THE EFFECTS OF STUDY-SUMMARY-QUIZ BASED FLIPPED LEARNING MODEL ON PRE-SERVICE TEACHERS' ICT SKILLS, ACHIEVEMENT, ENGAGEMENT, AND SELF-EFFICACY

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by

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LIST OF ABBREVIATIONS

FL	Flipped Learning
FC	Flipped Classroom
SSQ	Study-Summarize-Quiz
SSQ FLM	Study-Summarize-Quiz Based Flipped Learning Model
CFLM	Conventional Flipped Learning Model
PTs	Pre-service Teachers
ATIK	Achievement Test for ICT Knowledge
ISTBT	ICT Skills Tasks-Based Test
ICT	Information Communication Technology
EQ	Engagement Questionnaire
BE	Behavioural Engagement
AE	Agentic Engagement
CE	Cognitive Engagement
EE	Emotional Engagement
TPS	Think-Pair-Share

KESAN MODEL PEMBELAJARAN *FLIPPED* BERASASKAN *STUDY-SUMMARY-QUIZ* TERHADAP KEMAHIRAN, PENCAPAIAN, PENGLIBATAN DAN EFIKASI KENDIRI ICT GURU PRA-PERKHIDMATAN

ABSTRAK

Kaedah berasaskan kuliah tradisional untuk pengajaran kursus ICT dalam Pendidikan di institusi pengajian tinggi Nigeria menyumbang kepada pencapaian akademik guru pra-perkhidmatan yang lemah, kemahiran praktikal yang tidak mencukupi dan penglibatan yang berkurangan. Sehubungan dengan itu, kajian ini cuba mengkaji kesan strategi pembelajaran *flipped* genre baharu, iaitu model pembelajaran *flipped* berasaskan kaji-rumus-kuiz (SSQ FLM) dan jantina terhadap kemahiran ICT guru pra-perkhidmatan, pengetahuan ICT (pencapaian), penglibatan (tingkah laku, agentik, kognitif dan emosi), dan efikasi kendiri. Kesan jantina terhadap variable bersandar turut dikaji. Kajian selanjutnya menyiasat kesan interaksi antara strategi pengajaran dan jantina ke atas variable bersandar tersebut. Model pembelajaran *flipped*, teori konstruktivis sosial, teori pembelajaran koperatif, taksonomi Bloom, dan strategi kaji-rumus-kuiz (SSQ) menyediakan rangka kerja teori yang komprehensif bagi kajian ini. Reka bentuk kuasi eksperimen ber faktorial 2x2 menggunakan pendekatan praujian dan pascaujian. Teknik pensampelan mudah telah digunakan untuk mengambil 173 guru pra-perkhidmatan (108 lelaki dan 65 perempuan) sebagai responden daripada populasi guru seramai 956 orang yang dibahagikan kepada dua kumpulan. Kumpulan pertama (65 lelaki dan 26 perempuan) diajar menggunakan SSQ FLM, manakala kumpulan kedua (43 lelaki dan 39 perempuan) telah dirawat dengan model pembelajaran *flipped* konvensional (CFLM). Empat instrument terdiri daripada, Ujian Berasaskan Tugasan Kemahiran ICT, Ujian

Pencapaian Pengetahuan ICT, Soal Selidik Penglibatan, dan Soal Selidik Keberkesanan Kendiri telah diguna dalam kajian ini. Data yang diperoleh telah dianalisis dengan menggunakan statistik deskriptif, analisis varians dua-hala (ANOVA), dan analisis kovarian dua-hala (ANCOVA). Hipotesis *nol* telah diuji pada tahap signifikan 0.05. Dapatan kajian melaporkan bahawa SSQ FLM meningkatkan kemahiran ICT guru pra-perkhidmatan, pengetahuan ICT, penglibatan dan efikasi kendiri berbanding dengan CFLM. Walau bagaimanapun, tidak terdapat perbezaan yang signifikan dalam penglibatan kognitif guru pra-perkhidmatan semasa mempelajari kursus ICT dalam Pendidikan. Dapatan kajian selanjutnya memperlihatkan bahawa jantina mempunyai kesan yang signifikan terhadap pengetahuan ICT guru pra-perkhidmatan semasa mempelajari kursus ICT dalam Pendidikan. Namun begitu, jantina tidak mempunyai kesan yang signifikan terhadap kemahiran ICT guru pra-perkhidmatan, penglibatan dan efikasi kendiri. Keputusan menunjukkan tiada kesan interaksi antara jantina dangan kaedah pengajaran (SSQ FLM dan CFLM) terhadap semua variabel bersandar. Oleh itu, adalah disyorkan agar pendidik institusi tinggi Nigeria mengaplikasikan pendekatan SSQ FLM dalam pengajaran kursus ICT yang berkaitan.

