type of data using only interviews and/or questionnaire. When carrying out the semi-structured interview, the students were requested individually to voice their opinions about a specific topic and their motives for such views; by the same token, focus group provides a wider scope for students to challenge each other and question their motives for upholding a certain opinion (Bryman, 2016). Using the focus group platform allowed all participants the opportunity to share their thoughts and get involved in several discussions. For the current study, the focus group used to enrich the findings and provide the research with a thorough vision of the effect of flipped learning on students' learning experiences and perceptions. In addition, other forms of interviewing and questionnaire are also useful for triangulation with focus groups (Cohen, 2018).

In fact, it is possible for students to have diverse takes on the learning process, which is demonstrated through group discussions. Such discussions allow them to voice their opinions about the various aspects of learning environment be it flipped non-flipped that may be hard to obtain from other data sources. According to Bryman (2016), it is crucial to adopt this type of data collection when studying the variety of opinions. Furthermore, focus group can be useful in terms of eliciting a whole range of diverse opinions of relevance to a specific topic (ibid). Therefore, the researcher applied this approach to gain in-depth insights into students' experiences and attitudes towards learning environment, thus allowing him to identify the areas most highlighted by different students recalling their own learning experience in either the flipped learning or non-flipped learning environment. Given the time constraint, there were one group for each of the learning environments; in other words, one for flipped learning and one for non-flipped learning. One could focus on a small number of groups as more groups might lead to exhaustive analysis and become time-consuming. As claimed by (Bryman, 2016), having more groups can be a waste of time for researcher. It is worth arguing that a small number of groups, combined with other research methods, might be worth the while.

The size of the group was five, as suggested by (Morgan et al., 1998). The researcher had to select the number and the size of the groups in order to exploit the benefits of the focus group with the least effect on the research progress. As a matter of fact, the selection of the group was underpinned by two factors; namely time and resources, since the addition of more groups could make the analysis process even more complex (Bryman, 2016). In terms of the questions asked of the focus group, they were based on the research questions; more specifically, they were geared to motivate students to relate to their individual learning experiences (ibid). Broad questions were utilised by the author in order to stimulate discussion (See Appendix I).

3.7 Back Translation

The current study was carried out in Saudi Arabia and the first and mother language of the researcher and the participants is Arabic. Thus, the researcher had to create an Arabic version of research instruments (questionnaire, interview and focus group questions). The back-translation technique was applied for questionnaire and questions of interview to ensure the accuracy and truthfulness of translation. This technique is the most common procedure for translating (Tsang et al., 2017). It simply refers to the translation of the original version of the instrument (in English) into another language, such as Chinese, which is passed to another party that does not have access to the original English copy. The third party undertakes the translation of the Chinese copy back into English (Cohen 2018). Such process is more effective than that followed by the bilingual translators translating into their native language (ibid).

In the current study, the English version of the questionnaire was translated into Arabic by two PhD students in applied linguistics whose mother language is Arabic; then, two other PhD students in the same discipline but from another university translated the Arabic version of the questionnaire back into English. A comparison between both English versions of the questionnaire was carried out to assess the accuracy of the translation. In addition, the researcher sent the Arabic version to an expert in an Arabic country who had graduated from the UK to edit the language structure and relevance to the participants. Subsequently, various changes were introduced to the original Arabic version of the questionnaire following the pilot study, which resulted in the second version in Arabic.

3.8 Participants

Identifying the participants and places plan to study is one of the steps in the data collection process (Cohen, 2018). This study aimed to identify the impact of flipped learning on students' achievement, academic engagement, motivation and learning autonomy in Saudi high schools by drawing a comparison between two different learning environments. There have not been many studies focused on the flipped learning approach as far as high school is concerned. Most of the previous studies were done at the university level (Alharbi, 2015; ALRowais, 2014; Bernard, 2015; Bishop & Verleger, 2013; Caligaris et al., 2016;

McLaughlin et al., 2014; Shyr & Chen, 2018; Zainuddin, 2018; Giannakos et al., 2018). Therefore, the researcher selected a high school located in Saudi Arabia. In June 2018, the researcher contacted five schools and explained the nature of his study. Three of them invited the researcher to give a presentation about the requirements of the study and the idea of flipped learning. In August 2018, the researcher visited the schools and met with the teachers and head teacher in each school. They liked the idea of teaching using the flipped learning but did not commit to implementing the learning approach in the long term. Fortunately, one school in the Royal Commission at Jubilee City volunteered and offered to implement this study on one group studying a range of Computer subjects (see Appendix D). This school divided the students into parallel classrooms. Therefore, the research carried out on two parallel classrooms. These classrooms were divided into one experimental group, where instruction was delivered using the flipped learning, and control groups, who was taught using the normal teaching approach. All participants were from the first year of high school and their ages vary between sixteen and seventeen years old. They all had a copy of the participant information paper (see Appendix E). In addition, they had the opportunity to discuss last-minute issues with the researcher before giving their consent.

3.9 Sampling

The research design of the current research was mixed method, which could influence the research selection of the study sample. According to Teddlie and Tashakkori (2009), a mixed method study can use more than one kind of sampling (i.e. probability and nonprobability). In addition, the mixed method sampling design is based on two dimensions which are time orientation (concurrent vs sequential) and the relationship between the qualitative and quantitative samples (identical, parallel, nested, or multilevel) (Onwuegbuzie & Collins, 2007). So, the current concurrent mixed method used nested samples, which indicates that the sample participants selected for one phase (QUAL) of the study represent a subset of those participants chosen for the other phase (QUAN) of the investigation (ibid). This sample design allowed the researcher to apply two strategies: one for QUAN and the other one for QUAL, with each having their own rationale.

Regarding the aim of the current study, the field work was carried out in a Saudi context. The researcher contacted the Education Department of the Royal Commission and some popular private schools because of their accommodation of LMS, which could make it easy for the researcher in terms of the application of the flipped learning approach. In fact, one school which is under the Education Department of the Royal Commission in the Jubilee City, welcomed the researcher and offered support to conduct his study. The purpose of the current study was to investigate impact of flipped learning by comparing it with non-flipped learning in Computer subjects. The current study used a simple random sampling technique as the sampling procedure, (Punch & Oancea, 2014). Such sampling technique is the most basic kind of probability sampling, in which every section of the population has the option to be included (Bryman, 2016). There were six Computer classrooms in the school and the researcher randomly selected two Computer classrooms from the existing classes, whereby one would be used by the flipped learning group and one by the non-flipped learning group, with the study sample comprising 74 students. In this kind of sampling, all students in the six classrooms had equal chances of being selected. The researcher used a randomizer website to allocate the sample which was comprised of groups 5 and 6. However, because of the restrictions in school, the researcher could not assess the participants in group; they were assessed based on the administration of the school. The school assessed the students based on their evolution in the previous year and attempted to make all classes comparable and equal in terms of the academic level of students (see Table 3.5). The sample size included 74 participants that should far exceed the requirements for the minimum sample size needed for statistical analysis. As recommended by Cohen (2018), a sample size of thirty is largely considered to be the minimum figure of cases if investigators intend to utilise numerical examination on their data, even though it is not a big number and very significantly more cases are required.

Table 3.5: School Classrooms

Class/Rating	C1	C2	C3	C4	C5	C6	
Excellent	4	5	4	4	6	6	
Very Good	11	11	10	11	11	10	
Good	16	15	18	17	15	16	
Pass	6	5	4	5	5	5	
Total	37	36	36	37	37	37	220

The convenience strategy was chosen by the researcher as a procedure to be implemented using a non-probabilistic sample from both groups for the qualitative methods; namely, interview and focus group. According to the convenience strategy, the researcher basically selects the sample from people who are easily accessible and conveniently available and prepared to take part in the study (Onwuegbuzie & Collins, 2007; Cohen, 2018). The researcher politely requested the students in both groups to participate in the interviews and focus group. A total of 18 participants were interviewed, with 9 participants representing each group; similarly, 10 participants were part of the focus group, with 5 in each group. Once the teaching procedure had been explained to the students, all the participants voluntarily gave their consent to take part, with 37 in the FLG and 37 in the NFLG. In terms of the ethical issues pertaining to the participants' participation, all respondents from both groups had to fill in a consent form before engaging to the study and prior to the start of the data collection process itself. As shown in the consent form, the time and the aim of the study and the respondents' option to withdraw at any stage were fully explained.

3.10 Data Collection Procedures

The design of the current study was the concurrently embedded mixed-methods, which was employed to investigate the impact of flipped learning on student achievement, performance, academic engagement, motivation and learning autonomy. This design aimed to utilise the benefits of quantitative and qualitative to have a better understanding of the research phenomenon. In order to do that, the quantitative approach was the major instrument, while the qualitative data acted as a supplementary source for the achievement of deeper insight of the quantitative results. The design of quantitative part was a non-equivalent quasi-experimental design Pre-test and Post-test. As such, the data were collected before and after the experiment. In addition, the type of mixed method shaped the procedure of data collection. According to Creswell (2012), in this design the quantitative and qualitative data were collected simultaneously. For the data of the current study, they were gathered in 2019 between the 25th of August and the 18th of November. This section explains how the process of data collection went.

The First Step

In June 2019, an online meeting was arranged between the researcher and the teacher. The purpose of this meeting was to determine which weeks and contents of the Computer science curriculum to be included in the study. This step was to create a guideline for the teacher to apply the flipped learning approach and to design instructional videos. In July, the guideline was ready and sent to the teacher; then, the researcher and teacher started designing online materials, including videos and quizzes.

The Second Step

On the 25th of August 2019, the researcher visited the school and met with the school principal and the teacher. In this meeting, the researcher received an introduction about the available classrooms and how the school assessed the students into six parallel classrooms. Regarding the purpose of the study, the researcher randomly chose class six and five by using a randomised website. On the 27th of August 2019, the school principal and the teacher were informed about the outline of the study and choice of classrooms. The teacher was given the final version of the guideline for educational content within flipped learning, and he was made aware that the other classrooms would be taught using his teaching methods.

The Third Step

On the 28th and 29th of August, the teacher and researcher reviewed for the last time the online materials, including videos and quizzes and then uploaded them to the school online platform (https://sola.marefa.rcjschools.edu.sa/login/index.php).

The Fourth Step: Workshop outline

Date		Objectives
1st of September	**Workshop Part 1** The teacher introduced the researcher to the students in group five and six	- Explaining the purpose of the study: 20 minutes - Demonstrating the flipped learning approach: 25 minutes
2nd of September	Workshop Part 2	- Explaining to the students how to access the online platform: (https://sola.marefa.rcjschools.edu.sa/login/index.php): 45 minutes.
3rd of September	Workshop Part 3	- Explaining the course content (videos-quizzes): 30 minutes - Explaining how to use the website for discussion: 15 minutes
4th of September	Workshop part 4	- Asking students to practise and access the online platform and explore the learning materials.

		- Open discussion and receiving any questions from the students.

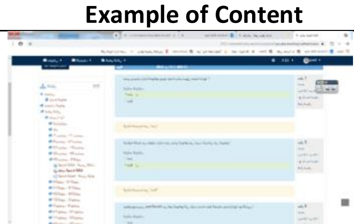
The Fifth Step: Collecting Pre-Quantitative Data

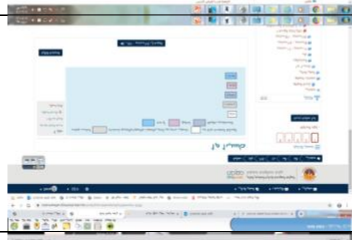
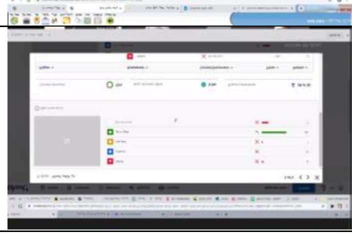
The information sheet and consent form were distributed to the students in group five and six, with a total of 74. In addition, the students were given another copy for their parent.

Date	Step	Objectives	Note
The 5th of September	**Collecting data Part 1**	- The consent forms were collected from the students who were then asked to bring their parents' copy on **the 8th** of September.	The students accounted for 37 in the flipped learning group and 37 in the non-flipped learning group.
The 8th of September		- Carried out the pre-test for two groups ns (37) for the flipped learning group and ns (37) for the non-flipped learning group at 8 AM	To examine the students' scores in the two groups before applying the intervention.

Note: we had to skip the second week because there was a technical problem with the online learning system, which related to the technical support team in the Education Department. We had to wait till they could provide usernames and passwords for the students. For training purposes, we gave the students temporary usernames and one password to allow them to practise. The educational materials, in particular the videos and quizzes, appeared to the students on a weekly basis.

15th September Starting the experiment for 8 weeks to 10th November 2019

Week	Lesson	Example of Content
16TH Sep	• The definition of open sources • The concept of open resources and closed resources licenses • Advantages of open sources	
22nd Sep	• The potential of using open-source software • Copyright • Plagiarism	

29th Sep	• What is Linux • How to install Linux • Identifying the Linux interface • Linux Applications for Office	
6th Oct	• Introduction to Multimedia • The concept of multimedia - its importance - its components	
13th Oct	• Multimedia use areas • Production stages • Software to create and edit multimedia files	
20th Oct	• Design and management of social networking sites	
27th Oct	• Steps to create site management software • Advantages of using site management software	
3rd Nov	• How to write content through site management software • Examples of sites and applications that use site management software (Blogging + Sharing resources with others).	

The Sixth Step: Collecting Data Part 2

Date	Step	Objectives	Note
11th of November	**Collecting-data Part2/Collecting**	- Carried out the post-test for the two groups at 8 AM - ns (37) for the flipped learning group and ns (37) for the non-flipped learning group	To examine the students' performance in the two groups before applying the intervention.

12th of November	**Post-quantitative Data**	- Carried out the questionnaire for the two groups ns (37) for the flipped learning group and ns (37) for the non-flipped learning group via SurveyMonkey at 10 AM Carried out the questionnaire for the experimental group ns (37) via SurveyMonkey	- To investigate the students' achievement, motivation, engagement and learning autonomy before the intervention. - To explore the students' perception toward flipped learning
The 13th 14th 16th of November	**Collecting-data Part2/ Collecting Qualitative Data**	- Face-to-face interviews - ns (9) for the flipped learning group and ns (9) for the non-flipped learning group - They carried out in each morning for 3 days	- To explore the students' experiences in two learning environments flipped learning and non-flipped learning.
The 17th and 18th of November		- Two focus groups - ns (5) for the flipped learning group and ns (5) for the non-flipped learning group	- To explore the students' experiences in two learning environments: FLG and NFLG

3.11 Data Analysis Procedures

The data analysis has adhered to the study's relevance (Cohen et al., 2011), as the aims of the research determine the form of analysis performed. Specifically, for QUAN data, Statistical Package for Social Sciences (SPSS) and Microsoft Excel software were utilised, while MAXQD software was implemented for QUAL data (i.e., interview and focus group transcripts). Figure 3.6 shows the overall form, followed by analyses' details.

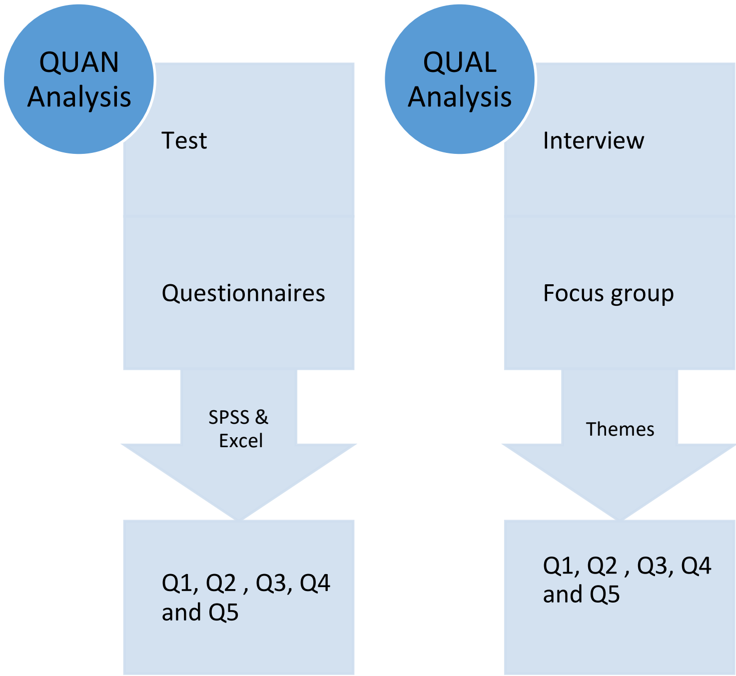


Figure 3.6: Data Analysis Procedures

3.11.1 Normality Test

This section presents the normality tests, which are also called the Kolmogorov–Smirnov test and Shapiro–Wilk test (Field, 2011), that are used for the pre-and post-tests, as well as the questionnaire. These assisted the researcher in terms of determining the kind of statistical test in the analysis stage. It is possible for the data to be normally distributed if the test is non-significant ($p > .05$); but if the test is significant ($p < .05$) this makes the data non-normal distributed (ibid). As shown in the following Table, there is Non-normal distribution of the date for both the FLG and NFLG in post-test. In terms of the data gathered from both groups in the questionnaire, there was also Non-normal distribution. Therefore, the researcher conducted non-parametric tests over parametric tests in the analysis, with the findings conveying most of the data where there was no normal distribution ($p<0.05$).

A parametric test needs specific assumptions to be met for it to prove validity (Gay & Mills, 2011). For instance, the measured variable is required to be distributed within the population; although if any assumption(s) is compromised to a significant degree, then the parametric statistics should not be utilised (i.e. when the distribution is noticeably incorrect. A nonparametric test in these cases makes no assumptions in regards to the distribution's shape (ibid). These nonparametric tests are beneficial to be used when data demonstrates an ordinal or nominal scale, or when a parametric assumption has been significantly violated, or when the form of the distribution remains unknown. Accordingly, parametric tests are more powerful than non-parametric tests (Gay & Mills 2011); hence, it is more challenging for a null hypothesis at a given level of significance to be rejected by a nonparametric test, with a larger sample size required in order to ascertain the same significance level as with a parametric test.

Table 3.6: Normality Test

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Pre-test	.109	74	.029	.953	74	.010
Post-test	.153	74	.000	.972	74	.000
Questionnaire (Intrinsic Motivation)	.260	74	.000	.844	74	.000
Questionnaire (Extrinsic Motivation)	.260	74	.000	.799	74	.000
Questionnaire (Total Motivation)	.260	74	.000	.840	74	.000
Questionnaire (Achievement)	.241	74	.000	.846	74	.000
Questionnaire (Performance)	.226	74	.000	.891	74	.000
Questionnaire (Learning autonomy)	.247	74	.000	.894	74	.000
Questionnaire (Engagement)	.209	74	.000	.908	74	.000

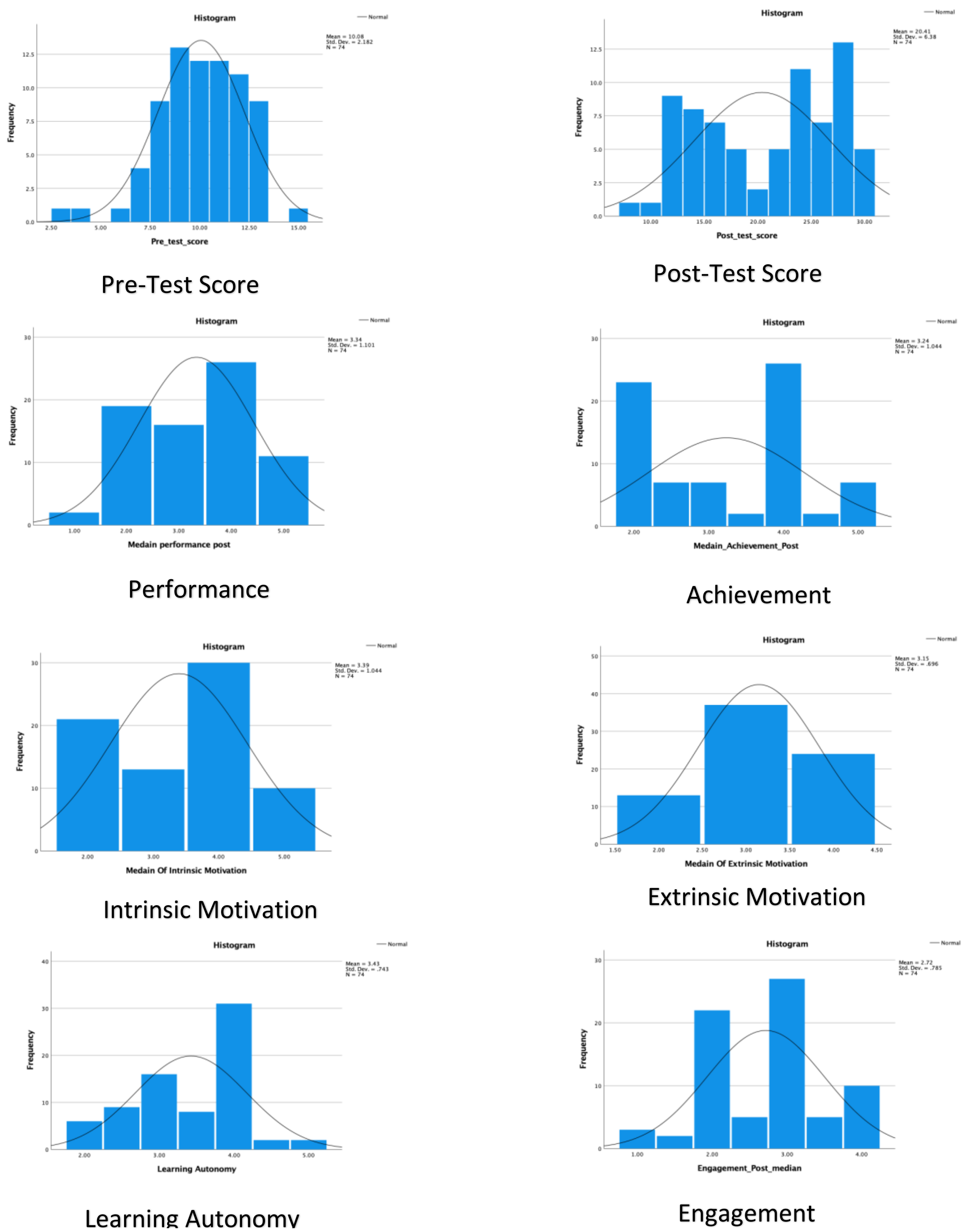


Figure 3.7: Diagrams of Normality Test

3.11.2 QUN Data Analysis

The researcher was employed statistical package for social sciences (SPSS) to analyse test and questionnaire data. There are some potential benefits for SPSS that helped the researcher in the current research. According to Ary et al. (2018, p.140), educational research employs one the best known and most widely used packages, which is SPSS as it provides descriptive and inferential statistics and graphical presentations of data as well as more sophisticated statistical procedures (ibid). Testing hypotheses are important in statistical analysis, as well as descriptions of what is occurring, providing comparisons to find similarities and differences, and understanding how the variables are distributed across the respondents. The current research involves measuring variability and differences in students' achievement, performance, academic engagement, motivation and learning autonomy in two separate learning environments. The researcher used SPSS and Excel software to assist in the determination of the study's projected results. In terms of the SPSS procedures, they included both descriptive statistics and inferential statistics. Descriptive statistics used to calculate the questionnaire items and pre-post test scores, including the median as well as the minimum and maximum range. The SPSS procedures will contain inferential statistics (i.e. A Mann Whitney U), which helped establish the statistically significant differences, if any, between variables. In addition, the effect size will calculated by r equation to see how big the difference was if it ever existed.

The researcher reviewed the benefits that were connected with flipped learning within the education system in Saudi Arabia, together with the different gains from flipped learning in other countries. For instance, the size effect of flipped learning were moderate in the study by Hinojo Lucena et al. (2020) in regards to motivation ($r=0.40$) and learning autonomy ($r=0.47$). In a different study, the size effect of outcomes was measured to be between ($r=0.58$) and ($r=0.90$), with class engagement shown to be high ($r=0.65$) (Kostaris et al., 2017). Meanwhile, in regards to male students the effect size of intrinsic motivation was found to be moderate ($r=0.40$) (Ferriz-Valero et al., 2022). There were certain studies, though, based in Saudi Arabia that show mixed results of flipped learning effect sizes. An example of this can be observed in the study by Alamri (2019), who found flipped learning on students' achievement to be minimally to moderately effective (0.33). Additionally, Al-Harbi and Alshumaimeri (2016) measured flipped learning effects on the performance and attitude of students, which demonstrated a minimal effect size ($r=0.34$). Najmi (2020), however, found the effect size to be ($r= 2.27$); thus, there was evidence of a large size effect from the flipped classroom approach on English language attainment levels of students, which proved more beneficial than traditional English language teaching classes. Similarly, a flipped learning classroom approach was shown to be significantly effective upon participants' acquisition of skills (r=2.45), and more so than a traditional teaching approach (Elmaadaway (2017). That particular study also highlighted that flipped learning has beneficial effects (r= 0.77) on students' engagement levels within a classroom setting.

The SPSS is based on numerical data for analysis, so the data from the questionnaires and test results must be coded in numbers. Therefore, the first stage of the data analysis was coding. The data of the questionnaire was coded and transferred into a specially designed data entry format. Each category was then given a specific value: *Strongly disagree* (1), *Disagree* (2), Neutral (3), *Agree* (4), and *Strongly Agree* (5). In reference to previous students attending a learning course with technology, 'Yes' is then coded as 1 and 'No' is coded as 2. In reference to: '*Do you have access to the internet at home*', 'Yes' is then coded as 1 and 'No' is coded as 2. In terms of '*Where do you use/get access to the web*', 'PHONE' is then coded as 1, 'IPAD' is then coded as 2, 'LAPTOP' is then coded as 3 and 'PC' is then coded as 4. With regards to the variables of the current study, the independent variable is learning environment (flipped learning and non-flipped learning), while the dependent variables refer to learning outcomes, students' achievement, performance, academic engagement, motivation, learning autonomy.

3.11.3 QUAL Data Analyse

Qualitative data analysis is often viewed as an extensive process, although it is transformed into something simpler when divided into specific stages. Therefore, the researcher may be able to manage the analysis of the qualitative data by determining how he analysed such data. According to Braun and Clarke (2006), thematic analysis is a useful method that offers a rich and in-depth account of data. In other words, it serves as a tool to identify, examine and report patterns (themes) pertaining to the collected data. In addition, it provides a minimal organisation and description of the data set in (rich) greater detail (ibid). The thematic analyse one of the most common approach to analysing qualitative data. In addition, Maguire and Delahunt (2017) stated thematic analysis is a very flexible tool with a significant impact on education research, i.e., learning and teaching. According to Braun and Clarke (2006), thematic analysis can be considered a valuable instrument in terms of investigating the viewpoints of various research respondents, underlining similarities and differences, and creating unexpected insights.

Thematic analysis can present the individual learning experiences of different students for both the flipped and non-flipped learning settings. Furthermore, it needs to be stated that this type of data analysis might assist the researcher in terms of identifying the effect of flipped learning on students' learning experiences in terms of their achievements, performance, motivation, academic engagement, and learning autonomy. Hence, thematic analysis has been used to examine the qualitative data extracted from the interviews and focus groups, with the researcher adhering to the six-phase guide offered by Braun & Clarke (2006), as it is a very convenient basis for conducting this type of examination (see Figure 3.7).

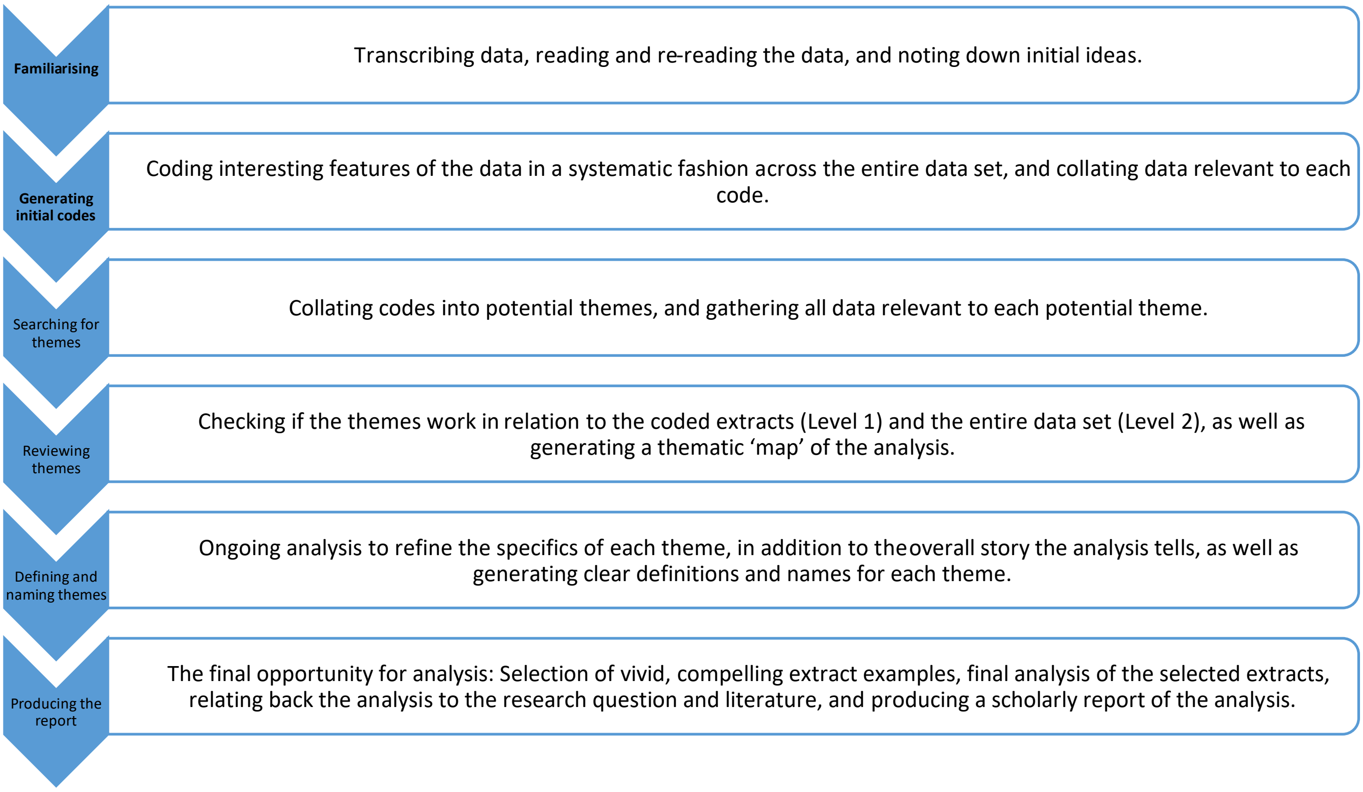


Figure 3.8 Phases of Thematic Analysis (adapted from Braun & Clarke, 2006)

The complete interview and focus group recordings were transcribed prior to the analysis stage, which was undertaken by listening to the recordings various times in order to ensure that no significant data was missed; Braun and Clarke (2006) stated that this helps in advancing data comprehension. The research then placed the transcriptions into a pdf file before using it in the MAXQDA software, which was noted as the most relevant for the data analysis in the current study, as it would function with the Arabic language. Indeed, it was imperative to the validity of the data that the analysis would occur in the participants' original language. Similarly, Vallance et al. (2005) argues that to maintain a text within its original language provides a more thorough grasp of the statements in full, with a more accurate analysis provided. What is more, to translate all the transcripts into English would have been time consuming and expensive, which could have resulted in a loss of key information (Smith et al., 2008).

The researcher decided on the broad themes in a deductive manner using the research questions, as opposed to the sub-themes, which emerged from the data collection and were thus inductively classified. The process of coding is also important, which can be directed either manually or through relevant software (Braun & Clarke, 2006). Hence, the data from the interviews and focus group were coded through MAXQD software, which enabled the possibility to write notes for the different transcripts, which helped to highlight certain patterns. Additionally, MAXQDA enabled the possibility to implement coding, sub-themes and themes from the data, with the responses categorised and subsequently classified into the central themes. Once these themes were selected, the different extracts were placed inductively into sub-themes, with the responses set into codes (see Figure 3.8).

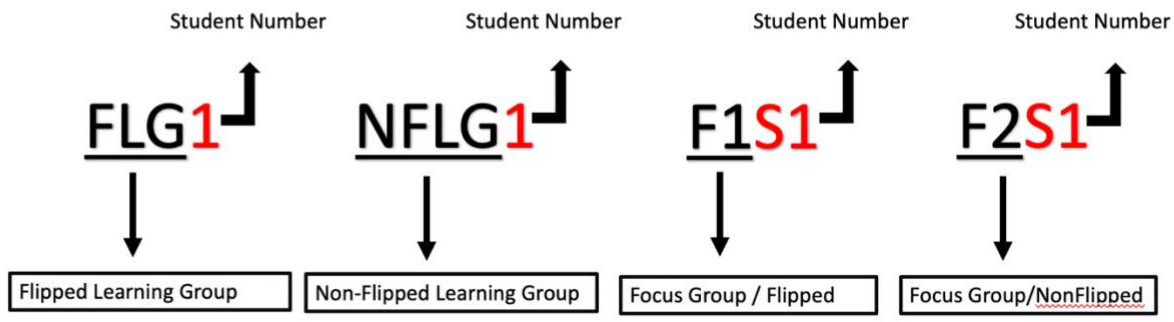


Figure 3.9: The Structure of Students' Responses Coding

3.12 Pilot Study

The researcher conducted a pilot study, which is considered significant in ensuring the relevance of the selected research tools. In fact, using pilot studies can have a beneficial impact in terms of identifying practical issues when embarking on a research process and highlighting shortcomings in the research tools and protocol before the application of the full study at a later stage (Van Teijlingen et al., 2001; Hassan et al., 2006). The pilot study of the current research could consequently validate the research tools and resources. In addition, one of the flipped learning basics is to provide online learning resources. As such, the pilot study enables the researcher to examine the learning management system provided by schools to ensure that all students have smooth access to online materials. Moreover, the research tools have been designed and then reviewed by experts before being used them in the pilot study. The researcher had presented the questionnaire to four PhD students, and then discussed it with the supervisor before using it in the pilot study. Also, the interview questions went through the same process before the pilot study. As mentioned in the methodology chapter, the test tool followed seven phases, and one of the phases was the pilot with a representative sample.

The researcher contacted the Department of Education in the Royal Commission in Jubail City to obtain permission for the pilot study to be undertaken, which was duly granted and subsequently took place during the second term of the academic year 2018-2019. In total, 68 students in Year 1 Computer Science in high schools were engaged in the pilot study for three weeks. They were already divided into two groups, with each group consisting of 34 students. One group was taught according to the flipped learning approach, while the other one was left to the teacher to choose the teaching method. Worth to mention is that the participants in the pilot study displayed similar characteristics to those of the target participants in the main study, where the school accepted the students that are from the same area and located students in parallel classrooms. As proposed by Turner III (2010), there should be as close criteria as possible between participants from the pilot study and their counterparts in the main study.

Prior to the study, all participants had already signed the consent form and been assured of confidentiality and then given pre-test. In addition, the researcher offered online training for the teacher to explain the flipped learning approach and how the latter could implement it during the in-class and out-of-class learning process (see figure 3.9). Then, the researcher and the teacher worked together daily to choose the relevant videos for the designated lessons during the pilot study period. The instructor was given responsibility to teach the learners in group one using the flipped learning approach, but he had to firstly explain the procedure to them. The learners were also provided with login details to access the LMS system so that they could watch the video and do the quizzes.

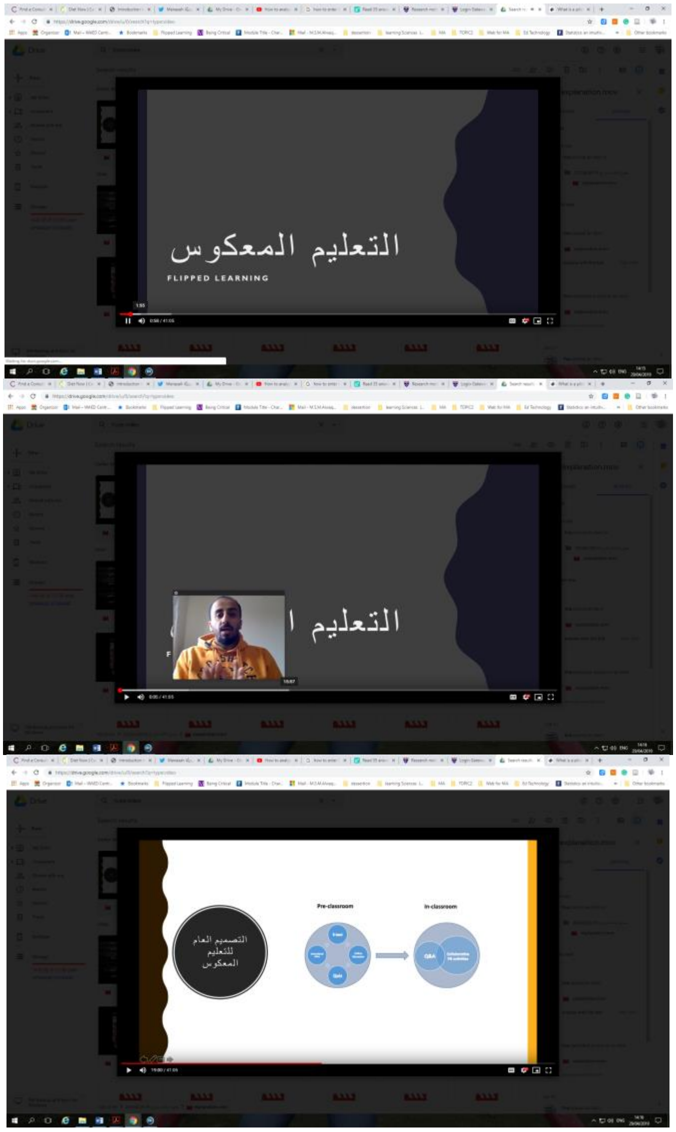


Figure 3.10: Video Explaining the Flipped Learning as Part of the Online Training for the Teacher

After the experiment, the students were given a post-test followed by the questionnaire. The researcher then conducted face-to-face interviews via the phone with two students from each group. The different tools that would be adopted in the main study were initially piloted in order to check their levels of reliability and validity. Unfortunately, the researcher was not able to meet the students as the end-term exam was due to begin. Figure 3.10 shows the process of the pilot study. In the first week, which was an induction week, the researcher collected the consent form from the students and their parents. The researcher aimed to estimate the time spent sending the forms and receiving them back from the students and their parents. Such practice might help the researcher to avoid any delay in the main study. The total time spent receiving all consent forms was two days. In addition, the researcher provided the teacher with online resources as part of the training to familiarise himself with the basic skills of flipped learning. Then, the teacher accepted full responsibility to commit to teaching his students in group one using the flipped learning approach and group two using the non-flipped learning approach, in other words, his day-to-day teaching approach. The implementation would be for three weeks with the researcher providing the required assistance and keeping in contact with the teacher on a daily basis. After the experiment, the researcher conducted a post-test following by the questionnaire. In addition, the researcher invited two students from each group to participate in the phone interviews.

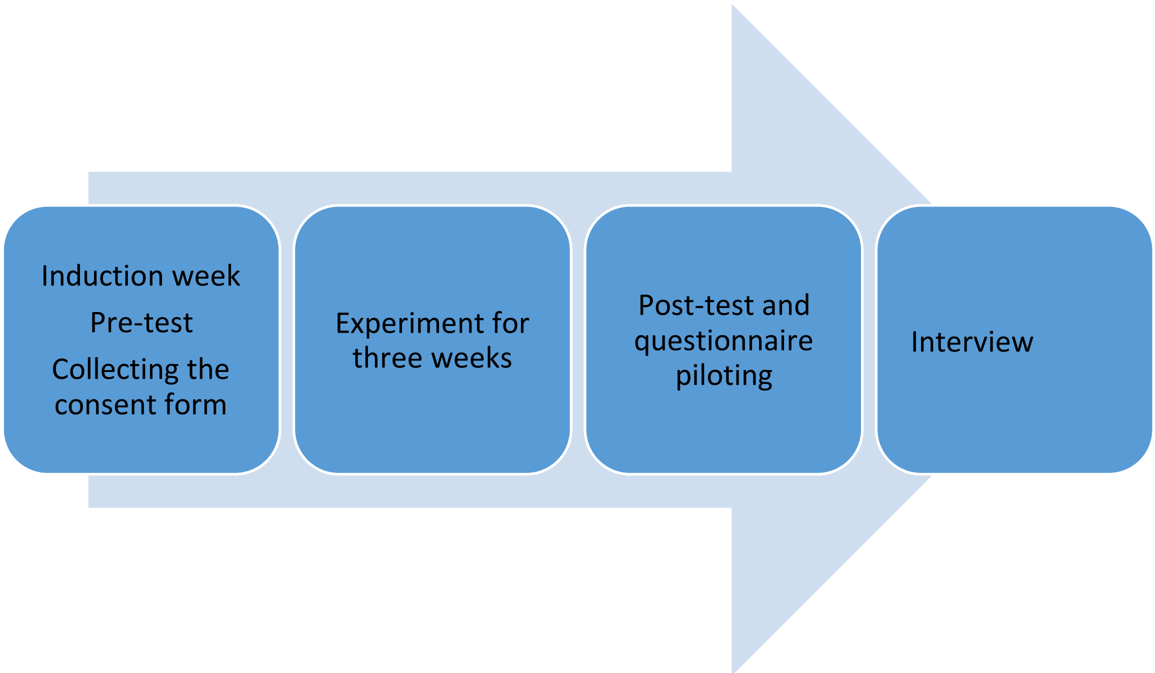


Figure 3.11: Pilot Study Process

3.12.1 Questionnaire

As mentioned earlier, the tool was piloted after completely preparing the questionnaire items. After that, the researcher translated the questionnaire into Arabic (see Section 3.7), then piloted the Arabic version with English version questionnaire with two university professors in Saudi Arabia and four PHD students whose mother tongue was Arabic. Their feedback has been very useful in terms of contributing to modifications introduced into the questionnaire, and assisted to ascertain how clear the questionnaire items instructions and design were (Cohen, 2018, p.496). They all agreed about the clarity of the questionnaire. Then, the questionnaire was piloted with two students from each group, with a total of four. The items were modified according to the students' reflections in order to ensure that any remaining ambiguous questionnaire items would be clarified, in addition to estimating the time taken to fill in the questionnaire. There were three items in the Arabic version that had to be slightly changed based on the students' feedback. So, the researcher attempted to modify these three sentences to make them clearer for the students. These three sentences were also discussed with the translators to ensure there is no change in their meaning.

There are several functions for the pilot study, which includes essentially increased reliability, rationality and feasibility of the questionnaire as a whole (ibid). Towards the end of the pilot study, a self-administered questionnaire (SAQ), which was designed specifically to be filled in by the respondents without intervention of the researcher, saw the participation of all 64 students, with 32 from each group. During the filling of the questionnaire session, the students did not raise any questions about the questionnaire even when the researcher asked them if there were any confusing questions. This practise ensured that the questionnaire was understandable and readable. The students in *Group One* completed the questionnaire within 22 minutes, while *Group Two* finished it in 19 minutes. The length of time was acceptable together with the advisable time.