THE EFFECTS OF STUDY-SUMMARY-QUIZ BASED FLIPPED LEARNING MODEL ON PRE-SERVICE TEACHERS' ICT SKILLS, ACHIEVEMENT, ENGAGEMENT, AND SELF-EFFICACY

ABSTRACT

Traditional lecture-based method for teaching ICT in Education course in Nigerian higher education institutions contributes to the pre-service teachers' poor academic achievement, inadequate practical skills, depleted engagement, and limited self-efficacy. As an ICT course with unique characteristics, it requires student-centred and technology-based learning approaches. The flipped learning model is one of the technology-based learning approaches used commonly in learning institutions where pre-class and in-class learning activities have a significant role. However, the inability of the students to complete their pre-class activities and the lack of clear instruction and proper teaching strategy during the in-class learning activities are serious issues affecting the model's efficacy. In this study, the researcher proposes study-summary-quiz based flipped learning method (SSQ FLM) to enhance pre-service teachers' ICT skills, ICT knowledge (achievement), engagement (behavioural, cognitive, agentic, and emotional), and self-efficacy. The effect of gender on the dependent variables was also explored. The researcher further investigates the interaction effect between instructional methods (SSQ FLM and CFLM) and gender on the aforesaid dependent variables. Flipped learning model, social constructivist theory, cooperative learning theory, Bloom's taxonomy, and study-summary-quiz (SSQ) strategy provide a comprehensive theoretical framework for this study. The study uses a quasi-experimental design of a 2x2 factorial involving pre-test and post-test approaches. A convenience sampling technique was used to recruit 173 pre-service teachers (108 males and 65 females) from a total

population of 956 in which they divided into two groups. The first group (65 males and 26 females) was taught using the SSQ FLM, while the second group (43 males and 39 females) was treated with the conventional flipped learning model (CFLM). Four instruments consisting of ICT Skills Tasks-Based Test, Achievement Test for ICT Knowledge, Engagement Questionnaire, and Self-efficacy Questionnaire were used in this study. The data obtained were analysed using descriptive statistics, two-way analysis of variance (ANOVA), and two-way analysis of covariance (ANCOVA). The null hypotheses were tested at a 0.05 level of significance. The findings reported significant differences between SSQ FLM and CFLM in four dependent variables (ICT skills, achievement, self-efficacy, and engagement). In terms of engagement, significant differences between the two groups were observed in behavioural, agentic, and emotional engagement, while there was no significant difference in cognitive engagement. The findings further revealed that gender significantly affected pre-service teachers' (ICT knowledge) when learning ICT in Education course. Nevertheless, gender had no significant effect on pre-service teachers' ICT skills, engagement, and self-efficacy. Results showed no interaction effect between gender and instructional method (SSQ FLM and CFLM) on all the dependent variables. Thus, it was recommended that the Nigerian higher institutions' educators apply the SSQ FLM approach in teaching-related ICT courses.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Information and communication technologies (ICTs) skills are essential and needful for teachers to disseminate information effectively. Over the years, ICTs have been integrated into teacher education programs to improve pre-service teachers' skills, knowledge, and confidence in using technologies (Gaurav, 2018). Countries like the United Kingdom, United States of America, Singapore, Australia, and Malaysia introduced ICTs policies and programs to enhance teachers' ICT skills and knowledge. As a developing country, Nigeria is aware of the importance of integrating ICTs in education. The Nigerian government has directed academic staff in all tertiary institutions to integrate ICTs into their teaching processes. The government provided technology infrastructures to support the integration of ICTs in education learning institutions.