3.12.2 Interview

Piloting the interview questions was aimed at examining the suitability of the interview questions so that any relevant information on the context can be sought.

Furthermore, it is important to explore the topic further and prepare for the major study, as well as ensuring that researcher has included the relevant questions to gauge the concept (Dikko, 2016). In addition, it is worth mentioning that the pilot study enabled the researcher to practise using the interview methods, applying the changes and being familiar with thematic analysis. During the process of the interview pilot, the researcher started by discussing the interview questions with the supervisor to determine whether the questions would be in keeping with the aims of the study. Moreover, three PhD colleagues provided their valuable feedback of the interview questions in terms of language, phrasing and significance, including open-ended questions; It is worth mentioning that two questions were partially altered accordingly to fit the aim of the research.

Once the initial reviews were undertaken, a total of ten questions were tested in the pilot work, with the researcher also resorting to probing questions to identify the participants' viewpoints that necessitate further explanations. The interview questions were easy to understand for the students in terms of the level of language complexity. Nevertheless, the interviewees did not feel comfortable at the start, but they became more confident with the passage of time. Following Jacob and Furgerson (2012), it was important to build a good rapport and relationship with the participants as it prompts the latter to provide better responses. As such, the researcher will adhere to the interview protocol that highlights starting the interview with a certain social conversation (See interview protocol in Appendix H). In the end, it can be safely stated that conducting in-depth semi-structured interviews was very useful for the researcher in terms of obtaining experience in and learning the relevant interviewing skills and the flow of conversation.

3.13 Reliability and Validity

The criteria that were used to determine the current research's quality is described in this section, with details on its levels of reliability and validity, which are important aspects in social research evaluation (Bryman 2016, p.49). A mixed-method strategy was used in this research due to its levels of reliability and validity, and this section presents how this has been shown.

3.13.1 Reliability of the Study

Reliability relates to whether a study can be replicated and whether it is possible to utilise the measurements process in a consistent manner within different areas of social sciences (Bryman, 2016, p.46). The mixed-method helped to answer the researcher questions and was able to integrate the quasi-experimental design. Additionally, the participants and the study context were shown, with the research instrument and the form of data collection presented, which became available for examination following analysis. As a result, the different stages helped to develop the mixed-method strategy, as well as the quasi-experimental design and make potentially replicable data. Furthermore, using different methods of collecting data through triangulation contributes to the increase in the internal reliability of the current study (Hussein, 2009). Thus, the replication of the study can be conducted in a simple manner (Zohrabi, 2013). In addition, a pilot study is performed in order to achieve a good level of constancy (Coombes, 2001); thus, there was a pilot study used in this research to develop the consistency and stability (see Section 3.12).

3.13.2 Validity of the Study

A study's validity can be seen to be the capacity of how a particular implemented method is able to provide an accurate evaluation, together with the capability to measure the intended data (Muijs, 2010, p.62; Kumar, 2011, p.166). Validity stems from determining the study's conclusions and their levels of integrity (Bryman, 2016, p.47). The concept of validity in research has been placed into different forms depending on the field; in the areas of social science, measurements, together with internal, external and content validity are the most frequently analysed (ibid). In regards to internal validity, findings need to present the phenomena of the research topic (Choen, 2018); this includes the focus of whether the conclusion includes any correlation between different variables (Bryman, 2016). An educational environment was used in the current study; thus, various factors can be seen to prove effectual upon the processes of teaching and learning (i.e. extraneous variables), which include the teacher's knowledge of the curriculum and students' previous knowledge of the subject.

The current study focuses on how flipped learning is impactful upon the achievement, motivation and engagement levels of students, as well as their autonomous learning, in comparison to non-flipped learning. Therefore, a pre-test was used to eliminate possible extraneous variables, such as students' prior knowledge. In addition, the current study focused on matching the groups before commencing the study, which could help to eliminate the extraneous variables. According to Kumar (2011), matching the groups is a way of ensuring that the two groups are comparable, which can eliminate extraneous variables (p.298). Additionally, the current research used a random selection policy for groups of students who had been assigned to the course previously, as this helped to remove any issues of selection bias, which is detrimental to internal validity (Choen, 2018).

In relation to external validity, Bryman (2016, p.90) provides the definition as the capability to generalise research outcomes to different areas of social research from the study's findings. In the current study, the population consisted of 74 Saudi Arabian students studying at a high school in Jubail city, which could be enough to prove representative of other students at school in Jubail. It has also been stated by Bryman (2016) that it is not possible to generalise a sample's results across all different demographics and populations. As a result, the study's results can be generalised in order to involve Saudi high school students. In addition, both quantitative and qualitative methods were used in the process of triangulation, as this functioned to ensure better levels of research validity and reliability (Johnson & Christensen, 2020).

3.14 Reliability and Validity of the Research Methods

3.14.1 Reliability and Validity of the Quantitative Methods

A review of previous literature was conducted in order to set the optimum concepts in the questionnaire, which would focus on important areas of the study, and specifically motivation, achievement, performance, and engagement levels of students, as well as their autonomous learning. The questionnaire was designed, translated, piloted and distributed to provide details of the guidelines required to be adhered to in future comparative studies .The reliability of the questionnaire was initially tested through the pilot process. Subsequently, the questionnaire's internal reliability was assessed through a consistency test using

Cronbach's Alpha to ensure the internal reliability. In recent years, the majority of researchers have utilised the Cronbach's alpha coefficient to test internal reliability (Bryman, 2016, p.169); this has developed due to the advancements and inclusion of Computer software when analysing quantitative (ibid). Therefore, the current research used the Cronbach's alpha coefficient test with a total of 64 students in the pilot study. Specifically, a scale's level of internal reliability is noted as high if the Alpha coefficient value is of a high level (range 0 -1) (Bryman, 2016, p.170). In addition, Table 3.7 lists the Cronbach's Alpha coefficients for each scale from the data collection in the main study. The first 34 items were designed on a five-point Likert scale (SD, A, N, D, SD) to measure students' motivation, learning autonomy, performance and achievement. The same scale was used to measure the students' perceptions of the flipped learning group. However, the engagement aspect was adapted from the National Survey of Student Engagement with a different measurement scale; namely, the four-point Likert scale (very often, often, sometime, never). Thus, the Cronbach's Alpha value shows the reliability for the questionnaires between α = 0. 719 to α = 0. 92, which are high.

Table 3.7: Cronbach's Alpha Coefficient

Domine	Cronbach's Alpha	Number of Items
Intrinsic Motivation	.87	5
Extrinsic Motivation	.71	5
Learning Autonomy	.75	12
Performance	.82	5
Achievement	.92	6
Engagement	.84	10
P	.86	12

The research focused on ensuring validity and reliability in the testing procedure (Buffum et al., 2015); in particular, in relation to Computer Science. Moreover, a pre-post-test is able to provide better measurements of reliability (Bryman, 2016, p.169). This factor includes determining whether a measure provides stability over a specific period, in order to demonstrate that the findings correlate in a stable manner with the particular participant sample. Hence, there will be minimal changes in the results if the form of measurement is taken from one group and re-administered with another. What is more, the sample size of 74 helped to increase the test's level of reliability (Cohen, 2018).

3.14.2 Validity of the Quantitative Method

In a study, the quantitative methods' validity needs to be verified if the findings are to be used. In the current study, the initial form was a questionnaire, which required high levels of reliability and validity to be proven valuable (Cohen et al., 2018; Johnson & Christensen, 2020). Thus, the questionnaire was tested in a pilot study to evaluate how it would measure (Wilkinson & Birmingham, 2003; Cohen, 2018; Bryman, 2016). In order to provide validity, both face and content validity were used. The questionnaire was first revised by the supervisor before the questionnaire was presented to four PhD students to provide both face and content validity. Similarly, experts' opinions in regards to the questionnaire's content were taken, which resulted in augmentation in the external validity levels (Bryman, 2016). Subsequently, the method of back-translation was used to ensure the validity was maintained following the initial translation stage (Chen & Boore, 2010; Tyupa, 2011). This technique aimed to provide better levels of accuracy to the questionnaire's Arabic version, which also included the help of an Arabic language professional, who also assisted in checking the suitability of the participants (see Section 3.7). As a result, these different stages were able to produce better levels of face and content validity.

Other quantitative methods were used in the current study in order to measure students' levels of achievement. This included test instructions, which adhered to the guidelines defined by Buffum et al. (2015), who focused on increasing reliable and validity in Computer Science testing instruments. Additionally, the current study has aimed to achieve face and content validity for the test (Cohen, 2018; Mills & Gay, 2019). Accordingly, the measure of the test's face validity needed to focus on the main purpose of the test (Cohen, 2018, p.572; Bryman, 2016, p.171). In order to achieve this, it was reviewed by two Computer Science teachers, as well as three professionals in the field from Umm AlQura University. What is more, content validity was vital to prove the value of the test, as a test is unable to accurately reflect a student's level of achievement when it fails to provide a measurement of what has been taught (Cohen, 2018).

3.14.3 The Reliability and Validity of Qualitative Methods

For semi-structured interviews and the focus group, testing the levels of reliability needs accurate data from the process needs to be presented in the report (Flick, 2018). Indeed, fieldwork is required to always be clear and consistent, as the research reliability will improve if the research process is successfully documented (see Chapter Three). Reliability and validity are analysed individually in quantitative studies, but not in qualitative research, as they are measured together in this method (Golafshani, 2003). Moreover, Bryman (2016) states that this increases levels of trustworthiness in the results, which is comprised of four specific parts that all have criteria equivalency (p.390). Firstly, there is credibility, which focuses on internal validity; secondly, transferability, which is based on external validity; thirdly, dependability, which connects with reliability; and fourthly, confirmability, which correlates with objectivity. Hence, trustworthiness in qualitative research has been shown to help in the assessment of these factors in the measurement against traditional standards. The current study adhered to this in order to evaluate the levels of trustworthiness and, thus, the research quality improved (ibid; Cohen et al., 2018).

Credibility

The focus of credibility derives from a study's internal consistency levels (Cohen et al., 2018). There are numerous different strategies that can be utilised to increase credibility levels, which include longer periods of time for fieldwork and data triangulation (Lincoln & Guba, 1985). The current study originally implemented a pilot study of the fieldwork in order to produce a better base for the main study and improve comprehension levels in relation to the context of research. Further, the current study utilised data triangulation known as "methods triangulation", which focuses on understanding the findings' regularity through the process of different methods of data collection (Lincoln & Guba, 1985, Cohen et al., 2018, p.265).

Four distinct methods of data collection were applied through triangulation: a pre- & post-test, a questionnaire, a focus group, and individual semi-structured interviews. Furthermore, the interview and focus group protocol were checked by five individual experts at Umm Al Qura University, as well as by the research supervisor in Newcastle University. In addition, the transcript of the focus group and interviews were verified in relation to their content to improve the level of research credibility. In addition, the research used the member check strategy to promote confidence and accuracy of the qualitative data (Birt et al., 2016). The transcripts were subsequently sent to six interviewees, as recommended by Bryman (2016, p.391), as well as to the focus group participants, as this enhanced the potential to achieve data credibility.

Dependability

Research requires data outcomes to be dependable, which relies on the potential for the process to be repeated in similar settings, with similar groups and the application of comparative methods (Shenton, 2004). Specifically, the research processes need to be reported in detail, in order to produce increased dependability, which will enable quality studies in the future that use the same method, although not necessarily with the same results (ibid). As a result, the researcher had to undertake certain procedures in order to establish the research findings' dependability; initially, the data collection and process was explained, and then the data analysis process was detailed. From these two steps, it becomes possible for a different researcher to implement the same qualitative methods into their study (Shenton, 2004).

Confirmability

The findings from the data must be able to be confirmed correctly, and to show that they are clearly established from the data (Lincoln & Guba, 1985). This is advanced through triangulation, which helps to produce confirmability of the findings and reduce researcher bias (Cohen et al., 2018). Moreover, Lincoln and Guba (1985) stated that triangulation, when used in humanities' research, can prove beneficial to the augmentation of confirmability, as shown in the current study, which adhered Shenton (2004), who stated that participants' opinions need to be taken with minimal researcher influence. Further, the findings from the focus group and semi-structured interviews were presented in detail, in order to increase confirmability levels. Specifically, an audio recorder was used in the interviews, as this allowed for more accurate transcriptions, which were also subsequently re-examined following the transcription.

Transferability

Transferability is an important part of qualitative research, as it enables the findings to be both scrutinised by other researchers and adapted to other studies through the production of quality data (Lincoln & Guba, 1985). Accordingly, the current research provides a clear description of the overall procedure, although the study aimed to demonstrate a better level of comprehension into the results of quantitative data, in order to analyse how flipped learning as a method would impact upon the learning experiences of students in Saudi Arabia, instead of purely generalising the findings. Correspondingly, the findings from a qualitative study need to be understood regarding the set context of the studied organisation, and potentially the geographical area of the fieldwork (Shenton, 2004). Hence, different cultures, education systems and policies need to be understood to determine whether the research method and process can be transferred to other Arab communities and nations. Overall, flipped learning and its effects still need to be examined throughout the world, as the literature review highlighted the requirement for additional research into flipped learning being used in pre-university education. Therefore, the current study's results could potentially be transferred to a more extensive and inclusive context worldwide.

3.15 Ethical Considerations

Ethical consideration is vital within the process of research for it to be taken legitimately (Johnson & Christensen, 2013, p.192). It is possible for ethical issues to arise depending on several factors, including the type of the research project itself, the context for the research, the procedures to be followed, such as creating a state of unease (Cohen, 2019, p. 111). In this sense, applying flipped learning as a new learning experience for students might cause stress and workload given the nature of learning in the flipped learning approach with the student having to go online and prepare for the classroom lesson by watching a video. The researcher attempted to overcome this issue by first keeping the length of the video and learning material short. Also, the students were trained on how to access the online platform and how the learning process would be accomplished via workshop training prior to the study. In addition, moving from a teacher-centred approach which the students use to it to involve students-centred approach might affect in their willing to learn. To overcome this possible risk as mentioned above the students had workshop explain all step of flipped learning. Also, the teacher might face difficult to keep teaching with his way and flipped learning at the same time. The researcher considers this risk and, subsequently, provides full support for teacher before the experiment by train him and the teacher has an experience with same situation in the pilot study phase. Moreover, each participant had a form stated his rights to withdraw at any stage of the study.

Following the attainment of the ethical approval of research from Faculty Committee at Newcastle University, the researcher embarked on the current research. In the initial stage, the approval was gained from ELCS School once the ethical approval form had been submitted, which included the study title, the central objectives, and the length of time needed to complete it. The researcher was granted permission to gain access to main study (See Appendix B), which took place to account for any issues based on advice of ethics committees and institutional review boards (Cohen, 2019, p.111). This is because the current study was carried out in a high school, it was necessary to gain early permission to access and conduct the research at royal commission schools. The researcher had contacted the school head-teachers verbally there before sending an official written paper to elucidate on the kind of study to be carried out, including aims of the research, the design, methods and procedures to be used, and the number of groups, as well as an explanation of the nature of flipped learning as intervention. Having planning and foresight allows both researchers and schools to gain better insights into the demands expected to be made on both participants and organisations (Cohen, 2019, p.134).

Based on such principle, it was important to give potential research participants as many details as might be required to make an informed decision about the likelihood of them taking part or refraining from participation in a study (Breymen, 2012, p.138). In addition, potential ethical issues in educational research are concerned with anonymity, confidentiality, the security of the data, and the risk of harm to the participants (Cohen, 2018, p.111; Breymen, 2012, p.138). As far as this study was concerned, any potential ethical issues were dealt with accordingly. For example, the researcher offered the consent form to overcome any anonymity concerns, which arose from the participant’s rights of freedom and self-determination (Groundwater-Smith & Mockler, 2007; Cohen, 2018, p. 122). The participants were informed about the nature of the study and the type of data that might be collected, the process of the study, and the non-obligatory aspect of their participation (See

Appendix E). In addition, they were informed that the data would strictly be kept for the purpose of this research solely (Breymen, 2012). Then, they were requested to give their permission to take part in the interview, questionnaires and pre-post-test. If they were to take part, they would still be able to withdraw at any time. In terms of the consent form, it contained comprehensive information about the study and the researcher. The researcher also had three consent forms for students, teachers and one for the students' parents (see Appendix E). These forms fully inform respondents about the research and how their participation is effectual (Bryman, 2012; Cohen, 2018).

Regarding the data confidentiality (i.e., security of data), it mainly focused on the research data that was achieved using several research methods. The researcher kept the data gathered from the pre-post-test, questionnaires, face-to-face interviews, and focus group in a secure manner, and ensured that the interviews and focus group recordings were also stored safely on his own devices with a very strong password. The participants were also kept anonymous in the analysis. In other words, they could not be identified by anyone else, and they were reassured that they would not be placed as part of the research. In addition, the school' name was not to be mentioned nor would it be quoted during publishing, as it may lead in the participants being identified, simply by referring back to the dates on which this study was carried out. Lastly, the participants were not to be mentioned in any shape or form in the day-to-day dealings and discussions with other colleagues or individuals.

Chapter Four – Quantitative Results

4.1 Introduction

The findings of the current study are presented in two chapters aiming to show analyses of data from the mixed-methods approach that is adopted. The data includes quantitative and qualitative analyses, and both are used to address the research questions (see Table. 4.1). This chapter is related to the quantitative data and includes six sections comprising students' achievement, performance, learning motivation, learning autonomy and academic engagement. This chapter reports the key results of the test scores and the questionnaire items in relation to the Saudi students attending high schools in Computer Science course. A quasi-experiment was conducted to determine whether there was a significant effect of an independent factor on a dependent variable. The independent factor was the learning approach (i.e., flipped learning and non-flipped learning), whereas the dependent variable was the learners' assessment scores, performance, achievement, motivation, academic engagement and learning autonomy.

Table 4.1: Research Question and Data

RQ	Test Score	Questionnaire	Interview	Focus Group
RQ1	√	√	√	√
RQ2	√	√	√	√
RQ3	√	√	√	√
RQ4	√	√	√	√
RQ5			√	√

This chapter presents the background of the two groups to ascertain the students' experience and preference in relation to using technology in their learning. In addition, this part includes statistical analysis to find out if students in the flipped learning group (FLG) show greater scores in the test compared to the non-flipped learning group (NFLG) same students in Computer Science, in addition to identifying the impact of the flipped learning approach on students' achievements, performance, learning motivation, academic engagement and learning autonomy through the comparison of the two different groups. In order to analyse these quantitative data, SPSS was used, along with descriptive statistics. The aim of descriptive statistics is to investigate a number of categories, including the basic participants' information, as well as the broad features of two groups (i.e., flipped learning group and non-flipped learning).

In addition, the researcher used descriptive statistics in order to formulate a view about the difference between the two groups in terms of students test scores, achievement, performance, motivation academic engagement and learning autonomy. With regards to normal distribution of the data, a few variables in the current study were identified as not presenting normal distribution; as such, its application could not be carried out using parametric statistics (Field, 2011). In this case, it was important to apply non-parametric statistical tests (the Mann–Whitney test) in order to illuminate discrepancies between a selection of variables, including students' scores, achievement, performance, motivation, academic engagement and learning autonomy. This test represents the non-parametric equivalent of the independent t-test (Field, 2011). In fact, the Mann-Whitney U Test provides a comparison between medians, rather than comparing the two different groups' means, which is what occurs in the t-test (Pallant, 2011, p.291). In addition, the effect size was calculated by *r* equation to see how big the difference was if it ever existed. Cohen (2018) stated that if an intervention has been given to an experimental group and not to the control group, then the effect size looks at how significant the effect/difference between the two groups is as this is something that possible through statistical significance. Regarding the effect size, it was measured as follows: ($r=\frac{Z}{\sqrt{N}}$). According to Field (2011), calculating the effect size using this equation for Mann–Whitney test was recommended. In addition, some widely used suggestions were given by Cohen about what represents a very small or large effect and guidelines for r: r = .10 (small effect) r = .30 (medium effect) r = .50 (large effect) makes it possible is the effect size referred to as 'strength of association' via "*r*".

The first section of this chapter presents the characteristics of two groups: namely the FLG and NFLG. In the second section, data in relation to "students' achievement and performance" is presented by carrying out a comparison between two groups in terms of their scores of pre-and post-tests and their responses in the achievement and performance sections of the questionnaire. Then, section three presents findings by comparing the students' intrinsic, extrinsic motivation and overall motivation to learn in two different learning environments. The fourth section provides the findings of the comparison of the students' academic engagement in FLG and NFLG. The fifth section presents findings of the impact of flipped learning on students' autonomous learning compared to non-flipped learning. Section sixth sheds light on the students' perceptions and experience of learning Computer Science using the flipped learning approach.

4.2 The Characteristics of the Two Groups

In the current experiment, the two groups were similar in terms of the number of participants; FLG (*N*=37), NFLG (*N*=37), who were all males because of the gender-segregation factor in the Saudi education system. Looking at the first figure (see Figure 4.*1*), it shows that most students in both groups have been exposed to learning with technology, with 29 of 37 students in Flipped learning, and 21 out of the same number of students in non-flipped learning. It can be said that the students would not seem to be affected by the novelty of integrating technology into their learning.

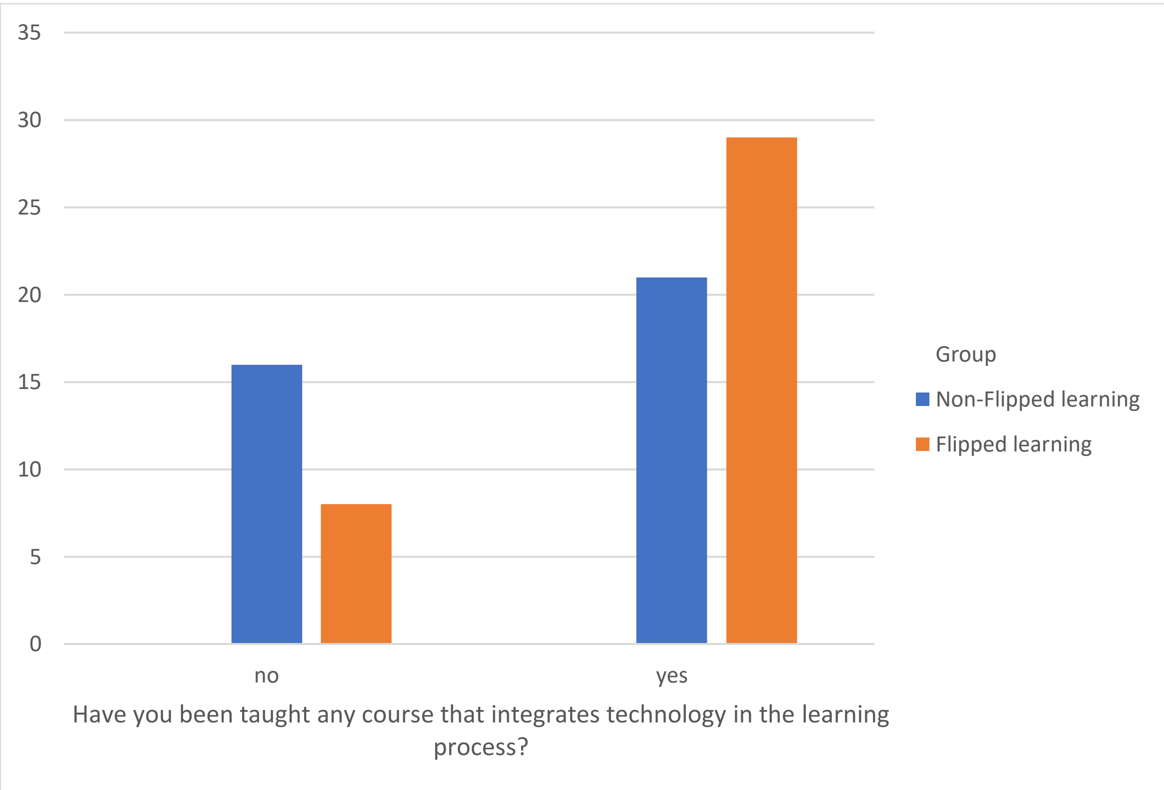


Figure 4.1: Previous Learning Experiences of Students

In addition, the survey aimed to confirm the availability of the internet for students at home. Figure 4.2 shows that all students in the two groups have access to the internet at home, which means that there is no digital divide in the context of the study.

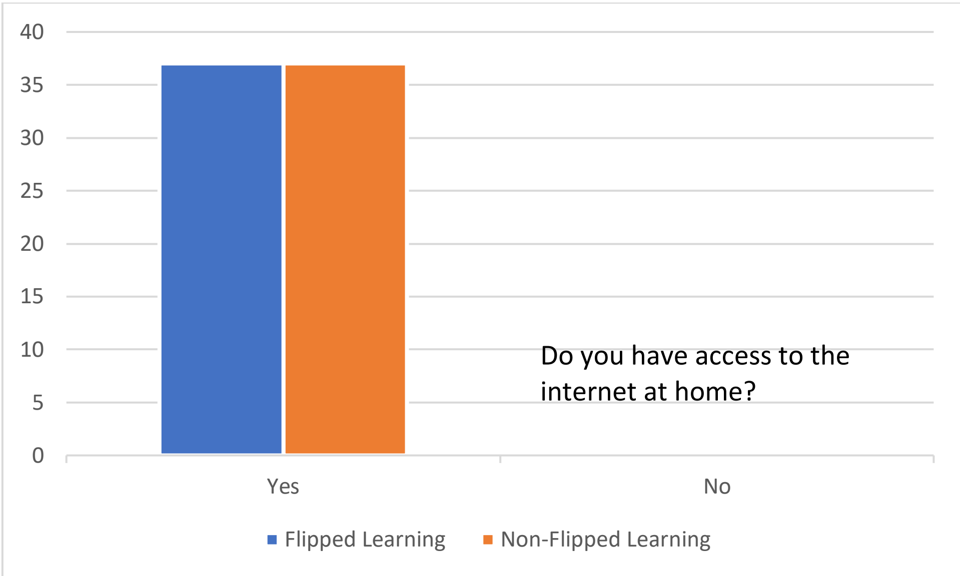


Figure 4.2: Access to the Internet at Home

The students experiencing learning with technology were asked to clarify where they had access to learning materials. As shown in Figure 4.2 above, the most of students exposed to learning with technology in both groups used the internet via their phones to study, which means they could access it everywhere. In addition, 15 of students in flipped learning group used the internet at home to study. On the other hand, only 12 of the students in both groups used the internet in the school to study. The difficulty when using the mobile phones or accessing the internet in the school could explain why the school had the lowest rate.

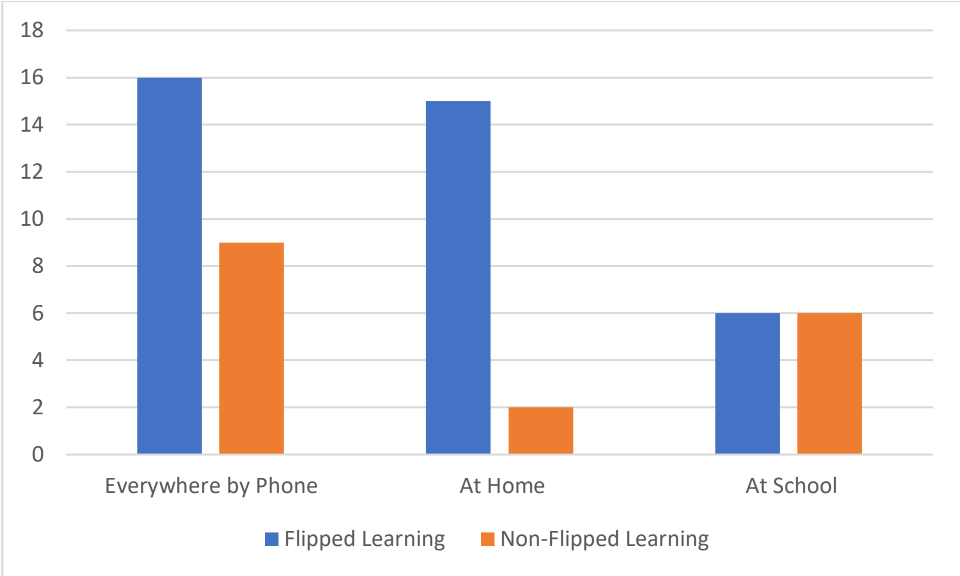


Figure 4.3: Where do you get access to the internet for learning?

For the question about students' device preferences for learning (see Figure 4.4), most students in both groups responded by stating that the device they prefer to use most in their learning is the phone 32 in non-flipped learning and 35 in flipped learning. When it comes to the preferred devices, the student in the flipped learning group reported the laptop as their best choice with 24, followed by the PlayStation with 18, then the iPad with 15 and finally the PC with 16. In contrast, the students in the non-flipped learning group selected the PlayStation with 8, then the iPad with 5, the PC 3 and the laptop with 2. This finding clearly shows the significance of the features of mobile phones in terms of attracting the student users. One can also infer those students are able to use their preferred device in their learning.

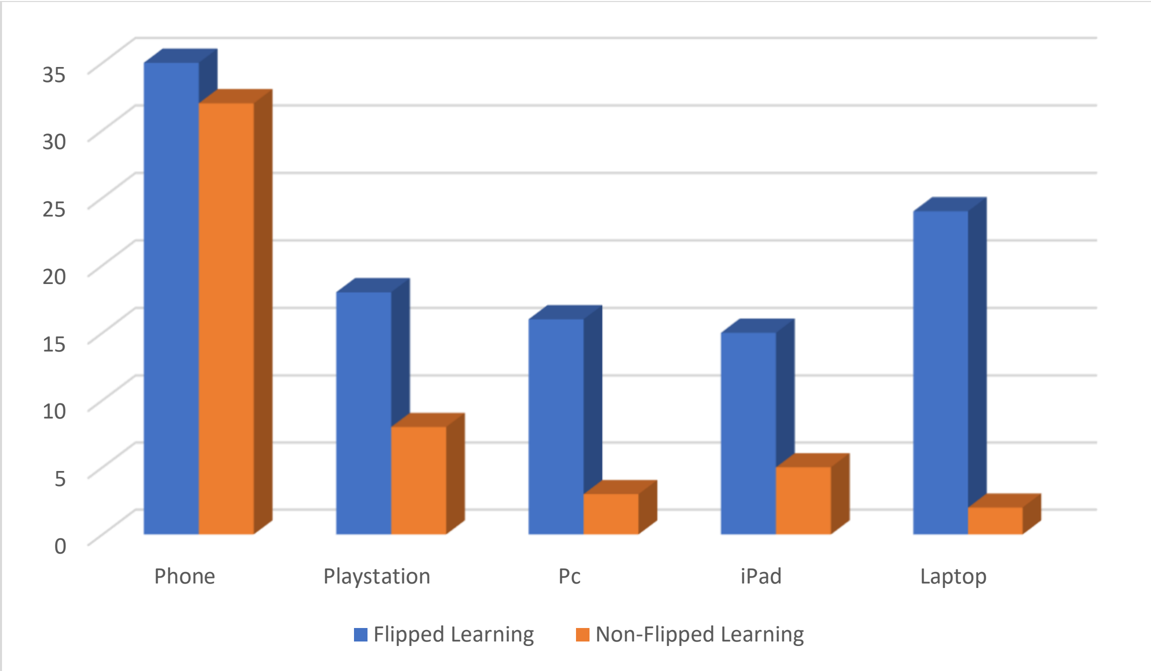


Figure 4.4: Which device do you prefer to use for learning?

The figure above (see Figure 4.4) provides information about the subjects that the students have experience in most when learning with technology. It is clear that most of the students have experience in learning with technology in Maths and Computer Science subjects (Maths FLG=10, NFLG=7 and Computer Science FLG=8, NFLG=6). It is also clear that students in both groups are almost experienced with technology in the same subjects (Math, CS, Chemistry, English, and Arabic). It can be said that the application of technology does not include all subjects. Overall, it is evident from the results displayed above that most of the students are familiar with the use of technology to consolidate their learning and could easily gain access to the internet from different devices to enhance their educational outcomes.

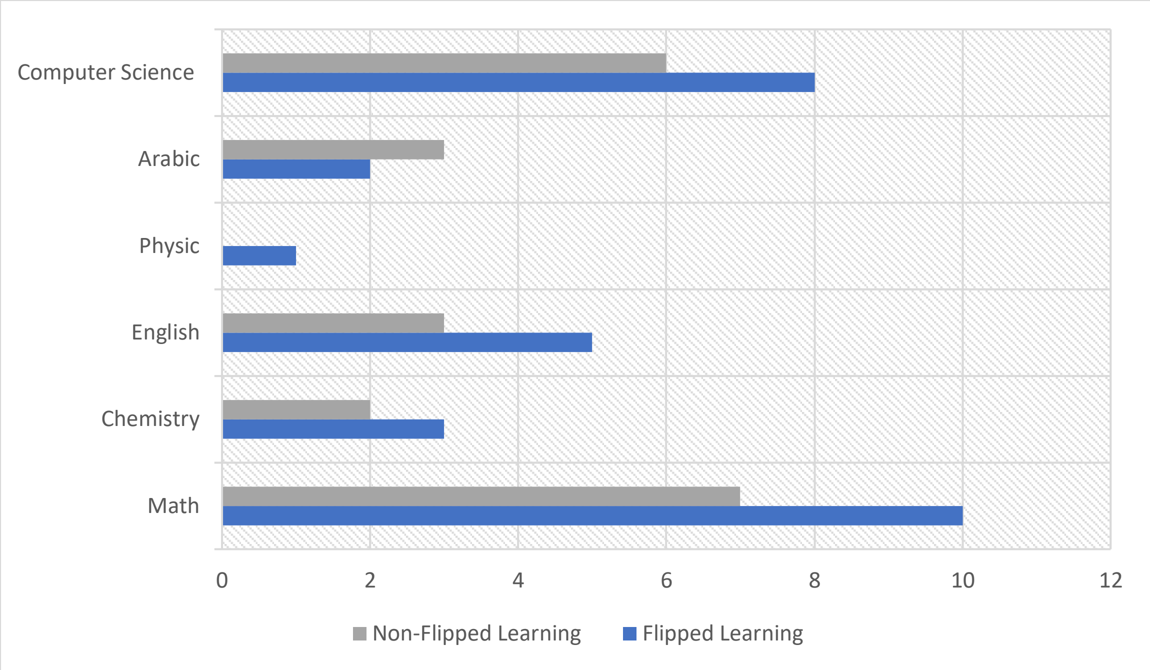


Figure 4.5: Which courses did you learn with technology?

4.3 Section Two: Students' achievement and performance

The first question to be addressed in the current study is concerned with any potential significant contrasts between the FLG and NFLG in relation to Computer Science students' achievement and performance after the experiment. In accordance, initially, the descriptive test is detailed, and then the non-parametric tests (the Mann–Whitney test) used to examine changes in students' scores, achievement, and performance. This section presents the data from the students' test score and from the questionnaire [Section 3 and Section 4], and these data addressed *Question One*. In addition, the data will test the first hypothesis (see Figure 4.6 below).

To what extent did Flipped Learning affect Saudi students' achievement in the first-year high school in the Computer Science subject?

H_0: There is no significant difference in terms of students' scores between the flipped learning classroom and the Non-Flipped classroom

H_1: There is a significant difference in terms of students' scores between the flipped learning and the Non-Flipped classroom

Figure 4.6: Question One and Hypothesis

4.3.1 Students' Test Score

The quasi-experiment was conducted to determine whether an independent factor created a significant effect upon a dependent variable. The independent factor was the learning approach, namely FLG and NFLG, whereas the dependent variable was learners' score in the Computer Science subject. The researcher conducted a test with 30 questions, with each question weighting 1, and with a total of 30 (see Section 3.5.1). A descriptive test, the Mann–Whitney test and effect size were conducted in order to evaluate the two different learning approaches and how they led to varying levels of students' learning.

Table 4.2: Descriptive Statistics of the Students' Scores

	N	**Flipped Learning Group**			**Non-Flipped Learning Group**		
		Med	*Max*	*Min*	*Med*	*Max*	*Min*
Pre-Test	*37*	10.00	13	4	10.00	15	3
Post-Test	*37*	26.00	30	22	14.00	24	8

The descriptive statistics of the students' score in Computer Science (see Table 4.2) showed the learning outcomes of students in FLG and NFLG. The lowest score at NFLG was 3 in pre-test and 8 in post-test; while in FLG, it was 4 in pre-test and 22 in post-test. The highest score, however, was 15 in pre-test and 24 in post-test for NFLG, as opposed to 13 in pre-test and 30 in post-test for FLG. It also can be observed that there was no difference in students' score level in both groups at pre-test FLG(*Med=10*) and NFLG(*Med=10*). In addition, it can be observed that the score of students in the FLG increased from (*Med=10*) to (*Med=26*), and so it did for the NFLG from (*Med* =10) to (*Med*=14). It can be concluded there was no difference in students' score level in both groups at pre-test. However, there were a difference in the median of students' score at post-test, with the FLG students scoring (*Med=26*), which was higher than their NFLG counterparts (*Med*=14). Thus, the FLG's total score is higher than for the NFLG, which could potentially highlight an improvement through the flipped learning approach (see Figure 4.7 below).

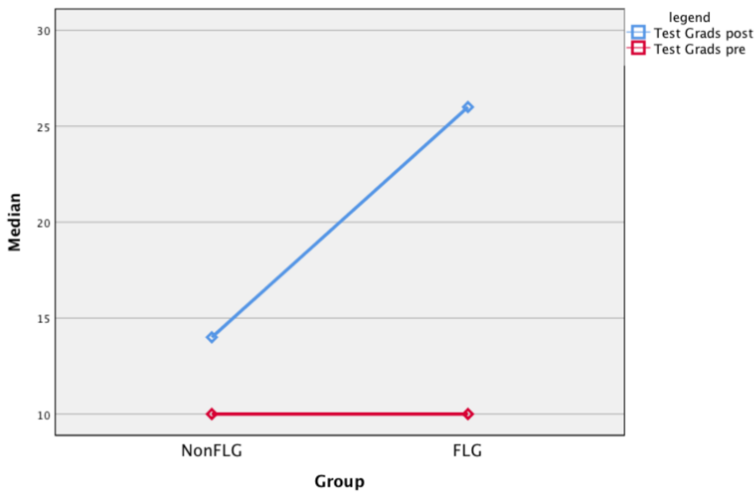


Figure 4.7: Pre-and Post-test Chart

As mentioned above, FLG reported a higher test score (*Med=26*) compared to NFLG (*Med*=14). In addition, the current research carried out a further statistical test to test the hypothesis of whether there was a statistically significant difference. A Mann–Whitney test was conducted to see if there was a statistically significant difference between the scores of students in FLG and NFLG. Regarding Table 4.3, a Mann–Whitney test indicates that the difference in students' test scores was statistically significant, FLG (Md=26, n=37) and NFLG (Md=14, n=37), $U = 24, z=7, p < .05$. This result demonstrates that the difference had relevance at the 0.05 level, as the *p* level was lower than 0.05. It is also suggested that there was a difference between FLG and NFLG in terms of students' score. As such, the result rejected H_0 and confirmed H_1, which indicates that there is a significant difference in the scores for FLG. Furthermore, the researcher calculated the effect size to find out how big the difference as approved in the Mann–Whitney test. As shown below, $r = .83$, which means that there was a large effect. Thus, the result of the statistical test suggested that there is a positive impact of the flipped learning approach on students' Computer Science score.

Table 4.3: Mann-Whitney Test and Effect Size (Test Score)

Group	N	Mean Rank	U	Z	P	*r*
Flipped Learning	37	55.35	24.00	-7.158	.00	.83
Non-Flipped Learning	37	19.65				
Total	74					

4.3.2 Learning Achievement Score According to Various Achievement Levels

The current study attempted to identify the impact of flipped learning on different levels of achievement. Therefore, the current research used the frequency of students score in pre-test to classify different students' score achievement level. Table 4.4 below displays the overall total of students with various achievement levels in Computer Science for the two groups. One can note that there is almost a similarity between the distributions of students for high, medium, and low achievers.

Table 4.4: Frequency Distribution of Different Students' Score Achievement Levels

Group	Low	Medium	High
Flipped Learning	3	24	10
Non-Flipped Learning	4	22	11
Total	7	46	21

The results of the achievement score of the learners based on the various achievement levels for pre-test and post-test for FLG and NFLG are illustrated in Table 4.5 below. Clearly, no significant differences were identified in the learners' learning score achievement between the groups for all levels in pre-test. Different mean scores for these groups in the pre-test stood at (M = 12.30, SD = .48) for the high achievers; while for medium achievers it stood at (M = 9.62, SD = 1.17); and with low achievers at (M = 6, SD = 1.73) in the FLG, which did not seem to differ much from the NFLG. However, the result revealed that there was a difference between students in all levels of achievement score in post-test, whereby the FLG achieved more than the NFLG. The Mann-Whitney test was carried out and the result showed that a significant difference was found in the post-test for all levels *(Low*

U= 7, Z=-2.12, p < 0.05), (Medium U= 46, Z=-5.80, p < 0.05) and (High U= 21, Z=-3.75, p < 0.05). There was a significant difference in the results of the mean scores of the high achievers, medium achievers and low achievers in the FLG compared to the NFLG. Similarly, one could notice that the effect size in all three level was high (*r= .80, r= .85 and r= .81*). Therefore, it is possible to infer that the students in the flipped learning group had a better performance than non-flipped learning groups in all various achievement levels.

Table 4.5: A Mann-Whitney Test for pre-test and post-test between the groups based on the achievement level

Achievement level		**Group**	***N***	***M***	***sd***	***Med***	***z***	***p***	***r***
Pre-Test	Low	FLG	3	6	1.73	7	-.39	.69	.14
		NFLG	4	5.75	1.89	6.50			
	M	FLG	24	9.62	1.17	10	-.29	.76	.04
		NFLG	22	9.54	1.01	9			
	High	FLG	10	12.30	.48	12	-1.59	.11	.34
		NFLG	11	12.81	.87	13			
Post-Test	Low	FLG	3	24	2.64	23	-2.12	.03	.80
		NFLG	4	14.25	4.5	14			
	M	FLG	24	25.45	2.18	26	-5.80	.00	.85
		NFLG	22	13.63	2.18	13			
	High	FLG	10	27.5	1.84	28	-3.75	.00	.81
		NFLG	11	17.72	4.19	17			

4.3.3 Students' Achievements and Performance

In the questionnaire, there were two sections, including 11 items that could reflect the students' achievement and performance. All items in the questionnaire were assigned a numerical value and rated on a 5-point scale: Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), and Strongly Disagree (SD = 1) as mentioned section 3.5.2.1. Thus, the higher the median is, the more strongly participants would agree with each statement in the questionnaires and vice versa. In other words, the median scores of the domain close to 5 indicate a positive impact either in students' achievement or students' performance. Each domain was computed and measured in terms of its median.

4.3.3.1 Students' Performance

The section included five statements to reflect the student performance. After the experiment, it was clear that the students' performance score in the flipped learning group and the non-flipped learning group were different, with *(Med= 2)* in NFLG and *(Med= 4)* in FLG. In addition, according to Table 4.6 below, when compared to the NFLG, the FLG displayed a higher percentage, whereas the median of students' performance score was numerically higher in the FLG (*Med*=4). Thus, as reported in the findings regarding FLG students, it can be said that their agreement score reflects higher performance than NFLG.

Table 4.6: Descriptive Statistics (Performance)

	Flipped Learning Group				Non-Flipped Learning Group			
	N	*M*	*SD*	*Med*	*N*	*M*	*SD*	*Med*
Performance	37	4.18	.616	4.00	37	2.48	.768	2.00

The Mann–Whitney test was conducted to present results on the relevance of the differences. This test was conducted to evaluate the impact of the intervention on students' performance at the two different learning environments of a FLG and a NFLG. According to Table 4.7, the results of Mann–Whitney test analysis revealed that this difference reached a particular significance $U = 84, z=6.74, p\ 0.05$. Thus, the result suggested that flipped learning has a positive impact in terms of students' performance compared to non-flipped learning in the Computer Science subject. In addition, the researcher calculated the effect size to establish the extent of the effect. The effect size was calculated by using (*r*). According to Table 4.7 below, the size effect $r = .78$; thus, in terms of the Cohen guideline, the effect size is large. As a result, it can be concluded that there is a significant difference between FLG and NFLG, in addition to a large effect size. It also reveals that flipped learning has a positive impact on students' performance compared to NFLG.

Table 4.7: A Mann–Whitney Test and Effect Size (Performance)

Group	N	Mean Rank	U	Z	P	*r*
Flipped Learning	37	53.37	84.00	-6.745	.00	.78
Non-Flipped Learning	37	21.27				
Total	74					

4.3.3.2 Students' Achievement

The achievement section includes six statements to reflect the academic achievement. This section examined students' achievement in two different groups. According to the descriptive analysis table (see Table 4.8), there is clearly a difference in the students' agreement score reflecting their achievement, with (*Med=4)* in the flipped learning group and (*Med=2*) in the non-flipped learning group. Thus, the result shows that the median of students' achievement score was higher in the FLG than in the NFG.

Table 4.8: Descriptive Statistics' Questionnaire (Achievement)

	Flipped Learning Group				Non-Flipped Learning Group			
	N	*M*	*SD*	*Med*	*N*	*M*	*SD*	*Med*
Achievement	37	4.08	.657	4.00	37	2.39	.559	2.00

The researcher conducted the Mann–Whitney test to examine the significance of this difference, and the results are presented in Table 4.9. it shows that the median difference reached a statistical significance *(U= 74, Z=-6.86, p < 0.05)*. This reveals that students achieved more in the flipped learning group and learnt more effectively than in the NFLG. In addition, the effect size was calculated, with (r = .71), which shows a large effect. Thus, the result demonstrates how learners perceive their achievement in two learning approaches. Flipped learning was reported by students to have a positive impact on their achievement in terms of helping them learn more effectively than the non-flipped learning approach did.

Table 4.9: A Mann-Whitney Test and Effect Size (Achievement)

Group	N	Mean Rank	U	Z	P	*r*
Flipped Learning	37	54.00	74.00	-6.865	.00	.79
Non-Flipped Learning	37	21.00				
Total	74					

4.4 Section Three: Students' Learning Motivation in Flipped learning and Non-Flipped learning environments

This section includes two sub-sections; namely intrinsic and extrinsic motivation, which in this study represent the students' learning motivation. The aim of this section is to examine the impact of flipped learning on students' learning motivation compared to non-flipped learning approach. For each aspect, there was an initial elaboration of the descriptive test; next, the non-parametric test. Afterwards, there was a calculation of the effect size in order to test any differences if found. Despite dividing the motivation into the intrinsic and extrinsic components, the current study would analyse the concept in general terms to address the second research question and hypothesis (see Figure 4.8).

To what extent did Flipped Learning affect Saudi students' motivation in the first-year high school in the Computer Science Subject?

H_0: There is no significant difference in terms of students' motivation between the flipped learning classroom and the Non-Flipped learning classroom

H_1: There is a significant difference in terms of students' motivation between the flipped learning classroom and the Non-Flipped learning classroom

Figure 4.8: Question Two and Hypothesis

4.4.1 Intrinsic Motivation

Gauging intrinsic motivation was carried out by requesting the group to show their answers to statements. In Table 4.10, the comparison between the FLG and NFLG students in terms of intrinsic motivation is shown. One can safely infer that there was difference in students' agreement answer, with higher score being noticed for most of the statements in FLG. In addition, it also clears that the overall score was higher in FLG (Med=4.00) than in the NFLG (Med=3.00). As shown in the Table 4.9, students in FLG achieved a high median score in most statements compared to NFLG. For example, in *"I feel excited while learning the Computer Science s course"*, the median score for FLG was (Med=4.00) compared to NFLG (Med=2.00). In this finding, it can be shown that the students in FLG had a higher level of enthusiasm than students in NFLG. Moreover, it was shown in the second statement that the students in FLG could administer their learning in Computer Science (Med=4) as opposed to NFLG students (Med=3). As suggested by this finding, students in FLG had a stronger feeling of autonomous learning than in FLG.

In addition, the highest median score for FLG was in this statement: *"I attended a Computer Science s course because I wanted to explore new ideas"* (Med=5.00), which, was the one of the lowest in NFLG (Med=2.00); however, this statement assumed that students in flipped learning attended Computer classroom with more motivation to learn new ideas, as compared to the students in the non-flipped learning group. It can be observed the three needs that related to intrinsic motivation (competence, autonomy and relatedness) was achieved in Flipped learning environment compared to a non-flipped learning environment. In addition, through the instructional video, the FLG students were able to understand the subject better than when having to listen to the teacher lecture, which was noticed in the students' answers to the following statement: *"Teacher lecture enabled me to better understand the subject/Using the video outside class enabled me to better understand the subject".* The students in FLG responded better to the statement in favour of the instructional video compared to their counterparts in NFLG who were more in agreement with the teacher lecture. Overall, it can be concluded that there was a difference in terms of students' intrinsic motivation between FLG and NFLG.

Table 4.10: Descriptive Statistics of Intrinsic Motivation

Items	*Flipped Learning Group*			
	N	***Median***	***N***	***Median***
I felt excited while learning the Computer Science s course.	37	4.00	37	2.00
I was able to manage my own learning in Computer Science s course.	37	4.00	37	3.00
I was able to interact with peers during and after the class time of Computer Science course	37	4.00	37	2.00
Teacher lecture enabled me to better understand the subject/Using the video outside class enabled me to better understand the subject	37	4.00	37	3.00
I attended a Computer Science course because I wanted to explore new ideas	37	5.00	37	2.00
Total Intrinsic Motivation	37	4.00	37	3.00

A Mann-Whitney test was carried out to test the significance of the differences of students' intrinsic motivation. As shown in the result of Mann-Whitney test, FLG exhibited a significantly larger difference with U= 139, Z=-6.20, p < 0.05 (see Table 4.11). Furthermore, the result of effect size presented a large size effect of r =.72. This result implies that the flipped learning approach is more effectual than non-flipped learning on students' intrinsic motivation.

Table 4.11: A Mann-Whitney Test (Intrinsic Motivation)

Group	N	Mean Rank	U	Z	P	*r*
Flipped Learning	37	52.24	139	-6.207	.00	.72
Non-Flipped Learning	37	22.76				
Total	74					

4.4.2 Extrinsic Motivation

In the second section of motivation, extrinsic motivation was reflected in the students' responses to the statements that related to the extrinsic motivation. Table 4.12 showed that the median of students in flipped learning group in all statements was slightly higher than students in NFLG. The highest median score was in FLG: *"I wanted to do well in Computer class because it was important to show my ability to my lecturer, family, friends, or other."; "I learned Computer Science in order to find a good job" and "The most satisfying thing to me would be to get a good grade in the Computer Science s subject"* (Med=4.00). The external rewards that motivated students in flipped learning included showcasing their abilities to others; belief in the importance of Computer subjects to achieve a lucrative job and to achieve a good grade. In addition, the highest median score in NFLG was (Med=3.00) for the following statements: *"I wanted to do well in Computer class because it was important to show my ability to my lecturer, family, friends, or other", "I learned Computer Science because it was a compulsory course", "I learned Computer Science in order to find a good job", and "The most satisfying thing to me would be to get a good grade in the Computer Science s subject"*. The external rewards that motivated students in the non-flipped learning included the compulsory nature of the course, showing their abilities to others, and the belief in the significance of the Computer subjects to gain career opportunities and better grades. However, the lowest median score was for both groups *"I learned Computer because of my fear of being punished by my lecturer" FLG* (Med=2.00) and (Med=2.00). Overall, the median of NFLG and FLG students' responses seemed to be in the middle of the agreement scale. However, the total result of the extrinsic motivation domain showed that there was no difference between students in FLG and NFLG.

Table 4.12 Descriptive Statistics of Extrinsic Motivation

Items	Flipped Learning Group		Non-Flipped Learning Group	
	N	Median	N	Median
I learned Computer Science s because it was a compulsory course.	37	3.00	37	3.00
I wanted to do well in Computer class because it was important to show my ability to my lecturer, family, friends, or other.	37	4.00	37	3.00
I learned Computer Science s in order to find a good job.	37	4.00	37	3.00
The most satisfying thing to me would be to get a good grade in the Computer Science s subject	37	4.00	37	3.00
I learned Computer because of my fear of being punished by my lecturer.	37	2.00	37	2.00
Total Extrinsic Motivation	37	3.00	37	3.00

Similarly, the researcher conducted a statistical test to further examine if there was a difference. A Mann-Whitney test revealed that the difference in extrinsic motivation was statistically evident with (U= 419.5, Z=-3.13, p < 0.05) (see Table 4.13). Furthermore, the size effect was calculated to see how big the difference was between extrinsic motivation of students in flipped learning group and non-flipped learning. Table 4.12 presented that r= 0.364, which is the moderated effect based on Cohen's guideline of effect size. Overall, the result showed that the students in flipped learning had greater extrinsic motivation than the students in non-flipped learning. Although this result assumed the positive impact of flipped learning on students' extrinsic motivation, the difference between the two groups was not too obvious as observed in intrinsic motivation.

Table 4.13: A Mann-Whitney Test (Extrinsic Motivation)

Group	N	Mean Rank	U	Z	P	*R*
Flipped Learning	37	44.66	419.5	-3.134	.002	.36
Non-Flipped Learning	37	30.34				
Total	74					

4.4.3 Motivation

As mentioned above, the motivation domain is divided into two sections; intrinsic and extrinsic motivation (Abeysekera and Dawson, 2015). The previous two sections showed that the flipped learning approach influences students in terms of the motivation aspect. In this section, the researcher combined the two aspects to examine the second research hypothesis: *"there is a difference in students' motivation"*. The ten items of the two aspects represented the students' motivation. Table 4.14 showed that the median of students' motivation in FLG (Med=4.00) was higher than students in NFLG (Med=2.50). This difference reflected how the students were more motivated in FLG than their counterparts in NFLG. However, to ensure if the difference is significant and to reject or accept the hypotheses, the non-pragmatic test was conducted below.

Table 4.14: The Median of Students' Motivation in FLG Compared to NFLG

	Flipped Learning Group		**Non-Flipped Learning Group**	
	N	*Med*	*N*	*Med*
Motivation	37	4.00	37	2.50

A Mann-Whitney test presented in Table 4.15 showed that the differences in students' motivation were statistically significant with U= 121.50, Z=-6.36, $p < 0.05$. Thus, the researcher rejected the null hypotheses based on the p value and accepted the H_1 which indicated that there is a difference in students' motivation between FLG and NFLG. Furthermore, the size effect was r=.74, which demonstrated that the difference was high. Overall, these results indicated a positive impact of the flipped learning approach on students' motivation.

Table 4.15: A Mann-Whitney Test (Motivation)

Group	N	Mean Rank	U	Z	P	*R*
Flipped Learning	37	52.72	121.50	-6. 36	.000	.74
Non-Flipped Learning	37	22.28				
Total	74					

4.5 Section Four: Students' Academic Engagement

This section of the questionnaire aimed at measuring students' academic engagement in two groups to determine if there was any difference. Similar to the previous section, this section attempted to draw comparisons between the two groups. All items in this section were assigned a numerical value and rated on a 4-points scale; Very Often (V = 4), Often (O = 3), Sometimes (S = 2), Never (N= 1). As such, the higher the median is, the more engaged the participants are and vice versa. That is, the median scores of the domain close to four would indicate a higher level of students' academic engagement.

To what extent did Flipped Learning affect Saudi students' academic engagement in the first-year high school in the Computer Science subject?

H_0: There is no significant difference in terms of students' academic engagement between the flipped learning classroom and the Non-Flipped classroom

H_1: There is a significant difference in terms of students' academic engagement between the flipped learning and the Non-Flipped classroom

Figure 4.9: Question Three and Hypothesis

The students were asked about how often they engaged in classroom discussion, communicated with students and with teacher, and prepared for the classroom. The result in the frequency Table 4.16 showed that the students in FLG were more engaged than in NFLG, with most of the students in FLG responding that they often engaged in classroom discussion and the students in NFLG stating that only did so occasionally. In addition, almost half of the students (*N=14*) in NFLG reported that they never prepared for the classroom, while in FLG, no one responded that they never prepared, which might show the effect of the pre-classroom phase of flipped learning approach where the students needed to watch the video and do the quizzes. Furthermore, the majority of students in FLG (N=27) reported that the Computer classroom was more engaging than other classrooms with NFLG students (N=19). Moreover, it can be clearly seen that most students in FLG (N=35) often engaged with instructional videos compared to NFLG, where just 10 of the students reported that they often engaged with the teacher's explanation, which showed that the instructional video was far more engaging for students compared to the teacher's lecture.

Table 4.16 Frequencies of Students' Responses

Items	***Code***	***FLG (37)***	***NFLG (37)***
I engaged in classroom discussion	V-Often	18	5
	Often	11	9
	Sometimes	5	15
	Never	3	8
I communicated with other students in classroom.	V-Often	14	2
	Often	15	16
	Sometimes	7	16
	Never	1	3
I had more communication with the teacher.	V-Often	12	7
	Often	17	10
	Sometimes	8	16
	Never	0	4
I work at home to prepare for classroom	V-Often	7	0
	Often	23	6
	Sometimes	7	17
	Never	0	14
Computer classroom is more engaging than another classroom.	V-Often	14	6
	Often	13	13
	Sometimes	8	11
	Never	2	7
I feel I engaged with course materials	V-Often	16	3
	Often	16	11
	Sometimes	5	11
	Never	0	12
I explained course materials to my classmates	V-Often	13	2
	Often	13	8
	Sometimes	8	15

	Never	3	12
I contributed to classroom discussion	V-Often	15	5
	Often	10	11
	Sometimes	11	12
	Never	1	9
I work with other students in course projects	V-Often	14	7
	Often	13	12
	Sometimes	4	12
	Never	6	6
I engaged with instructional video/ teacher explanation Computers subject	V-Often	17	3
	Often	18	7
	Sometimes	2	13
	Never	0	14

In addition, the median of students' academic engagement domain was calculated. According to Table 4.17, the median of students' academic engagement score in FLG (*Med=3*) was higher than in NFLG (*Med=2*). It can be concluded that the students' academic engagement in FLG was different from in NFLG. A Mann-Witney U test was applied to examine the significance of the difference in students' engagement between FLG and NFLG. According to Table 4.18, there was a significant difference in students' academic engagement with U= 231, Z=-5.10, $p < 0.05$. Thus, this result rejected the null hypothesis and accepted the *H1*, which indicates that there was a significant difference in the academic engagement of students between FLG and NFLG. In addition, the size effect was calculated to identify the extent of the difference. The effect was moderate regarding the Cohen guideline, where the r=.59. This result suggested that the students in flipped learning were more engaged compared to students in the non-flipped learning environment.

Table 4.17 Total of Students' Academic Engagement

	Flipped Learning		Non-Flipped Learning	
	N	Median	N	Median
Total of Students Engagement	37	3.00	37	2.00

Table 4.18 A Mann-Whitney Test Students' Academic Engagement

Group	N	Mean Rank	U	Z	P	*r*

Flipped Learning	37	49.76	231	-5.10	.00	.59
Non-Flipped Learning	37	25.24				
Total	74					

4.6 Section Five: Students' Learning Autonomy

One of the current research questions was aimed to find out the impact of flipped learning on students' learning autonomy compared to the non-flipped learning approach. There was a section in the questionnaire attempting to address this question by asking the students to respond to 11 statements that reflected on their level of autonomous learning.

To what extent did Flipped Learning affect Saudi students' autonomous learning in the first-year high school in the Computer Science subject?

H_0: There is no significant difference in terms of students' autonomous learning between the flipped learning classroom and the Non-Flipped learning classroom

H_1: There is a significant difference in terms of students' autonomous learning between the flipped learning classroom and the Non-Flipped learning classroom

Figure 4.10: Question Four and Hypothesis

According to Table 4.19, there was a slight difference in most statements; for example, in the first statement, "*I felt free to express my ideas and opinions in the classroom activities*", the median score of students in FLG (Med=4.00) was higher than NFLG (Med=2.00), which assumed that the students in flipped learning group had the opportunity to express their ideas and opinions in the classroom. In addition, one can observe from the median score of the statement "*Outside of the classroom, I enjoyed the freedom to learn whenever I want"* that the students in FLG (Med=4.00) were more enjoyed the freedom to learn on their own time compared to students in NFLG (Med=3.00). Also, the students in the flipped learning indicated that the teacher encouraged them to ask questions; with FLG (Med=4.00) and NFLG (Med=2.00). This could be ascribed to the fact that the students in the flipped learning approach showed more aptitude in terms of getting involved in the classroom discussion and activities. On the other hand, the students in NFLG showed that they needed help from their teacher, as opposed to the students in FLG who seemed to be neutral in their response by stating: "*I do not need the teacher to offer help to me*". However, the students' median score to statements *"I do not need the teacher to tell me what to do in the Computer course"* showed that the students seemed to be still in need for the teacher to guide them in the Computer class since the course was offered to both groups. Overall, the total of students median score enabled the researcher to assume that students in flipped learning had the chance to learn more autonomously than in NFLG, with the median of FLG (Med=4.00) higher than NFLG (Med=3.00).

Table 4.19: A Mann-Whitney Test Students' Academic Engagement

Items	Flipped Learning Group		Non-Flipped Learning Group	
	N	Median	N	Median
I felt free to express my ideas and opinions in the classroom activities.	37	4.00	37	2.00
Outside of the classroom, I was able to control my learning environment by working on my pace.	37	4.00	37	3.00
Outside of the classroom, I enjoyed the freedom to learn whenever I want	37	4.00	37	3.00
Outside of the classroom, I was able to control my learning time.	37	4.00	37	4.00
I do not need the teacher to offer help to me.	37	3.00	37	2.00
I do not need the teacher to tell me what my difficulties are.	37	3.00	37	2.00
I do not need the teacher to tell me what to do in the Computer course.	37	2.00	37	2.00
I felt that my instructor provides me with choices and options.	37	4.00	37	3.00
I felt understood by my instructor.	37	3.00	37	4.00
My instructor conveyed confidence in my ability to do well in the course.	37	4.00	37	4.00
My instructor encouraged me to ask questions.	37	4.00	37	2.00
My instructor used to listen to how I would like to do things.	37	4.00	37	4.00
Total Learning Autonomy	37	4.00	37	3.00

Furthermore, the statistical test was conducted to examine the difference of learning autonomy between students in FLG and NFLG. According to Table 4.17, the result suggests a statistically significant difference with U= 108, Z=-6.52, $p < 0.05$. This result rejected the null hypotheses and accepted the *H1*. In addition, the size effect was calculated to see how big the difference was. The effect was big according to Cohen guideline, where the r=.75. These results suggested that the students in flipped learning had the opportunity to learn autonomously compared to students in non-flipped learning.

Table 4.19: Mann-Whitney Test Students' Learning Autonomy

Group	N	Mean Rank	U	Z	P	*R*
Flipped Learning	37	53.08	108	-6.523	.00	.75
Non-Flipped Learning	37	21.92				
Total	74					

4.7 Section Six: Students' Perceptions

The students in FLG were asked about their perception towards flipped learning approach to learning the Computer Science subjects. The last section of the questionnaire had two parts; the first one included 12 statements asking the students about their learning experiences. The second part was a ranking question, where the students were asked to classify the most effective element in the design of a flipped learning approach.

4.7.1 Students' Perception toward the Flipped Learning Experience

The students were asked to show the level of their agreement statements according to the 5- Likert scale. The researcher computed the students' responses to the statements based on whether they were 'neutral', 'Agree', or 'disagree'. Regarding the Figure 4.12, most of the students liked flipped learning because it made the classroom more social and because of the idea of using technology in their learning. In addition, 78% of the students liked communication with classmates in flipped learning and 70% of students liked the length of the video, and while 8% disagreed, 68% liked the classroom activities. The students agreed that they improved by engaging in the learning process, including video quizzes online discussions and collaborative learning. Although 68 of students liked to be at home preparing for the classroom activities, 76 % of the students felt that flipped learning needed hard work. Finally, 68% of the students preferred the instructional video to the teacher's lecture.

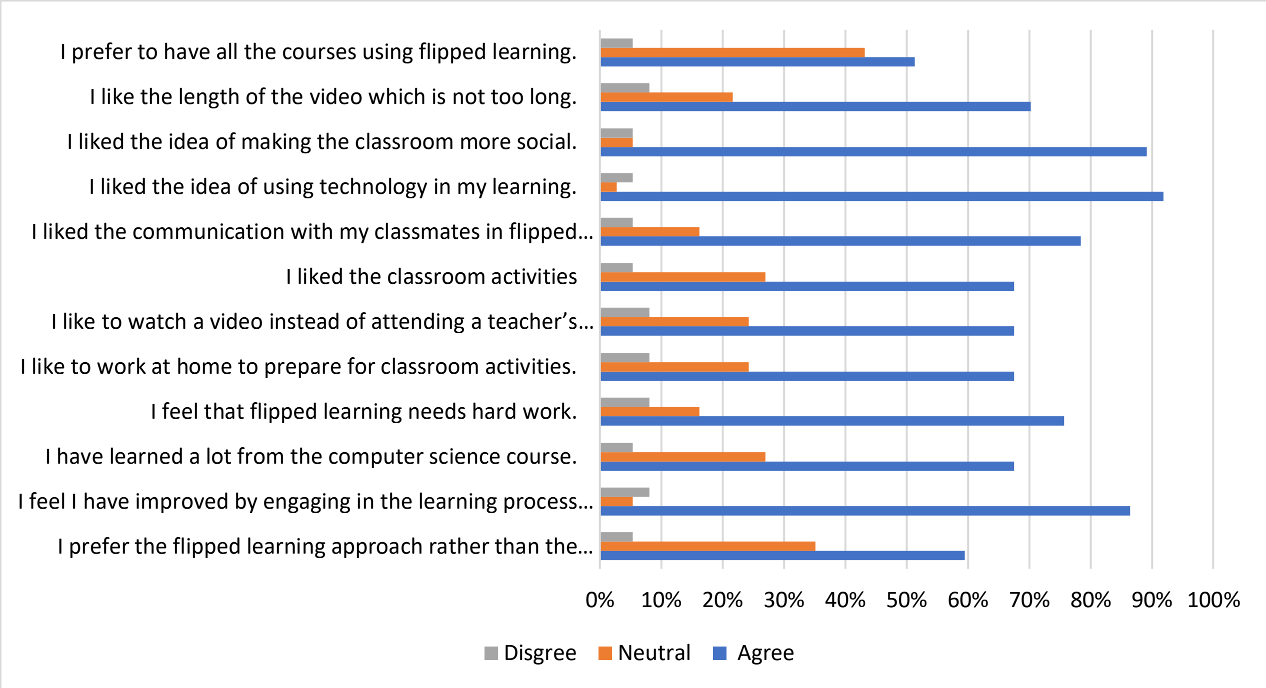


Figure 4.11: Students' Perception toward the Flipped Learning Approach

4.7.2 The Most Effective Element in the Design of a Flipped Learning Approach

The current study applied the design of flipped learning, including four elements (Video, Online Discussion, Quizzes, Classroom activities). The students were asked to rank in order which elements were the most effective for their learning. According to the Figure 4.13, it can be observed that the instructional video stood as the most effective element. The students ranked other elements as follows; the second most effective element was classrooms activities, while the third was online quizzes. The students ranked online discussion, which they had to do, as the least effective element in the design of flipped learning approach.

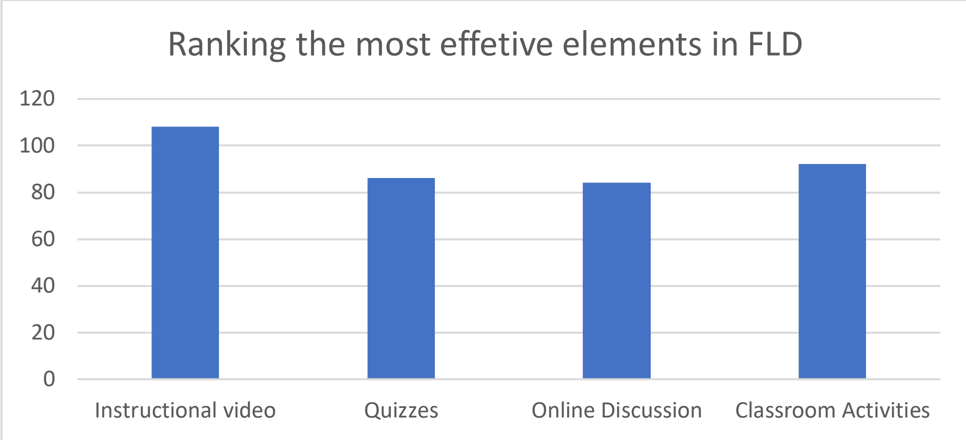


Figure 4.12: The Most Effective Elements in Flipped Learning Design

4.8 Conclusion

This chapter provided an analysis of the quantitative data collected that examined the impact of flipped learning on students' achievements, motivation, academic engagement, and learning autonomy. A comparison of the medians of the experimental group and control group, as well as the Mann-Whitney tests and effect size, were conducted in order to address the research questions that required statistical analysis. The quantitative data was collected from the pre-and-post-test to measure both student performance and the questionnaire, which focused on five aspects: namely students' achievement; performance; learning motivation, academic engagement; and learning autonomy; as well as another aspect for the experimental group, which was based on students' perceptions towards flipped learning. Addressing the first research question that aimed to examine the impact of flipped learning on students' achievement was conducted via a pre- and post-test, as well as the two sections in the questionnaire. The result of the pre-and post-test showed that there was an overall increase in the students' scores in flipped learning compared to non-flipped learning, particularly in the post-test stage. Moreover, as revealed in the analysis of the questionnaire regarding the students' perceptions toward their achievements and performance, there were more positive responses in the data collected from the FLG students than from their NFLG counterparts.

In addition, the second question considered the examination of the impact of flipped learning on the students' motivation. This chapter has addressed this question by using the analysis of the section on motivation in the questionnaire, which revealed that the results demonstrated that the students in flipped learning were more motivated than in NFLG. Furthermore, the third and fourth questions were concerned with the examination of the impact of flipped learning on students' academic engagement and learning autonomy. It was also found that the positive impact of flipped learning was observed in terms of students' engagement and autonomy learning, while there were more positive responses in the data collected from the FLG students than from their NF counterparts. The findings will be discussed in more detail in Chapter Sixth.

Chapter Five – Qualitative Results

5.1 Introduction

In the current study, the mixed method design was used as it enabled the researcher to better understand flipped learning and how it is effectual upon students' achievement levels, as well as their academic engagement, motivation, and learning autonomy. This was achieved through various data collection methods, such as a pre- and post-test, a questionnaire, interviews, and a focus groups. The previous chapter presented the quantitative findings, with a statistical analysis of the data from pre-post-test and questionnaire to examine the effect of the flipped learning approach on students' achievement, performance, academic engagement, motivation and learning autonomy, in comparison to the non-flipped learning approach. The qualitative data is employed in order to provide further rich explanation of how flipped learning impacted on the students' learning experience in the Computer Science course and to gain further insights into the phenomena of flipped learning. In order to address these issues, a semi-structured interview was carried out during *Week 11* with 18 participants; half of whom constituted the flipped learning group and the other half the non-flipped learning group. This was followed by focus group discussions, with one group of five students forming the flipped learning focus group and another group (also five students) making up the non-flipped learning focus group (*Week 12).* The current chapter presents the qualitative findings in relation to (1) students' learning experience, (2) motivation, (3) performance, (4) academic engagement, and (5) learning autonomy within two learning environments. In addition, the students' perceptions towards the use of flipped learning in the Computer Science subject and about the flipped learning design.

The findings provided an important counterpoint to and in support of the quantitative results and in response to the following research question: "*how do the students perceive their learning experience in two different learning environmen*ts". A total of five main themes emerged from the analysis of the qualitative data, as collated from the interview and focus groups. These were then presented based on the research questions, in addition to some sub-themes emanating from this analysis (see Figure 5.1). In other words, the researcher decided on the broad themes in a deductive manner using the research questions, as opposed to the sub-themes, which emerged from the data collection and were thus inductively classified. In this chapter, demonstrative quotations are used for students’ responses for each key theme and sub-themes. The participants’ perspectives are further documented in this chapter, resulting in a deeper understanding of flipped learning and its efficacy in terms of consolidating students’ achievement, performance, academic engagement, learning motivation and learning autonomy in the Computer Science subject.

From the qualitative results it can be observed that the participants reported the benefits of “the use of technology, greater effort from the teacher, share learning goals and their engaging in novel learning experience”, which was only possible because of the flipped learning design. For example, The teacher in the study context benefited from having the classroom time free to apply different activities, which would not have been possible if he had used the time in the classroom as normal with the requirement to explain the lesson topic and then be able to engage the students in group activities in just 45 minutes. The use of technology also helped the teacher to deliver the lesson by using instructional videos in their place, which allowed the students to watch the lesson and to consider their differentiation. This would simply not have been possible under the design of the learning if flipped learning had not been used. Overall, it can be state that the design of flipped learning combines these features.

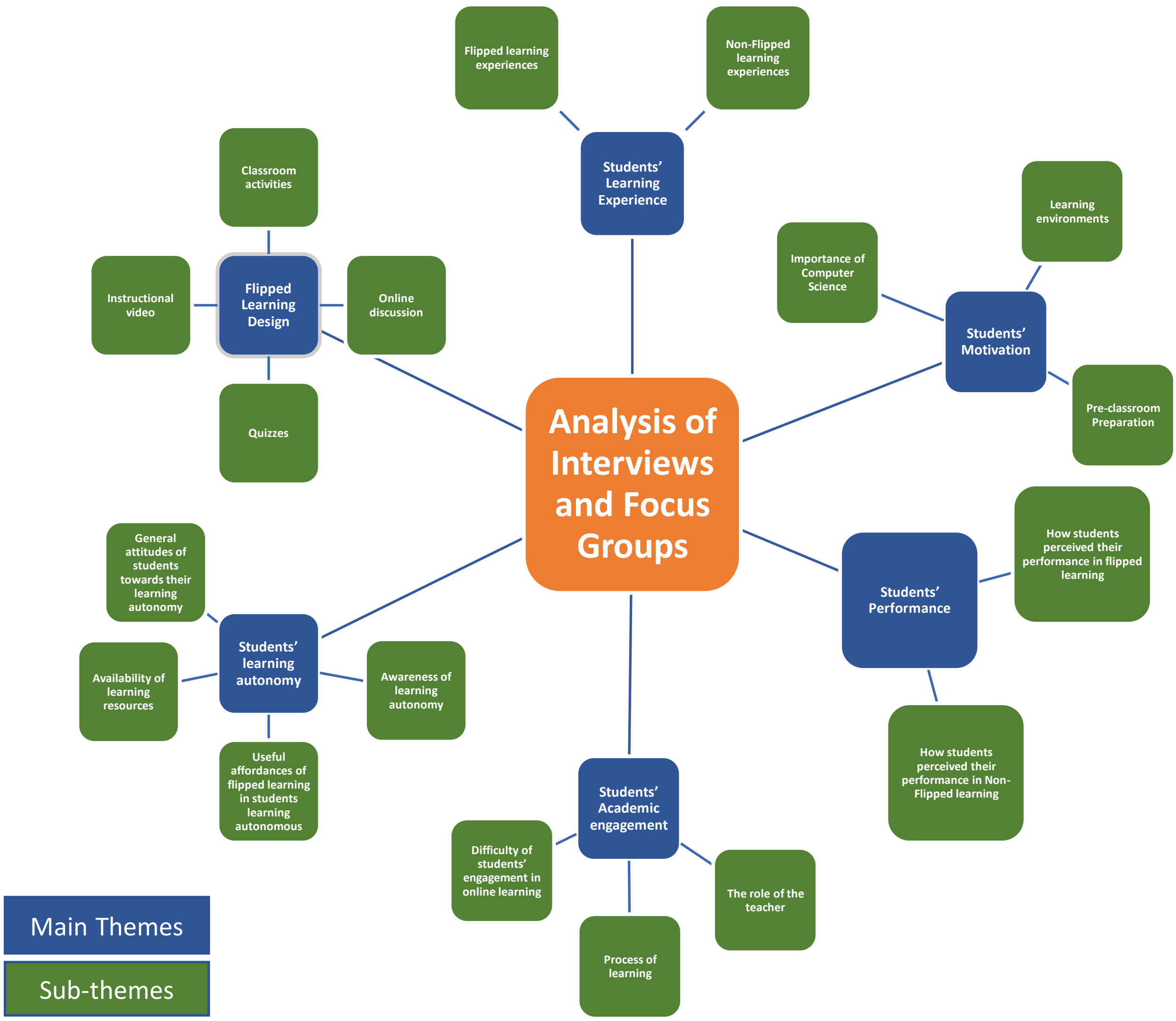


Figure 5.1: Emergent Themes and Sub-themes based on Analysis of Interviews and Focus Groups

In relation to the outline of the current chapter, it first presents the findings related to students' learning experiences in the Computer Science course, then moves to the findings of their learning motivation. Next, the students' performance will be covered followed by their academic engagement and learning autonomy. The last theme to be addressed is the flipped learning design before concluding with a summary of the chapter.

5.2 Students' Learning Experience in Two Learning Environments

In the current study, the researcher aimed to explore two Computer Science classroom environments, with the first group exposed to the flipped learning approach, while the other to the non-flipped learning approach. The students in the flipped learning group took part in learning over two phases; the first phase included an instructional video, quizzes, and an online discussion, while the second phase involved a variety of classroom activities, such as collaboration activities and problem-solving activities. On the other hand, the students in the non-flipped learning group experienced learning in the teacher preferred way and often a lecture method. This section attempts to address the research question about how each group perceived their learning experience. The data from the interview and focus group was inspected and revealed several differences between both the flipped learning group and the non-flipped learning group regarding their learning experience in the Computer Science course. The two sub-themes below spotlight the most prominent of these differences.

5.2.1 Flipped Learning Experience

This sub-theme aims to understand students' learning experience with flipped learning in the Computer Science course, including the pre-classroom and in-classroom phases. The finding showed that the students in the flipped learning indicated that their learning experience in the Computer Science was positive, which was clearly found in the interview. For example, one student stated that *"the experience was new and good … I like it"* (FLG1), while another mentioned: *"It was a good experience learning Computer in FL"* (FLG2). The focus group findings are also aligned with what was mentioned in the students' interview where the students in the focus group agreed that flipped learning was a good experience. According to one student, *"it is a unique experience and a nice idea in terms of learning about Computer"* (FG1S1). In addition, the students reported how online learning in the pre-classroom phase was a new and novel experience that improved their overall learning experience, as mentioned by one student: *"what is distinctive about this experience was that we learned at home via the video, which is something new and great for our learning"* (FG1S2). Another student argued that *"learning Computer Science has become easier and fun in this different way of learning where you use your laptop to study online"* (FG1S5). This finding showed that the students had a new way of learning and seemed to enjoy using technology in their learning experience of the Computer Science subject.

Furthermore, the students from the interview identified the features that rendered the learning experience positive in flipped learning. First, flipped learning enabled them to learn at home without the distraction that was often present in the classroom environment. For example, one student praised FL in that *"… the video was always available, and no one was distracting [him] while studying."* (FLG1), and another student emphasised that *"I learned by watching the video, doing quizzes, and participating in the discussion, which was better than learning from the teacher, where there is usually a lot of distraction in the classroom … I study at home with full consideration."* (FLG5)

Similarly, the element of freedom and flexibility of learning was also mentioned in the responses of the students who reported that they had the opportunity to learn at their own pace from the comfort of their homes. Thus, using their own devices allowed them to review the materials anywhere and anytime, giving a sense of flexibility to their learning routines (FLG1, FLG2, FLG4, FLG8). Also, a student in FLG8 reported that flipped learning provided a solution for when he could not attend the Computer Science class by providing online materials for him to review at home in case he was not able to physically attend on the day:

> *"I am a member of the robot team and sometimes we represent our school in the competition during school time … As a result, I missed many classes, but the Computer Science class only had its materials accessible via Marefa, which helped me to overcome the difficulties of missing the lessons*." (FLG8)
>
> *"… In FL, I was free to learn at home and on my pace."* (FLG1)
>
> *"The lessons were easy … I watched the video for 8 to 10 minutes and did the quizzes in my own time, and if I did not understand it, I had the option to re-watch it."* (FLG2)
>
> *"I liked the idea of studying the materials anywhere and even sometimes on the way to school by using my tablet."* (FLG4)

One can also ascribe the students' overall satisfaction to the use of the LMS platform to provide them with the learning materials and to show them the lesson plan with the learning objectives. The students reported that the presentation of the learning objectives appealed to them and so did the planning of online materials for each week, which provided guidance on how their learning should be conducted. Student FLG9 supported this idea when he mentioned that: *"I like that the teacher provides us with the objectives and goals of learning in Marefa, and we know what we should do at home and in the classroom … It was the same learning experience in Edraak"*. This resonates with student FLG3, who confirmed this idea by saying that: *"The learning materials were divided clearly … I know what I will learn for the whole week and what the lesson is for each day … I like this helpful experience"*.

Additionally, the students in the interview referred to the use of classroom activities as one of the learning experiences that enabled them to work as a team and gave them the opportunity to learn from each other. Expanding on this, FLG2 reported that:

> *In the class, we work together doing the activities that the teacher asks us to do, and all classmates get together and help in the completion of the task … For example, the teacher gave us a task to design a video about the Saudi National Day, and we to set out to plan and each one had a part … One of us sketched the plan, another used the Internet to collect pictures, the third downloaded the song, and the last team member used Moviemaker to implement the video … At the end of the class, each group presented their video, and it was really fun and useful as we took advantage of it to learn from each other*. (FLG2)

There were two students who supported this idea when they said that their experience learning Computer Science enabled them to gain the opportunity to have more communication and discussion with each other, which makes the classroom more interactional and proactive than it was the case for other subjects. As stated by students (6, 5), respectively,

> *It was a nice experience … if I were to compare the Computer Science learning class to, for example, the English class. In the English class, it was boring, whereas*

in the Computer class, we communicated with each other and engage in discussions, and we were also happy to help each other. (FLG6)

I felt that we were close to each other when communicating in the classroom. (FLG5)

In addition, the students in the focus group emphasised how the flipped learning experience changed their perspectives about the preparation for the classroom. As one student pointed out, *"in this semester, the Computer Science classroom changed my learning behaviour and I have developed into a student who prepares for the classroom and studies at home"* (FG1S4). Moreover, flipped learning offered the students a completely different experience of preparation for the classroom compared to their previous experiences, which is clearly shown in this statement: *"In the past, we did not have videos or online learning … We used to rely on the textbook for our preparation"* (FG1S1), and in another one: *"I agree with FG1S1 … The way we learnt at home was new and attracted me to study"* (FG1S3). Also observed in the students' discussion was the impact of using technology tools in terms of encouraging them to prepare for the classroom. One student confirmed that *"preparing for the Computer subject by "Marefa" was the most enjoyable experience ever"* (FG1S5), while another student acknowledged that he *"totally agree[s] … It is something I was not used to doing before and now it keeps me interested"* (FG1S2). From the finding above, it can be argued that flipped learning provides the students with a valuable experience for preparation; one that they had not been used to up to then.

Despite the positive experience of flipped learning reported above, the students in the focus group raised several points about the difficult learning process they witnessed in some Computer Science lessons. First, they arguably suffered from mental and cognitive overload caused by having to carry out homework for other courses, and at the same time, having to always review materials from the Computer Science subject, which sometimes resulted in attending the class without any adequate preparation for the expected classroom activities. Also, they mentioned that the instructional video was not appropriate for all topics and suggested that it might be better to sometimes watch it as a post-classroom task after the teacher's explanation. The following are the responses of the four students in focus group regarding this point:

Watching and reviewing the video is not always good … It happened with me twice … I was facing difficulties watching the video because I had an exam for another subject and I am a person who sleeps early … So, I came to my class without full preparation for the activities. (FG1S3)

I explicitly agree with you, because the teacher asks us to watch the video even if we have other difficult homework or exam. (FG1S2)

I would like to add that the video in some Computer lessons like the Linux interfaces, which is useful after the teacher's explanation as a review. (FG1S1)

Most of the lessons were interesting and easy in this method of learning, but the design lesson was difficult for me and I agree with my colleagues. The video could sometimes be used as a review of the lesson. (*FG1S4)*

Furthermore, the students reported experiencing technical issues whilst on their learning journey of Computer Science, which in turn seemed to affect their learning experience. For example, they claimed that the usability of the online platform on their devices was not that effective, adding that the layout of the online platform '*Marefa*' did not work well on their phones. It can be noticed that only the video element was working well, while for the other elements, which they had to access through their laptops, such as quizzes and online discussion forum, they were not working properly. This point is further explained in these responses:

I faced a problem when I used my Phone to do the quizzes … The problem was that the page became a mess and icons did not appear, and sometimes, I could see just half a page, but when I use the Computer, everything works well. (FG1S1)

I faced the same problem with my phone too … Sometimes, I could not see the quiz question option, but on my laptop, it was clear. (FG1S2)

Only the video was working on my phone, but the quiz, forum, and fills were not working. (FG1S1)

5.2.2 Non-Flipped Learning Experience

This sub-theme relates to understanding students' learning experience in the Computer Science course with non-flipped learning to identify the differences in comparison to FLG. All students in the non-flipped learning group felt that the learning experience in Computer Science was a normal routine that they witnessed in other subjects in their school classes. One student exclaimed that *"there is nothing new in the way I learnt Computer Science apart from the new information"* (FG2S1), which is consistent with another student's response: *"the same routine … You sit and listen to the teacher and wait for the teacher to ask you a question"* (FG2S3). In other words, the students in the Computer Science classroom did not go through a different learning experience from other subjects, which may suggest that the lecture was a common feature in their school. Interestingly, emphasising that the teaching method had not changed since primary education, two students, respectively, stated that *"there is no difference from the primary school, which does not appeal to me"* (FG2S2) and that *"it is true that the teaching style has always been the same since we were in year 4 until today … We thought high school is different, but it is the same"* (FG2S4). This view vis-a-vis NFLG students' learning experience was also found across their interview responses. In addition, it can be observed from the findings of the interviews that the students lacked interest because of the teaching approach despite the teacher's use of technology tools, such as Smart Board interactive whiteboard. One student complained about it openly, claiming that *"for [him], it was boring with the teacher reading from the slides in the smart whiteboard. It was like the Arabic class"* (NFLG6). Adding to the unappealing learning experience, the students mentioned that the difference in the Computer classroom experience compared to other learning experiences in other courses was the practicality of the lessons using a Computer (NFLG3). This point shows that despite the presence of technology in their classroom, the students needed educational practices that could improve their learning experience.