The learning institutions in Nigeria had redesigned their curriculum; the ICT training course (ICT in Education) was introduced into the teacher education programs. The course helps pre-service teachers (PTs) improve their ICT knowledge; it is divided into two parts: ICT skills and ICT knowledge part. The ICT skills part comprises practical skills in Microsoft Word, Microsoft Excel, Microsoft PowerPoint, Internet skills, information networking, information security, image processing, and database. These skills provide flexible and effective ways for teachers' professional development (Alasela, Ogunlade, Ogunlade, & Obielodan, 2016). Despite introducing the ICT in Education course as a mandatory course in teacher education programs, PTs' ICT skills are below the average (Bakare, 2017;

Garba, 2014a; Idowu, Oluwaseun, Olubunmi, & Abraham, 2021). Therefore, PTs' ICT skills and knowledge need to be improved.

Introducing ICT in Education course is not just acquiring ICT skills and knowledge but also enhancing PTs' ICT self-efficacy and engagement. Self-efficacy measures a student's confidence in mastering new technology (Compeau & Riggings, 1995). Students' self-efficacy in integrating ICT is among the essential factors considered when learning ICT in Education course. Students' engagement is among the most important indicators for success at all levels of education. A high-level students engagement improves students' confidence in integrating technology into the teaching and learning processes. Engagement is a critical element for boosting students' academic progress and promoting active learning (O'Donnell, Reeve, & Smith, 2011). It represents the range of students' actions, from not having a skill to having skill and knowledge (Reeve, 2013). The engagement has been categorized into four dimensions: behavioural, agentic, cognitive, and emotional.

Gender is another variable to examine in this study. According to Hassan (2015), gender describes the social definition of sex roles rather than the distinct biological distinction itself. It also plays a significant role in science, technology, engineering, and mathematics (STEM). It is a variable whose effect on pre-service teachers' ICT skills, learning achievement, self-efficacy, and engagement has not been well-explored by researchers, especially in developing countries like Nigeria. ICT course is commonly considered as one area in which males have higher achievement in terms of skills and knowledge (Ilomäki, 2011). Moreover, gender differences are often found in self-efficacy; learners believe in their success in performing ICT-related tasks. Girls feel less confident about their capability to integrate ICT facilities and tend to underestimate their abilities, while boys

overestimate their confidence and achievements (Punter et al., 2017). Gender is believed to be a strong predictor of behaviour and attitude in technology information seeking; therefore, understanding gender differences allows for the development of reliable teaching and learning models in helping individual learners acquire needed ICT skills, knowledge, and building confidence in using technology (Soetan & Ominuta, 2018).

Since the introduction of the ICT in education course into the teacher education program, teacher training institutions have been struggling to get effective teaching method that is better than the current conventional teacher-centred approach. One of the biggest challenges of teaching and learning ICT-related courses in Nigeria is the teaching method employed by the teachers (Odo & Eze, 2017). This problem generates a lot of questions regarding the credibility of ICT in Education course in Nigerian institutions. Some of the questions include: Does the ICT in Education course designed to solve the problems of ICT literacy skills? Are the appropriate teaching methods used in teaching the ICT courses? Are there enough facilities to teach the courses in the schools?

Under this circumstance, teaching ICT in Education course needs to change from a teacher-centred approach to a student-centred learning. Flipped learning (FL) teaching method potentially offers a liable learning environment and improves students' academic achievement (Akingbemisilu, 2017; Siti Zuraidah, 2016). It is a teaching strategy through which instructors advise learners on how to solve problems and interact with peers in the class (Lin, Hwang, & Hsu, 2019). High-order learning skills and academic performance are achievable when students acquire basic knowledge at home, deep discussion, and hands-on practice during the in-class time (Xu & Shi, 2018). Because of the potentiality of the FL Model, the researcher

conductes research using the FL model to improve the teaching and learning in ICT in Education course. The model is supported by social constructivist learning theory, Bloom's taxonomy, cooperative learning theory (think-pair-share), and study-summary-quiz (SSQ) strategy.