> *"Computer Science was the same boring routine and the same experience we learnt to pass the exams … The difference was just in the practical lesson where we used the Computer."* **(***NFLG3)*

Also, what is important to note, in addition to what is mentioned above, is that there were two students in the interviews who enjoyed it when the teacher used digital activities, such as Plickers or watching YouTube, which could be considered as one of the educational practices to attract the students in the classroom. The students mentioned that they were exposed to these practices a few times.

"Indeed, I found some classes interesting whenever the teacher used Plickers or opened YouTube to give an explanation of how to use open source ... This practice was enjoyable ... It would be interesting if all classes were like that." (*NFLG1)*

"There were interesting activities in the classroom once the teacher used just Plickers." (NFLG4)

Furthermore, it was found that the students in non-flipped learning missed having learning activities in the classroom. The students expressed that they did not have lots of classroom activities due to the nature of the teaching method. One student (NFLG5) mentioned that they preferred to have a better role in the classroom in the form of a group discussion, as they did in the Social Skill course. These ideas are further documented in the following statements:

"We did not have lots of activities in the Computer classroom, and the teacher talked too much. We should have a new teaching method. For example, I like the teaching style in the Social Skills course in which we discuss and participate in activities and use the internet to find examples." (NFLG2)

"I remember using only Plickers as a classroom activity despite the fact that there were no activities. The Computer classroom started with the teacher and ended with him." (NFLG4)

"I did not like the way we read from the book. I would like to have new information about the production of multimedia and learn about it in a different way, not like physics and maths. For example, I might work with my friends to produce a video and discuss each step … I worked with my friends in the Social Skills subject to prepare a presentation and we enjoyed it." (NFLG5)

The students in the focus group also explained the difficulties they faced in their Computer Science learning experience. First, it was difficult for them to follow the teacher's explanation for the whole class duration. As one participant pointed out, *"when he is explaining for 37 students or more, the teacher cannot ensure if I am able to understand or not or if I am paying attention to him or not … Indeed, even if I do pay attention for the first 10 mins, I am not sure if I will afterwards"* (FG2S1), not to mention that the teacher must explain for all students regardless of their differing levels of understanding, as highlighted by one respondent: *"as students, we have different levels, and we are not similar in how we learn"* (FG2S2). Moreover, the students felt that they needed to exert extra effort because of the lack of teacher explanation and the shortcomings of the textbook. One participant highlighted this issue by stating:

> *"I would like to add that the teacher's explanation in the Computer classroom was not enough … I needed to make extra effort to understand the concept … For example, the difference between open and closed source software and which one is open source … The teacher's explanation confused me, and the textbook was not clear because it was limited to a few software programmes and there are many of those programmes around us, but I cannot classify which one is open and which one is closed."* (FG2S5)

It can be inferred from this view that students need to gain a lot of experience to avoid facing this difficulty when learning certain concepts in the Computer lessons. Also in the discussion, the lack of teacher classroom management skills was noticed as influencing students' learning Computer Science experiences. For example, a student in NFLG7 reported that *"the learning experience would be better if the teacher could be in control in the classroom … Indeed, there were often students who played in the Computer class and spoke to each other while the teacher was explaining … This annoyed me"*. This view about the lack of classroom management and distraction in the non-flipped learning environment was also reported by students in the focus group (FG2S3, FG2S4). This experience could only occur when a teacher oversees over 37 students, where sometimes matters can get out of control and become a source of distraction for some students.

"I would like to say that our teacher tries his best, but sometimes one student can distract all students and cause them to lose focus with the teacher, especially when the teacher stops the class to take the student out." (FG2S3)

"I agree … Sometimes the teacher can stop the whole lesson because one student did a bad behaviour, and this happened more than once … Then the teacher stops teaching and counts it as an explained lesson." (FG2S4)

5.3 Students' Motivation

The students' responses to this main theme provide explanations and further insights into their level of motivation within two distinct learning environments, i.e., flipped learning and non-flipped learning. Analysing data obtained from the focus group and the interviews generated three sub-themes, namely, *Learning environments, Pre-classroom Preparation and Importance of the Computer Subject*, which are explored further in the following sub-sections.

5.3.1 Learning Environments

In this sub-theme, the students explained how the two different learning environments affected their motivation. The students in the FL environments interview reported that the FL environment provided them with a motivational learning experience to learn Computer Science. They stated that the components of the flipped learning environment enhanced their motivation to learn, which is further exemplified in the following examples:

"… With the video, online learning, and teacher's support, I was highly motivated to learn Computer, and this will help me in the future." (FLG1)

"… The Computer learning environment was very different from learning other subjects, so I was more motivated to learn Computer s than the previous year." (FLG5)

"I felt increasingly motivated in the Computer classroom because it was different. By involving in the classroom activities and watching videos at home, it felt like a new experience." (FLG7)

Furthermore, the classroom activities were considered as enjoyable tasks to enhance students' learning, with the teacher encouraging the students to play a part in group tasks and other activities. This supplementary practice to the flipped learning environment contributed immensely to increasing students' motivation, as shown in the following statements:

"I like the Computer class, and I enjoyed learning this subject … The teacher allowed us to work together in the classroom and I was always enthusiastic because I know my time in the classroom will be enjoyable." (FLG2)

"I like to be part of a team with classroom activities, and this makes me motivated to accomplish the task before the others." (FLG1)

"To be honest, this year I was motivated to study Computer s more than the ever before. For example, I felt I am a creative person in the classroom when I led the group to design a blog." (FLG8)

In addition, all the participants in the focus group agreed that the learning environment was totally interesting and enjoyable, and enhanced their level of motivation. The group tasks, including the discussion with a classmate and problem-solving activities encouraged the students to learn during the classroom (FG1S2, FG1S5). Furthermore, the teacher's continuous monitoring and encouragement of the students during classroom activities was mentioned as one of the major motivational aspects that occurred in the Computer classroom (FG1S4). The students also mentioned that working and collaborating during group activities proved to be an incentivising factor and gave them a sense of equality and fulfilment (FG1S1, FG1S5). The following statements further document this point:

"We work in the classroom in task groups, which was encouraging for me. It allowed me to exchange my opinion with my classmates as I'm no longer just listening to the teacher's lecture - So, it was very interesting for me." (FG1S2)

"The teacher was walking and encouraging me and all my classmates to try to answer and finish the task with our team, and we like it this way as we feel the teacher was motivated and supported each team." (FG1S4)

"Flipped learning helped me to understand Computer concepts, such as copyright and how I could avoid copyright infringement when I create YouTube content … Also, it encourages me to discuss matters with classmates by expressing views and answering to achieve the group task goals." (FG1S5)

"…We work as a group and help each other to understand … This is enough to be motivated to learn … Learning is not just for a clever student." (FG1S1)

"I agree with (FG1S1) … We all come to the classroom with a different level of understanding, and by cooperating with each other, we could fully understand the lesson, and this makes the Computer classroom unique." (FG1S5)

Interestingly, there was a student in the interview who described how the flipped learning approach changed his view towards learning Computer Science, where at the beginning he did not give this subject the same importance as the Maths subject. This point shows how the student became more motivated because of the change in the FL learning process.

"At the beginning, I did not give the Computer classroom as much importance as I did Maths and Physics, but with video, quizzes, and classroom activities "the flipped learning elements", I become more motivated. It was an interesting way to learn." (FLG3)

On the other hand, the students in the non-flipped learning group who were also taught using the lecture method showed how this approach did not help them to improve their motivation. As implied in their responses, the students criticised the learning style and how it was not appealing to them, thus negatively affecting their motivation. This is further illustrated in these examples:

"… The manner we learnt about Computer s in class should be more attractive to motivate the students." (NFLG1)

"I do not want to say the teacher was boring, but his teaching method and his class did not attract me." (NFLG3)

"I thought learning Computer would be different to other subjects, but it was the same, so I can say I was not highly motivated." (NFLG5)

In addition, the non-flipped learning students in the focus group showed a low level of motivation regarding the learning environment. They agreed that the routine of the classroom environment did not help them become motivated during their learning journey of the Computer Science subjects. Their definition of a routine in relation to the classroom lecture was that *"the teacher stands in front of us and speaks about the lesson for the whole duration of the class"* (FG2S1). The students illuminated that they had the motivation to learn the subject (Computer Science), but they were then shocked by the unappealing instruction style in the classroom, which did not seem to motivate them.

"... I was thinking this year would be different, but the routines of the classroom did not attract me or made me motivated enough even though I was motivated to learn about Computer s." (FG2S1)

"The teacher did his role, but the Computer Science teacher did not rise to our expectations for the high school level … You cannot be motivated with the same routine in the classroom." (FG2S3)

"The first two weeks I was excited when I was in the Computer classroom, but after that, I was disappointed with the learning method of an interesting topic such as "Linux application." (FG2S4)

"I was not highly motivated in the Computer Science classroom, and the reason as my friend said … In that we learn Computer Science as any other subject, and this was not our expectation of the Computer class in a high school where there is a Computer lab and is ready for use." (FG2S5)

In addition to the abovementioned, the students in the non-flipped learning environment expected interesting educational practices in the Computer Science lessons that could keep them motivated to learn. The NFG students in the focus group discussion expressed that they had high expectations of the Computer Science classroom in terms of allowing them to (1) practice their Computer skill, as one respondent stated: *"I am good at*

Computer, and I thought the Computer classroom would help me to learn and practice more" (FG2S4); (2) work with classmates collaboratively to enhance those skills. According to one student, *"we all use technology, and we work together to create a blog or produce a video instead of doing it at home as a homework"* (FG2S1). It was clear that the students had the desire and determination to be more active in the classroom, and as they indicated, the learning environment did not meet their expectations, which had consequential effects on their motivation. In addition, the students mentioned how using the group activities and the new activities, such as Plickers, had increased their motivation (FG2S5, FG2S2). Regarding this point, it can be evidently proven that compared the FL, the students in NFLG are found more wanting for educational practices that can potentially keep them motivated.

> *"I love Computers and I think it can be a more interesting class if the teacher uses interesting activities like Plickers all the time." (FG2S5)*

> *"I remember enjoying it when the teacher was using Plickers … When we work as a group, we encourage each other to learn and my friend knows how the class of social skills, all students get motivated and wait for this class." (FG2S2)*

In addition, the NFLG students interviewed aspired for some changes to be introduced into the learning environment in order to enhance their motivation. For example, one interviewee suggested the use of gaming in their learning. Another suggestion was a request for more space in the classroom for students to be involved in group or peer projects. These suggestions might give an indication of what the students had missed out on in the NFLG for them to be motivated, which goes to show that the students are missing the enjoyability element in their learning, as explained by these respondents.

> *"… It would be motivating if we learnt Computer with gaming." (NFLG1)*

> *"I'm motivated to learn technology, and I love technology … I really wish the learning method were more attractive, but it wasn't. I would enjoy it more if I were allowed more freedom in class to use the Computer with my peers to explore new topics in technology or to work on a project." (NFLG6)*

5.3.2 Pre-classroom Preparation

Analysing the data obtained from the interviews, the students voiced opinions as to how pre-classroom learning activities were affecting their motivation to learn. It seems that using technology tools has helped enhance the students' motivation for at-home learning. A student from (FLG4) emphasised that *"preparation at home using the Internet without the pressure of missing out on information helps me to be motivated in my Computer learning"*. Also, a student from (FLG7) mentioned the use of the Marefa platform in his learning at home was motivational for him. In addition, the at-home learning approach was more attractive than undertaking traditional homework (FLG2). This point could explain the students' motivation to engage in learning prior to the classroom phase, as illuminated in these statements:

> *"… Learning online was more interesting than doing textbook homework, and this motivated me to prepare before coming to every classroom." (FLG2)*
>
> *"Preparation at home without the pressure of missing information helped me be more motivated in my learning." (FLG4)*
>
> *"Only the Computer teacher asked me to use the Marefa platform for learning, and I was really motivated to revise and study the Computer subjects at home." (FLG7)*

In addition, the students in the focus group highlighted how preparation for the classroom enhanced their motivation. They mentioned that their increased interest in learning stemmed from coming to class well-prepared and in having that beforehand knowledge about the lesson (FG1S1, FG1S3). In addition, the pre-classroom activities gave them the extra edge, which resulted in them being confident and enthusiastic about attending the classroom (FG1S2). The well-preparation through the pre-classroom phase increased students' motivation to learn in Computer Science class.

> *"The Computer classroom started at home where I explored the online materials, and this gave me confidence … I felt enthusiastic to attend the classroom because I knew what the lesson was about." (FG1S2)*

"…The video prepared me for classroom activities, and even sometimes I needed the teacher to help me before the start, but I felt motivated for most of the Computer classroom because I came to the class well-prepared." (FG1S3)

"...In fact, the video and online learning attracted me … Attending the class with prior-knowledge motivated me to participate in class activities and with the teacher." (FG1S1)

In contrast, no one from the non-flipped learning group mentioned the pre-classroom preparedness when asked about how they perceived their motivation in a focus group and interview. In addition, the students did not consider the learning approach as helpful in terms of motivating them, which was clear in their depiction of the Computer classroom as a reading group or a listening classroom (NFLG4: NFLG9). It can be inferred that the students in the non-flipped learning do not seem to be taking advantage of the interesting pre-classroom activities that could enhance their motivation, as in the case of the FLG students.

"The way we learn Computer did not motivate me so much … It was the same group reading the book." (NFLG4)

"The Computer class was not suitable for my level as I am in high school … The class was similar to other classes just listening and this had an effect on my desire to learn Computers, and I was not motivated enough." (NFLG9)

5.3.3 Importance of Computer Science as a Subject

This sub-theme is focused on the relevance of Computer Science as a subject that can spur students' learning in both groups. The finding of the interview data showed that most of the students in NFLG reported that Computer Science as a subject enhanced their motivation (NFLG1, NFLG3, NFLG4, NFLG5, NFLG8). Worth of mention, however, is that two students in FLG shed light on the importance of this subject. These students not only believed that flipped learning was a source of motivation for them, but also highlighted the importance of Computer Science as a potential career opportunity for them, hence their motivation (FLG7: FLG9). In addition, there were some lessons in the Computer Science subject that met students' interests, which could have had a positive influence on their motivation (FLG8).

"The way of learning helped me be motivated and participate more in the classroom. The Computer Science is more important for my future career … This is the main reason for learning it." (FLG7)

"I was motivated because as you know in the future I plan to be an expert in Computer." (FLG9)

"I was interested in learning more about the technology that I have to use in my daily life, and the Computer subjects had some lessons, as I said, that were interesting such as blogs." (FLG8)

As mentioned above, many of the students in the non-flipped learning group reported the importance of the Computer Science subject as a motivating factor to learn. The students in the non-flipped approach reported that the importance of Computer Science for their future motivated them to learn. In addition, there was a student who mentioned that the desire to attain good grades to ensure passage to the following academic year was a motivating element for him. This can be seen in the following responses:

"I think I was motivated in the Computer class because it is important for my future and will help me with my career… Even though I don't like the classroom, but I needed it." (NFLG3)

"I need the Computer skills … As you know, everything around us needs one to be an expert in technology." NFLG5

"Honestly, I didn't want to learn Computer s, but it is compulsory, and I need to get good grades to make sure I pass to the next year". (NFLG2)

Furthermore, the students in NFLG found some of the lessons in the Computer subject, such as open-source and design blogs, a source of motivation for them (NFLG8). These lessons attracted the students because they found them interesting to learn. In addition, one of the students raised a direct point that he was motivated because of the lesson itself even though the class was not that appealing to him (NFLG4). This sub-theme showed how the Computer Science as a subject could enhance the students' motivation in NFLG.

"The Computer is something that's very important in our life, so I must learn how to use it, and I am always motivated to learn more about this subject. I am working on design, so some lessons motivated me to learn about which software are open source and which ones are not in order to avoid using copy software." (NFLG1)

"I was motivated to learn design blogs or websites, and I like this … I wanted to learn more about these skills." (NFLG8)

"I like Computer s as a subject, and this keep me motivated even though the class was not interesting." (NFLG4)

5.4 Students' Performance

The data of the interviewees and focus group for this key theme provide explanations and more detail about how the students perceived their performance in two different learning experiences. These responses are classified into two sub-themes, as showed in the following sections.

5.4.1 How Students perceived their Performance in Flipped Learning

This sub-theme includes a description of how the students' performance was in flipped learning and the factors that affected their performance. According to most of the participants in the flipped learning interviews, they indicated that they are satisfied with their performance. The students boasted their achievement of high scores, which reflects how good their performance was, as in the case of FLG1 who mentioned that *"my performance is good … I got a high grade*", and FLG2 who stated that *"I am satisfied with my performance as you can see my grade is 27"*. The students in the focus group discussion expanded on this view when reporting on their performance in the flipped learning classroom. For example, in the view of FG1S2, "*The teacher changed the way of my learning, and this helps me to get a high score in the last exam"*. As for FG1S3, he was satisfied with the fact that "*in the Computer Science subject, I had video explained to me and also, I can ask the teacher during class if I am struggling …",* adding that: *"if all subjects are like this, my performance in all subjects would* *be high*". This finding goes to show the level of the impact of flipped learning on the interviewed students' performance.

Furthermore, when asked about the tools in the flipped learning design with the most impact on their performance, most students in the interviews mentioned the instructional video. For example, FLG9 expressed that *"In my view, the video simplifies the concepts for me. An eight-minute video is better for me than a forty-five-minutes talk by the teacher"*, while FLG6 reported that *"the video helps better understand and perform in the Computer Science"*. Watching the instructional video followed by the quiz was another effective learning practice that impacted on the students' performance in FLG. On such positive influence one student commented: *"my performance flipped around 360 degrees through learning by studying the video and testing myself by doing the quizzes, which improved my performance".* The students in the focus group agreed in terms of the contribution of using quizzes into enhancing their performance and its significance as a tool of regular evaluation. For instance, FG1S2 stated that *"the quiz was helpful for me to check my performance weekly during the term … If it was not good, then I ask the teacher to help me … The result was that I have managed a good score in the Computer Science exam"*.

In addition, analysing data from the interviews identified other learning practices that seemed to improve the students' performance. For example, enabling the students to take responsibility for their own learning by doing so at their own pace, as one student clarified: *"the video improves my performance, it is available for me to study in my preferred time … I can watch and write and re-watch if there are any misunderstandings"* (FLG1). Another learning practice was students studying the video while writing notes for further discussion, as indicated by one student: *"my learning habit improved my performance … I watched the video while writing notes, and on the following day, I was able to ask the teacher or classmates for more clarification*" (FLG5). In addition, the teacher was available to have a discussion with the students and give them feedback, which was highlighted by one student: *"in the class, I had the time to ask the teacher and have a one-to-one discussion with him … He was keen to see all students giving a high-level performance"* (FLG6). Furthermore, the classroom activities were mentioned as another effective practice influencing their performance; *"my performance has improved throughout the learning process, but the most effective part was* *classroom activities where we were encouraged to work … This pushed me to work hard to catch up with my classmates",* one student (FLG3) reported.

However, two participants, who took part in the interview, reported different views about their performance. They claimed that their performance was not good in Computer Science in flipped learning (FLG7, FLG8). The first reason was the difficulty to gain access to online materials when using the phone. One participant complained that "*I am not happy with my low grade … The reason was that I did not have a Computer to access online materials every day and my phone was not good enough to study or explore Marefa" (*FLG7). This point raised the equality of students in terms of access to online materials with the right device to ensure the usability of the LMS for different devices. Other participants reported that the learning method did not help them to understand as there was no option to interact with the teacher if they struggled with online learning. This is clearly shown in this statement: "*first I would like to say the learning style did not help me to understand. There was no way to do online interaction with the teacher if I ever needed to ask about a concept or for more explanation … In general, the learning method did not help me to achieve a good grade … It needs more time and development"* (FLG8). Another point was raised by one of the students in the focus group about his frustration in flipped learning as he did not manage to finish his pre-classroom tasks.

> *"Sometimes, I felt annoyed about my performance because I could not finish the online learning, including the quizzes for each lesson … At times this affected my performance in the classroom especially when the teacher asked a question at the beginning of the class and I was not able to answer." (*FG1S5)

5.4.2 How Students perceived their Performance in Non-Flipped Learning

This sub-theme involves a description of how the students' performance was in non-flipped learning and the factors that affected their performance. When gauging the perceptions of the students in the non-flipped learning group about their performance, some students reported that they were satisfied (NFLG1, NFLG4, NFLG8). The findings showed that their performance was good in terms of (1) the ease of the subject: "*I can say my performance is good even though I do not study a lot at home, subject is easy"* (NFLG1); (2) the in-home preparation using the textbook and Google: "*my performance is very good, I spend time at home studying and reading the book, and I have a Computer which I use to search for more information on Google whenever I need to"* (NFLG4); and (3) the interest in the Computer Science subject: *"My performance is good because l like Computer Science from when I was a child, which has pushed me to perform better* (NFLG8). It can be observed that the students' perceptions of their performance stood at a satisfying level.

Although there were some students who considered their performance as good, there were others who expressed that they could have performed better if they had been able to overcome some difficulties. They reported that it was difficult to focus on the teacher's explanation and that they suffered boredom during in the lecture (NFLG2, NFLG7). In addition, NFLG6 mentioned that having more classroom activities could help to achieve a high grade. There was also a student in a focus group asking for a different teaching method that the students could employ to improve their performance: "*we could improve our performance if, for example, the teacher asks each group to explain one lesson each week and the following day the groups discuss the lesson and in the end the teacher gives us the conclusion of the lesson*" FG2S4. It can be said that the students could eventually enhance their performance level provided that the learning approach is further developed to allow the students the opportunity to embrace more learning practices.

> *"My performance is good, but it could have been better … Sometimes, it is difficult to focus with the teacher all the time when he is in the middle of explaining, and it is difficult for me to go back home and study … I did not have the time for the Computer class, and I have to study another difficult subject, which is Maths." (NFLG2)*
>
> *"However, the teacher's explanation helped me to understanding the concept, and with time this method has become boring and affected my performance." (NFLG7)*
>
> *"I am really happy with my performance … My grade is good, but I would like to have more activities in class with my teacher and classmates … This can help me to get higher grades." (NFLG6)*

However, there were students in the interview and focus group who were not satisfied with their performance in the Computer Science classroom. For example, one student complained that *"my grade was 17 and I am not happy … The reason was that I misunderstood some points"* (NFLG3), while another said that: "*I am not satisfied with my performance and my grade is low*" (NFLG5). Such dissatisfaction was shared by another participant who mentioned that *"my score was not what I wanted … I need to make more effort in the Computer classroom to improve my performance*" (FG2S1). The students mentioned some of the reasons behind their dissatisfaction with the level of their performance; first, there was the teaching method, claiming that the teacher did not cover all concepts or completely left some complex points unexplained. In addition, they said that their classmates were annoying during the class lesson. Another reason lay in the difficulties to revise for the exam using the Computer Science textbook. Some of these statements are documented as follows:

> *"The teacher did not cover the concepts in more detail and he sometimes skipped them … In the exam, I will not then be able to understand some of them even if I read the textbook." (NFLG5)*

> *"Also, sometimes, I can't focus with the teacher in class because some students are quite annoying whether to me or to the teacher." (NFLG9)*

In addition, the students in the focus group pointed out some reasons that might have caused their low level of performance. First, the students did not have a weekly assessment that could help them to track their performance. For example, one student reported that *"we were surprised about our performance when the teacher announced the results of our first unit exam, and it was difficult to improve our performance in the second unit because we were still struggling in the first unit, and this situation was repeated" (*FG2S2). This view was consistent with what another student (FG2S5) mentioned: *"the math teacher gave us an exam every two weeks, so we performed better in the Math class than in the Computer class where we just had an exam per unit"* (FG2S5). This point shows the difficulties that the students faced when they measured their performance far too late, i.e., after having many lessons, which then required them to do extra work in the hope that their performance might improve. In addition, there was an interesting point discussed by students in the focus group in relation to the fact that the concepts and information in the Computer classroom were not explained sequentially, which had an effect on their understanding. For example, one student argued that *"the teacher did not sometimes explain the concepts fully and sequentially in one lesson because of the time … He continued on the following day when I definitely forgot the information … This made feel lost, especially in the Linux unit"* FG2S3.

5.5 Students' Academic Engagement in the Learning Environment

One of the areas on which the current study has focused is the examination of the students' academic engagement by way of a comparison between two learning environments, where the students in the interview and focus group explained how their engagement in Computer Science sessions was. While analysing the collected data, several sub-themes emerged, including Process of learning, which identified how the students' engagement can be affected; The role of the teacher, which explained how it could play a part in the students' engagement; Difficulty in the students' engagement when undertaking online learning, which explained the difficulties the students in FLG face that impact on their engagement.

5.5.1 Process of Learning

In this sub-theme, the students showed how the process of learning can affect their engagement. Analysis of the focus group data revealed that the students in a flipped learning group environment had a discussion on their engagement in the Computer Science class and agreed that they were more engaged in that kind of class. In fact, most of the students in the focus group reported how the process of learning in the classroom was engaging. As stated by most of the group, *"the online learning and the classroom environment enhanced our engagement in the Computer Science class"* (FG1S4). They explained how pre-classroom engagement helped them in terms of being engaged and proactive in the classroom. In addition, there seemed to be an impact of the pre-classroom phase on their engagement in the classroom: *"… I have become more confident answering the questions and participating in group tasks"* (FG1S2); *"I come to the class with at least some knowledge of what the lesson is about"* (FG1S3). It seems that the process of learning based on the FL approach enhances the students' engagement as clearly manifested in their engagement in the pre-classroom phase, which also reflects on their engagement during the classroom session where they felt confident and prepared to participate. Some of the statements further illustrate this point:

> "*My engagement is very good especially with online learning, and I had a feeling that I always fully understand the topic, so I become more confident answering the questions and participating in group tasks." (FG1S2)*

> "O*ur engagement was different in Computer classroom because we come to the class with at least some knowledge of what the lesson is about." (FG1S3)*

> *"Indeed, in the online learning process I spent more time engaged with the content of the lesson and I was always participating with the teacher." (FG1S1)*

> *"We like the way of learning, simply because if I could not understand the lesson in pre-classroom, I would have the opportunity to engage with my classmates and the teacher to understand the lesson." (FG1S5)*

Furthermore, the students in the interview reported how they engaged with pre-classroom content and in-classroom tasks. Using video clips and quizzes in the process of learning was mentioned as elements that contributed to enhancing their engagement (FLG1, FLG2, FLG9). This demonstrates the effect of the design of flipped learning based on interactive technology tools, particularly during the pre-classroom phase in terms of helping engage the students in some prior knowledge about the lesson. The students also mentioned that watching videos and writing questions and then discussing them in a teacher-led setting increased the level of their engagement (FLG3, FLG7). In addition, according to most students' responses, the instructional video was quoted as an essentially engaging tool in the design of flipped learning despite the whole process. The students also reported how the learning process in FL offered them the opportunity to immerse in the classroom activities.

> *"Engaging in the video and doing the short quizzes made me participate more in the classroom with my teacher and classmates." (FLG1)*

> "*The video and quizzes helped me engaged in learning." (FLG2)*

"Now I watch videos and write questions, then discuss my questions with the teacher. So, I can say this practice increased my engagement in the Computer classroom." (FLG3)

"*I came to class fully prepared, and when the teacher asked a question, I had the opportunity to participate and engage more effectively in the classroom activities." (FLG9)*

"…*Whenever I come to the classroom with some pre-knowledge, I usually engage more in the activities." (FLG7)*

On the other hand, the findings of the non-flipped learning focus groups revealed that all participants struggled to engage in the Computer Science classrooms: *"It was difficult to focus or get engaged in the Computer classroom"* (FG2S1). They indicated that the teaching approach had a negative effect: "*we could not engage with the teacher's way of teaching Computer Science*" (FG2S2). In addition, one of the obstacles faced by the students in the NF learning class was understanding the lesson, which failed to keep them engaged in the classroom. This issue was raised in the students' discussion during the focus group, with FG2S4 and FG2S5 both mentioning: *"It all depended on whether I could understand the lesson at the beginning of the class … I felt that if so, I could engage in all class-time"* (FG2S4); *"if I could catch what he tried to teach us, I would engage during the class, but if I couldn't understand, then it's difficult to engage"* (FG2S5). As can be suggested from the students' viewpoints, they felt that their level of engagement was affected due to the lack of understanding of the lesson provided, which could be ascribed to the process of learning, including the lack of pre-information about the lesson. In contrast, the students in FL group expressed that the process of learning, particularly the pre-classroom activity, helped them to gain a better understanding, which further enhanced their engagement in the classroom.

"It was difficult to focus or be engaged in the Computer Science classroom … The teacher gave too much information and I couldn't interrupt him until the end of the lesson." (FG2S1)

"We could not engage with the teacher's way of teaching Computer Science, which, as we all know, every teacher in the school follows." (FG2S2)

"It all depended on whether I could understand the lesson at the beginning of the class … I felt that if so, I could engage in all class-time." (FG2S4)

"The way the teacher explained the lesson determined if I could catch what he was trying to teach us … I would then engage during the class … If I could not understand, then it would be difficult to engage." (FG2S5)

In addition, the students in the interview mentioned that the process of learning was unattractive and boring, which in turn affected their engagement (NFLG1: NFLG6). Similarly, as mentioned by NFLG2 and NFLG5, the process of learning in NFLG did not allow any space for the students to engage in the classroom, which can be ascribed to the nature of the teaching style as the teacher needs to cover the lesson with the class time, and he might not usually offer the opportunity for students to engage. This can be documented in the following statements:

"The *reason was that the lecture was not attractive, and the learning environment was boring." (NFLG1)*

"*In the classroom, there was not any opportunity to discuss with my classmates or even the teacher … I engaged just when the teacher asked a question." (NFLG2)*

"*There was two or three times that I engaged by working in a group, so I cannot say I was all the time engaging in classroom." (NFLG5)*

5.5.2 Role of the Teacher

This sub-theme shows how the role of the teacher in the Computer classroom can affect students' engagement. A closer scrutiny of the data of the focus group showed how important the role of the teacher was and how his presence during the classroom time kept the students engaged, as highlighted by the respondents in FLG (FG1S3, FG1S4). It can be said the teacher in the flipped learning approach plays an essential role in terms of promoting students' engagement by being a facilitator during class time. In addition, the students showed a good relationship with the teacher due to the support provided with their tasks (FG1S5). This good relationship between students and teacher can boost their engagement. Some of the statements further illustrate this point:

"In my opinion, the teacher Computer classroom enables all of us to engage either with him or other classmates in activities … He walks around us supporting each student to participate." (FG1S3)

"*I agree with FG1S3 … I am better and I can see all class engaged in activities, and if we need to correct anything as a group, the teacher is available and close by and happy to be involved with us." (FG1S4)*

"*The teacher comes closer to us and supports each one to accomplish the task … We used to see the teacher as just a speaker, but teacher Saraj was different in the Computer classroom." (FG1S5)*

In the same vein, the role of the teacher was mentioned during the interview as another factor contributing to students' increased engagement in the Computer classroom. It appears that the teacher helped the students to engage by directly encouraging them to participate in the classroom activities. For example, according to one student (FLG8), "*In this semester, I was more engaged in the Computer classroom … The reason is that the teacher allowed me to engage in class and encouraged me to participate in the group discussion.*" Also, the approachability of the teacher in the classroom seemed to be an additional factor in terms of stimulating increasing learners' engagement in the classroom. For example:

"I was active student asking my classmates and teacher. The teacher was answering all my questions which encouraged me more participation in classroom." (FLG7)

However, comparing the role of the teacher in non-flipped learning, the students in the interview mentioned that the teacher is in full charge of the class and the activities and makes use of all class time, which indicates that they did not have the opportunity to engage during the classroom (NFLG6: NFLG2). The students also stated the difficulty to be focused and paying attention to the teacher's explanation for 45 minutes, which also seemed to be a recurring issue that the students encounter in all subjects. This finding clearly points out to the all-influential role of the teacher in the NFL as he holds total authority of the class-time, which leads to the students' lack of engagement or, at best, low level of engagement, especially in the classroom. This is documented further in the following statements:

"During the teacher's explanation, I cannot be engaged because he wants to finish the lesson first, and then we could ask a question, but most of the time, I avoid asking him." (NFLG2)

"... Learning in the Computer classroom was boring … The teacher was explaining and talking all the time." (NFLG6)

"Also, I could not pay attention with the teacher talking for the whole 45 minutes … It is difficult for me … And by the way, all the subjects are like this." (NFLG4)

Furthermore, the impactful role of the teacher and how he could affect the students' engagement in NFLG was discussed in the focus group. The students in the focus group figured out that the Computer class did not engage them at all. One participant said that *"for most classes, when the teacher started explaining the lesson, my mind was focused elsewhere … The teacher did not attract my attention to be involved with his explanation"* (FG2S3). Another mentioned that *"Sometimes I would like to understand the lesson … I tried to do all I could to focus and engage with the teacher, but as I said, it is difficult because he gives too much information and speaks very fast"* (FG2S1). It is obvious that the role of the teacher in NFLG as a leader cannot promote the students' engagement compared to when he is a facilitator. In addition, the students emphasised that the learning environment in the Computer lab can easily distract them because while the teacher was explaining, most of them were busy with the Computer. These participants emphasised that the teacher's lack of Computer lab management can have an impact on their engagement within the classroom. The following statements highlight this viewpoint:

"It is also difficult to focus or engage with the teacher especially when we are in a Computer lab … Most of us use Computer s and do not listen to the teacher." (FG2S4)

"In the Computer lab, it can be impossible to engage with the teacher when the students around you are playing games … Even with the teacher placing restrictions, we now restart our Computer s, then play games again." (FG2S5)

5.5.3 Difficulty in Students' Engagement in Flipped Learning

The students found some difficulties when engaging in the flipped learning environment. One student expressed how he struggled to engage with materials, such as the recorded video, where he could not interact with the video to ask or express ideas (FLG4). In addition, the students mentioned that the online discussion tool, which was an online forum, could not help them engage effectively in the online discussion (FLG6, FLG5). In addition, it was found that the students could engage better with synchronous online learning sessions than asynchronous online learning sessions. In addition, it was found that the students prefer to engage better with synchronous online.

> *"I am good at Computer s, and I like to learn about them, which is the reason why I showed more engagement. To be honest, I will engage in FL or other teaching methods. FL could help me to engage more if the teacher provides me with more real-life cases. I could not engage with the video because, really, during the video, I sometimes have an idea or a question, but I find that I am not able to pose such a question or convey such an idea. The process of 'go and write in forum' or 'send the teacher the questions' did not help me engage in the online discussion." (FLG4)*

> *"The way of learning was interesting, which helped me show better engagement in the classroom activities. But it was difficult for me to engage with the online discussion, I did not have time to wait and respond. Sometimes, I write questions, and no one responds to me." (FLG6)*

> *"… The online discussion had to be in written form, which was not interesting for me, and I could not engage with it … It would be better if we used Zoom." (FLG5)*

Another interesting find was that of a student who expressed that he was engaging with the instructional video only in the first few weeks. Afterwards, he lost that sense of engagement, which he ascribed to the design of the video being the same for the whole duration. This finding showed how important the design of the video is for the students' engagement.

"In the first weeks, I liked it because it was a new way of learning and I engaged with it, but then I could not be engaged with the videos because all of them had the same design." (FLG8)

5.6 Students' Learning Autonomy

In this theme, the students revealed how they perceived their autonomous learning in the two learning environments. This section aimed to understand how students' autonomous learning differs in two learning environments; flipped learning and non-flipped learning. The theme is divided into four sub-themes generated by analysing data from the interviews and focus group. The four sub-themes include: *the general attitudes of students towards their learning autonomy; awareness of learning autonomy; availability of learning resources; and useful affordances of flipped learning in students learning autonomy.*

5.6.1 General Attitudes of Students towards their Learning Autonomy

In this sub-theme, the interviewees reported on their perceptions pertaining to learning autonomy. The findings indicated that the students in flipped learning experienced some form of autonomy when learning. For example, Student *FLG1* stated that the learning process helped him to depend on himself learning about Computer, as well as consolidating his interest in learning Computer Sciences using a Computer. On the other hand, Student *NFLG2* expressed that *"I need the teacher to explain the lesson for me first, then I have to revise at home what the teacher has taught me, and when I find difficult concepts, I use the Internet not the textbook because it is not helpful"*. To a large extent, it seems that the students in FLG have far more confidence and thus self-dependence in terms of exploring external possibilities, such as online materials than the students in NFLG who appear to be helplessly reliant on the teacher in relation to their learning.

"The learning process helped me to depend on myself and learn via video and online materials … I think the reason was that the learning method was interesting for me like watching videos and answering quizzes. Also, because we are learning about Computers by using Computers." (FLG1)

"I need the teacher to first explain the lesson to me and then I review at home what he's taught me. Sometimes, I use the Computer and the Internet to find out more about the concepts because the textbook was not that helpful for me." (NFLG2)

Equally, an interesting point that the students in flipped learning raised during the discussion was their ability to learn by themselves (FG1S3, FG1S5). It can be argued that according to the flipped learning approach, the processes of studying online materials and being involved in in-depth classroom activities are very much at the core, which, depending on students' aptitude to learning, can increase students' learning autonomy. Furthermore, the students showed how they need time to adopt to a learning process such as that of, which shifts the responsibility to their direction and not the teacher's, as mentioned in the focus group (FG1S2, FG1S4). This point further reinforces how the flipped learning approach can be effective for the students to be autonomous learners when applied for the long term.

"In the Computer class, I watch the video then I test myself with the quiz… If I make a mistake, I review the video to correct it, and during the classroom, if a group fail to answer the task, another group will help them … All of us can be teachers." (FG1S3)

"I wrote a note during the video and reviewed it before the quiz … If there are any mistakes, I re-watch the video to correct myself before attending the classroom." (FG1S5)

"I think it was difficult for us in the first three weeks because it was a new experience for us at the high school to be responsible for going online and learning about the lesson before coming to class, where there is no longer a teacher explanation. But after that, most of us liked the way we were taught Computer Sciences." (FG1S4)

"I remember taking one week to realise that I had to study at home then engage with other students in class where usually home was for doing paper and pen homework. " (FG1S2)

5.6.2 Awareness of Learning Autonomy

Analysis of the data obtained from the discussion with the focus groups about their learning autonomy showed that all participants agreed that flipped learning has somehow improved their independence when learning Computer Science. According to students in FG1S1, FG1S3, FG1S4, and FG1S2, respectively, they felt that *"my learning depends on me"*; *"we can manage our learning and learn by ourselves"*; *"we were responsible for accessing online and preparing for the lesson before coming to class"*; and *"you can see all steps of learning depend on us"*. This highlights the fact that not only has the flipped learning process had an impact on their learning autonomy, but it also sheds light on their awareness of being autonomous learners. One student expanded on this idea when he said: *"I think learning the Computer Subject starts out of school then finishes inside the school, which we did not use to experience before, and this meant we had to study more at home, or we would fail to understand the Computer Science lesson"* (FG1S5). It seems that flipped learning provides a rich experience in terms of practising learning autonomy skills, particularly when diverting the learning process away from school and then following it up with in-school content and activities.

> *"We learnt Computer lessons in steps, starting from accessing the online website, watching videos, doing quizzes, and then in-class, we led the discussion about what we had learnt … You can see all the steps of learning depend on us." (FG1S2)*

> *"I think learning the Computer Subject starts out of school then finishes inside the school, which we did not use to experience before, and this meant we had to study more at home, or we would fail to understand the Computer Science lesson".* (*FG1S5)*

Furthermore, the participants expressed their awareness of the difference in the role of the teacher; more specifically, they realised that he was not a mere lecturer in exclusive charge of the whole lesson explanation taking place in the classroom. For example, one student (FG1S1) reported that *"in class, the teacher does not do the usual explaining of the lesson"* (FG1S1). It seems the students' understanding of the process of their learning has evolved, whereby their teacher is assuming a different role from the customary, while their perspective has equally changed, which indicates how the new approach has contributed to their self-autonomous learning.

"Now learning depends on us and we do not need the teacher for everything … I had to go online to access learning, and in class, the teacher does not do the usual explaining of the lesson … We just work on applying what we have learnt online". (FG1S1)

In relation to the non-flipped learning approach, it can be said that the teacher features heavily in the process, which explains why the students' responses clearly indicated how this it has had an adverse effect on their autonomous learning skills. Referring to the findings of the interviews, students 1, 8, 6, and 9 indicated that the learning process did not give them a sense of responsibility towards their learning. They said their role was to take home what the teacher had taught them, which is accompanied with a sense of gratitude and reverence for the teacher whose role is important because he knows what is right and oversees the exam. In other words, the students in the NFLG are not aware of learning autonomy as much as they see the importance of the teacher as a source of knowledge. This can be seen in the following interview responses:

"I did not need to study at home for each class as the teacher would explain the important points and I just prepare and read the book for the exam." (NFLG1)

"I learn from the teacher and I revise at home if I have an exam. I need the teacher to explain to me and tell me what to do so that I don't make a mistake." (NFLG8)

"I was not learning independently because the teacher was enough … He prepares the exam test, and he knows what is important for me in the Computer Science course ... If there is anything, he will ask me to study it." (NFLG6)

"I did not do much self-learning because the role of teacher is to deliver the lesson and my role is to revise I tat home." (NFLG9)

"I like Computer s … My mother is expert in Computer and she always helps me." (NFLG5)

Besides, an analysis of the data obtained from the discussion with the focus groups about their learning autonomy showed that the students in non-flipped learning believed that their learning falls on the teacher's shoulders: *"The teacher can give all that we need to* *achieve and pass"* (FG2S1). According to the discussion response, they also displayed a sense passive learning: *"We learnt that staying focused with the teacher's explanation will lead to success; the teacher designs everything, and it's him who will give us the score"* (FG2S2); *"I do not always revise at home … When I come to class, the teacher gives me the important information"* (FG2S3). It seems that the students hold strong views about the teacher's role in that they depend totally on him, which may explain their lack of awareness of learning autonomy.