Social constructivist learning theory encourages student-centred learning. It is applied in FL studies to support in-class activities (Xu & Shi, 2018). FL model and constructivist learning theory argue that students are active constructors of knowledge and controller of their learning processes while teachers only guide the students to achieve their autonomous learning outcomes. On the other hand, Bloom's taxonomy is an instructional model for classifying what learners should learn. Bloom's taxonomy of learning cognitive is classified into the lower cognitive level (remembering and understanding) and higher cognitive level (applying, analysing, evaluating, and creating) (Krathwohl, 2002). It is applied to guide flipped classroom activities so that a lower cognitive level is achieved outside the class and an upper cognitive level of learning is attained inside the classroom under the supervision of the teacher/instructor (Zainuddin, Habiburrahim, & Hermawan, 2018).

The researcher applied cooperative learning theory (think-pair-share) to guide in-class activities to reduce learners' psychological pressure in the classroom and improve students' engagement (Zhang, 2018). Both the FL model and the cooperative learning theory require learners to learn before the class hour. Therefore, for students to learn effectively before the class hour, the SSQ based flipped learning model (SSQ FLM) was employed.

The SSQ is a strategy developed by the researcher to guide students toward completing their pre-class learning activities. The detail of the SSQ strategy was

discussed in chapter three. The researcher used Google Form to create a link where students submitted their SSQ activities. The lecture shared the link with students via Edmodo. The Edmodo is a free learning management system, and lecturers use it in a virtual learning environment (Enriquez, 2014). Though different learning management systems (LMSs) such as Moodle, Blackboard, Schoology, Kahoot, and Sakai have been used by other researchers, the researcher observed that these LMSs are not familiar with the lecturers and students in the chosen university. Edmodo has been utilized by both lecturers and students in the chosen university.

While implementing the FL model, the researcher investigated the role of gender. There are mixed reports on the effect of gender on technology-based instructional strategies. Therefore, understanding the role of gender in FL model studies is necessary. Gender is a moderator variable in this study. The inclusion of gender expands the scope of the study and provides proper suggestions that benefit all students. It also helps faculty and flipped educators to understand how male and female students respond to a new teaching approach (FL model).

1.2 Background of the Study

Information and communication technology (ICT) in education course is one of the compulsory courses offered at teacher training institutes in Nigeria. The course is designed to prepare PTs (pre-service teachers) to understand and appreciate the application of computers in education and the role of ICT in daily teaching and learning processes. The aims and objectives of ICT in education course in teacher education in Nigeria as contained in the university curriculum are to:

1. Integrate computer and Information and Communication Technology tools to solve problems.

2. Examine computer applications in teaching and learning.
3. Examine the application of ICT in education.
4. Identify the problems, prospects, and challenges of applying ICT in education.
5. Become familiar with distance learning, open learning, e-learning, blended learning, and FL.
6. Enhance pre-service teachers' ICT skills and knowledge to integrate ICT in teaching and learning.

In Nigeria, PTs are university students in the Faculty of Education or students in the Colleges of Education. They undergo rigorous training to become professional in-service teachers who can master their subject matters and integrate ICT tools in their classrooms to reassure critical thinking and independent work. Compared with other countries, PTs in Nigeria have inadequate ICT skills and ICT knowledge (Agbu & Mishra, 2017; Bakare, 2017; Garba, 2014). On the contrary, pre-service, and in-service teachers in the United Kingdom and the United States of America had fair and reasonable ICT skills and knowledge (Morris, 2006). PTs in Malaysia had an average level of ICT skills and knowledge (Mazalah et al., 2016; Umar & Yusoff, 2014).

The researcher investigated what could have been responsible for the Nigerian students' poor ICT skills in ICT in Education classes. Generally, the problem of a large of content in the ICT in Education course, limited practical sections, and traditional lecture-based methods have contributed to PTs' poor learning achievement. Table 1.1 indicated the poor results of PTs in an ICT in education course in a sampled University.