However, there were interestingly some students in the NFLG who showed awareness of learning autonomy. For example, Student *NFLG2* and Student *NFLG7* stated that they were studying at home using the internet or YouTube instead of the textbook to help them absorb some concepts that they found too difficult to understand. Also, Student *NFLG3* mentioned that he had a habit of coming prepared for the classroom because having prior knowledge helped him understand the teacher. Another participant (*NFLG5*) mentioned that he received assistance at home from his parents when revising the Computer Science subject. Even though there were students with a predisposition to independent learning, the manner learning was conducted in the NFLG did not appear to offer them an adequate educational practice to improve their learning autonomy skills. This point is clearly evidenced by the individual attempts of students to pursue their own learning in the absence of an organised structure to enhance their learning autonomy skills.

> *"I go through what the teacher has taught me at home ... I use the Computer and the Internet to find out more about some concepts background of the Linux system, because I find the book boring for me ... So, I need the teacher first to explain for me." (NFLG2)*

> *"I learnt some interesting lessons, such producing a video by myself, and there are many videos in YouTube ... But the teacher is important for me to understand the concepts that would-be part of the exam." (NFLG7)*

> *"For me, I usually prepare myself at home because I would like to attend the class and understand what the teacher is saying ... But it is difficult to learn Computer sciences without a teacher." (NFLG3)*

"In the Computer class, I studied at home and tried to apply what I had learnt with the teacher … Sometimes, my mother helps me. I tried to learn the practical lesson by myself because I like Computer s and my mother is an expert in Computer s and she always helps me." (NFLG5)

5.6.3 Useful Affordances of Flipped Learning in Students' Autonomous Learning

This sub-theme highlighted the useful affordances of flipped learning in terms of improving students' learning autonomy. Students 2, 3, 4, 5, 6, and 7 in the interview showed noticeable enthusiasm when they explained flipped learning and the ways that it had assisted them in changing their way of learning. They reported how flipped learning was helpful in terms of rendering them autonomous learners; the first point was that FL was useful in terms of meeting their learning style. The second was that FL provided students with some background idea about the lesson expectations and outcomes, including the learning objectives and lesson plans, so that they could be more organised and better prepared. As for the third element, FL allowed the students to be in full charge of their learning and to study at their own pace. In addition, *Student FLG5* and *Student FLG6* added how the extension of learning beyond school time in the flipped learning approach helped them to study and work by themselves. The students also referred to supplementary elements, such as the quiz, which helped them to evaluate their understanding as part of a novel self-learning process. Providing an evaluation tool in the flipped learning design could help the students learn autonomously. This can be further exemplified in the following interview responses:

"… I did not like reading textbooks … I am a person who likes to listen and watch when learning something … So, videos and online discussions facilitated my own learning. Also, flipped learning has given me a sense of responsibility and confidence to learn by myself in my own style." (FLG2)

"I became more dependent on myself in learning Computers … I spent hours learning and reviewing online materials and then solving the quizzes to assess my understanding. This learning makes me confident when I come to the class." (FLG3)

"I like that the teacher writes the headline and learning objectives every week on the front page of the learning system, and this helps me to see what I will learn. Then I can

manage my time to study every day for one hour based on the learning objectives, and I also know what I will have in the classroom. It is similar to an online course." (FLG4)

"My self-learning was good because I study at home and not just in the school. Also, I studied without any pressure and distraction, which helped me to achieve the learning objectives that the teacher set for us. I studied and wrote all the information to be ready for the classroom activities … I do not want to come to class as a non-diligent student. The learning practice shows how I can learn by myself." (FLG5)

"In the past, the learning was dependent on the teacher and the learning was just in the school ... Now, I do put more effort at home … I can study in my own time and re-watch the lesson many times until I fully understand, and if I need help, I can let the teacher know in the classroom. This new method of learning gave me more confidence and will help me at university in the future … My brother told me it would be helpful for me at the university level." (FLG6)

"I like this way of learning because it allowed me to control my learning … For example, the quiz helped me to know if I need to review the video or whether I am ready to attend the class with the right knowledge ... Also, the teacher was helpful just when I needed him … So, I am confident that when the exam comes, I will have a good grade." (FLG7)

5.6.4 Availability of Learning Resources

This sub-theme showed how the availability of the learning resources could play a part in the students learning autonomy. During the discussion, the students (FG1S2, FG1S3, FG1S5) indicated that it was a struggle to study autonomously in other subjects that use textbooks as a main resource, unlike in the Computer Science classroom where they used the flipped learning approach, including video, etc. In so doing, they felt that they could learn autonomously. As boasted by one student, *"we felt like a teacher of ourselves and for each other"* (FG1S5). It can be argued that flipped learning design provides a variety of learning resources for students which enables them to learn independently; as such, this practice can ultimately increase students' learning autonomy.

"The good thing about the Computer classroom is that we know the teacher is not going to explain the lesson … So, to learn, we need to watch the video and sort out the quiz … This kind of learning has given me the feeling that we can manage our learning and learn by ourselves." (*FG1S3)*

"I agree with FG1S5 … The option when learning other subjects is by using the textbook and the teacher's explanation … For example, in the Math class, we just ask the questions, but in Computer Science, we depend on online content and classroom activities, which makes it easy for us to learn by ourselves." (FG1S2)

"In other subjects, we cannot learn from the textbook without explanation … So, we come to the classroom and the teacher explains the lesson, but in the Computer classroom, we care to learn and enjoy learning at home using interesting videos that explain the concepts … We know that there is no teacher lecturing anymore and thus we become our own teachers and teachers to each other." (FG1S5)

Nevertheless, a close examination of the data collated from the discussion with the NFLG (focus groups) about their learning autonomy showed that the students lacked the learning resources and were dependent on the teacher. According to the findings, the students in the discussion seemed keen on practising the skills of learning autonomy. One participant stated that *"It is necessary to have these skills"* (FG2S1), while another expressed that *"I have the desire to learn Computer s by myself"* (FG2S4). Similarly, another participant confirmed that *"sometimes I use YouTube to review the lesson"* (FG2S5). In addition, one student commented on the missing guidelines and the learning resources that could help them with their independent learning. Additionally, he highlighted the importance of not accessing online materials without scaffolding as this might lead to misunderstanding the concept (FG2S4). It seems that as students have limited learning resources, namely the textbook, the teacher's explanation, and the required homework, this might not be sufficient in terms of providing them with the opportunity to practise learning autonomy skills.

"It is necessary to have these skills [meaning LA skills], but the teacher can give us all that we need to achieve and pass the course." (FG2S1)

“For me, sometimes I use YouTube to review the lesson, but it depends if I have the time.” (FG2S5)

“We learnt that focusing when the teacher is explaining will be enough to succeed … The teacher designs everything and he will score us.” (FG2S2)

“I do not always revise at home with this boring and difficult textbook … When I attend the lesson, the teacher gives me the most important information.” (FG2S3)

“I had the desire to learn Computer s by myself, and I know the teacher will not remain forever in my life, but honestly, I did not have any guidance on how to depend on myself … All the time, I felt the need for the teacher … For example, the textbook is not a clear resource, but if I use an external website without the teacher’s guidance, I might misunderstand or waste my time learning something not applicable.” (FG2S4)

However, there was a student who argued against the rest of the group when he claimed that independent learning differs from one person to another, and that it is based on the personality of students, not teachers or resources. It is thus the responsibility of learners to pursue their self-development in their learning journeys by ensuring they seize all the learning opportunities that come their way, such as a YouTube channel for high school projects.

“I disagree with you all … The students are different, and those who want to learn by themselves, they should expect not to wait for the teacher, like when learning the steps to make a film … I had a different option to learn from a YouTube channel and the teacher was happy.” (FG2S1)

5.7 Flipped Learning Design

In order to explore their opinions further, the students in the flipped learning group were asked about the design of flipped learning. The interview and focus groups yielded a host of comments on how the students perceived the components of the flipped learning design used in this study and how they could be developed. The following sub-themes lay emphasis on the instructional video, classroom activities, quizzes, and online discussion as potential flipped learning design components.

5.7.1 Instructional videos

This sub-theme presents the students' perspectives about the instructional video and what they have suggested to improve it. A close examination of the data showed that the students provided an explanation of some of the features of the video used in their learning. The students stated that the length of the video was reasonable, which was approximately five to nine minutes. The students in the focus group also agreed that the length of the video was suitable. As stated by one student, *"most of the videos were 6 or 7 mins, which was appropriate for me"* (FG1S2). Explaining why this particular video duration was helpful, the students stated that a short-length clip was good to focus and follow the content, which can be clearly seen in these statements (1) *"The length of the video was good and helped me to pay attention to the content" (*FLG1); (2) *"The use of the short video was interesting compared to reading the textbook … It was easy to follow"* FLG4. In addition, the potential of watching the video on their devices was mentioned as an advantage of using the video. One student mentioned that *"I like the idea of watching the video on my phone"* (FLG8), while another said: *"it was good and easy for me to watch the video using my own tablet or else my phone"* (FLG6). This point showed that the students did not struggle when trying to access the video using their own devices.

Most videos used in the current study came with the teacher's face showing during the explanation. In the interview data, the appearance of the teacher in the video was mentioned as important, allowing the students to understand the body language and facial expression, for example, one participant stressed that *"the video of my teacher was better for me … I can understand his expression and hand movement ... In general, I prefer videos with the speaker's face shown, otherwise it would be boring*" (FLG5). This point was supported in the students' discussion in the focus group, with one student saying: *"I like watching the teacher explain with the facial expression and hand … It is better than just voiceover slides, which are boring as you cannot see who is speaking to you"* (FG1S1). Another member of the group agreed, saying that *"The video is most effective with the presence of the teacher because the teacher's movement of his hand helps in our interaction with him"* (FG1S3). This point shows how important the visual aspect (teacher's presence) in the video design is as it allows for facial expression and body language, which can have the potential to stimulate students and grab their attention.

Furthermore, the students offered some suggestions that could make the video affordance more interesting for them and to ensure they would engage with it. For instance, using animation videos was mentioned as another format of the video, along with the use of an infographic resume after the videos. This can be seen in the following statements by two participants FLG1 and FLG2, respectively: *"I wish if the video be designed by using animation or the video be done live"* (FLG1); *"I would like to continue to use flipped learning, but I wish for a change in the design of the video, for example, using animation or having a video and summary infographic"* (FLG2). This point was also supported by a student in the focus group who said: "*if the teacher continues to teach us using the flipped learning method or the school applies it to all courses, I think that the first thing that the teacher needs to change is the format or design of the video ... I mean if you want to attract the students' attention, then use animation, for example"* (FG1S4). Another interviewee added to the above by recommending that students ask questions during the video to enhance their thinking and keep them involved: *"The teacher could, for example, ask a question halfway through the video for us to think about. This would encourage us to study more to identify the answer"* (FLG7).

Additionally, the students in the focus group expressed their preference to use synchronous video instead of recorded videos, which allows them to benefit from live interaction with their teacher. For example, as one participant mentioned, *"I prefer to have the class live at a specific time, with the option of a chat to ask the teacher a question"* (FG1S2). In the same vein, the students in the interview expressed their interest in having a live class where they could interact and communicate with the teacher. For example, one student called for blending between live learning with recorded learning (live vs. recorded):

> *"A mix of online class videos, the teacher can ask the class to access at particular or preferred time. In an online class, we can ask the teacher and communicate with him ... The teacher can record the online class for the students who could not attend the class"* (FLG4).

Another interviewee mentioned about the importance of receiving feedback on the spot when he said that *"The live video would be more attractive for me … It allows me to have feedback quickly"* (FLG8). The finding showed that the students were hoping for an online class that enables them to have live interaction with their teacher.

5.7.2 Online Quizzes

The students reported that online quizzes in the flipped learning design helped them to review their understanding of the lesson, as shown in these statements: *"the online quizzes allowed me to test myself and decide if I need to review the video or not"* (FLG4), and "*The online quizzes were short and effective and informed me if I need more time for review"* (FLG8). Besides, *Student 6* added that comparing online quizzes to the unit review questions, by undertaking a quiz for each lesson, was more effective and helpful in terms of determining his areas of concern in order to address them: *"The online quiz helped too much to identify if I understand the lesson … It is better than the textbook review questions of each unit because with online quizzes, I review the questions for each lesson, and it is easy then to know where my weakness is so that I find out how to improve it with my teacher"* FLG6. One of the students in the focus group supported the idea that quizzes improved his ability to evaluate his understanding lesson by lesson. In his own words, he confirmed that *"I now know which lesson I can understand, and which one needs reviewing by using the quiz, which shows me my level for each lesson"* (FG1S4). The finding showed how the use of online quizzes for each lesson proved to be a good component in the flipped learning design by allowing the students to monitor their own progress.

Although the students seemed to relish the idea and were aware of its effectiveness, some students had a different view. For example, *Student 5* stated that setting a deadline for the online quizzes made him feel under pressure. He suggested removing the deadline element in the quiz to allow him to study worry-free about missing out on the quizzes. In addition, the students proposed including more features other than just the multiple choices as it limited their response options. The students also needed to use a different form of a question to allow them to write a detailed answer and help them express their understanding and receive teacher assessment (For example, FLG2, FLG3).

"The quiz cannot only be in the form of multiple choices … Sometimes, I need to express my understanding and I need the teacher to assess me." (FLG3)

"…In some lessons, it would be good if the teacher asked one question to allow me to write detailed answers." (FLG2)

"Sometimes, it is difficult for me to watch the video, read materials and then answer the quiz … I told the teacher that he could leave the quizzes without a deadline so that all students can tackle it without any pressure. This would help to test my understanding without worrying about the teacher's reaction." (FLG5)

5.7.3 Classroom Activities

The second component in flipped learning is the classroom activities. From the finding, it appears that the students enjoyed the classroom activities they were offered, especially when using technology applications, such as Plickers. In the opinion of two participants, *"The classroom activities were attractive, especially Plickers …"* (FLG1) and *"Using digital activities, such Plickers, was interesting"* (FLG4). Also, in relation to classroom activities, the students brought up the idea of collaboration and working as a group, which was helpful and interesting for them, as reported in FLG6: *"I like the idea of working in groups on Computer task where all of the team help each other"*. In addition, the students claimed that the classroom activities allowed the teacher to evaluate all the students, which seemed more effective than before when the teacher would ask random questions and limited students would be assessed and scored. As shared by one student, *"the teacher gives all the group students a score for their collaboration in the classroom activities, whereas in the past, the teacher would ask anyone, and the score goes to a few students"* (FLG9). Collaborative activities led students to have a sense of satisfaction and enabled them to receive their teacher's evaluation at the same time.

The students in the focus group also revealed how much they enjoyed teamworking and completion of the tasks collectively in the Computer Science subject. To the delight of one student, *"working together as a team was very enjoyable, and we enjoyed creating an interesting video about natural catastrophes and climate change"* (FG1S5) and "*… producing a video activity where each one of the team does his bit in the video production"* (FLG1). The students added that the classroom activities provided them with a challenge, which gave them a sense of achievement upon accomplishment of these activities. For example, FG1S3 reported that *"we'd have a feeling of success once we finished the challenge activities"*, while another mentioned that *"we cherished some challenging activities where we all worked hard to finish before the other group … Last week, the teacher asked each group to create and design a full blog with different topics, and it challenged us to finish in-class time"* (FG1S2). It can be said that collaborative activities, especially when accompanied with challenging tasks, can be a source of inspiration for the students in flipped learning and can give them a sense of achievement.

However, the students in the interview mentioned some disadvantages associated with classroom activities. First, there was not adequate classroom space for the students to work in groups, as reported by one student: "*I did not like the messy class, and all students were close to each other … We do not have the space to readjust the tables for group work*" (FLG2). Further, the students mentioned that the level of noisiness in the classroom was unbearable, which acted as a distraction and an impediment in terms of rendering the classroom a space for group activities. According to FLG3, "*the classroom was too noisy and there were lots of distractions because of the activities*". Given that the classroom accommodates 37 students, it seemed difficult to divide them into groups without causing such disadvantage. In addition, the students faced the additional burden of the group coming to classroom unprepared. As reported by FLG7:

> *"It was difficult when not all students came prepared for the practical activities because sometimes half of my group did not prepare and make the task difficult for the rest of us … For example, we were not able to do the activity about using LibreOffice to write a list of open sources*."

It seems that the teacher in flipped learning has a duty to ensure all students come prepared for the classroom to avoid facing any further issues during the group task.

5.7.4 Online Discussion

The students in flipped learning did not relate much to the online discussion. The finding showed that the online discussion in the flipped learning design received criticism from students in the focus group and interview sessions. The first criticism referred to the delayed responses in the discussion, with one participant complaining: *"I post a question and wait for 48 hours, but no one answers me, then the teacher answers me"* (FLG2), which was also mentioned by another student: *"I used it twice and the response takes a long time from my classmates and the teacher"* (FLG7). In addition, the use of the forum as a form of online discussion was inappropriate, as justified in the students' responses. For example, one interviewee claimed that *"Using the forum is not an attractive way … It is old-style"* (FLG3), while another agreed: *"I used the forum five years ago, and it is not appropriate for online discussion"* (FG1S4). The students also added that the teacher was not always available online and that they needed him to be involved in the discussion: *"The teacher asked us to respond to each other, but he did not post comments on a regular basis … We needed him to be with us in case no one responded to us"* (FG1S3). It seems that the presence of the teacher in the online discussion is paramount to encourage the students to participate.

Furthermore, the students stated that they preferred to have an interactive online platform using an application, such as Zoom or WhatsApp for their discussion and chats, which was evident in one of the students' responses: *"We need to have the discussion and we can go live on Zoom or a group on WhatsApp … It is better than accessing the platform and forum when writing a question and waiting for a response"* (FG1S2). Based on the collated data, there was a perfect example on how the students can use such a technology in an interactive discussion:

> *"There was a question on how to cut the voice from a video and add it to the middle of the design … I answered my friend, but not on the online forum … I called him and used Zoom to explain how to do it step by step by using desktop sharing features."* (FG1S5)

The above examples clearly indicate the factors that can contribute to students' willingness and predisposition to have an online discussion, including those that can support learning in the flipped learning design.

5.8 Conclusion

The findings of this chapter were collected from the Computer Science students in Saudi High school, by interviewing a total of 18 students (nine in each group: FLG and NFLG) and 10 students in the focus group discussions (five students in each focus group). In this chapter, the analysis of the qualitative data aimed to provide an in-depth investigation into the impacts of the flipped and non-flipped learning environment. The findings revealed two distinct learning environments and how they affected the students' learning experience, achievement, motivation, and academic engagement, as well as learning autonomy. Regarding the first research question about the students' achievements, the findings show how students in flipped learning boasted their achievements of high scores, which reflected how good their performance was compared with the students from the non-flipped learning, who said that they could perform better if they had been able to overcome some difficulties caused by the teaching approach. Moreover, the students in flipped learning reported that their performance was affected by learning practices in a flipped learning environment, which seemed to improve their performance.

The analysis of the qualitative data showed how the learning environment of flipped learning and the concept of pre-classroom preparation contributed to the students' motivation levels, and these results helped to address the second research question deeply. The result also addressed Research Question Three to understand students' autonomous learning in two learning environments, and the findings demonstrated that the students in flipped learning hold a positive attitude toward their autonomous learning skills. Moreover, they show that they are more aware of autonomous learning skills. It also highlighted the useful affordances of flipped learning in enhancing students' autonomous learning. In addition, Research Question Four, regarding students' academic engagement, was addressed in this chapter. The findings showed that the process of learning and the role of the teacher in flipped learning improved the engagement of the students in their learning. In addition, there were difficulties from some students when engaging in the flipped learning environment, such as participating in the online discussion. Finally, this section answered Research Question Five, which focused on how the students perceive their learning environment in terms of understanding the differences between learning environments, and explored the understanding of how flipped learning students perceive the design of flipped learning.

Overall, the learning practices reported by students in focus groups and interviews, such as enjoyment learning environment, the role of the teacher, the use of Instructional video, the benefit of the online quiz, pre-preparation for the classroom were possible by using the design of flipped learning that was applied in the current study, where for the Saudi context it is considered to be unique. The next chapter will discuss both qualitative and quantitative findings to establish how the current study can positively contribute to research in the context of flipped learning.

Chapter Six: Discussion

6.1 Introduction

This study has explored the impact of flipped learning on students' learning experiences in Saudi Arabian high schools. The aim of the study was to investigate the impact of flipped learning on students' achievement, motivation, engagement and learning autonomy as a teaching method to teach Computer Science. To fulfil its objectives, the study used an embedded mixed-methods design and adopted a quasi-experimental format, as this enabled an assessment of the impact of the flipped learning on Computer Science students' learning experiences when the comparison was made between the flipped learning group (FLG) and non-flipped learning group (NFLG). Additionally, this was beneficial in determining why and how flipped learning affects students' achievements, motivation, engagement and learning autonomy. It also explored the group participants' perspective learning experiences on flipped learning and non-flipped learning in order to highlight flipped learning affordances. The current research incorporated quantitative questions, as well as hypotheses, together with a qualitative question.

This chapter includes a discussion of the findings for the research questions. Chapter Four presented the quantitative data that was ascertained through the questionnaires and pre- and post-test, which helped to answer the initial research question on achievement in learning and how a learning setting is influential upon motivation, engagement, and learning autonomy that connect with research questions 2, 3 and 4. Separately, qualitative findings were presented in Chapter Five that were taken from the focus group and interviews, which helped in the data cross-validation process from the questionnaire in order to present additional information in relation to the supporting setting that was set up for both groups of students. This was also beneficial in answering the fifth research question, which focused on students' perspectives on their own learning experiences in a flipped learning environment, in comparison to non-flipped. The overall results are taken from the quantitative and qualitative data, which are subsequently evaluated in correlation with other relevant studies, in order to provide justifications for specific findings.

Table 6.1: The Relevance of Each Section of the Discussion Chapter to the Research Questions

RQs / Sections	**RQ1**	**RQ2**	**RQ3**	**RQ4**	**RQ5**
6.1 The Impact of the Flipped Learning and Non-Flipped Learning Approach on Students' Achievement	√				
6.2 The Impact of the Flipped Learning Approach on Students' Learning Motivation		√			
6.3 The impact of Flipped Learning on Students' Academic Engagement			√		
6.4 The Impact of the Flipped Learning Approach on Students' Learning Autonomy				√	
6.5 Students' Learning Experiences in Two Learning Environments					√
6.6 Flipped Learning Design					√

6.2 The Impact of the Flipped Learning and Non-Flipped Learning Approach on Students' Achievement

One of the aims of this current study has been to examine the impact of flipped learning on students' achievements. This section discusses the result obtained from the pre- and post-tests, as well as the questionnaire, in order to examine the developments in students' achievements and their performance in two learning environments. In addition, this section discusses the qualitative results, as this will help to understand how different learning environments affect students' achievements and performance. This section relates to the first research question: "*To what extent did flipped learning affect Saudi students' achievements in first-year high school in Computer Science?".*

The results of the pre- and post-tests, in relation to achievement scores for students, addressed the first question, and demonstrated that there were not significantly different scores between groups in the pre-test (see Section 4.3.1). Hence, the students presented the same baseline test score, as well as prior to the intervention. Following the experiment, the results revealed that the students' scores in both groups increased. However, the students' achievement scores in the flipped learning were higher than in non-flipped learning, based on a Mann-Whitney U test ($U = 24$, $z = 7$, $p < .05$); thus, there are statistically significant differences with a large effect size ($r = .83$). The result rejected H0, but confirmed H1, which indicates that there is a significant difference in the scores for FLG. Thus, it can be claimed that the flipped learning approach has a positive impact upon students' achievement scores in Computer Science courses in Saudi high schools who adopt the mechanisms and processes as outlined within this study.

Furthermore, the above finding concurs with different research studies which demonstrate that flipped learning is positively impactful on students achievement in higher education (Yough et al., 2017; Santikarn & Wichadee, 2018; Karaca & Ocak, 2017); and at pre-university level (Chao et al., 2015; Bhagat et al., 2016; Baris, 2017). Even though there are studies that have found insignificant differences between student outcomes when they are compared to non-flipped learning (Clark, 2015; Huang & Hong, 2016; Esperanza et al., 2016; Lo, 2018), the current result correlated with a meta-analysis undertaken by Strelan et al. (2020). That study determined that flipped learning produced improved student performance through all different education levels, while the effect was moderately strong among secondary school students, and moderate among tertiary students. The current study specifically focuses on Saudi high school students, which add evidence to the research in a Saudi high school context.

In addition, the current study carried further examination regarding the flipped learning effect on different levels of students' achievement. The current study used the results of pre-tests to separate the student groups into three individual performance-based sub-groups (low, medium and high) (see Section 4.3.2). The results show that the students' achievement scores were at different levels from students' high achievements in flipped learning, compared to non-flipped learning (Low $U= 7$, $Z=-2.12$, $p < 0.05$), (Medium $U= 46$, $Z=-5.80$, $p < 0.05$) and (High $U= 21$, $Z=-3.75$, $p < 0.05$), and with a large effect size sequentially ($r= .80$, $r= .85$ and $r= .81$). This result presented that flipped learning can improve Computer Science students' achievements to a different level. These results contrast with the research studies by Bhagat et al. (2016) and Kostaris et al. (2017), as they determined that the flipped learning method would produce better results with lower attainment level students. In particular, Kostaris et al. (2017) analysed Computer Science and determined that the effect was on all students' levels, and particularly more with low performance students. The current study, nevertheless, may be able to improve upon the findings and demonstrate that flipped learning is able to augment students' achievement levels through all different attainment levels for Computer Science in high schools.

The current study also carried further comparisons between students' perceptions toward their performance and achievement in FLG and NFLG. This can help in the assessment of students' perceptions, as well as produce practical knowledge regarding participants' opinions, in order to ensure the significance of the difference between FLG and NFLG in terms of their performance and achievement. Regarding the result of the questionnaire, there is a statistically significant difference between FLG and NFLG students' responses in relation to their performance with $U = 84$, $z=6.74$, $p\ 0.05$ and the large size effect $r = .78$ (see section 4.3.3.1). Thus, the students through flipped learning hold positive perceptions toward their performance compared to non-flipped learning. Moreover, the students in flipped learning hold the same positive perception toward their achievement in Computer Science courses, with $U= 74$, $Z=-6.86$, $p < 0.05$ and effect size $r = .71$ (see section 4.3.3.2). This result, along with the pre- and post-test results assisted the researcher to closely observe the students' achievements and performance in the two learning environments.

It was also demonstrated how flipped learning students are more satisfied with the increased achievement scores compared to non-flipped learning. Moreover, students hold positive perceptions toward their achievements and performance, as they ascertain higher scores compared to NFLG. The findings of students' achievement scores and their perceptions could also add evidence of the possible impact of flipped learning on Computer Science high school students. Even though there are distinct limitations of past studies into the Computer Science field, there are some studies that have presented a positive impact on students' Computer Science achievements (e.g., Karaca & Ocak, 2017). It was also found by Seitan et al., (2020) that the flipped learning approach affected academic achievements positively in secondary students' Computer discipline. The current study showed further examination by adding students' perceptions regarding their learning performance and achievements, which were not covered by past studies.

Previous research has confirmed that flipped learning is impactful upon students' achievement levels, although no additional information has been presented to determine the reasons for this impact. Thus, the current mixed-methods study enabled the researcher to gain an in-depth understanding of how flipped learning affects students' achievements and performance via qualitative methods. Correspondingly, regarding the qualitative data, the students reported generally that flipped learning has a positive impact on their achievement in terms of helping them learn more effectively than the non-flipped learning approach did, which aligned with the quantitative results. Indeed, the results showed that the students in the FLG boasted of their high scoring achievements, which reflects how good their performance were; for example, FLG1 mentioned that *"my performance is good … I got a high grade"*; while FLG2 stated that *"I am satisfied with my performance as you can see my grade is 27"*. The students claimed that their performance was at a good level from the evidence of their scores, and it seems that the high scores made them satisfied with their levels of performance and achievement. In addition, the students in the focus group discussion reported that the shift of teaching method helped them; for example, FG1S2 added that *"the teacher changed the way of my learning, and this helps me to get a high score in the last exam"*.

However, the non-flipped learning approach, where the focus was on teacher-centred methods, did not show that the teaching approach contributed to their performance, even among some positive perceptions of the students' performance (e.g., NFLG1, NFLG4, NFLG8). The NFLG students reasoned their good performance to three reasons: the ease of the subjects; the in-home preparation using textbooks and Google; and interest in Computer Science. Overall, the comparisons of students' responses from two learning environments can generally support the claim that the nature of the flipped learning approach affects students' achievements (e.g., Karaca & Ocak, 2017). Further, the triangulation of the findings between pre-to post tests, the questionnaire, and qualitative data showed that the flipped learning approach contributed to the improvement of the students' achievements and performs in attaining high scores.

It can be determined that flipped learning enhances the potential for more practical learning, which helps students' increase their achievement levels, in comparison to non-flipped learning. Moreover, instructional videos, which were mentioned among most students in FLG, also helped. The students claimed that the videos make lessons and concepts of Computer Science easier; for example, FLG9 expressed that "*In my view, the video simplifies the concepts for me. An eight-minute video is better for me than a forty-five-minutes talk by the teacher*"; while FLG6 reported that "*the video helps to better understand and perform in Computer Science*". This concurs with previous studies, which have determined that instructional videos prove to be beneficial upon students' levels of achievement (Bos et al., 2016; Brame, 2016; Hew & Lo, 2018). The students could observe the instructional video many times, as this would assist in the improvement of comprehension, which links with the concept of ZPD for social constructivism theory. Vygotsky (1978) stated that students produce their most productive learning when information is processed correctly during their different stages of development, in order to be able to better understand into the future what has been learnt. In contrast, the students in 'NFLG reported that it was difficult to focus on the teacher's explanation and that they suffered boredom during the lecture (NFLG2, NFLG7). This can be explained by how the videos help to explain the concept of Computer Science in an attractive and helpful manner for the students compared to face-to-face lectures, where it is difficult for students to concentrate. Indeed, the cognitive load is potentially reduced due to the way that students can control their viewing frequencies and speed of viewing the material prior to the class, as learner-controlled videos support students to better understand learning material (Clark, Nguyen & Sweller, 2005).

In addition, the students in flipped learning reported that the use of the LMS platform enabled them to review the instructional videos and other learning resources at any time; in contrast, the NFLG students faced difficulty that the teacher could not cover all the concepts or would completely leave some complex points unexplained, which could be due to time limitations. Consequently, it appears that the students in flipped learning benefit from the use of LMS, as the reference of learning resources enable them to learn and review without the issue of missing information; while the students in the NFLG faced this issue, which could affect their performance in the long term. For example, it was mentioned that *"the teacher did not cover the concepts in more detail, and he sometimes skipped them … In the exam, I will not then be able to understand some of them even if I read the textbook"* (NFLG5). Moreover, the class time limitations could lead to issues, as mentioned in students' discussions, particularly that the concepts and information in the Computer classroom were not explained sequentially, which influenced their understanding. For instance, "*the teacher did not sometimes explain the concepts fully and sequentially in one lesson because of the time … He continued the following day when I definitely forgot the information … This made feel lost, especially in the Linux unit*" (FG2S3). Hence, the use of LMS as a platform allowed students to work at their own frequency and speed, with the learning resources helping the students to perform better when they have their time to review, in contrast to a live classroom, which coincided with the study by (Louhab et al., 2020; Oguguo et al., 2020).

Furthermore, the findings from the qualitative data in Chapter Five show that using online quizzes in flipped learning group is an effective learning practice that impacts on the students' performance in a FLG. The students in the interview and focus group agreed in terms of the contribution of using quizzes to enhance their performance, with it seen as significant as a tool of regular evaluation. The use of quizzes in the design of flipped learning as a tool function in the evaluation of students' understanding of the effect on their performance levels; also determined by Flynn (2015) and Wilson (2013). Additionally, the findings were confirmed by a large-scale study carried out by Zhang et al. (2016), which found that taking a quiz multiple times promote Computer Science students' learning. Comparatively, the students in the NFLG did not receive this form of practice, as the students reported that they did not have a weekly assessment that could help them to track their performance. The effect of this can be clear, as FG2S2 reported that "*we were surprised about our performance when the teacher announced the results of our first unit exam, and it was difficult to improve our performance in the second unit because we were still struggling in the first unit, and this situation was repeated"*. So, it can be argued that the use of online quizzes for the regular evaluation of student's performance levels can help students to track their performance, which could enable them to improve their performance level; this distinguishes the flipped learning approach. Accordingly, quizzes have been noted to prove beneficial, due to their similarity to testing (Dirkx et al., 2014), stated. Meanwhile, a meta-analysis review by (van Alten et al., 2019) showed that students would improve better following the implementation of quizzes in comparison to classes without them.

Previous studies have stated that flipped learning enables teachers to provide their students with classroom activities that are able to enhance achievement levels (Hodkiewicz, 2014; Zhang et al., 2016). In the current study, the flipped learning design utilised problem-solving and collaborative learning activities, which were found in qualitative data as a factor that improves students' performance. For example, FLG3 stated that "*my performance has improved throughout the learning process, but the most effective part was classroom activities where we were encouraged to work … This pushed me to work hard to catch up with my classmates*". This finding correlates with the research by (Wang, 2017), who demonstrated that flipped learning is effectual upon Computer Science students' achievement levels due to engaging activities proving beneficial. Similarly, (Kyndt et al., 2013) has provided results that show the benefits of co-operative learning.

Flipped learning arguably enables teachers to make their classroom environments conducive to active learning (Bergmann & Sams, 2012; Hamdan et al., 2013; DeLozier & Rhodes, 2017). Flipped learning through numerous active learning techniques has also been highlighted in the improvement of exam scores (Flynn, 2015); this coincides with the current study (see Chapter Five). This finding was also confirmed by van Alten et al. (2019), who conducted a meta-analysis that included eligible comparative studies (28 in total), which demonstrated that students improve their achievement levels through active learning, as this augments constructive and interactive engagement in the classroom. Additionally, teachers can be available to have discussions and provide feedback on students' performance levels. For example, FLG6 added that *"in the class, I had the time to ask the teacher and have a one-to-one discussion with him … He was keen to see all students giving a high-level performance"*. Kostari et al. (2017) also noted that student performance levels improved following formative feedback from teachers in face-to-face sessions, together with from other students during collaborative activities.

Previous research has shown that teachers for Computer Science need to apply greater levels of effort in attempting to make the subject learning process more amenable to students, which is achieved through sufficient working boundaries in order to implement the different ideas and abilities, including computational thinking (Bender et al., 2016). Hence, the current study argues that flipped learning could be one of the possible teaching approaches for Computer Science. This point is also supported by the past studies that focus on using flipped learning in teaching programming, which has determined a positive effect upon students' performance levels (e.g., Karaca & Ocak, 2017; Psycharis & Kallia, 2017; Tugun et al., 2017; Yildiz-Durak, 2018). Indeed, the flipped learning design could enable a Computer teacher to reshape the learning process where he could prepare the students by exposing them to the foundation knowledge using the pre-classroom phase, particularly instructional videos. This would be followed by implementing classroom time to focus on higher-order thinking tasks via problem-based activities and collaboration activities.

Hsu et al. (2018) conducted a study that utilised problem-based learning in Computer Science, together with the method of collaborative learning, which included programming as the most optimum form, which is utilised in teaching computational thinking. In the Saudi context, flipped learning can suggest teaching Computer science in high schools, where the three central concepts of the Computer Science curriculum are contemporary applications, programming, and digital citizen; with these subjects including many practical lessons. Indeed, lessons such as design, producing multimedia, and coding, require time to practise, while applying flipped learning seems beneficial, where the pre-classroom phase helps the Computer Science teachers to offer their students basic theoretical information, as well as utilising the whole period of class time for intensive practice with the supervision of the teacher.

Overall, this section has attempted to answer the first research question, with the mixed-method results showing that flipped learning can affect positively on students' achievements and can also affect the different levels of students' achievements. The use of instructional videos and the potential to improve students' performance and the use of online quizzes as self-evaluation tools also help students to track their performance. In addition, the design of flipped learning involved t students in the active learning process in the classroom via problem-solving activities and collaborative activities, which enhanced the students' achievement in the Computer Science course. In accordance, social constructivism theory explained how the Computer Science students in flipped learning learnt through exposure of new knowledge at home, as they were able to understand basic forms and then construct new knowledge by becoming involved in social learning in the classroom. What is more, the comparison between the two groups found that students in the flipped learning enhance their performance, compared to the non-flipped learning students, who have faced certain issues, such as unattractive lectures, uncovered concepts, and being inactive learners, which affects negatively on their achievement levels. The potential of flipped learning, nevertheless, seems to be able to overcome these issues that occurred in non-flipped learning. The current study agreed with (Yildiz-Durak, 2020), as it was noted that extracurricular videos and course content for flipped learning enables additional time for students to implement learning in an active manner. It was also added by Yildiz-Durak that learning the concepts that comprise Computer Science outside of the classroom environment is beneficial, such as tutorial videos which prove effectual upon the attitudes of learners when undertaking challenging tasks, which affects how programming is developed.

6.3 The Impact of the Flipped Learning Approach on Students' Learning Motivation

This section aims to discuss the main findings from the second researcher question: "*To what extent did Flipped Learning affect Saudi students' motivation in the first-year high school in the computer science subject?*". The questionnaire produced quantitative data that helped to determine the differences of students' motivation in the flipped learning approach and non-flipped learning approach. In addition, the qualitative data obtained from the focus group and interviews were used to gain in-depth understanding of the flipped learning effect on students' motivation.

Determining students' motivation levels was undertaken by requesting the groups to show their answers to statements in two sections in the questionnaire: section one was aimed to provide measurements of intrinsic motivational levels in students within the process of learning Computer Science in comparative flipped and non-flipped learning; the second section measured the extrinsic motivation. In terms of intrinsic motivation, the results show that there were differences in students' intrinsic motivation, with a higher score being noticed for most of the statements in FLG, compared to non-flipped learning (see Section 4.4.1). The findings of the current study also showed that students in flipped learning presented higher excitement levels compared to the NFLG. Moreover, they showed the capability to administer their learning and abilities to interact and communicate with peers. In addition, the students showed the motivation to learn new ideas compared to NFLG. Based on Self-determination theory, it can be claimed that flipped learning improves the students' intrinsic motivation by enhancing the three psychological needs: autonomy, competence and relatedness. Intrinsic motivation has been shown to be driven by three clear psychological requirements for all individuals: firstly, autonomy, which is the aim to gain personal ownership of one's actions; secondly, competence, which is the aim to create desired outcomes and ability; and thirdly, relatedness, which is the ability of feeling connected to others (Niemiec & Ryan, 2009). Comparatively, it proves detrimental to intrinsic motivation when these three psychological needs are not achieved (Wang et al., 2019). It can be said that flipped learning helps Saudi Computer students to achieve these three psychological aspects, which reflect on their high intrinsic motivation.

The statistical results of the domain of intrinsic motivation show that there are significant differences in students' intrinsic motivation levels; the Mann-Whitney test was $U= 139$, $Z=-6.20$, $p < 0.05$ and large size effect $r =.72$. This result revealed that the students were intrinsically motivated as a result of enjoyment from the flipped learning environment. Students who are intrinsically motivated commonly search for innovative concepts and challenging tasks, as their levels of exploration, learning, and knowledge expansion start to grow whilst practising their skills (Ryan & Deci, 2000). Likewise, it has been stated that flipped learning develops better competence, autonomy and relatedness, and thus, student motivation levels increase (Abeysekera and Dawson (2015). The finding of the current study argue that flipped learning can promote students' intrinsic motivation, which agrees with the results of previous studies (Segura-Robles et al., 2020, Zainuddin and Perera, 2019). In particular, the study undertaken by Zainuddin and Perera (2019) found that flipped learning increased students' intrinsic motivation to learn English as a Foreign Language (EFL). The current study could add to literature on how flipped learning could enhance intrinsic motivation for students to learn Computer Science courses.

In relation to extrinsic motivation, the students had similar mean agreement scores in a statement about having to learn Computer Science, as this course was compulsory, and they feared punishment from the teacher and the mean score showed that the students in both groups disagreed about these statements (see Section 4.4.2). However, the flipped learning students showed high motivation to learn Computer Science when finding a good job, and the importance to show their ability to others and get a good grade. Hence, the comparison of the extrinsic motivation of students in flipped learning and non-flipped learning shows that the difference was statistically evident with ($U= 419.5$, $Z=-3.13$, $p < 0.05$) with a moderated size effect of $r= 0.364$. Similar results were found in a study on elementary school students who learnt Computer Science, where the students showed a high level of extrinsic motivation to learn Computers (Mladenović et al., 2015). Even though the results of the current study indicated the positive impact of flipped learning on students' extrinsic motivation, the differences between the two groups were not too obvious, as observed in intrinsic motivation. Furthermore, the qualitative results show that both groups of students reported that the importance of Computer Science motivated them to learn the subject (See section 4.2.2.3). The students from both groups shared the same views regarding the importance of the subject for their future, receiving a grade and developing an interest in some lessons, which were all factors that extrinsically motived them. What is more, the majority of the flipped learning students demonstrated higher levels of intrinsic motivation to learn Computer Science through this approach, with the evidence also highlighting that they were extrinsically motivated to learn Computer Science in order to obtain good grades, and thus, be able to acquire a good job later in life.

In general, the current study has examined the overall concept of motivation, which includes extrinsic and intrinsic motivation domain to determine the differences between the overall students' motivation levels in the two learning approaches. The results from the total motivation domain show that the students in a flipped learning environment were better motivated than those receiving non-flipped learning, with a Mann-Whitney test $U= 121.50$, $Z=-6.36$, $p < 0.05$, and with large size effect at $r=.74$ (see Section 4.4.3). Thus, the researcher rejected the null hypotheses based on the p-value, and accepted the H1, which indicated that there is a difference in students' motivation levels between the FLG and NFLG. This result is compatible with the previous studies (e.g., Hwang & Lai, 2017; Davies et al., 2013; Tawfik & Lilly, 2015; Baris, 2017; Chen et al., 2017; Seitan et al., 2020), which have indicated the effects of flipped learning in terms of promoting students' motivation to learn. The added value of the current research is that the flipped learning approach could encourage students to learn Computer Science in a high school context in Saudi Arabia.

The qualitative findings show that the students in the non-flipped learning group who were taught using the lecture method demonstrated how this approach did not help them to improve their motivation levels. As implied in their responses, the students criticised the learning style and how it was not appealing to them; thus, negatively affecting their motivation. They agreed that the routine of the classroom environment did not help them to become motivated during their learning journey of Computer Science subjects. Their definition of a routine in relation to the classroom lecture was that *"the teacher stands in front of us and speaks about the lesson for the whole duration of the class"* (FG2S1). This correlates with (Alrabai, 2016, Al-Harbi & Alshumaimeri, 2016) who stated from their research findings that a teacher or teacher-led lecturer who exercises too much control in Saudi Arabia often negatively affects motivation levels in students. In accordance, Law et al. (2010) added that students commonly lose their motivation levels quickly in Computer Science subjects, which can include programming.

Therefore, in the field of teaching Computer Science, there is a need to employ a teaching approach that can encourage students to learn; especially nowadays, there is a demand in education 4.0 to increase students' technology skills. Indeed, one of eight critical characteristics in learning content and experiences has been identified to define high-quality learning in the Fourth Industrial Revolution, which is the improvement in Technology skills (The World Economic Forum Report, 2020). It is important to consider that the new generation could inherently be motivated to learn Computer skills through understanding its importance to their own future; however, teaching methods could potentially affect negatively upon their motivation. Indeed, there is an attempt in Saudi education to encourage the teachers of Computer Science to keep abreast of new and effective teaching methods in order to ensure that the students are motived to learn Computer Science concepts and skills. One of the studies in Saudi Arabia has recommended Computer Science to be taught in order to better develop these skills using blending learning methods, which combine digital instruction and one-on-one face instructions in a traditional classroom setting (Malik et al., 2018). Thus, it can be said again that using approaches, such as flipped learning, could attract students and motive them to learn Computer Science. Specifically, flipped learning can be one of the suggestions that could be implemented in teaching Computer Science in Saudi Arabian High Schools.

Furthermore, the current study used qualitative data to understand how flipped learning could positively affect students' motivation levels, as the interview and focus group findings show compared to non-flipped learning (see Section 5.3). In the current study, the students in flipped learning perceived that the components of the flipped learning environment enhanced their motivation to learn. In fact, the positive students' impressions of the flipped learning environment play a key role in enhancing their motivation to learn. Correspondingly, it has been noted that the motivation levels of students can be changed through their own perceptions of their classroom setting (Meece et al., 2006). The flipped learning students also mentioned elements such as the instructional video as enhancing their motivation to learn. Indeed, Chao et al. (2015) state that videos help to increase students' motivation levels in flipped learning settings, which is also shown by (Kay, 2012, McGarr, 2009). Additionally, students have been shown by Muir and Geiger (2016) to increase their relatedness levels to the subject and teacher using videos in lessons in comparison to external videos; thus, increasing their motivation. The students in the current study experienced two types of videos (one created by the teacher and the other by the researcher), and it seems that both formats can motivate the students to learn through a more fun and interactive medium of learning.

Furthermore, the students reported that the group tasks, including discussions with classmates and problem-solving activities, encouraged them to learn during the classroom (FG1S2, FG1S5). Psycharis and Kallia (2017) found that through PBL, students would increase their motivation levels, demonstrate better autonomous learning and self-efficacy, in comparison to those who did not engage with PBL. Thus, PBL activities in flipped learning can play distinct roles in improving motivation levels. The students also mentioned that working and collaborating during group activities proved to be an incentivising factor and provided them with a sense of equality and fulfilment (FG1S1, FG1S5). In accordance, students' motivation levels have also been shown to improve through flipped learning setting through the utilisation of collaborative activities (Clark, 2015). Additionally, Lam et al. (2020) found that in-class active learning activities motivated student-to-student interaction. It can be argued that using active student-centred activities in flipped learning settings enhances students' motivation levels positively (Baeten et al., 2013).

It can also be argued that the advantage of flipped learning, when compared to non-flipped learning, is that it enables free class time for the Computer Science teacher to apply motivational activities such as mentioned by the students. The current study offers a suggestion to any Computer Science teacher who employs PBL activities and collaborative activities as pedagogical practices in the design of flipped learning, as they can motive the students to learn. Furthermore, the students in the current study reported that when a teacher continuously monitors and encourages them during classroom activities, it is a major motivational aspect to learn Computer Science (FG1S4). The flipped learning environment enables the teacher to play the role of facilitator in the classroom more than the delivery of knowledge (Bergmann and Sams, 2012), which can evidently play the role to motivate students to learn. Hence, the abovementioned learning practices combined together distinguish the flipped learning environment in terms of enhancing students' motivation in learning Computer Science.

The qualitative findings showed that the pre-classroom phase plays a vital role in terms of enhancing students' motivation (see Section 5.3.2), which can explain the importance of pre-classroom in the flipped learning design. It appears that using technology tools has helped enhance students' motivation for 'at-home' learning, which has less pressure. A student from (FLG4) emphasised that *"preparation at home using the Internet without the pressure of missing out on information helps me to be motivated in my Computer learning"*. In addition, the 'at-home' learning approach was more attractive than undertaking traditional homework (FLG2). The students felt enjoyment in learning in the pre-classroom stage using technology in the form of online quizzes and instructional videos, as well as online discussions, which seem relevant to the new generation to increase their motivation to learn. This finding concurred with (Kurt, 2017), who found that students are generally more satisfied with flipped learning as they engage better with the subject, due to the opportunity to direct their own learning experience during the pre-classroom phase.

Indeed, researchers have mentioned the positive effect of using digital tools to enhance students' motivation levels (Lin & Chen, 2017; Jeno et al., 2019). Correspondingly, (Bin-jomman & Al-Khattabi, 2018) undertook a study set in Saudi Arabia, which directed experimental research through the comparisons between a control group and an experimental group in order to measure how Web 2.0 technology is effectual on Saudi Arabian students' motivation levels. It was determined following the results that there was a marked contrast between the two groups regarding the use of Web 2.0 technology. Hence, the use of digital tools in the pre-classroom phase is one of the factors that makes flipped learning enhance students' motivation. Moreover, the current study can deduce that Saudi students were attracted to using technology through the flipped learning process, which affects positively on their motivation.

The impact of pre-classroom activities appears to lead to increased students' motivation in-classroom activities, as students mentioned that their increased interest in learning stemmed from coming to class well-prepared and in gain knowledge before the lesson (FG1S1, FG1S3). Additionally, it was believed that the pre-classroom activities would give them the extra edge, which would result in them becoming more confident and enthusiastic about attending the class (FG1S2). It shows the importance of the pre-classroom phase, which positively affects students' motivation to learning in the classroom. Nevertheless, when students fail to engage with preparatory activities prior to a class due to lack of motivation, there are potential negative effects, as it will be challenging for new learning materials to be applied in the class by the students (van Alten et al., 2019). At the beginning of the study, the researcher and the teacher explained the possible benefits of flipped learning for students, which seems play a key role in keeping them motivated, especially during pre-classroom activities. The instructions to students in regard to how flipped learning will enhance their progress will help to augment motivation levels to study pre-class (ibid).

6.4 The Impact of Flipped Learning on Students' Academic Engagement

It has been determined that many Computer Science departments aim to improve teaching standards and techniques through the introduction of new approaches and pedagogies that will better engage students (Sinclair et al., 2015). One of the aims of the current study is to find out to what extent flipped learning impacts on Computer Science students' academic engagements at Saudi high school level. The flipped learning approach has received significant attention in higher education, as it provides an instructional method that increases learning engagement (Doo & Bonk, 2020; Kim, 2017; Chen Hsieh et al., 2017; Louhab et al., 2020; Butt, 2014; Mortensen & Nicholson, 2015); and at a pre-university level (Chao et al., 2015, Muir & Geiger, 2016; Baris, 2017). The results from the current study are compatible with these studies, as it has found that the students were more engaged with Computer Science when using flipped learning compared to non-flipped learning (see Section 4.6); with a Mann-Witney $U= 231$, $Z=-5.10$, $p < 0.05$ .Thus, this result rejected the null hypothesis and accepted *H1*, which indicates that there was a significant difference in the academic engagement of students between FLG and NFLG. Similarly, the size effect was calculated to identify the extent of the difference, with the effect at moderate regarding the Cohen guideline ($r=.59$).

Analysis of the qualitative data aligns with what the quantitative results reveal about the students in a flipped learning group, as they agreed that they were more engaged in a Computer Science environment compared with the responses of non-flipped learning students. Specifically, in contrast to traditional learning techniques, flipped learning had a significant effect on Maths and English students' perceived learning engagement, as shown by Hung (2015) and Clark (2015), who both utilised quantitative and qualitative methods in their research. Additionally, the present study contributes to the growing body of research that demonstrates one of the benefits of flipped learning, particularly on teaching Computer Science in high schools. However, it is important to understand how flipped learning could enhance students' levels of engagement; thus, the following paragraphs attempt to discuss and explain that.

The analysing of the frequency of students' responses to the statements in the engagement domain showed that the FLG were more engaged than in the NFLG, where most of the students in the FLG responded that they often engaged in classroom discussions, communicated with peers and their teacher; while the students in the NFLG stated that they only engaged occasionally (see section 4.5). The students clearly stated here the extent of utilising the advantage of flipped learning, which employs active learning activities in the classroom, which allows students to more actively, in comparison to non-flipped learning. Indeed, active learning activities (i.e., teamwork and discussions) encourage higher levels of engagement (Prince, 2004, Burke & Fedorek, 2017). In addition, almost half of the students

(*N=14*) in the NFLG reported that they never prepare for the classroom, while in the FLG, no one responded that they never prepare, which might show the effect of the pre-classroom phase of the flipped learning approach, where the students needed to watch the videos and do the quizzes. There is also evidence that the students engage out of the classroom via online learning, compared to non-flipped learning. This result concurs with (Jensen et al., 2015) who undertook a comparative quasi-experiment, which showed that students who engage with flipped learning complete their pre-classroom homework to a greater extent than students from non-flipped learning settings.

It can be clearly seen that most students in the FLG (N=35) often engaged with instructional videos compared to the NFLG, where just 10 of the students reported that they often engaged with the teacher's explanations, which showed that the instructional video was far more engaging for students, compared to the teacher's lecture. It could be argued that the use of an instructional video could engage the students more than the teacher's explanation in the classroom. The teacher's explanation in the classroom could have disadvantages, such as that the students could not pay attention for a long time and there is chance of missing information, which normally occurs due to the students' diversity in their abilities. Indeed, instructional videos have been shown to prove advantageous to participation levels, emotional and content engagement (Carmichael et al., 2018). The following parts of this section discuss the sub-themes emerged from qualitative data in regard to the students' engagement, which is divided into three sub-themes that discuss the impact of flipped learning on students' academic engagement, alongside the difficulties in students' engagement in flipped learning.

6.4.1 Process of Learning

The analysis of qualitative data showed how effective the learning process of flipped learning helped engage students' learning (see Section 5.5.1). In fact, most of the students in the focus group reported how the process of learning in the classroom was engaging. As stated by most of the FLG, "*the online learning and the classroom environment enhanced our engagement in the Computer Science class*" (FLG1S4). The students also mentioned that watching videos and writing questions, and subsequently discussing them in a teacher-led setting, which increased engagement levels (FLG3, FLG7). This correlates with (Kim, 2017, Chao et al., 2015) who presented findings on flipped learning that show that the learning environment provides learners with increased flexibility to interact with other students and the teacher, with collaborative tasks improving students' engagement levels. Thus, it is evident that the process of learning in a flipped learning approach helps students to become engaged in the Computer Science classroom. On the other hand, the findings of the NFLG revealed that all participants struggled to engage in the Computer Science classrooms: *"It was difficult to focus or get engaged in the Computer classroom"* (FG2S1). They indicated that the learning process had a negative effect: *"we could not engage with the teacher's way of teaching Computer Science"* (FG2S2). It appears that the process of learning in two different learning environments plays a role in terms of enhancing students' engagement; this was also found by (Hung, 2015).

One of the obstacles faced by the students in the NFLG was in understanding the lesson, which failed to keep them engaged in the classroom. This issue was raised in the students' discussion during the focus group, with FG2S4 and FG2S5 both mentioning that *"it all depended on whether I could understand the lesson at the beginning of the class … I felt that if so, I could engage in all class-time"* (FG2S4); as well as *"if I could catch what he tried to teach us, I would engage during the class, but if I couldn't understand, then it's difficult to engage"* (FG2S5). As can be suggested from the students' perspectives, they felt that their levels of engagement were affected due to the lack of understanding of the lesson provided, which could be ascribed to the process of learning, including the lack of pre-information regarding the lesson. In contrast, the students in the FLG expressed that the process of learning, particularly the pre-classroom activities, helped them to gain a better understanding, which further enhanced their engagement in the classroom. They explained how pre-classroom engagement helped them in terms of being engaged and proactive in the classroom: *"… I have become more confident answering the questions and participating in group tasks"* (FG1S2); and *"I come to the class with at least some knowledge of what the lesson is about"* (FG1S3).

Similarly, Hodklwicz (2014) found these results from a quantitative study, where students stated that undertaking pre-class preparation helps engagement levels to increase in regard to lecture activity workshops. It seems that the process of learning based on the flipped learning approach enhances the students' engagement, as clearly manifested in their engagement in the pre-classroom phase, which also reflects on their engagement during the classroom session where they felt confident and prepared to participate. Flipped learning enhanced active involvement in learning activities, as demonstrated by (Lo and Hew, 2017, Tütüncü and Aksu, 2018), as teachers from the studies remarked upon student pre-class preparation and increased active engagement during the class with a flipped learning approach. The flipped learning process, such as aforementioned, provides the students to understand well the concepts of Computer Science compared to the teacher-centred approach, such as through lectures, which were used in the control group which clearly showed how flipped learning, especially in the pre-classroom phase, enhances students' engagement in the in-classroom phase. This was a clarification example of implementation of flipped learning from the current study. The students learned how to produce multimedia, such as videos, where they were first exposed to basics knowledge concepts (i.e., types of multimedia, principles of design, the software that could use and how to use it, etc.). This functioned as preparation for the students in the pre-classroom phase with this knowledge found to make them confident to engage in classroom activities that required the application of this knowledge, such as working in groups to produce videos (i.e., for climate change) by applying what they had learned during the pre-classroom phase. Therefore, a teacher who applies flipped learning should ensure that students engage with the pre-classroom phase in order to avoid any disengagement in the classroom. A teacher may achieve this by tracking the results of the online quizzes and log-on systems' static, which could signify students' preparation levels. What is more, it was clear from the present study that the flipped learning design of pre-classroom and in-classroom activities complements each other, even in term of students' engagement.

Further analysis was subsequently carried out in order to understand how the students engaged in the pre-classroom phase. The findings showed that using the technology tools played a key role in engaging the students in the pre-classroom phase. The students in the interview reported how they engaged with pre-classroom, with the use of video clips and online quizzes in the process of learning mentioned as elements that contributed to the enhancement of their engagement (e.g., FLG1, FLG2, FLG9). This could demonstrate the effect of the design of flipped learning based on interactive technology tools, particularly during the pre-classroom phase in terms of helping to engage students in some prior knowledge regarding the lesson. This result concurred with Zhang et al. (2016), who carried out a study on the higher education level, and found that online homework increases students' engagement levels with studying Information Technology courses. Likewise, Clark (2015) undertook a separate study, which included participants who stated that the use of technology in flipped learning settings augments their sense of engagement. Previous research studies in general, in relation to educational technology, have determined that the utilisation of technology in learning helps students to engage more in their learning (Boyce et al., 2014, Casey & Jones, 2011). In an effort by the Education Ministry of Saudi Arabia to integrate technology into teaching practices, they could consider the benefit of a flipped learning approach as a form of utilising the advance of technology in teaching practice to enhance students' engagement.

According to most students' responses, the instructional video was quoted as an essentially tool for the engagement in the design of flipped learning, despite the whole process. This finding could clarify the effectiveness of using the instructional videos in the flipped Computer classroom. In a study carried out among Maths students, it was found that the instructional videos were perceived to help engagement and improve their overall learning process in Maths (Muir & Geiger, 2016). Indeed, media helps to engage students more, and improves knowledge retention through relevant illustrations of different concepts, as well as to increase interest levels in learning (Calhoun and Mateer, 2011). It is also worth mentioning that the median of instructional video length was used in the current study at 6 minutes, which was suggested by (Brame, 2016) to be the maximum median engagement time for a video, as student engagement would decrease when longer. Likewise, Guo et al. (2014) stipulated that videos that do not exceed 6 minutes are the best to engage students. Meanwhile, Bond (2020) states that videos on YouTube or the Khan Academy are particularly useful to increase enjoyment levels, although they should be seldom used, in order to activate their full benefit (Bond, 2020). In general, the tutorial videos that explain the use of software or programming are often of long duration. Thus, it can be advised for Computer Science teachers who would like to implement flipped learning to use short videos, particular tutorial videos of practising, such as coding or how to use software and avoid using long videos.

6.4.2 The Role of the Teacher

The second observation in the qualitative findings of the students' engagement was the importance of the teacher's role (see Section 5.5.2). Closer scrutiny of the data of the focus group showed how important the role of the teacher was and how his presence during the classroom kept students engaged, as highlighted by the respondents in the FLG (e.g., FG1S3, FG1S4). It can be stated that the teacher in the flipped learning approach plays an essential role in terms of promoting students' engagement by acting as a facilitator during the class time. In addition, the students showed a good relationship with the teacher due to the support provided with their tasks (e.g., FG1S5). Accordingly, it has been acknowledged by Krause (2005) that a teacher/instructor is vital in enhancing students' engagement levels. Hence, flipped learning settings offer social environments that enable good relationships between students and teachers, which can boost students' academic engagement. Indeed, the significance of the teacher-student relationship has been shown to be important in developing student engagement (Parsons and Taylor, 2011, Martin and Collie, 2019, Wang and Eccles, 2012). In a similar manner, Günüç and Kuzu (2014), and Linvill (2014) have emphasised that the interaction between students and their teacher (both inside and outside the classroom) proves beneficial to engagement levels.

The results of the current study show that flipped learning enables teachers to become more connected with their students and to make space for them to interact, which enhances student engagement. What is more, the results of the systematic review presented by (Bond, 2020) showed that flipped learning can advance better equality in a learning setting between a teacher and the students, which was deemed to be one of the most beneficial of flipped learning. From the findings of the current study, it appears that the teacher helped the students to engage by directly encouraging them to participate in the classroom activities. For example, according to one student (FLG8), "*in this semester, I was more engaged in the Computer classroom … The reason is that the teacher allowed me to engage in class and encouraged me to participate in the group discussion.*" Also, the approachability of the teacher in the classroom seemed to be an additional factor in terms of stimulating increasing learners' engagement in the classroom; for example: *"I was an active student asking my classmates and teacher; the teacher was answering all my questions which encouraged me more participation in classroom"* (FLG7). A good explanation of this finding has been presented by Bryson and Hand (2007) who state that the teacher's disposition generally improves a student's disposition; with a teacher who is enthusiastic stimulating better engagement. Bryson and Hand (2007) also determined that students commonly increase their levels of engagement when teachers support them and provide learning settings that augment accessibility to interact and increase academic discussions. Indeed, flipped learning provides the Computer Science students with an inviting learning environment, which reflects positively on their academic engagement.

In contrast, non-flipped learning students in the interview mentioned that the teacher was in full charge of the class/activities and made use of all the class time, which indicates that they did not have the opportunity to engage during the classroom (NFLG6; NFLG2). The students also stated the difficulty of focusing on the teacher's explanations for a full 45 minutes, which also seemed to be a recurring issue that the students encounter in all subjects. This finding clearly stipulates to the all-influential role of the teacher in the NFL, as he holds total authority of the class-time, which leads to the students' lack of engagement or, at best, a low level of engagement, especially in the classroom. The role of the teacher in the NFLG takes full charge of the class, which make the students become more passive learners, and thus, it is difficult to promote students' engagement compared to the FLG, where a teacher is a facilitator. Regarding the teacher-centred approach, which is prevalent among Saudi teachers (Bou Aishah, 2018; Khoshaim, 2017), it seems not to affect Computer Science students' engagement levels, as students miss the space to communicate or to interact with teachers or classmates during the classroom. Communication could be required across different disciplines, as it is one of the 4c skills; however, in Computer Sciences, the benefit of the communication between students is when involving them in group-tasks, where the more knowledgeable students help the less knowledgeable students. In addition, this functions to acquire the skills of communication and exchange the experience. The current study found that the advantage of flipped learning is the student-centred approach, which helps the students to engage in the classroom through the students who can interact and communicate with their teacher and classmates. Zepke et al. (2014) specifically stated that a learner-centred approach improves overall students' engagement, while according to Umbach and Wawrzynski (2005), engagement is improved when teachers actively encourage relationship development through communication of high expectations, quality feedback, learning activity diversity, collaboration, and the implementation of more challenging cognitive activities.

Additionally, the students in the current study emphasised that the learning environment in the Computer lab can easily distract themselves, as while the teacher was explaining, most of them were busy with their Computers. These participants noted that the teacher's lack of Computer lab management impacted negatively on their engagement within the classroom. This finding demonstrates how teaching approaches, such as flipped learning can help Computer Science teachers to overcome this kind of issue, which affects students' engagement levels. Flipped learning can help a teacher to initially establish a social environment and have a good relationship with the students, which can be possible when flipped learning enables the students to transfer the knowledge to more practical activities (Johnson & Renner 2012). In this process, each group of students becomes involved in a task, where the teacher is free to move around the groups and encourages the students to engage in their learning, without worrying about gaining the attention of all the class for the full 45 minutes, while simultaneously delivering the lesson, which is difficult to manage.

6.4.3 Difficulties in Students' Engagements in Flipped Learning

Analysing the qualitative data showed that there were some difficulties faced by the students in the flipped learning environment, which could affect their engagement (see Section 5.5.3). For instance, one student struggled to engage with materials, such as the recorded video, where he could not interact with the video to ask or express ideas (FLG4). This point showed how some students could potentially lose the interaction with the teacher during the video, which could lead to disengagement from the students with learning the content. It can be a disadvantage of the used video in the design of flipped learning, although the teacher can overcome it by encouraging the students to become involved in online discussions while simultaneously watching the videos. It is also possible to utilise social media tools, such as WhatsApp to ensure fast interaction, as the teacher or other students could respond to students when they have a question. Social media applications and mobile applications, as shown by Imlawi et al. (2015), help to provide opportunities to develop online groups and increase communication and education processes. Student engagement is enhanced through social networking during courses, as learning motivation and satisfaction increase (ibid). Using social media for online discussions could be a solution for another flipped learning challenge, as mentioned by the participating students, which was the difficulty to engage in online discussions via online forums. For example, student FLG5 reported that "… The online discussion had to be in written form, which was not interesting for me, and I could not engage with it … It would be better if we used Zoom".

Another interesting find was that of a student who expressed that he was engaging with the instructional video only in the first few weeks. Afterwards, he lost that sense of engagement, which he ascribed to the design of the video being the same for the whole duration. Despite similar comments from a small number of students, it was determined that the design of the video generally helps students' engagement. Indeed, the video is one of the important of the design flipped learning (Bond, 2020; Zainuddin et al., 2019), where students are exposed to knowledge and acquire the information they need to engage in the learning process. However, this finding assures the importance of carefully considering the design of the video to ensure that the students engage with one of the main learning resources in the flipped learning approach. In the current study it was very important that students watched the video at home to enable them to effectively practice in the Computer lab on activities such as designing a blog. If most of the students did not engage with the video that would mean that the teacher would re-explain the lesson or ask the student to watch the video in the classroom. Indeed, both solutions could take time and affect negatively upon the time of practice and application. Particularly, the advantage of flipped learning in Computer Science, where most of the lessons are practical, enables more time for students to practise, so any disengagement of the student with the instructional video or any online resource could threaten the success of the implementation of the flipped learning approach. Subsequently, in Section 6.6 there are more discussions of the use of instructional videos in a flipped learning design, which highlights impactful use.

6.5 The Impact of the Flipped Learning Approach on Students' Learning Autonomy

Nurturing students' autonomous learning both in and out of school is one of the aims of education across the world in general, and currently in Saudi Arabia in particular. School learning outcomes should encompass being equipped with autonomous learning skills, due to their significance for the workplace (Luna Scott, 2015). Moreover, success at a university level can be considered as another factor in the importance of independent learning (Field et al., 2014). Subsequently, the current study aimed to examine the impact of flipped learning on students' learning autonomy in order to address the question: "*To what extent did flipped learning affect Saudi students' autonomous learning in first-year high school in Computer Science?"*. Data collected from the questionnaire, semi-structured interview and focus group showed that the flipped learning students were more autonomous learners than non-flipped learning students. The quantitative results of the students learning autonomy suggests a statistically significant difference with $U= 108$, $Z=-6.52$, $p < 0.05$. In addition, the size effect was big with $r=.75$. These results suggested that the students in flipped learning learn more autonomously compared to students in non-flipped learning (see Section 4.6). In addition, the qualitative findings clearly show that based on their learning experiences in the flipped learning environment, Computer Science students had a positive attitude towards their self-learning. Compared to their counterparts in the NFLG, the students felt more autonomous and in charge of their learning (see Section 5.6.1). Hence, this result is congruent with the literature in stating that implementation of flipped learning could have a positive impact in terms of gaining higher learner autonomy (Challob, 2021; Wulandari, 2017; Bergmann & Sams, 2012, Tsai, 2019).

Additional quantitative data analysis has presented evidence that those students working in flipped learning were able to control their learning and enjoyed the freedom to learn on their own time and learn at their own pace, especially outside of classroom learning (see Section 4.6). The students in flipped learning gain more comfort and confidence in their learning both in and outside the classroom compared to the NFLG. This was also found in the qualitative results, as the students in the FLG presented with far more confidence, and thus, self-autonomy by investing in external opportunities, including online materials, in comparison to the students in the NFLG, who seemed to be powerlessly dependent on the teacher for their learning (see Section 5.6.1). It can be claimed that the students' levels of interest and their confidence could push them to learn autonomously in flipped learning by holding the responsibility to complete learning tasks outside the classroom and then by becoming involved in student-centred activities in the classroom. In accordance, Crick and Wilson (2005) have stated that confidence is an invaluable factor in students being able to develop autonomous learning. Likewise, self-confidence needs to be combined with control in learning, which together help to advance autonomous learning skills (Nafiati, 2017).

The following example shows the experience of the students during their learning. It was possible for a student in flipped learning to write a note during the video and review it prior to the quiz. If mistakes occurred, a student would re-watch the video in order to correct before engaging in classroom activities (FG1S3, FG1S5). It can be safely suggested that based on the flipped learning approach, the processes of studying online materials and being engaged in detailed classroom activities are very much central, which, if students are motivated to learn, can enhance students' learning autonomy. It can be suggested that flipped learning would enable students with strategies that enhance their learning autonomy skills. Weinstein (1987) states that autonomous learners are required to utilise specifically designed strategies to produce effective learning management, as they are unable to take responsibility autonomously. In contrast, the non-flipped learning approach, which was based on teacher-centred methods, resulted in students clearly missing the opportunity to practise strategies that could make them autonomous learners, as based on the current finding. Moreover, Herlina et al. (2012) added that students are generally more passive when learning is more centred on memorising information, which results in a failure to develop analytical learning. Correspondingly, in the current study, it is evident that flipped learning seems to provide strategies for effective management for Computer Science students' learning, which enhances their learning autonomy.

Furthermore, there are a number of contributing factors to achieve autonomous learning, such as the creation of a strong bond between teachers and learners, as well as the provision of an 'enabling environment', in which technology has an integral role to play as an external factor (Meyer, 2010). The current results show that the student-teacher relationship is statistically stronger in a flipped learning environment, where the students reported that the teacher demonstrated confidence in their abilities, encouraged students to ask questions, and listened to students (see Table 4.19). In the current study, the role of the teacher in flipped learning was of a designer of the digital learning environment with the researcher, also participated in discussions, monitored the progress of group learning, encouraged students' interactions, and provided scaffolding for students' independent and collaborative learning throughout the classrooms. As a result, flipped learning can be seen as a learning approach that fosters the teacher-student relationship by allowing more interaction in the classroom and by enabling technology to play a part in the learning environment. It has also been noted by Blau and Shamir-Inbal (2017) that guidance with continuous dialogue from the teacher to the students, together with the development of collaboration between students can enhance extensive autonomous learning. Moreover, a teacher should help learners develop their own sense of learning responsibility (Ho, 1995, cited in Han, 2014). Hence, Computer Science teachers should consider what has been mentioned above in regard to developing their role in the flipped learning approach and how they could foster the students' learning autonomy skills.

Further analysis of qualitative data questions revealed how the students in flipped learning were aware of the concept of learning autonomy (see Section 5.6.2). The participants in the flipped learning group expressed their awareness of the differences in the role of the teacher; more specifically, they realised that he was not merely a lecturer, and was in exclusive charge of the whole lesson explanations that took place in the classroom. The focus group findings in regard to students' learning autonomy showed that all participants reported that flipped learning has somehow enhanced their independence when learning Computer Science. Students in the focus group all felt the same, stating *that "my learning depends on me"*; *"we can manage our learning and learn by ourselves"*; "*we were responsible for accessing online and preparing for the lesson before coming to class"; and "you can see all steps of learning depend on us"*, respectively. Therefore, not only has the flipped learning process influenced the students' learning autonomy, but it also reflects on their understanding of being self-dependent learners. Comparatively, the students of non-flipped learning showed how they depend on their teacher, which was also determined following their responses in the focus group and interview. The results clearly indicate from the students' responses that it can be easily inferred that the teacher has a strong presence in the process, which has had an adverse effect on their autonomous learning skills.

In terms of the findings of the interviews, students reported that the learning process was not empowering, and they did not take charge of their learning. For example, NFLG9 stated that "*I did not do much self-learning because the role of the teacher is to deliver the lesson and my role is to revise I at home".* In addition, the students added that they had to rely on what the teacher had to give them, to which they were grateful, as they deemed his role important because he knew what was right and oversaw the exam. This shows that the students in the NFLG did not seem to be aware of learning autonomy as much as they recognised the importance of the teacher as the only source of knowledge. In fact, the nature of the non-flipped learning approach and traditional teaching approach can explain the reason behind being a passive learner. Talbert (2015) has noted that learners who are used to traditional methods in the classroom fail to demonstrate willingness to present autonomous learning responsibility. Further, Cotterall (1995) has stated that teacher-centred methods in the classroom result in the teacher becoming an authority figure, which reduces the ability for students to become autonomous learners in comparison to students who view the teacher as a facilitator who can assist with their learning. Thus, a Saudi Computer teacher who is willing to enhance students' learning autonomy should consider flipped learning instead of relying on traditional or lecture methods.

Overall, these results suggest that the students in flipped learning can learn autonomously compared to students in non-flipped learning. Finally, it was clear that the students in flipped learning were active learners in the learning environment, whether that is through pre-classroom and/or in-classroom, which as a result seems to foster their learning autonomy skills compared to a non-flipped learning environment where the students appeared to be inactive. Flipped learning could be recommended to be applied in teaching Computer Science, where there is a need to apply a teaching approach that makes students active autonomous learner. Autonomous learning cannot be advanced when learners of Computer Science learners are not actively engaged in the classroom, while these students commonly just copy tasks and follow procedures from their teachers if they are inactive (Hutapea, 2019). It has also been stated that the use of merely traditional lecture methods fails to promote autonomy (Srisupawong et al., 2018; Schilling & Klamma, 2010). Additionally, Srisupawong et al. (2018) have added that online learning, interaction or collaboration, alongside problem-based activities help learners in Computer Science and develop their levels of autonomy compared to traditional lectures. However, it is worth mentioning that the current study found that to have a positive impact on students learning autonomy it requires time. Students showed how they need time to adapt to a learning process which shifts the responsibility to their direction and not to the teachers, as mentioned in the focus group (FG1S2, FG1S4). This point further reinforces how the flipped learning approach can be effective for Computer Science students to be autonomous learners when applied for the long term.

Analysing the findings of the qualitative results helped to understand how the students in flipped learning were significantly different in terms of learning autonomy. There is a theme that emerged as useful affordances of flipped learning in students' autonomous learning (see section 5.6.3). The students reported how flipped learning was helpful in terms of rendering them autonomous learners; the first point was that flipped learning provided the students with some background ideas regarding the lesson's expectations and outcomes, including the learning objectives and lesson plans, so that they could be more organised and better prepared. Hence, the use of the online platform in flipped learning, that contains the objectives of each lesson and the lesson expectations, seems to help students in terms of managing their independent learning, which could gain them the skills of being an independent learner. It has also been noted by Mueller et al. (2011) that technologies help students to organise and track their learning autonomy. Here it can be claimed that this is one of the advantages of integrating technology into the design of flipped learning, which is one of the basic principles of its design (McLaughlin et al., 2014, Jenkins et al., 2017, Lo et al., 2017); this affects the possibility of enabling students to practise their learning autonomy skills. It was also shown that flipped learning is useful in terms of meeting the students' learning styles, as students can find space in their learning, where they become free to use whatever devices to learn and design the way of their learning based on the available online resources. This result concurs with (Challob, 2021) that flipped learning is particular adept at engaging the new generations of students through their own learning preferences, due to their personal use of electronic devices, which helps to advance students' autonomy, and especially in learning English writing, for example.

The students also referred to supplementary elements, such as the quiz, which helped them to evaluate their understanding as part of a novel self-learning process. Relating to this, Lacey (2007) stated that the implementation of self/peer assessment is the most accurate way of describing learner autonomy. Providing an evaluation tool in the flipped learning design could help the students to monitor their learning progress and determine whether they need to review or require more time for study. It could be argued that the flipped learning approach provides a metacognitive strategy, which allows students to monitor, cornel and evaluate their learning, which can help with their learning autonomy skills (Toney, 2000). This also develops the students to take an active role in their learning in educational settings (Winne, 2010). Moreover, Gandhimathi and Devi (2016) stated that autonomy correlates with metacognitive strategies that focus on the learning process, prepare students for learning, and self-assessment. What is more, the flipped learning approach allows students to manage their out-of-classroom learning, which seems to provide the opportunity for students to acquire the skills to become autonomous learners.

It is also important to note that flipped learning aims to extend the learning process beyond the school environment, which requires the students to be committed to learning by themselves, which could help them to build autonomy skills. This point was found in the current study when the students reported the extension of learning beyond school time in the flipped learning approach, which helped them to study and work by themselves. For example, *"My self-learning was good because I study at home and not just in the school. Also, I studied without any pressure and distraction"* (FLG5). In accordance, Lai and Gu (2011) state that self-regulated learning can be determined through out-of-class learning; Fernández-Martín et al. (2020) also determined that the flipped learning activities outside the classroom advance the ability to become autonomous.

One more advantage of flipped learning was found in the qualitative results, which is how the availability of the learning resources that emerged could play a part in the students' learning autonomy (see Section 5.6.4). This result aligns with (Challob, 2021) who have found that the availability of various sources of learning and knowledge is a factor for the improvement in students' autonomy. During the discussion, the students in the FLG indicated that it was a struggle to study autonomously in other subjects that use textbooks as the main resource, unlike in Computer Science, where they used the flipped learning approach, including video, etc.; hence, they felt that they could learn autonomously. As remarked by one student, *"we felt like a teacher for ourselves and for each other"* (FG1S5). It can be argued that flipped learning design provides a variety of learning resources for students, which enables them to learn independently; as such, this practice can ultimately increase students' learning autonomy. The current study used videos in the learning process, as this enabled students to choose what they would view, which also included the possibility of watching the video on a repeated basis (FG1S5). Lai and Gu (2011) have specifically noted that numerous resources are provided to independent learners through the utilisation of ICT, and with multimedia, such as with the Internet. Comparatively, the students in NFLG lacked the learning resources and were dependent on the teacher. According to the findings, the students in the discussion seemed keen on practising the skills of learning autonomy, as students had limited learning resources (i.e., textbooks, and the teacher's explanations and the required homework would probably not be sufficient in terms of providing them with the opportunity to practise learning autonomy skills.

6.6 Students Learning Experience in Two Learning Environments

One of the research aims was to understand the students' perspectives regarding their learning experiences in Computer Science learning environments, namely the flipped learning and non-flipped learning environments, in order to understand the differences, and subsequently, highlight the implications of applying flipped learning in Computer Science. The fifth question, which was a qualitative question attempted to be answered by the interview and focus group, in order to highlight the differences in students' experience between the two groups: *"How did the Saudi high school students perceive their learning experiences in the flipped learning classroom and non-flipped learning classroom?"*. However, the current research used a questionnaire to determine the perception of the flipped learning group about their learning experiences. The following section will discuss the Computer Science students' perspectives regarding their learning experiences, how the flipped learning experience was distinguished, the difficulties faced by the students during the flipped learning experience, and the components of flipped learning design.

6.6.1 Computer Science Students' Experiences

It is worth examining the students' viewpoints regarding their learning of Computer Science in two different groups in order to observe the implications of flipped learning on students' learning experiences. In the current study, the students were exposed to flipped learning through instructional videos that explained different concepts, online quizzes to assess their understanding, and online discussions prior to, which all involved active learning activities and problem-based activities and collaborative learning. In contrast, the students in the NFLG faced the experience of the teacher's preferred teaching methods, which were often a lecture method in the classroom and completed homework at home. The finding showed that in general, the views of the students in the flipped learning environment showed that their learning experience in Computer Science was positive compared to the students in the NFLG, which was clearly found in the interview and focus group (see Section 6.1); this has also been determined in different discipline contexts, such as English, Medicine and Mathematics by a variety of other studies (i.e. Hung, 2015; Bates & Ludwig, 2020; Zhai et al., 2017).

Separately, the flipped learning students reported how online learning in the pre-classroom phase was a new and novel experience that improved their overall learning experience, as mentioned by one student: *"what is distinctive about this experience was that we learned at home via the video, which is something new and great for our learning"* (FG1S2). Another student argued that *"learning Computer Science has become easier and fun in this different way of learning where you use your laptop to study online"* (FG1S5). This finding demonstrated that the students in flipped learning had a new way of learning and seemed to enjoy using technology in their learning experiences of Computer Science. On the other hand, all students in the NFLG felt that the learning experience in Computer Science was a normal routine that they witnessed in other subjects in their school classes. Hence, the students in the Computer Science classroom did not go through a different learning experience from other subjects, which may suggest that the lecture was a common feature in their school; (ALRowais, 2014) mentioned that the majority of Saudi schools used the same way. Interestingly, emphasising that the teaching method had not changed since primary education, two students, respectively, stated that *"there is no difference from the primary school, which does not appeal to me"* (FG2S2) and that *"it is true that the teaching style has always been the same since we were in year 4 until today … We thought high school is different, but it is the same"* (FG2S4).

It can be claimed that Computer Science students enjoy more in their new learning experiences that are provided by flipped learning, which concurs with the study by (Baytiyeh, 2017) as flipped classroom learning enhanced students' experiences to augment their interest levels. Moreover, (Jeong & González-Gómez, 2016) determined that 80% of students who studied Computer Science believed flipped learning as a way to improve learning experiences. The result of the current study also agreed with Alamri (2019), which is one of the few studies undertaken in Saudi Arabia, where it was found that the participants presented positive responses towards the implementation of flipped learning. What is more, the current study can contribute that flipped learning can provide high school Computer Science students with positive learning experiences.

6.6.2 Distinguishing the Flipped Learning Experience

The qualitative results show that the students identified the features that rendered the learning experience positive in flipped learning. Firstly, flipped learning enabled them to learn at home without the distraction that was often present in the classroom environment. For example, one student praised flipped learning in that *"… the video was always available, and no one was distracting [him] while studying"* (FLG1). Secondly, the element of freedom and flexibility of learning was also mentioned in the responses of the students who reported that they had the opportunity to learn at their own pace from the comfort of their home. Thus, using their own devices allowed them to review the materials anywhere and anytime, which provided a sense of flexibility to their learning routines (see Section 5.2.1); this has also been shown in other studies (Gehringer & Peddycord III, 2013; Network, 2014b; Betihavas et al., 2016).

The flipped learning approach offers Computer Science students to develop a flexible learning environment that enables them to learn without distractions, learn using their preferred devices, and can meet the new generation's needs daily. For example, the potential of watching videos on students' devices was mentioned as an advantage of using the technology. One student mentioned that *"I like the idea of watching the video on my phone"* (FLG8); while another said: *"it was good and easy for me to watch the video using my own tablet or else my phone"* (FLG6). This point showed that the students did not struggle when trying to access the video using their own devices. Furthermore, one student (FLG8) reported that flipped learning provided a solution for when he could not attend the Computer Science class by providing online materials for him to review at home in case, he was not able to physically attend on the day. This point was the same as the motivation for Bergmann and Sams to apply the concept of flipped learning, as they started to apply flipped learning in order to allow the absent students to catch up with what they had missed in the classrooms

(Bergmann & Sams, 2012). This is one of the advantages of flipped learning, as the students sometimes might feel behind their peers if they cannot attend the classroom for any reason.

The students in the interview referred to the use of classroom activities as one of the learning experiences that enabled them to work as a team and presented them with the opportunity to learn from each other. There were students who supported this idea when they said that their experience of learning Computer Science enabled them to gain the opportunity to have more communication and discussions with each other, which makes the classroom more interactional and proactive than was the case for other subjects; for example, *"I felt that we were close to each other when communicating in the classroom"* (FLG5). In addition, the results from the questionnaire relating to the perceptions of students in the FLG supported this view, with 78% preferring the way of communication with their classmates, and 89% of students also agreeing on the classroom being more social. In contrast, it was found that the students in NFLG missed having learning activities in the classroom. One student (NFLG5) mentioned that they preferred to have increased roles in the classroom in the form of group discussions, as they did in the Social Skills course. Correspondingly, Fautch (2015) states that traditional methods of instruction normally fail to provide sufficient time for the presentation of content and activities. It can said that flipped learning makes the learning environment more social and interactive, particularly within the classroom when it allows for more interaction between students with more organised group activities, which increases the intake of different perspectives and improves students' critical thinking, together with enhancing the ability to problem solve (Hurst et al., 2013).

An interesting finding of the students' learning experience in flipped learning related to their views about class preparation or home studying. The students in the focus group emphasised how the flipped learning experience changed their perspectives regarding the preparation for the classroom. For example, one student from the current study stated that, *"in this semester, the Computer Science classroom changed my learning behaviour and I have developed into a student who prepares for the classroom and studies at home"* (FG1S4). Moreover, flipped learning offered the students a completely different experience of preparation for the classroom compared to their previous experiences, which is clearly shown in this statement: *"In the past, we did not have videos or online learning … We used to rely on the textbook for our preparation"* (FG1S1), and in another one: *"I agree with FG1S1 … The way* *we learnt at home was new and attracted me to study"* (FG1S3). In particular, this could relate to video lectures, which (Guo, 2019) found to be more effective in gaining students' attention in comparison to text-based materials. This result from the current study determined that 68% preferred the videos instead of teacher explanations. Additionally, observed in the students' discussion was the impact of using technology tools in terms of encouraging them to prepare for the classroom and adding attractiveness for the preparation. For example, one student confirmed that *"preparing for the Computer subject by "Marefa" was the most enjoyable experience ever"* (FG1S5); while another student acknowledged that he *"totally agree[s] … It is something I was not used to doing before and now it keeps me interested"* (FG1S2). Overall, 92% of students in the FLG liked the concept of using technology in their learning process. Hence, it can be argued that flipped learning provides students with valuable experiences for preparation. Liebert et al. (2016) support this finding, as they undertook research with a mixed-methods approach, which produced results that showed how students valued pre-class materials that were easy to access and utilise, including concise, organised, and delivered content through numerous modalities.

Based on what has been mentioned above, flipped learning could be one of the suggestions for Saudi teachers to provide a rich interactive learning experience for Saudi students. One of the issues in Saudi education is that the practice process for most teachers is totally dependent on the teacher-centred approach, such as the lecture method. This issue was considered in Vision 2030 for education in Saudi Arabia, with one of its aims to make the shift by applying the student-centred approach in teaching practices. Indeed, the current study demonstrated that the Saudi students' perspectives of their learning experiences in the flipped learning environment was positive compared to the non-flipped learning environment. As a result, this study can be taken as an example of the benefits of the implementation of flipped learning in the Saudi context. Further, with respect to the variety of flipped learning design, Section 6.8 will discuss the adopted flipped learning design that is used in the current study.