Table 1.1 Pre-service Teachers' Scores in ICT in Education course Between 2015 and 2019

Session	**Practical ICT Skills Examination**							**Theoretical ICT Examination**						
	A-C		**D-E**		**F**		**Total**	**A-C**		**D-E**		**F**		**Total**
	No	%	No	%	No	%		No	%	No	%	No	%	
2015/2016	40	21.3	56	29.9	91	48.6	187	56	29.9	60	32.1	71	38	187
2016/2017	41	20.9	48	24.4	107	54.6	196	86	43.9	80	40.8	30	15.3	196
2017/2018	30	14.8	75	36.9	98	48.3	203	73	36	70	34.5	60	29.5	203
2018/2019	61	28.6	58	27.3	94	44.1	213	80	37.6	63	29.6	70	32.8	213

Source: Field work (2019) **NB:** A-C = 50% and above, D-E = 49-40%, and F = 0-39%

In the 2015/2016 session, over 75% of the students scored between D, E, and F in the practical ICT skills examination. It means the students had inadequate ICT skills. More than 70% of the students scored D, E, and F in the theoretical ICT examination in the 2015/2016 session. It shows that students had less ICT knowledge. In the 2016/2017 session, more than half (54%) of the students scored F in the practical ICT skills examination, while 15.3% failed in the theoretical ICT examination. Close to half (48.3%) of the students scored F in the ICT skills-based examination in the 2017/2018 session, and more than 29% of the students scored F in the theoretical ICT examination. In 2018/2019, more than 70% of the students scored between D, E, and F in the practical ICT skills examination, and more than 30% of the students failed the theoretical ICT examination. These results indicated that over four years now, the performance of PTs in the ICT in education course offered at 200 Level has not been as expected in both practical and theoretical aspects of the course. Table 1.1 shows that the pre-service teachers' ICT skills and knowledge level is below average. They lack the skills to integrate ICT facilities in their future classrooms. By implication, the pre-service might have less or no confidence in using ICT facilities since they lack the required skills. That is to say, the students' self-efficacy continued to be low as far as their achievement was below average. The table not only reveals the pre-service teachers' level of knowledge and skills but also elaborates on why students have poor ICT self-efficacy.

Though other factors, such as large class sizes and lack of environmental and technical support, might contribute to students' failure, the traditional teacher-centred method is believed to be a significant predicament distorting students' progress. Using a traditional teacher-centred approach to teaching ICT and computer-related courses has contributed to students' poor learning achievement, self-efficacy, and

engagement (Zakana & Esther, 2019; Samuel, Onasanya, & Yusuf, 2019; Khan & Ibrahim, 2017). Therefore, this study intends to enhance PTs' belief to integrate the acquired ICT skills and knowledge into their future classrooms.

Nigerian institutions are gradually adopting modern technology-based methods like e-learning, mobile learning, cloud computing, and FL models to enhance PTs' knowledge and skills (Akingbemisilu, 2017). Each of these methods has unique-features and characteristics that make them exceptional. E-learning is one of the popular teaching methods used in the twenty-first century; it offers unlimited access and efficient communication between teachers and students (Kattoua, Al-Loza, & Alrowwad, 2016). Nevertheless, the method is more suitable for non-practical-based courses (Gamal & Aziz, 2012). Mobile learning plays a significant role in distance education and online studies where students access learning materials on the mobile application; it serves primarily as a supporting tool for teaching and learning (Qureshi, Khan, Ahmad, & Raza, 2020).

Among these technology-based teaching methods, the Flipped learning model is always deployed for courses with a large volume of content that is usually hard to cover in the conventional classroom (Akingbemisilu, 2017; Lai, 2015; Wen et al., 2016). The flipped learning model, also known as 'inverted classroom', 'flip teaching' or 'reverse instruction', has different meanings and explanations. It refers to the situation in which students are exposed to lecture materials either in video, audio, or print materials to read before the class hour. In contrast, during class hours, the students discuss what they have learned outside the class (Eppard & Rochdi, 2017). In other words, conventional flipped learning model (CFLM) refers to a process whereby lecturers use technology, especially videos, to transmit information (lecture) outside of class. Many studies adopted the concept of the CFLM in

educational settings (e.g., Bergmann & Sams, 2012; Casasola, Nguyen, Warschauer, & Schenke, 2017; Ugwoke, Edeh, & Ezemma, 2018).

The CFLM needs additional support to improve students' engagement and practical learning activities, especially during pre-class and in-class learning activities. Therefore, the study-summary-quiz-based flipped learning method (SSQ FLM) is proposed in this study. Study-summary-quiz (SSQ) developed by the researcher to enhance pre-class activities and the think-pair-share (TPS) teaching strategy adopted to guide the students during in-class activities. In addition, the SSQ FLM is supported by constructivist learning theory and Bloom's taxonomy.