6.6.3 Difficulties in the Flipped Learning Experience

Despite the positive experiences of flipped learning reported above, the students in the focus group raised a variety of points based on the difficulties they witnessed in some

Computer Science lessons. Firstly, they arguably suffered from mental and cognitive overload caused by having to undertake homework for other courses, while simultaneously having to always review materials from the Computer Science subject, which sometimes resulted in attending classes without any adequate preparation for the expected classroom activities. For example, it was stated that "*I explicitly agree with FG1S3, because the teacher asks us to watch the video even if we have other difficult homework or exam" (FG1S2*). This difficulty could affect upon students' performance levels in-classroom, where the teacher has expected that they come to class well-prepared to continue their learning by being involved in the activities. Indeed, the review of certain subjects of Computer Science, such as creating and designing multimedia, requires high effort from students to gain the knowledge and skills that help them to become more involved in classroom activities. This requirement effort, though, could conflict with the requirements from other subjects, which can prove challenging for students. This point has also been found in the students' responses to the questionnaire, as 76 % felt that flipped learning required more dedication than traditional learning. Increased workload for students has been shown to correlate with associated pre-class learning activities (Khanova et al., 2015); the cumulative workload of various concurrent flipped courses can overwhelm students and cause stress. It was also stated in that study that students are often presented with an unmanageable amount of pre-class work, which proves detrimental upon in-classroom engagement, and thus, reduces the effect of flipped learning. However, there are studies, such as by Mattis (2015) that indicate how accuracy increases and mental effort decreases through the implementation of flipped learning. Therefore, a teacher needs to measure the time and effort that students exert on their pre-class activities, in order to maintain the flipped learning approach (Khanova et al., 2015); this could potentially help to keep the students from suffering mental and cognitive overload.

Other difficulties showed that the instructional video was not appropriate for all the topics, and it was suggested that it might be better to sometimes watch it as a post-classroom task after the teacher's explanation. For example, *"I would like to add that the video in some Computer lessons like the Linux interfaces, which is useful after the teacher's explanation as a review"* (FG1S). This can provide advice to the teacher in order to be able to evaluate the design regularly, particularly the pre-classroom phase, which can help to improve the design during the semesters. However, providing the instructor's video as a post-classroom activity might not agree with the concept of flipped learning (Bergmann & Sams, 2012; Hamdan et al., 2013; Abeysekera & Dawson, 2015; Voronina et al., 2017; Karabulut-Ilgu et al., 2018); where the aim is for students to initially acquire the knowledge at home, and subsequently to come class for active learning.

The students reported experiencing technical issues whilst studying Computer Science, which in turn seemed to affect their learning experience. For example, they claimed that the usability of the online platform on their devices was not that effective, adding that the layout of the online platform '*Marefa*' did not work well on their phones. It can be noticed that only the video element was working well, while for the other elements, which they had to access through their laptops, such as quizzes and online discussion forum, they were not working properly. As a result, this problem would affect the students learning experience in flipped learning; these difficulties could explain the findings that only 51% of flipped learning students prefer to use flipped learning with other courses (see Section 4.8.1). This issue could affect negatively on students' learning experiences in flipped learning; whilst, (Akçayır & Akçayır, 2018; Gough et al., 2017) found that problems with technology, including accessibility, and personal competency can also result in students experiencing challenges within flipped learning. Therefore, the teacher who would like to apply flipped learning should assess the technology tools and evaluate the use of platforms or tools on different devices to examine the applicability of the platform, and to make the intervention if improvement is required, which avoids the issues that can threaten the success of applying flipped learning. In Saudi Arabia, there is support for teachers to overcome digital issues in their educational practice, which could help teachers who apply flipped learning to use this support for better implementation of flipped learning by minimising the challenges often incurred with technology.

6.7 Flipped Learning Design

One of the current research aims was to provide and test a design of flipped learning derived from a review of the literature, the flipped learning design in the current study was based on the principle of social constructivism theory and Bloom's taxonomy. The design employed content elements: an instructional video, online quiz, online discussion, PBL and collaborative classroom learning activities; these elements were also used in the literature

(Kim, 2017; Wang, 2017; Yough et al., 2017). Figure 6.1 shows the adopted flipped learning design in the current study, where the focus during the pre-classroom phase is based on hierarchy, memory, and comprehension. Correspondingly, social constructivism theory, within zone of proximal development, is implemented during the pre-classroom stage, where learners who learn more quickly do not have to watch video content, as they are already able to understand the particular content and factors (Chen, 2016). Comparatively, during the phase of in-classroom, the level is increased, as the focus is directed towards application, analysis, evaluation and creation. Additionally, during the process of flipped learning, scaffolding is implemented, as this provides a base for support in the form of guidelines, videos, and online discussions with peers. Further, social constructivism theory is used within the classroom environment for students to gain the opportunity for social interaction, as the prior acquired knowledge before the class enables collaborative and PBL activities to take place, which develops social interaction in the classroom. The current study, however, collected data via a questionnaire, interviews and focus groups to evaluate the design and understanding the students' perspectives about the potential of the design and how they could also develop the content elements that are used in the design.

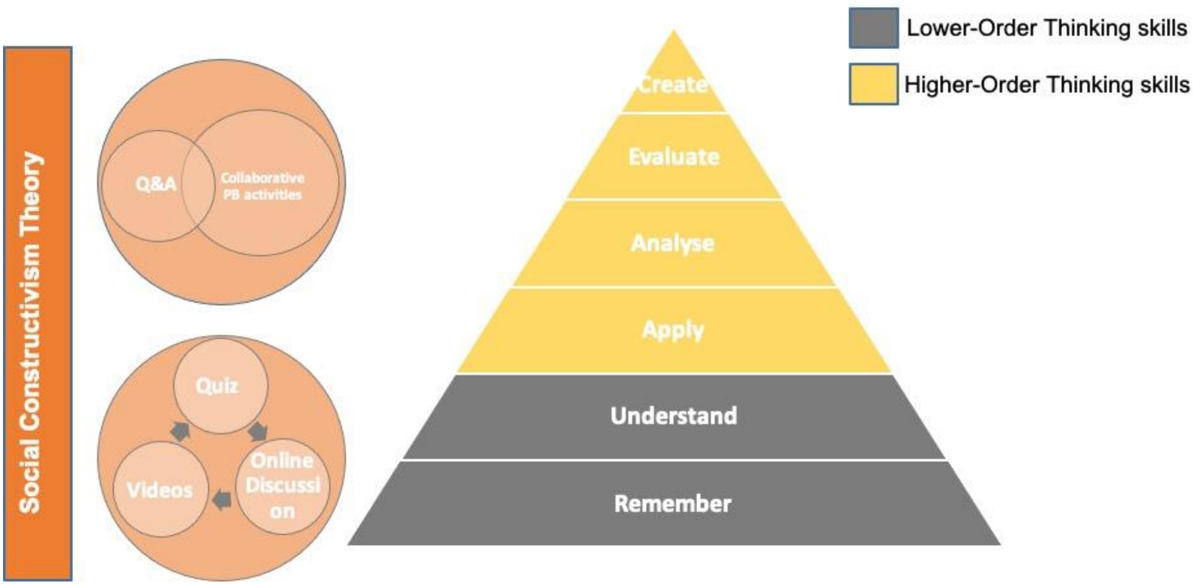


Figure 6.1: Adopted Design of Flipped Learning in the Current Study

Consequently, the flipped learning students were asked via a questionnaire to rank in order the elements that were the most effective for their learning in their opinion (see Section

4.8.2). According to the findings, it can be observed that the instructional video stood as the most effective element. The students ranked other elements as follows: the second most effective as classrooms activities, while the third was online quizzes. The students, however, ranked the online discussions, which they had to complete, as the least effective element in the design of the flipped learning approach. Further, the following sections present the discussions of more findings, in order to understand the potential of flipped learning design components as used in the current study.

Instructional Videos

One of the important elements in flipped learning is the instructional video, which helps to expose the student to important knowledge that assists them in their learning process in the classroom. The students ranked the video as the most effective element in the flipped learning design, which is consistent with other studies (i.e., Sohrabi & Iraj, 2016; Santikarn & Wichadee, 2018). This demonstrates that students generally believe videos enhance their learning, as video-recorded lectures enable them to better comprehend the content. The current study asked questions to the students during the interview and focus group in order to understand more about their preferences for instructional video. The students stated that the length of the video was reasonable, which was approximately 5-9 minutes. The students in the focus group also agreed that the length of the video was suitable, as stated by one student: *"most of the videos were 6 or 7 mins, which was appropriate for me" (*FG1S2). Explaining why this video duration was helpful, the students stated that a short-length clip was good to increase focus and follow the content, which can be clearly seen in this statement: *"the length of the video was good and helped me to pay attention to the content"* (FLG1). Indeed, short length videos help to improve students' engagement levels and to reduce cognitive load (Brame, 2016). It can be said that employing short video that focusing on facts and concepts easy for students to follow and to keep them engaged with the content.

Most videos used in the current study used the teacher's face to present explanations. In the interview data, the appearance of the teacher in the video was mentioned as important, as it allowed students to understand body language and facial expressions; for example, one participant stressed that *"the video of my teacher was better for me … I can* *understand his expression and hand movement ... In general, I prefer videos with the speaker's face shown, otherwise it would be boring*" (FLG5). This point was supported in the students' discussion in the focus group, with one student saying: *"I like watching the teacher explain with the facial expression and hand … It is better than just voiceover slides, which are boring as you cannot see who is speaking to you"* (FG1S1). This emphasises how important the visual aspect (teacher's presence) in the video design is, as it enables for facial expression and body language, which have the potential to stimulate students. In a different study, students negatively remarked that their teacher was unavailable during video lectures, and the videos were too long, which sometimes were split between two classes, and thus, increased the overall homework level (Schultz et al., 2014). Additionally, another study examined teachers' faces in video instructions, with students reporting that the lecture experience would improve when the face was seen (Kizilcec et al., 2015). Correspondingly, social cues were seen as beneficial to a multimedia document, as they would help to instil social responses, and develop a clearer process of knowledge acquisition and learning quality (Colliot & Jamet, 2018). Therefore, the current study recommends that a teacher of Computer Science should apply flipped learning with engaging videos that ensure the students watch and engage.

The students offered some suggestions that could make the video affordance more interesting for them and to ensure that they would engage with it. For instance, using animation videos was mentioned as another format of a video, along with the use of an infographic resume post-video. This can be seen, for example, in the following statement: *"I wish if the video be designed by using animation or the video be done live"* (FLG1). Another recommendation was for the teacher to ask questions during the video to enhance students' thought processes and keep them involved: *"The teacher could, for example, ask a question halfway through the video for us to think about. This would encourage us to study more to identify the answer"* (FLG7). Additionally, the students in the focus group expressed their preferences to use synchronous videos instead of recoded videos, as they allow them to benefit from live interactions with their teacher. For example, as one participant mentioned, *"I prefer to have the class live at a specific time, with the option of a chat to ask the teacher a question"* (FG1S2).

Similarly, the students in the interviews expressed their interest in having live classes, where they could interact and communicate with their teacher. For example, one student called for blending between live learning with recorded learning (live vs recorded); another interviewee mentioned about the importance of receiving feedback on the spot: *"The live video would be more attractive for me … It allows me to have feedback quickly"* (FLG8). This finding demonstrated that the students were hoping for online classes that enable them to have live interactions with their teacher; this suggestion can be considered by the teacher before applying flipped learning; this will improve students' levels of engagement with the videos (Guo et al., 2014). It is then possible to offer them a variety of designs to ensure that all the students engage with videos, as different instructional designs could add value to flipped learning; although this could result in overwork for the teacher (Sage & Sele, 2015; Wanner & Palmer, 2015). To overcome this challenge, it can be suggested to encouraging Computer Science teachers who apply the flipped learning approach to share their learning resources and provide a library that could help teachers to provide their students with different formats of instructional videos.

Classroom Activities

The second component in flipped learning that was ranked by students is the classroom activities. From the findings, it appears that the students enjoyed the classroom activities they were offered, especially when using technology applications, such as Plickers. In the opinion of one participant in particular, *"the classroom activities were attractive, especially Plickers …"* and *"Using digital activities, such Plickers, was interesting"* (FLG4). The teacher in the current study used Plickers as a technological tool for some classroom activities, together with students' feedback, which has shown that the use of technology tools made classroom activities in flipped learning more interesting experiences. Indeed, previous studies that have applied such technologic tools in classroom activities found it makes the classroom activities interesting (Thomas et al., 2016; Mshayisa 2020).

Moreover, in relation to classroom activities, the students brought up the concept of collaboration and working as a group, which was helpful and interesting for them, as reported by FLG6: *"I like the idea of working in groups on Computer tasks, where all of the team help each other"*. In addition, the students claimed that the classroom activities enabled the teacher to evaluate all the students, which seemed more effective than before when the teacher would ask random questions and limited students would be assessed and scored.

From the findings it is clear that collaborative activities have led students to gain a sense of satisfaction and has enabled them to receive their teacher's evaluation simultaneously. Seitan et al. (2020) found that the students in Computer flipped learning presented positivity in their learning following collaboration during class time, which also develops the ability to enact teamwork and share contrasting perspectives with other students; this also increases communication with the teacher. Indeed, teachers are better situated to offer support through a flipped learning environment, as are peer students (van Alten et al., 2019).

Flipped learning aims to provide additional time for students to engage in interactive in-class activities, which is deemed to be active learning (Haak et al., 2011). The findings from the current study demonstrate that providing the interactive activities enhances students' learning experiences. The students in the focus group also revealed how much they enjoyed teamwork and to complete tasks collectively in the Computer Science subject. To the delight of one student, *"working together as a team was very enjoyable, and we enjoyed creating an interesting video about natural catastrophes and climate change"* (FG1S5) and "*… producing a video activity where each one of the team does his bit in the video production"* (FLG1). The students added that the classroom activities provided them with a challenge, which provided them with a sense of achievement upon accomplishment of these activities. For example, FG1S3 reported that *"we'd have a feeling of success once we finished the challenge activities"*; while another mentioned that *"we cherished some challenging activities where we all worked hard to finish before the other group … Last week, the teacher asked each group to create and design a full blog with different topics, and it challenged us to finish in-class time"* (FG1S2). It can be said that PBL and collaborative activities, especially when accompanied with challenging tasks, can be a source of inspiration for the students in flipped learning and can instil a sense of achievement.

Providing students with challenging activities, such as problem-based and cooperative activities, are factors of the flipped learning design that meet students' satisfaction; this result agreed with other studies (i.e. Chao et al., 2015; DeLozier & Rhodes, 2017). In a different study, students who studied in a flipped learning environment had higher levels of motivation to work collaboratively and engage in classroom activities when compared to traditional classroom taught students (Strayer, 2012). Hence, it can be claimed that classroom activities in flipped learning design in Computer Science courses can be more effective when active learning activities are provided, such as collaboration activities and problem-solving activities; this claim is supported through the results of different studies, although in regard to different disciplines (Roach, 2014; Kim, 2017). Jensen et al. (2015) adds that active learning in-class activities are vital to a flipped learning setting in order to make the learning process more engaging and productive in comparison to non-active learning activities.

The current study, however, found certain disadvantages that occur with classroom activities. Firstly, there was inadequate classroom space for the students to work in groups, as reported by one student: *"I did not like the messy class, and all students were close to each other … We do not have the space to readjust the tables for group work"* (FLG2). Further, the students mentioned that the level of noise in the classroom was unbearable, which acted as a distraction and an impediment in terms of rendering the classroom space for group activities. According to FLG3*, "the classroom was too noisy and there were lots of distractions because of the activities"*. Nonetheless, the classroom accommodated 37 students, and it seemed difficult to divide them into groups without causing such a disadvantage. This challenge is one of the obstacles to the application of active learning, which was found in different studies (Niemi, 2002; Aksit et al., 2016). These kinds of difficulties though can account for one of the flipped learning challenges that face teachers, and it needs intervention from the school administration to consider the class size, in order to help the teachers overcome this challenge.

In addition, one of the students faced the additional burden of the group members coming to classes unprepared. As reported by FLG7: "*It was difficult when not all students came prepared for the practical activities because sometimes half of my group did not prepare and make the task difficult for the rest of us … For example, we were not able to do the activity about using LibreOffice to write a list of open sources"*. Indeed, one challenge in flipped learning was mentioned in previous studies in regard to students coming to classes unprepared, which affects the overall learning process for them and their classmates (Chen, 2016; Al-Zahrani, 2015; Kim, 2017). It seems that the teacher in flipped learning has a duty to ensure that all students come prepared for classes in order to avoid facing any further issues during the group tasks. The current study did train the students about flipped learning prior to applying the process, while the teacher during the experiment encouraged the students to complete the pre-classroom tasks, which seemed to reduce the difficulty levels. Therefore, it can be suggested that the teacher could track the students when they log-on and their performance in the online quizzes, which would help to monitor the students' preparation. What is more, it is possible to train the students in relation to flipped learning and explain the process at the beginning of implementation that can help the students to be aware of the importance of preparation for their progress in the classroom.

Online Quizzes

The students reported that online quizzes in the flipped learning design helped them to review their understanding of the lesson, as shown in these statements: *"the online quizzes allowed me to test myself and decide if I need to review the video or not"* (FLG4); and "*the online quizzes were short and effective and informed me if I need more time for review"* (FLG8). Besides, *Student FLG6* added that comparing online quizzes to the unit review questions, by undertaking a quiz for each lesson, was more effective and helpful in terms of determining his areas of concern in order to address them: *"the online quiz helped too much to identify whether I understand the lesson … It is better than the textbook review questions of each unit because with online quizzes, I review the questions for each lesson, and it is easy then to know where my weakness is so that I find out how to improve it with my teacher"* (FLG6).

One of the students in the focus group supported the idea that quizzes improved his ability to evaluate his understanding lesson by lesson; he confirmed that: *"I now know which lesson I can understand, and which one needs reviewing by using the quiz, which shows me my level for each lesson"* (FG1S4). This finding correlates with the results presented by (Bequette, 2019), who showed online quizzes to motivate students to review their learning material. Moreover, the finding showed how the use of online quizzes for each lesson proved to be a good component in the flipped learning design by enabling the students to monitor their own progress. Overall, the addition of quizzes in flipped learning seems to positively affect students' learning experiences, which coincides with previous studies that have found the effectiveness of the quizzing effect in the design of flipped learning (Aidinopoulou & Sampson, 2017; Peterson, 2016; DeLozier & Rhodes, 2017). It is also consistent with Spanjers et al. (2015), who found that using online quizzes in blended learning increased attractiveness and effectiveness levels.

Even though most students seemed to relish the idea of flipped learning and were aware of its effectiveness, some students had a different view. For example, FLG5 stated that setting a deadline for the online quizzes made him feel under pressure. He suggested removing the deadline element in the quiz to allow the possibility to study worry-free about missing out on the quizzes. In addition, the students proposed including more features other than just the multiple choices, as it limited their response options. The students also needed to use a different form of a question to allow them to write a detailed answer and help them express their understanding, as well as receive their teacher's assessment (FLG2, FLG3). This finding shows the possibility to reduce the effect of using the online quiz in a flipped learning design, and thus, the Computer Science teachers could consider these two points when using quizzes in a flipped learning design. Sun and Xie (2020) note that quizzes may provide students with the motivation required to engage in studying pre-class. The current study showed that the variety of forms of online quizzes and the flexibility of the deadline might engage the students and improve the effectiveness of online quizzes.

Online Discussion

Previous studies that have used online discussions in flipped learning did not examine the benefit of using it in the design (Aidinopoulou & Sampson, 2017; Kim, 2017; Wang, 2017; Yough et al., 2017). The current study found that online discussions were ranked as the least effective element of the flipped learning design. The findings showed that the online discussion in the flipped learning design received criticism from students in the focus group and interview sessions (see Section 5.7.4). The first criticism referred to the delayed responses in the discussion, with one participant complaining that: *"I post a question and wait for 48 hours, but no one answers me, then the teacher answers me"* (FLG2); this was also mentioned by another student: *"I used it twice and the response takes a long time from my classmates and the teacher"* (FLG7). This has been shown to be a common issue for virtual groups that rely on participants to sustain their progress (Amichai-Hamburger et al., 2016).

Accordingly, the students also added that the teacher was not always available online and that they needed him to be involved in the discussion: *"The teacher asked us to respond to each other, but he did not post comments on a regular basis … We needed him to be with us in case no one responded to us"* (FG1S3). Rollag (2010) demonstrated that students start to feel ignored and are less willing to contribute to discussion when an instructor/teacher displays minimal involvement in the online discussions. The role of the instructor/teacher is vital in the same manner as a face-to-face classroom discussion (Comer & Lenaghan, 2013). The current study presents evidence that the presence of the teacher in the online discussion within a flipped learning design is paramount to encourage the students to participate, with students being provided with constructive criticism and/or suggestions from the teacher.

Finally, there was a technical issue mentioned in the findings, which is that that the use of the forum as a form of online discussion was inappropriate, as justified in the students' responses. For example, one interviewee claimed that: *"using the forum is not an attractive way … It is old-style"* (FLG3). This finding concurs with Amichai-Hamburger et al. (2016), who added that technical failures within online systems can result in situations where students do not have a choice but to merely attend in the 'background'. Therefore, the teacher should consider which type of online discussion could meet students' satisfaction levels. The current study found some suggestions from students that could make their online discussions more interactive, which could help to overcome the limitations mentioned above. The students stated that they preferred to have an interactive online platform using an application, such as Zoom or WhatsApp for their discussion and chats, which was evident in one of the students' responses: *"We need to have the discussion and we can go live on Zoom or a group on WhatsApp … It is better than accessing the platform and forum when writing a question and waiting for a response"* (FG1S2).

6.8 Chapter Summary

This chapter has discussed the findings of the current mixed-method research in order to address the research questions that focus on students' achievement, motivation, engagement and learning autonomy in Computer Science. The analysis of both the quantitative and qualitative strategies were taken together, detailed, and correlated and compared to corresponding past research. From the discussions, flipped learning was found to be an effective teaching approach that can improve Computer Science students' achievement levels. It was also suggested that flipped learning experiences, including the use of instructional videos and the use of online quizzes as self-evaluation tools, which also enhance students' performance. Furthermore, this chapter shows how flipped learning could play a role in terms of motivating students to learn. The flipped learning was found to develop better competence, autonomy and relatedness, and thus, student motivation levels increase based on self-determination theory.

In addition, the potential of flipped learning to be able to overcome the issue of students' academic engagement that occurred in non-flipped learning was shown in this chapter, as the learning process of flipped learning and the role of the teacher in flipped learning help to improve students' academic engagement. What is more, the discussion of the findings demonstrated how the students in the flipped learning setting were more autonomous than in non-flipped learning, whilst it was also shown that students' autonomous learning skill can be advanced through a flipped learning environment. Further, the last research question that was addressed related to Computer Science students' learning experiences in the flipped learning and non-flipped learning environments, which focused on what distinguished the flipped learning experience compared to non-flipped learning experience. Finally, there was an examination for the design of flipped learning used in the current study, which allows the researcher to draw a suggestion design of flipped learning on the recommendation section. Therefore, the current study claimed that the flipped learning environment can improve the Saudi Computer Science students' achievement, motivation, engagement and autonomous learning.

Chapter Seven - Conclusion

7.1 Introduction

This chapter has aimed to detail of the main results from the quantitative and qualitative methods for the specific set of research questions. In addition, the contributions of the current study regarding the implementation of flipped learning through international literature, and specifically in the Saudi context, will subsequently be discussed. The implications of the study findings in terms of knowledge, students, policymakers and teachers will be emphasized. The limitations of the current study will be discussed and the recommendations for future research will also be explained.

7.2 Summary of the Study

The current study attempted to investigate the possible impact of flipped learning on Computer Science students in Saudi Arabian high schools. Flipped learning could be considered to be one of the most interesting topics in the field of educational technology that has gained attention, and it is recommended to be used in higher education, as well as in all forms of formal education. However, there is a need for more rigorous studies to examine its benefits on students' learning experiences, particularly in the Saudi context. Indeed, there is orientation in Saudi education with the Saudi Vision 2030 to apply a new direction of teaching methods, particularly those integrating the technology and the student-centred approach. In addition, the important aspect of teaching Computer Science required the teachers to employ attractive teaching methods that ensure the students have valuable learning experiences.

Thus, the aim of the research has been to examine the impact of flipped learning on Computer Science students' achievements and to identify the effects of flipped learning on their motivation, engagement and learning autonomy. It has also focused on exploring the benefits of the flipped learning approach for Saudi high school students' educational and learning experiences. Even though flipped learning has started to become popular due to it promotion through social media, limited evidence remains, and in the context of Saudi Arabia. The current study has aimed to focus on developing future contributions in the field of education technology in Saudi Arabia, and whether flipped learning is able to be considered an innovative pedagogy that provide a positive learning experience for students and whether students' achievements, motivation, engagement and autonomy can be improved.

Flipped learning consists of two phases, which are the pre-classroom and in-classroom, and the utilisation of only one source of data would restrict the study from gaining a better level of comprehension of flipped learning. As a result, a concurrent embedded mixed-method design was used in this study, while employed a quasi-experimental design was also implemented, as the intention was to measure how flipped learning would impact upon the learning experiences of different students through a comprehensive comparison between the control and experimental groups. This provided the researcher with the opportunity to determine the contrasts and comparisons between the pre- and post-test outcomes for students. In addition, the researcher employed the questionnaires to compare the students' perceptions towards their achievements and performance in two learning environments. In addition, the questionnaires helped to determine the students' levels of motivation, academic engagement and learning autonomy in two learning environments, as well as highlighting any differences. Furthermore, the researcher employed the interviews and focus group as qualitative methods to gain an in-depth understanding of the impact of flipped learning on Saudi Arabian Computer Science students in terms of their achievement, performance, academic engagement, motivation and learning autonomy.

Both pre- and post-tests were used to collect quantitative data and provide measurements of students' levels of achievement. Separately, the questionnaire focused on specific key aspects: students' achievement; performance; learning motivation, academic engagement; and learning autonomy. These were combined with a further analysis in relation to the experimental group, as the students' perceptions of flipped learning were assessed. In addition, interviewing a total of 18 students, with 9 in the FLG and 9 in the NFLG, while there were 10 students in the focus groups (5x2 groups). Moreover, thematic analysis was taken of the qualitative data in order to investigate how the flipped and non-flipped learning settings were implemented and progressed. This was undertaken in a high school in Jubilee City, Saudi Arabia from the 25th of August to the 18th of November 2019, with a total of 37 participants for the flipped learning group and another 37 for non-flipped learning environment.

The pre- and post-tests, together with the questionnaire, semi-structured interviews and focus group produced results that showed how flipped learning would prove to act positively upon students' levels of achievement, motivation, engagement and learning autonomy. The results highlighted that the students' scores from the FLG normally increased in comparison to NFLG, and specifically for the post-test. Additionally, the questionnaire produced results that showed how students' perceptions of their own achievements and performance were of a more positive nature in the FLG group. Flipped learning was also noted following the qualitative results to increase performance levels for students who study Computer Science. Moreover, students' motivation levels were shown to increase, as the answers from the questionnaire generally provided data that the FLG students were more motivated than in the NFLG. Pre-classroom work and preparation, learning environment, and the importance of Computer Science subject would also augment motivation levels, which helped to answer the second research question. In addition, students' learning autonomy, which is the focus of research questions three, was shown to increase following a flipped learning environment. The findings also highlighted those students from the FLG commonly feel positive about autonomous learning, and an understanding of the skills required to implement and develop it.

The questionnaire was used to measure students' academic engagement within a flipped learning environment, which was more positive compared to non-flipped learning. What is more, the overall learning process in the FLG, as well as the role of teacher and his interaction with the students helped enhancing students' engagement. However, certain students found it challenging at times to engage with the flipped learning process, especially in relation to online discussion participation. The current study has also attempted to demonstrate how students' experiences are distinctive between the FLG and NFLG. Accordingly, the students from the FLG noted a higher level of positive results when using technology in Computer Science courses, while they also felt that more freedom and flexibility was evident in their learning, with students reporting greater potential to learn at their own individual pace when they were able to learn from home. It can also be noted that learning Computer Science in a flipped learning environment allowed the students to increase communication and discussions, which helped to progress the classroom setting into a more interactive place. The students from the FLG, nevertheless, remarked upon certain technical issues while studying their Computer Science courses, and thus, prove to be negatively effectual upon their learning experiences. Meanwhile, some students in the FLG would add that they would feel pressurised personally to study individually at home, especially when other subjects required attention and work.

Finally, the current study adopted a flipped learning design, which is based on the principle of social constructivism theory and Bloom's taxonomy, where the pre-classroom-based activities for the remembering and understanding levels, and for the in-classroom stage, were based on activities at the level of the application, analysis, evaluation and creation. The design employed content elements such as: instructional videos, online quizzes, online discussions, PBL, and collaborative classroom learning activities. These findings above showed who this design would affect positively for students' learning experiences. Therefore, the utilisation of videos appears as a vital element in the design of flipped learning, with students reporting it as the most effective element in the design. Most of the videos used in the current study were short in length, which was reported by the students as an advantage. There were also suggestions from students to have a synchronous lesson, instead of the video or use animation, which could attract them more. The online quizzes and classroom activities were reported positively, where online discussions received criticism from the students, as the use of the online forum was not appropriate for them.

Even though there is an inference in current research that shows the gains are directly associated with flipped learning, it may be possible to infer that the gains associated are not necessarily related to flipped learning. In fact, it could be associated with the educational practices provided by flipped learning, such as the use of technology, greater effort from the teacher, shared learning goals, or allowing students to do something different in their learning process when compared to the traditional classroom. It could be assumed that the effect occurs with the use of instructional videos instead of lectures or the change of the role of students in the classroom when they have more time to become involved in activities. Subsequently, future studies should attempt to determine the effect of flipped learning as an approach, and investigate which practices play a major role in the effect.

7.3 Research Contributions

The current study provides findings and a methodology that contribute to originality in the field of research. Similarly, it may contribute to the teaching methods suggested in Saudi high schools, where there is a need for more studies to keep up with a big change of Saudi education which based on the Saudi Vision 2030 and the two big aims is integration technology in teaching practice and adopted the students-centred approach.

This study has provided evidence to demonstrate that flipped learning is beneficial to improving students’ learning experiences, and especially regarding their levels of achievement, motivation, academic engagement and autonomy in learning. Indeed, the data from the questionnaire, interviews and focus groups showed that learning which includes technology together with a student-centred approach is effective upon the achievement of high school students in Saudi Arabia; while it is also helps to motivate them to engage with their individual learning, when compared to non-flipped learning. Additionally, prior research from subjects such as English have highlighted that flipped learning helps students to become more autonomous (Tsai, 2019). Similarly, the current study has provided evidence that flipped learning helps high school students of Computer Science to improve their autonomy skills for learning. Nonetheless, there has not been any study found from the analysed literature that focuses on students’ flipped learning and the advancement of learning autonomy in Computer Science, even though the current study presents findings that show traditional methods of teaching Computer Science to not be very beneficial to Saudi Arabian students. Accordingly, the current study advocates the use of flipped learning to improve upon traditional methods and progress the achievement, motivation, academic engagement and learning autonomy levels of students.

The current study’s findings can potentially build upon previous literature on flipped learning in high schools and develop the theory in a Saudi Arabian context, as prior studies have been based outside of Saudi Arabia (Graziano & Hall, 2017; Shaffner & Hyland, 2017;

Cukurbasi & Kiyici, 2018; et al., 2020). This study has shown, though, that flipped learning has been implemented in Saudi high schools and has proven beneficial to the Saudi context, and for teachers of Computer Science in particular, who have reaffirmed that a student-centred approach to teaching is beneficial to the students' learning process and development. The study provides an adopted model of flipped learning that suggests a flipped learning design based on social constructivism theory and Bloom's taxonomy. The adopted model also shows the educational practice that the teacher could follow in the pre-classroom phase and the in-classroom phase. The model helps the teachers and the students to understand their roles in the learning environment. The use of digital tools such as videos, online quizzes and online discussion was also found to be good practice for the students to help them in their autonomous learning, and to motive them to learn. Accordingly, the study identifies those videos and online quizzes are the best practices in the flipped learning design to enable students to progress self-evaluation. The whole process of a pre-classroom helps students to become involved in interactive classroom activities, such as PBL activities and collaborative activities, which was also found to positively affect students' learning experiences.

The current research has provided practical contributions, as well as the theoretical ones, with the practical contributions showing that flipped learning can potentially benefit high school students studying Computer Science in Saudi Arabia. It could even be possible to contemplate the introduction of flipped learning for students prior to their formal learning, which could be achieved through workshops, for example. This would enable the students to become familiar with the flipped approach and advance the student-centred learning approach. What is more, the students could be trained to comprehend content accessibility and their own roles in the process of flipped learning. This would ultimately reduce the potential for unfamiliar students to alleviate any challenges when faced with a new scenario of flipped learning.

Furthermore, the previous literature has highlighted that rigorous extensive empirical research is required into the benefits of the flipped learning approach, as studies have mostly focused purely on quantitative data, and failed to provide evidence from qualitative research (Karabulut-Ilgu et al., 2018). Previous studies have generally also utilised only a single form of methodology, although others have used mixed-methods in data collection, which include surveys and/or interviews, as well as analysis of documents in order to evaluate how flipped learning is beneficial to students. Nonetheless, there remains the requirement to develop additional research through mixed-methods, as this will provide a better level of understanding of flipped learning as an innovative approach to teaching (Bishop & Verleger, 2013a; Jdaitawi, 2020). The current study also contributes methodologically, as it adopted a mixed-methods' approach to explore the analysed issue of research in order to develop a better holistic view of the concept. The quantitative and qualitative combination in this single study has helped students to provide more data on the extent, why and how their learning may be impacted by a flipped learning experience.

The contributions from the mixed-method approach, though, have been combined with a quasi-mixed-methods design that included a comparative study of flipped and non-flipped learning settings. This enabled comparisons to be provided from the sample groups following the application of flipped learning, as the two groups were analysed for their similarities and differences in the findings. Moreover, a pre- and post-test assisted in showing how students' learning outcomes changed; while questionnaires helped to present comparisons among students' levels of motivation, engagement, and learning autonomy, as well as how they perceive their own achievements and performances. Further, the interviews and focus groups produced qualitative data that helped in the exploration of learners' views of how they were supported in the two learning environments, which could help to increase achievement and motivation levels, which would subsequently progress students' engagement with Computer Science and learning autonomy. Hence, this study has explored how flipped learning has been implemented and become effective in Computer Science classes in Saudi Arabian high schools.

7.4 Implications

This section aims to present a discussion of who might be impacted by this research and in which manner, which is vital to the study. The implications have been separated into different categories in order to ensure that all are viewed as relevant: knowledge; students; educational policymakers; and teachers.

7.4.1 Implications for Knowledge

The flipped learning approach has been a trend since 2012, and the evidence regarding this approach is still taken from different education courses and different contexts. This study, however, discovered a lack of flipped learning studies within the Arab world in general, and in Saudi Arabia. This issue might not meet the movement in Saudi education, which is led by Vision 2030, where there is an aim to transfer the education which includes integrating the technology in teaching practice and has employed the student-centred approach. One of the solutions to overcome this issue is to support the research community and scholars to conduct research in the field of educational technology, which will consider the aim of the Vision 2030 and the new direction in the field globally. This research could be one of the points that could provide evidence regarding the innovative teaching approach of flipped learning, which could be one example for the researcher in Saudi Arabia to follow up. Particularly, in Computer Science, which is one of the most important fields that is required for the future, it needs to use teaching approaches that could increase students' knowledge and skills in a beneficial way.

In addition, this study could provide evidence to scholars in Saudi Arabia that the need for mixed-method research is imperative with the utilisation of quantitative and qualitative designs. Moreover, the design of the research could be beneficial to researchers globally who are interested in flipped learning with a view that mixed-methods could help in the examination of complex behaviours, especially with the design of flipped learning, where the students experience the use of online learning phases at home combined with social learning in the classroom. The qualitative method, such as interviews, enables researchers to determine which pedagogical practice of the design could affect students in their learning experiences and understand how and why this occurs. In accordance, the current study aimed to evaluate the potential of flipped learning to improve learning autonomy as limited, and particularly in the field of teaching Computer Science. This is important, as, there has currently been no study, as far as the researcher is aware, that has been conducted that analyses how flipped learning impacts upon the learning autonomy of students in Computer Science, which is why the current has aimed to evaluate this specific area. The results have shown that flipped learning helps students gain the ability to self-manage their own learning, and to combine and autonomously guide both their pre-classroom and in-classroom activities. These students are also capable of advancing their skills of awareness on autonomous learning skills, which would potentially be beneficial in future emergency educational events.

7.4.2 Implications for Students

The current study showed how students accepted the changes in their learning environment, particularly the use of technology and provided them with more attention by using a learner-centred approach. The students in the flipped learning group showed enthusiasm to learn, while comparatively the non-flipped students complained about the way of teaching. The students in the current study used to teach often in the same way, which was teacher-centred, and when they experienced the student-centred approach in flipped learning, they showed high motivation. In general, the technology in this process does not show serious issue for the students, as they all had access to technology. Indeed, flipped learning was shown to be beneficial for students, as it allows them to learn at their pace. The flipped learning was also helpful for students to practise Computer Science skills, such as producing videos, where they have time to practise basic knowledge in their home and then utilise all the classroom time to work collaboratively in the classroom. The use of videos in the flipped design was attractive for students, as they could control their speed of learning, and have time to return and review their work. Furthermore, the use of quizzes was a good self-evaluation tool that enabled the students to ensure they understood the lesson. This practice in the flipped learning design could be one of the implications that improve students' achievement levels. Meanwhile, working as a team in PBL activities was an implication on students' views toward learning Computer Science, where they have time to apply what they learn and create by using Computers under the support of the teacher. However, using the online forum for pre-classroom discussion was less beneficial for students, where they see the online forum as old style and not attracted to it. In addition, the students complained about the overload of work when they have obligations to study other subjects, which proved detrimental to studying the materials in the pre-classroom phase. However, this issue required quality time management from the students, which was a skill that could be attained after a while of applying flipped learning, with the help of a teacher who should also measure the amount of time that students need to spend on materials while considering students' duties to other subjects.

7.4.3 Implications for Educational Policymakers

Even though, there is intent to redirect the Saudi educational culture to be open for different practices that ensure the best learning experiences for students, a traditional method with a strong teacher dominating the classroom environment is still the first choice among teachers in Saudi Arabia. Hence, the encouragement of the teachers to apply a new innovative teaching approach, such as flipped learning, should be accompanied quality training for teachers with the best use of digital tools, including how to design instructional videos, using LMS effectively, and managing the online learning to minimise the effect on the acceptance of new teaching methods that integrates technology. The policymakers should also have the vision to improve the teacher programmes and pay attention to provide the experience and knowledge, as well as ensure that pre-service teachers become qualified with the requirements of the educational field. It is also important to remember that it is easy to lecture the teachers to apply a new method of teaching, although it is difficult how to ensure that the teachers believe in these new educational practices and whether they have the abilities to apply them in the field. For example, a teacher who experiences learning in an environment, such as flipped learning, might find it easy to apply the experiences in practice, where a teacher who is required to apply flipped learning without experiences could resist this change, due to a lack of belief in its effect or because of the difficulties of implementation. It could be suggested that teacher training programmes should provide up to date educational technology and the trainers should be aware of the new direction of teaching methods. This can provide the pre-service teacher with valuable experiences that could enhance their thinking and analytical skills to select the right digital tools and the best pedagogical practices based on the need of the curriculum and the students.

Teaching approaches, such as flipped learning, which is based on a combination of online and in-classroom phases needs consideration from policymakers. Firstly, the ability of each school to provide access for their teachers and students to the online platform is required. In this sense, the Covid-19 crisis has the advantage of accelerating the effort of the Saudi MoE, and as such, they have published a national online platform called "Madrasati". However, there is a need to ensure that all students have the devices required to access the necessary websites and be able to access them via different device types, such as phones, iPads, Laptops, etc. Secondly, flipped learning, particularly in the in-classroom phase, aimed to engage the students in a social learning environment based on group activities. The teacher could face an issue with the classroom size and the space of the classroom to group the students, which could affect the process of learning in the classroom. Moreover, the policymakers should re-think the design of the Computer lab, which is often designed in a row-and-column seating plan, which could prove to be an obstacle to the teacher to apply student-centred activities that require students to be divided into groups for collaboration activities. These notes about the learning environment must be considered before a policy is made to put pressure on teachers to apply a teaching approach that integrates technology and is based on a student-centred approach, such as flipped learning.

The MoE in Saudi Arabia released in 2021 a decision to apply the blended learning approach in schools into the future. The current study could advise policy makers on the teaching approach that integrates technology, such as flipped learning, blended learning, HyFlex, etc., which requires well-prepared teachers that have digital skills to deal with online tools. Teachers also need to know the strategies for online teaching, and which are the best practices and how and when to use them in good time. This is the initial step of the success of the redesign that the MoE aims to achieve. The Saudi MoE has three categories of teachers that need to be qualified to align with the aim of the shift. The first are the in-service teachers, which is based on encouraging teachers to attend to extensive workshops as part of their professional development (PD programmes). PD programmes need to focus on teachers' personal requirements for their specific subject. PD programmes could provide workshop focus on general development, such as basic digital skills, the introduction of new teaching approach or tools, and workshop focus for specific development based on which is the best pedagogical practice for teaching Computer Science based on research evidence. The second category focuses on teachers who graduate and are waiting to start their careers, where they must gain the professional educator licence, which measures general standards, such as the knowledge of the planning of teaching and implementation; together with specialised standards, such as knowledge of Computer architecture. The professional educator licence exams, however, could be more effective if they were accompanied by a short programme with cooperation with the universities to qualify these teachers with the up-to-date requirements. Lastly, the pre-service teachers' programme should be improved to ensure that the outcomes of these programmes meet the ordination of the vision of the Saudi MoE.

7.4.4 Implications for Saudi Arabian Teachers

A teacher needs to understand that flipped learning is not just the use of videos instead of lectures; it requires careful design and each element in the design should be based on the objectives of the lesson. The videos need to be well designed and reviewed to meet the students' interests to ensure that they engage with the important elements. The videos could be used to deliver a low level of Bloom's taxonomy that focuses on remembering and understanding. Further, the online quiz is important to be added into the flipped learning design, in order to offer the students a self-evaluation tool. The teacher should use digital tools that enable students to review the results of the student quizzes before each lesson, which could help them to view the extent that the students are ready to become involved in classroom activities. Additionally, the use of social media apps, such as WhatsApp, could be considered as helpful in discussions, instead of the use of online Forums. LMS can be used effectively when it offers students the outline and learning objects of each lesson; this practice could help students to learn independently when they know the explanation of each lesson. Furthermore, the classroom activities require effort from the teacher to scaffold the students during the activities and support them to keep them focused and active.

A teacher should be aware that the use of flipped learning could be a cognitive load for students when it crosses other subjects' requirements. To avoid this load, the teacher should consider when and how to apply flipped learning. Indeed, the students need to study other subjects, and thus, the pre-classroom learning phase should be short and keep them engaged and not affect overall their load. In addition, the current study offers a flipped learning model that teachers could use to guide them to apply in their practice. Computer Science teachers could consider the use of flipped learning to teach the students the basic skills at home and make sure that they have time in-classroom to apply learning between each other. For example, the students could learn the function of codes in the home, and subsequently, in-classroom the students could work in-depth to see how the code functions while working together. This process could be more effective than asking students to copy-paste the codes without prior knowledge and understanding. Indeed, the current study focused on Computer lessons, such as creating social media and multimedia. Hence, Computer Science teachers who teach the same lessons could consider this study as a guide in terms of a flipped design and pedagogical practices to improve the students' learning experience in terms of their achievement, motivation, engagement and learning autonomy.

It is important to note that due to the global Covid-19 pandemic, technology has increased in utilisation within the area of education, and in Saudi Arabia in particular, learning has been transferred to online remote teaching approximately 18 months since the middle of 2020. As a result, it is possible to perceive how Saudi education will develop, where students and teachers will be required to become familiar with technology, while autonomous learning skills for students have been imperative during this period, as many schools had remained closed for substantial periods, and consequently, learning was taking place at students' homes. However, this was often challenging for many students, as they had to quickly learn how to autonomously learn, as they had not had prior practice of these skills. Therefore, teachers had to make sure that all students were presented with key learning experiences online, which could be enhanced through a flipped learning process that could improve students' abilities to manage their own learning both in the pre-classroom and in-classroom activities.

The Saudi teachers advised applying teaching approaches that utilise the benefits of integration of technology and implementing the student-centred practices together such as what was examined in the current study "flipped learning". However, the current study could give some insight into the advantage of integrating technology by itself such as instructional video, online quizzes and learning management systems. The use of technology improves the learning experience of the students and it was clear for example their preference for watching videos instead listing to a teacher lecture in the classroom. So, the Saudi teachers could consider the use of technology in their teaching and not necessarily move to full technology. They could use technology for some practice such as the explanation of the lesson. Furthermore, the current study found that the shift from teacher-centred practices to students-centred practices seems to reflect positively on the learning environment. So, it could advise the Saudi teachers who are still with the idea of just applying a teacher-centred practise to think of the benefits that students get when they are involved in the students-centred practice. The students could have more time to improve their learning when they involve in collaboration activities under the supervision of the teacher. In addition, they could engage and motivate more in their learning when they play more roles than teachers compared to a teacher-centred approach.

7.5 Future Research

The current study observed the potential of flipped learning as one of the valuable teaching approaches for Computer Science education. The study examined the impact of flipped learning on the students who were participants in the Computer Science classroom and the findings are promising in terms of enhancing students' achievements, increasing their motivation and engagement, and improving the students' autonomous learning skills, particularly in a Computer Science area, such as producing the multimedia. The findings clarify the role of flipped learning design and the correlation between pre-classroom and in-classroom pedagogical practices, while future studies could focus on Computer Science in a more complex manner, such as programming to evaluate the potentiality of flipped learning.

The current study examined motivation and engagement using a questionnaire and qualitative methods, namely interviews and focus groups. Future studies could apply the observation method to enable the researcher to observe the students' engagement during the classroom, observe the students' motivation in classroom activities, and observe the role of the teacher during the classroom, which could provide a comprehensive and precise understanding. The current study used a pre-post-test to examine the changes in students' outcomes following the intervention. Future studies could add delay-tests to examine how long the effect of flipped learning would remain. The students in flipped learning have a responsibility to study at home dependently and this work at home requires effort from parents to take responsibility for the children to study. Further studies need to embed the parent perspective, which could help to understand the role of parents on students' motivation in flipped learning and to what extent they affect the success of flipped learning. Furthermore, flipped learning requires effort from teachers to enable this to be applied successfully, which includes thinking carefully about designing online learning, such as videos, quizzes, etc., as well as providing learning activities in the classroom, which includes changing their roles in the classroom. Therefore, additional research should be undertaken based on Computer Science teachers' perceptions of flipped learning and how it affects students' learning experiences.

In relation to data analysis, researchers need to focus on equation modelling, as this will help to develop greater comprehension of both the direct and indirect effects of flipped learning upon students' levels of achievement, motivation, engagement and learning autonomy. It is also necessary to determine the comparative correlations that occur between variables through a mediation effect. Further, the study's findings were based on a representative sample that was taken from individual students at one city high school in Saudi Arabia. Subsequently, it is necessary to conduct similar studies in many more high schools throughout Saudi Arabia. Furthermore, the current study only focused on male students, due to gender segregation in education in Saudi Arabia. Indeed, gender as a defining factor needs to be explored in more depth in order to determine how effectual it is over the results. As a result, there is a need for a similar study to be conducted to examine the impact of flipped learning on the subject of Computer Science for female students in high school and to compare the findings with the current study.

7.6 Limitations of the Study

The current study has focused on developing an instructional educational method – flipped learning, which has not yet been used in most schools, as there remains limited literature on the subject. Flipped learning has not been applied in High school Computer Science courses in Saudi Arabia and the students in Saudi Arabian high schools are not familiar with the concept of research and researchers, which might affect their responses. However, the induction week, which was prior to the study, attempted to make the situation more comfortable. The researcher also increased the numbers of interviewees from 5 to 9 for each group to ensure that the data was received to achieve the aim of the interview utilisation. Additionally, respondents' responses could be affected by fatigue if they are required to answer too many questions. Indeed, the questionnaire covered four domain names: achievement, performance, motivation, engagement, as well as learning autonomy and flipped learning. The researcher attempted to minimise these limitations by conducting the questionnaire in the early morning of school time, as students are often more active in those moments. Students were also provided with a long time to respond, and assured of their right to withdraw, which had been already provided to them in the consent form. In addition, observations were not viewed as a method of data collection in the current study, and thus, the study's overall findings could potentially be limited. Observations could be used to provide a different perspective of how students engage in classroom activities, together with their motivation levels during the classroom period. However, this was generally not possible, as the headteacher and teachers had only accepted the researcher to be present for classes during the induction week. However, interviews and focus groups were beneficial as students can express their views regarding their own experiences, and ultimately reduce the effects of this limitation.

A different limitation can be seen in the amount of focus groups, as it would be beneficial to have more than two, as there is always the possibility that certain responses are not generic and only restricted to a particular group. Nevertheless, the mixed-method study in the current research reduced the issues with this limitation as interviews provide additional understanding to the subject matter. Another point when considering the number of groups is that additional groups will augment analysis complexity; while accessibility to schools is also complex in many circumstances, which was a particular limitation of this study. Lastly, the current study was limited to male students, which is considered to be a limitation; indeed, the inclusion of female students would have helped to augment the level and detail of evidence provided. However, it needs to be stated that significant effort was made to ensure that different potential forms had been taken into consideration in order to reduce/remove their effects, and the aim is for the current study to increase knowledge in this field, and to address the current gaps in the literature in order to improve the development of flipped learning for Computer Science students in Saudi Arabian high schools.

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Appendices

Appendix A:

N	Author and Year	Research Tittle	Subject	Context	Research design and method	Findings
1	(Sajid et al., 2016)	Can blended learning and the flipped classroom improve student learning and satisfaction in Saudi Arabia	Medical	Undergraduates	Quantitative study: Survey and scores Sample:154/155	Comparing the students' performances between two years2014/2015, there is no significant different. Students were satisfied toward multiple resources to learning and they said these resource improve their understanding Students showed that flipped classroom were butter at better at achieving the learning objectives when compared to traditional classroom. Flipped classroom improve students' engagement with faculties and peers which reflected to increase their understanding.
2	(Al-Zahrani, 2015)	From passive to active: The impact of the flipped classroom through social learning platforms on higher education students' creative thinking	e-Learning course	Undergraduates	Quasi-experimental design (Questionnaire and qualitative creativity test)	The flipped classroom scores of students in test of creativity, were higher than the traditional classroom students' scores Students' general views about the flipped classroom were positive.
3	(Al-Harbi and Alshumaimeri, 2016)	The Flipped Classroom Impact in Grammar Class on EFL Saudi Secondary	English	Secondary school	A quasi-experimental research design (Questionnaire	There is no statistical conclusion that the flipped classroom positively affected students' proficiency in this study.

		School Students' Performances and Attitudes			Semi-Structured Interview)	Students' opinions and attitudes toward the flipped learning were positive, and that they agreed the strategy promoted their communication, benefited their learning, and encouraged their autonomy. The most favoured aspects of the flipped classroom were watching videos and in-class activities Most students indicated that the students' value having authority to control the video, like repeating the video, and watching the videos anytime, anywhere and appreciated the collaborative and competitive in-class activities.
4	(ALRowais, 2014)	The Impact of Flipped Learning on Achievement and Attitudes In Higher Education	Teaching Methods &Communication Skills	Undergraduates	Quasi-experimental method AND the descriptive method	There were significant differences between the students' scores. This difference showed the positive impact of flipped learning on students' achievement There were significant differences between the students' attitudes towards studying courses and this in favour with flipped learning.
5	(Alsowat, 2016)	An EFL Flipped Classroom Teaching Model: Effects on English Language Higher-order Thinking Skills, Student Engagement and Satisfaction	English	Undergraduates	Quasi-experimental approach (Questionnaires) Sample:67	There is positive impact of flipped learning on higher order thinking skills of students. The flipped classroom teaching model was effective in language learning. There was statistically significant difference between the mean scores of the pre and post administration of the engagement scale in favour of the post administration

						Students were most satisfied with the flipped instruction which encouraged them to have creative thinking and evaluation.
6	(Alharbi, 2015)	A Flipped Learning Approach Using social media in Health Informatics Education.	Health informatics courses electronic health records	Undergraduates	Qualitative study Focus group Sample :14	All students agreed that the flipped learning activities helped them better understand the concepts of the course in an interactive and collaborative learning environment The students state that the educational benefits of flipped learning and social media were that -Activation of prerequisite knowledge -Support Self-Regulated Learning -Collaborative learning environment -Removing barriers between students and instructors The study showed that there were some limitations of flipped learning: -More load on the side of the teacher -Internet connection problems -Some students copy from the internet -Some students were not comfortable
7	(Elmaadaway, 2017)	The effects of a flipped classroom approach on class engagement and skill performance in a Blackboard course: Effects of the flipped classroom approach.	Blackboard course	Undergraduates	Quasi-experimental (Questionnaire and performance exam) Sample:57	The flipped approach contributed to perceptions of increased classroom engagement Flipped learning participants interacted with their classmates more frequently. The flipped classroom approaches in this study had larger effects on classroom engagement compared with the traditional approach Flipped participants indicated generally high behavioural and emotional engagement

						Students in Flipped learning achieved a higher mean score than their traditional counterparts indicating that the flipped approach facilitated skill development with respect to the use of Blackboard tools.
8	(Al-Ghamdi and Al-Bargi, 2017)	Exploring the Application of Flipped Classrooms on EFL Saudi Students' Speaking Skill	English as a Foreign Language	Undergraduates	A quasi-experimental design (Questionnaire)	The results revealed that the FC did not sufficiently enhance the experimental group's speaking skill to cause a statistical significance in comparison to the controlled group. Students held a positive attitude toward the flipped learning and the used instructional videos Further research should utilize other research methodologies, such as mixed-methods
9	(Jdaitawi, 2020)	Does Flipped Learning Promote Positive Emotions in Science Education? A Comparison between Traditional and Flipped Classroom Approaches	Science	Undergraduates	A pre- and post-quasi-experimental design (Questionnaire) Sample:65	The results show that the flipped group had obtained higher learning emotions mean score compared to its traditional counterpart, and they showed improvement in learning emotions mean score over the period of the study. There is need for further studies adopted other data collection such as the mixed method

10	(Alsmari, 2020)	The Effect of Flipped Classroom Instruction on Developing Saudi EFL Learners' Comprehension of Conversational Implicatures	EFL	Undergraduates	a pre/post-test experimental and control design Sample:100	The effectiveness of flipped learning over the traditional teaching method is supported in contributing to better learning outcomes in comprehending pragmatic conversational implicatures. Out-of-class activities promote autonomous learning and self-directed learning skills, whereas in-class activities provide opportunities for active collaboration and language communication.
11	(Alamri, 2019)	Students' academic achievement performance and satisfaction in a flipped classroom in Saudi Arabia	Education technology course	Undergraduate	A mixed- methods research. (an achievement test, questionnaire and interviews)	The results indicated a statistically significant difference in students' academic performance for the flipped classroom group. Almost all students had a high level of satisfaction in the flipped classroom and generally enjoyed learning in the flipped classroom environment.
12	(Rawas et al., 2020)	Comparing the Effects of Individual Versus Group Face-to-Face Class Activities in Flipped Classroom on Student's Test Performances	Medical/Surgical course	Undergraduate	A two-group post-test only true experimental design (Performance test)	Flipped classroom design with group based face-to-face class activities yielded better test scores compared to the design comprising of individual face-to-face class activities.
13	(Najmi, 2020)	The Effectiveness of Flipped Classroom Approach on Students' Achievement in English Language in Saudi Arabian Southern Border Schools	English	Primary school	A quantitative research design (pre and post-test)	There are statistically significant differences between the mean scores of the control group who were taught using the traditional teaching method and the experimental group who were taught using the flipped learning approach in their academic performance in English language in the post-test.
14	(Alnuhayt, 2018)	Investigating the Use of the Flipped Classroom	EFL	Undergraduate	A quantitative research design (pre-post-test and questionnaire)	Students' performance in the post-test revealed that there were significant differences which were in favor of the experimental group.

		Method in an EFL Vocabulary Course				Findings of the questionnaire indicated that students' hold positive attitudes towards using the flipped classroom method in EFL vocabulary and the result confirmed that the participants strongly enjoyed their experience with the flipped vocabulary class. The results also showed that most of the students believed that using the flipped classroom method was not challenging for them.

Appendix B: Ethical Approval

RE: Ethical approval (Ref: 2286/2017)

RES Policy & Information Team

Mon 4/16/2018 11:37 AM

To: Mohammed Alwaqdani (PGR) <M.S.M.Alwaqdani2@newcastle.ac.uk>;

1 attachments (16 KB)

2286.xlsx;

Hi Mohammed,

According to the answers that you provided on the online ethical survey form (attached here), submitted on 28/11/2017, your project was deemed low risk, and no further approval was required. On submitting the form, you should have received an email to the address provided (m.s.m.alwaqdani2@newcastle.ac.uk).

Please could you check your answers attached, and provided that these are correct and that there have been no further changes to your project, the University Ethics Committee grants its approval for your project to progress. Please be aware that if you make any significant changes to your project then you should complete the online ethics form again as further review may be required.

I hope this helps, but please just let us know if you have any further questions.

Kind regards,
Sara

Dr Sara Garcia
Policy and Information Officer

Research and Enterprise Services
Newcastle University
Kings Gate Building (Level 5)
Newcastle upon Tyne
NE1 7RU

Tel: 0191 208 5499

Appendix C: Outside Study

Newcastle University; Outside Study Confirmation

Beth Blanks <Beth.Blanks@newcastle.ac.uk>
on behalf of
Research Student Support Team Role Account <rssteam@newcastle.ac.uk>
Thu 6/6/2019 10:28 AM

To: Mohammed Alwaqdani (PGR) <M.S.M.Alwaqdani2@newcastle.ac.uk>
Cc: Caroline Walker-Gleaves <Caroline.Walker-Gleaves@newcastle.ac.uk>; James Stanfield <james.stanfield@newcastle.ac.uk>; Frances Cook <frances.cook@newcastle.ac.uk>; Student Data <student-data@newcastle.ac.uk>

Ref: BB/ 160747508
Date: 06/06/2019

Newcastle University

Research Student Support Team
Student Progress Service
Student Services
Newcastle University
King's Gate
Newcastle upon Tyne
NE1 7RU United Kingdom

Dear Mohammed,

The Dean of Postgraduate Studies acting on behalf of the Faculty of Humanities and Social Sciences has approved your application to undertake study outside the University. Please retain the following details of your candidature.

Location of Outside Study:
Al-jubail Industrial City, Saudi Arabia

Supervisory Team:
Professor Caroline Walker-Gleaves
Dr James Stanfield

Outside Study effective from:
01/08/2019

Outside Study end:
26/11/2019

End of Minimum Period of Study
24/09/2020

Latest Submission Date of Thesis:
24/09/2021

You must report any change to the above dates to the Research Student Support Team.

You are expected to maintain contact with your supervisor at Newcastle University on a regular basis.

Your period of outside study will be reported to the UKVI as a 'Change of Study Location' and will not impact on your Tier 4 visa status.

Please note that on your return to Newcastle, you should visit a Research Student Support Team drop-in session between 10:00am to 12:00pm, Monday to Friday, Level 2 Reception, King's Gate. You should bring your passport and visa, and/or any documents indicating your UK re-entry date and RSST will take a copy of the documents for our records.

Appendix D: Letter from the Head of School, Saudi Arabia for Conducing Study (Arabic)

Appendix E: Information sheet and Consent Form (student)

Newcastle University
School of Education, Communication & Language Sciences

Participant Information Sheet

1. You are invited to take part in a research study entitled "**Investigating the Impact of Flipped Learning on Students' Engagement and Achievement in Saudi High Schools**"
2. Please read this document carefully and ask any questions you may have before agreeing to take part in the study.
3. The study is conducted by Alwaqdani, Mohammed as part of his **"PhD in Education"** at Newcastle University.
4. This research project is supervised by **Professor Caroline Walker-Gleaves** from the School of Education, Communication & Language Sciences at Newcastle University.
5. The purpose of this study is to research **whether flipped learning can be adopted as an impactful innovation in education, and how it can contribute positively to Saudi students' learning**
6. You have been invited to take part in this study because of one of the research objectives is that **exploring the benefits of the flipped learning approach for high school students in the Saudi context.**
7. If you agree to take part in this study, you will be asked to do **pre-and post-tests and Questionnaire, and you might invite to take part in interviews or focus group.**
8. Your participation in this study will take approximately 16 weeks.
9. **Briefly describe debriefing arrangements**: In this study, t**he participants will experience to a new pedagogical practices which is "flipped learning"**. Flipped learning is basically composed of two main components. Firstly, students should acquire new knowledge via pre-classroom tasks such as reading some materials or being exposed to instructional videos. Secondly, students should involve in classroom activities to construct and consolidate their knowledge in a greater depth. **The main aims of this study is to investigate the impact of flipped learning on students' achievement and engagement**. So, to achieve the aims of this study the participants will do Pre-test in the first week of the study. At the end of the study, the participants will do post- test and Questionnaires and then some of participants will invite to take part in a semi-structured interview and focus group.

10. 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**.
11. All responses you give or other data **collected will be kept confidential**. The records of this study will be kept secure and private (researcher's computer with password). All files containing any information you give will be password protected and locked. In any research report that may be published, no information will be included that will make it possible to identify you individually. There will be no way to connect your name to your responses at any time during or after the study.

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 **whether flipped learning can be adopted as an impactful innovation in education, and how it can contribute positively to Saudi students' learning**

- 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 data collection will involve the use of recording devices.
- 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 investigator will answer any questions regarding the study and its procedures. The investigator's email is M.S.M.Alwaqdani2@newcastle.ac.uk. And they can be contacted via email or by telephone on 00966540593427

- 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 ecls.researchteam@newcastle.ac.uk

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

Information sheet and Consent Form (Parents)

Newcastle University
School of Education, Communication & Language Sciences

APPENDIX D

Parent Information Sheet

1. Your child is invited to take part in a research study entitled "**Investigating the Impact of Flipped Learning on Students' Engagement and Achievement in Saudi High Schools**"
2. Please read this document carefully and ask any questions you may have before agreeing to allow your child taking part in the study.
3. The study is conducted by Alwaqdani, Mohammed as part of his **"PhD in Education"** at Newcastle University.
4. This research project is supervised by **Professor Caroline Walker-Gleaves** from the School of Education, Communication & Language Sciences at Newcastle University.
5. The purpose of this study is to research **whether flipped learning can be adopted as an impactful innovation in education, and how it can contribute positively to Saudi students' learning**
6. Your child has been invited to take part in this study because of one of the research objectives is that **exploring the benefits of the flipped learning approach for high school students in the Saudi context.**
7. If you agree to allow you child taking part in this study, he will be asked to do **pre-and post-tests and Questionnaire. Your child might invite to take part in interviews.**
8. Your child participation in this study will take approximately 8 weeks.
9. **Briefly describe debriefing arrangements**: In this study, the participants will experience two different learning environments; one is flipped learning and the other is non-flipped learning. Flipped learning is basically composed of two main components. Firstly, students should acquire new knowledge via pre-classroom tasks such as reading some materials or being exposed to instructional videos. Secondly, students should involve in classroom activities to construct and consolidate their knowledge in a greater depth. Non-flipped learning, the teacher will teach the students with his normal way without any intervention from the researcher. The main aims of this study is to investigate the impact of flipped learning on students' achievement and engagement. So, to achieve the aims of this study the participants will do Pre-test and Pre-Questionnaires in the first week of the study. At the end of the study, the participants will do post- test and post-Questionnaires and then some of participants will invite to take part in a semi-structured interview.

10. You are free to decide whether or not to allow your child to participate. If you decide not to participate, you are free to withdraw at any time without any negative consequences for you and your child.
11. All responses your child gives or other data collected will be kept confidential. The records of this study will be kept secure and private (researcher's computer with password). All files containing any information you give will be password protected and locked. In any research

Newcastle University
School of Education, Communication & Language Sciences

APPENDIX F

Parent Informed Consent

- I agree to allow my child to participate in this study, the purpose of which is to research **whether flipped learning can be adopted as an impactful innovation in education, and how it can contribute positively to Saudi students' learning**

- 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 data collection will involve the use of recording devices.
- 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 investigator will answer any questions regarding the study and its procedures. The investigator's email is M.S.M.Alwaqdani2@newcastle.ac.uk And they can be contacted via email or by telephone on 00966540593427

- 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 ecls.researchteam@newcastle.ac.uk

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

Consent Form Teacher
Information sheet

Appendix F: Pre-Post Test

اختبار مقرر حاسب1

اسم الطالب ....:

الأسئلة من 1 إلى 22 اختر الإجابة الصحيحة و ظلل الإجابة الصحيحة في ورقة التظليل الخارجية :

1) تقوم فكرة المصادر الحرة على:

أ	توفير تطبيقات برمجية بصورة مجانية	ب	عمل المبرمجين دون أي مقابل مادي	جـ	الأنتفاع المشترك وتقاسم المعرفة	د	منافسة البرامج مغلقة المصدر

2) نظام تشغيل يعد له الفضل في انتشار مفهوم المصادر عام 1990 هو نظام:

أ	ويندوز	ب	آبل	جـ	لينكس	د	أندرويد

3) أي من الرخص التالية تعد مغلقة المصدر:

أ	*GPL*	ب	*EULA*	جـ	*BSD*	د	*FDL*

4) قامت احد الشركات التجارية بتصميم برنامج لتحديد القبلة تحت رخصة *GPL*و, وقد رغب خالد بإقتناء البرنامج وتوزيعه على زملائه بصورة مجانية, إن ما قام به خالد يعد:

أ	سرقة لحقوق الآخرين	ب	قرصنة للبرنامج	جـ	نشر للخير	د	مخالفة لحقوق النشر

5) قام مهند بتقديم بحث بعنوان "اثار التقنية على الأطفال" وقد قام بالرجوع الى محرك البحث قوقل للحصول على المصادر والمعلومات وفي نهاية البحث وضع المصادر كمراجع ولكن دون ان يشير لمصدر كل معلومة , ان ما قام به مهند يعد انتحالا علميا يمكن تصنيفه بأنه:

أ	مزيج	ب	استنساخ	جـ	نسخ	د	تكرار

6) اذا قمت بنسخ جزء من أبحاثك ودراساتك السابقة دون الأشارة الى هذه الأبحاث والدراسات في بحثك الجديد , فأن هذا يعد من أنواع الأحتيال العلمي ويطلق عليه:

أ	استبدال	ب	نسخ	جـ	تكرار	د	مزيج

7) تعد حزمة مايكروسوفت أوفيس ضمن برامج :

أ	حرة المصدر	ب	مفتوحة المصدر	جـ	مغلقة المصدر	د	المجانية

8) من الأسباب التي أدت إلى انتشار الوسائط المتعددة كونها :

أ	تساعد في اجراء العمليات الحسابية بدقة.	ب	تمكن من تنظيم الملفات والمجلدات	جـ	تساعد على سرعة وصول المعلومة	د	تساعد في تنظيم وإدارة الوقت.

9) لقطات فلمية متحركة سجلت بطريقة رقمية

أ	الفيديو	ب	الرسومات الخطية	جـ	الرسوم المتحركة	د	الصور الثابتة

10) التعبيرات التكوينية بالخطوط والأشكال هي :

أ	الفيديو	ب	الرسومات الخطية	جـ	الرسوم المتحركة	د	الصور الثابتة

11) يتم استخدام الأدوات والبرامج لإضافة المحتوى وإنشاء الصور والحركات والأفلام الغير متوفرة في مرحلة:

أ	التحليل والإعداد	ب	التصميم وكتابة السيناريو	جـ	التنفيذ والأنتاج	د	التجريب والتطوير

12) عندما نستخدم الوسائط المتعددة في مساعدة العاملين على التمكن من العمل على الأنظمة الجديدة فإننا نتحدث عن استخدامها في مجال:

أ	التدريب	ب	التعليم	جـ	التجارة	د	الصحافة

13) عندما نستخدم الوسائط المتعددة لتقديم تقارير غير تقليدية تمكننا من إيصال صوتنا إلى العالم بلغة مشتركة لا تحتاج إلى ترجم . فإننا نتحدث عن استخدامها في مجال :

أ	التجارة	ب	الصحافة	جـ	التدريب	د	التعليم

14) من أشهر البرامج لتحرير ومعالجة الصور:

أ	Adobe Photoshop	ب	Pencil	جـ	Audacity	د	Jokosher

15) من أشهر البرامج لتحرير ومعالجة الرسوم المتحركة :

أ	Jokosher	ب	Pencil	جـ	Audacity	د	Adobe Photoshop

16) من مميزات برمجيات إدارة المواقع

أ	تتطلب مختص في الحاسب	ب	قلة البرمجيات التي تخدم مدير الموقع	جـ	وجود لوحة تحكم لها تسهل عملية إداراتها	د	تتطلب إعادة بناء الصفحات لإضافة محتوى

17) موقع يتيح إنشاء مدونة سهل التحكم والتعديل وهي خدمة مقدمة من قوقل

أ	www.wordpress.com	ب	www.slideshare.com	جـ	www.blogger.com	د	www.edublogs.com

18) موقع يتيح إنشاء مدونة سهل التحكم والتعديل وهي متخصصة بمدونات التعليم

أ	www.wordpress.com	ب	www.slideshare.com	جـ	www.blogger.com	د	www.edublogs.com

19) موقع يوفر للمستخدم مساحة مجانية خاصة على الإنترنت تمكنه من حفظ جميع أنواع الملفات:

أ	www.edublogs.com	ب	www.slideshare.com	ج	www.scribd.com	د	www.dropbox.com

20) من أكبر الموسوعات على شبكة الأنترنت تسمح للزوار بالأضافة والحذف والتعديل على الصفحات

أ	Facebook	ب	Wiki	ج	Blogs	د	Twitter

21) من أشهر شبكات التواصل الأجتماعي على شبكة الأنترنت التي تتيح خدمة التدوين المصغر بين أفراد تلك الشبكة

أ	Facebook	ب	Snapchat	ج	Blogs	د	Twitter

22) من المواقع التي تقدم خدمة حفظ ملفات العروض التقديمية على شبكة الإنترنت ومشاركتها مع الآخرين

أ	www.edublogs.com	ب	www.slideshare.com	ج	www.scribd.com	د	www.dropbox.com

اجب بعلامة صح(√) أو خطاء(x):

1) لكل برنامج فى المصادر المغلقة فى الغالب رخصة استخدام خاصه به	
2) تسمح المصادر المغلقة بالتعديل والتطوير على البرنامج	
3) من مزايا استخدام برامج المصادر الحرة انها شبه خاليه من الفيروسات وبرامج التجسس	
4) يحق للشركات والأفراد أخذ عائد مالي جراء الدعم التقني للمصادر الحرة	
5) الوسائط المتعددة هي منتج يدمج بين النص والصوت والصورة و الفيديو باستخدامبرمجيات الحاسب لتحقيق أهداف محددة للمستفيدين بطريقة تفاعلية	
6) مرحلة التجريب والتطوير تعتبر المرحلة الأخيرة من مراحل انتاج الوسائط المتعددة	
7) موقع ***Slide share*** من المواقع التى تقدم خدمة حفظ ومشاركة المستندات	
8) أول خطوة لعمل برنامج إدارة المواقع هى تجهيز قاعدة البيانات وتوزيع الصلاحيات بين المستخدمين	

Appendix G:

1- Questionnaire (Flipped learning group)

Introduction

Dear participant,

Thank you for agreeing to take part in this study. The study is about the impact of Flipped learning in computer science students achievement , performance, engagement , motivation and learning autonomy. This questionnaire will endeavour to measure the achievement , performance ,engagement , motivation and learning autonomy in computer science subject. Be assured that all the given answers will be kept in strictest confidentiality, and they will not be used for any evaluation purpose in any of your courses

Instructions

This questionnaire consists of six sections as follow:
1- Biographical information
2- Motivation
3- Learning Autonomy
4- Performance and Achievement
5- Engagement
6- The last section include two parts, the first one include 12 statements to measure your perception about your experience toward flipped learning approach. The second section will be ranking question to rank the elements of flipped learning approach.

Section One

A. Biographical information

1. Name (optional):
2. Have you been taught any course that integrates technology in the learning process? Yes/No

   If yes, please state which course and when?
   ....
3. Do you have access to the internet at home? Yes/No
4. Where do you use/get access to the web? (for example, college, mobile device, home etc)
5. Which device do you prefer to use for learning? Please Tick

   Phone iPad Laptop PC Gaming device

Section Two

A. The following section includes items related to your motivation. Please read them carefully and choose the one that best expresses your opinion. Please Tick (√) in your selected response :

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Adopted from
Motivation						
Intrinsic motivation						(Zainuddin and Perera, 2019)
I felt excited while learning computer sciences in the flipped learning.(excitement)						---
I was able to manage my own learning in the flipped learning. (autonomous)						
I was able to interact with peers during and after class time of computer sciences.(relatedness):						
Using the video outside class enabled me to better understand the subjects of computer sciences. Competence						
I attended class of computer sciences because I wanted to explore new ideas. (Competence)						
Extrinsic motivation						
I learned computer sciences because it was a compulsory course.						
I wanted to do well in computer class because it was important to show my ability to my lecturer, family, friends, or other.						
I learned computer sciences in order to find a good job.						
The most satisfying thing to me would be to get a good grade in the computer sciences subject.						
I learned computer because of my fear of being punished by my lecturer.						

Section Three

The following section includes items related to your learning autonomy. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Autonomy						Adopted from
Statement	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Adopted from**
I felt free to express my ideas and opinions in the classroom activities.						(Zainuddin 2018)
Outside of the classroom, I was able to control my learning environment by working on my pace.						-----
Outside of the classroom, I enjoyed the freedom to learn whenever I want .						-----
Outside of the classroom, I was able to control my learning time.						------
I did not need the teacher to offer help to me.						
I did not need the teacher to tell me what my difficulties are.						
I did not need the teacher to tell me what to do.						
I felt that my instructor provides me choices and options.						LCQ (Feri, Soemantri et al. 2016)
I felt understood by my instructor.						-----
My instructor conveyed confidence in my ability to do well in the course.						-----
My instructor encouraged me to ask questions.						-----
My instructor used to listen to how I would like to do things.						-----

Section Four

The following section includes items related to your learning performance and achievement. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Adopted from
Performance						
I feel better understand the concept of computer sciences in flipped learning approach.						
I feel flipped learning enhanced my ability in computer sciences.						
I feel my performance was better in flipped learning.						
Using instructional video in Flipped learning was very effective in helping me understand the concept of computer sciences.						
The classroom activities helped me to performed better in computer sciences.						
Achievement						
I feel that I have improved overall comprehension about the concepts of computer sciences as a result of enrolled in flipped learning.						
Learning process in flipped learning helped me to achieve the objectives of computer sciences subjects.						
I believe that this computer classroom improved my knowledge about the concepts of computer science.						
I am satisfied about my learning achievement in computer science subject.						
I am satisfied about my grade in computer science.						

My overall grade in computer science is higher as a result of flipped learning approach.						

Section Five

This section includes items related to your engagement. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

Response options
Very often
Often
Sometimes
Never

Statement	Very Often	Often	Someti mes	Never		Adopte d from
Engagement						
I engaged in classroom discussion						
I communicated with other students in the classroom						
I had more communication with the teacher						
I work at home to prepare for classroom						
Computer classroom is more engaging than other classrooms						
I feel I engaged with course materials						
I explained course materials to my classmates						NSSE+ (Burke and Fedorek 2017)
I contributed to classroom discussion						NSSE
I work with other students in course projects						NSSE
I engaged with instructional video of computers subject						NSSE

Section Six

A. The following section include items related to your Perception toward flipped learning experience. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Adopted from
Student Perception						
I prefer flipped learning approach rather than traditional learning approach.						
I feel I have improved by engaging in the learning process including video, quiz, collaborative learning.						
I have learned a lot from the computer science course.						
I feel that flipped learning needs hard work.						
I like to work at home to prepare for classroom activities.						
I like to watch a video instead of attending a teacher's lecture.						
I liked the classroom activities						
I liked the communication with my classmates in flipped learning.						
I liked the idea of using technology in my learning.						
I liked the idea of making the classroom more social.						
I like the length of the video which is not too long.						
I prefer to have all the courses using flipped learning.						

B. Please rank the following statements from your opinion as 1 is the most effective element of flipped learning whereas 4 is the least effective element.

Statement	Rank
Watching a video to paper for classroom activities	
Quizzes	
Online discussion	
Classroom activities	

2- Questionnaire (non-flipped learning group)

Introduction

Dear participant,

Thank you for agreeing to take part in this study. The study is about the impact of Flipped learning in computer science students achievement , performance, engagement , motivation and learning autonomy. This questionnaire will endeavour to measure the achievement , performance ,engagement , motivation and learning autonomy in computer science subject. Be assured that all the given answers will be kept in strictest confidentiality, and they will not be used for any evaluation purpose in any of your courses

Instructions

This questionnaire consists of six sections as follow:
1- Biographical information
2- Motivation
3- Learning Autonomy
4- Performance and Achievement
5- Engagement

Section One

A. Biographical information

1. Name (optional):
2. Have you been taught any course that integrates technology in the learning process? Yes/No

   If yes, please state which course and when?
   ………………………………………………………………………….
3. Do you have access to the internet at home? Yes/No
4. Where do you use/get access to the web? (for example, college, mobile device, home etc)

5. Which device do you prefer to use for learning? Please Tick

☐ Phone ☐ iPad ☐ Laptop ☐ PC ☐ Gaming device

Section Two

A. The following section includes items related to your motivation. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response :

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Adopted from
Motivation						
Intrinsic motivation						(Zainuddin and Perera 2017)
I felt excited while learning computer sciences in non-flipped learning.						---
I was able to manage my own learning in non-flipped learning.						
I was able to interact with peers during and after class time of computer sciences						
Teacher lecture enabled me to better understand the subjects of computer sciences.						
I attended class of computer sciences because I wanted to explore new ideas.						
Extrinsic motivation						
I learned computer sciences because it was a compulsory course.						
I wanted to do well in computer class because it was important to show my ability to my lecturer, family, friends, or other.						
I learned computer sciences in order to find a good job.						
The most satisfying thing to me would be to get a good grade in the computer sciences subject.						
I learned computer because of my fear of being punished by my lecturer.						

Section Three

The following section includes items related to your learning autonomy. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Autonomy						
Statement	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Adopted from**
I felt free to express my ideas and opinions in the classroom activities.						(Zainuddin 2018)
Outside of the classroom, I was able to control my learning environment by working on my pace.						-----
Outside of the classroom, I enjoyed the freedom to learn whenever I want .						-----
Outside of the classroom, I was able to control my learning time.						------
I did not need the teacher to offer help to me.						
I did not need the teacher to tell me what my difficulties are.						
I did not need the teacher to tell me what to do.						
I felt that my instructor provides me choices and options.						LCQ (Feri, Soemantri et al. 2016)
I felt understood by my instructor.						-----
My instructor conveyed confidence in my ability to do well in the course.						-----
My instructor encouraged me to ask questions.						-----
My instructor used to listen to how I would like to do things.						-----

Section Four

The following section includes items related to your learning performance and achievement. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

1. Strongly agree (I absolutely concur with this statement)
2. Agree (to a certain extent, I concur with this statement)
3. Neutral
4. Disagree (I do not fully agree with this statement)
5. Strongly disagree (I am absolutely against this statement)

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Adopted from
Performance						
I feel better understand the concept of computer sciences in non-flipped learning approach.						
I feel non-flipped learning approach enhanced my ability in computer sciences.						
I feel my performance was better in non-flipped learning.						
In-class lecture in Non-flipped learning approach was very effective in helping me understand the concept of computer sciences.						
The classroom activities helped me to performed better in computer classroom.						
Achievement						
I feel that I have improved overall comprehension about the concepts of computer sciences as a result of enrolled in non-flipped learning approach.						
Learning process in non-flipped learning helped me to achieve the objectives of the concepts of computer sciences subjects.						
I believe that this computer classroom improved my knowledge about the concepts of computer science.						
I am satisfied about my grade in computer science.						
My overall grade in computer science is higher as a result of teaching method non-flipped learning approach.						

Section Five

This section includes items related to your engagement. Please read them carefully and choose the one that best expresses your opinion. Please Tick (✓) in your selected response:

Response option
Very often
Often
Sometimes
Never

Statement	Very Often	Often	Sometimes	Never		
Engagement						
I engaged in classroom discussion						
I communicated with other students in classroom						
I had more communication with the teacher						
I work at home to prepare for classroom						
Computer classroom is more engaging than other classroom						
I feel I engaged with course materials						NSSE+ (Burke and Fedorek 2017)
I explained course materials to my classmates						NSSE
I contributed to classroom discussion						NSSE
I work with other students in course projects						NSSE
I engaged with teacher explanation of computers subject						

Appendix H: Interview Protocol

(Interview Protocol)

Interview no.:

Date of interview:

Introduction

The purpose of this interview is to gain a deep understanding of your experiences of the Computer science course you have just taken. Your responses will be used for the purposes of this research. I would like you to read the consent form informing you that this interview will be recorded and to sign it if you consent to being audio-recorded.

- How would you describe your experience on computer sciences course? (FL-NON)
- How would you describe your academic engagement on computer sciences course? (FL-NON)
- How would you describe your performance on computer sciences course? (FL-NON)
- Were you able to understand the course-related concepts explained through … (instructional videos – In-class lectures)? (FL-NON)

- Did you engage in the learning process (in-classroom / at home)? Why? (FL)
- Were you motivated during learning computer sciences course? Why? (FL-NON)
- How would you describe your 'autonomous learning' in computer sciences course? (FL-NON)
- How did find preparing for classroom activities at home? (FL)
- What elements of flipped learning do you perceive as effective learning practises? (FL)
- Do you have any other comments about computer sciences course?

Appendix I: Focus Group

Focus Group

Group no.:

Date of Meeting:

Introduction

The purpose of this discussion is to gain a deep understanding of your experiences of the Computer science course you have just taken. Your responses will be used for the purposes of this research. I would like you to read the consent form informing you that this discussion will be recorded and to sign it if you consent to being audio-recorded.

- How would you describe your experience on computer sciences course? (FL-NON)
- How would you describe your academic engagement on computer sciences course? (FL-NON)
- How would you describe your performance on computer sciences course? (FL-NON)
- Were you able to understand the course-related concepts explained through … (instructional videos – In-class lectures)? (FL-NON)

- Did you engage in the learning process (in-classroom / at home)? Why? (FL)
- Were you motivated during learning computer sciences course? Why? (FL-NON)
- How would you describe your 'autonomous learning' in computer sciences course? (FL-NON)
- How did find preparing for classroom activities at home? (FL)
- What elements of flipped learning do you perceive as effective learning practises? (FL)
- Do you have any other comments about computer sciences course?

Appendix J: SEM Model

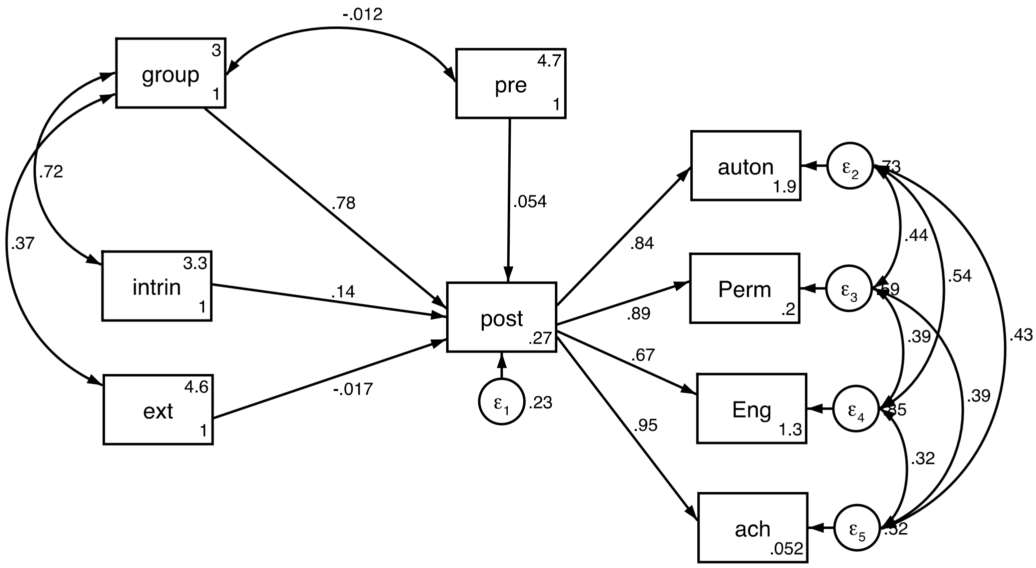

Figure xx: the model of Learning environment impact on students' learning experience

Variables	*Cofe*	*std*	*z*	*P value*
group→ Post	0.77	.052	14.86	0.00
Pre → Post	.054	.037	1.45	.146
Interin→Post	.137	.52	2.60	0.00
Ext → Post	-.017	.041	-0.41	.680
Post → auton	.84	.060	13.89	0.00
Post → perm	.88	.051	17.34	0.00
Post → Eng	.66	.087	7.57	0.00
Post → ach	.95	.042	22.30	0.00

Table xx: Standardised path coefficients and p-value for the relationships in the research mode

	Fit Index						
	X^2	df	RMSEA	S-RMR	CD	TLI	CFI
Model	23.071	12	0.112	0.046	0.90	0.923	0.969

Table xx: Fit indices of model for the current study