In applying CFLM and SSQ FLM for teaching ICT in education courses, gender is considered one serious concern because previous studies have indicated that gender is a significant variable when implementing technology-driven strategies. A previous study showed that male students acquired better ICT skills than female students (Singh, 2017; Soetan & Ominuta, 2018). Another study indicated that female teachers need ICT knowledge and skills compared to male teachers (Mustafa, 2014). In contrast to this, there was research that found no significant difference in the level of ICT literacy and achievement between male and female PTs (Daramola, Yusuf, & Oyelekan, 2015; Tyler & Yessenbayeva, 2018). The results from previous studies are contradictory regarding the role of gender in instructional technology-based research. Therefore, the researcher used gender as a moderator variable in this study.

1.3 Problem Statement

One major problem in training pre-service and in-service teachers in Nigeria was that their ICT knowledge and skills were limited despite introducing the ICT in

education courses (Abubakar, 2010; Agbu & Mishra, 2017; Bakare, 2017; Garba, 2014). Nigerian students had inadequate skills in word processing, spreadsheet, PowerPoint presentation, database management, E-mail, information networks, and data analysis (Idowu et al., 2021). This is consistent with the results of PTs presented in table 1.1. It is also observed that the lecturers are still using the traditional lecture-based method in teaching the ICT in Education course, where students sit on their chairs listen to the lecturer without making significant contributions. In this case, the students have limited time for practical activities and less interaction with lecturers and peers (Bakare, 2017). The traditional lecture-based method offered few learning opportunities and undermined the students' progress (Li, Qi, Wang, & Wang, 2014; Adedoja, 2016; Uwaifo, 2010).

The second problem faced by the Nigerian PTs was poor ICT self-efficacy when learning ICT in Education course. The students' ICT self-efficacy was below the average, thereby hindering the agenda of transforming the educational system (Agbu & Mishra, 2017). Most of the Nigerian institutions are characterized by using lecture-oriented pedagogy in which the students have inadequate time to develop their self-efficacy. The students hardly see their lecturers modelling the use of ICT facilities in their classroom instructions. Even the lecturers handling ICT-related courses teach the courses using the traditional lecture-based method (Garba, 2013). Another factor responsible for the students' poor ICT self-efficacy includes environmental support such as school culture, time, technical support, and training. Though this issue caused a severe concern about actualizing Nigerian educational goals, few researchers have tried to improve PTs' ICT self-efficacy by using appropriate teaching strategies such as a student-centred learning approach and a technology-based approach.

The third problem faced by the students was having limited behavioural engagement. That is inability to complete learning tasks in time and engage in the learning process (Samuel, Onasanya, & Yusuf, 2019; Zakana & Esther, 2019). This occurs due to a lack of appropriate teaching strategies in the traditional classroom; students are often asked to complete their assignments at home without supporting strategies. These are critical problems that lead to students' poor academic achievement. The lecturers from the chosen university observed that students lack courage to express their opinion during the learning process (agentic engagement), they were disengaged and faced difficulties connecting what they were trained in the class with what they were trying to apply when doing assignments or homework (cognitive engagement). The lecturers further noticed that students could not answer the questions that required them to apply previous knowledge in the given situation and have less interest of academic activities (emotional engagement). Researchers agreed that students could complete their learning tasks in time and participate in the learning process when they were engaged in the learning activities (Subramaniam & Muniandy, 2019). Hence, the teaching and learning paradigm must shift from a teacher-centred to a learner-centred approach, which can be achieved using technology-based methods. Therefore, adopting a technology-based approach such as flipped learning (FL) model provides PTs with a solution for the abovementioned problems.

Against this background, this study contributes to the body of existing knowledge by using the FL model to teach ICT in Education courses in a Nigerian university. The FL model is a teaching method that allows students to learn before the class hour, at their own pace, anywhere, anytime. The FL model was a better teaching strategy this century than the traditional classroom. However, few or no

studies were conducted in Nigeria regarding the effect of the FL model on PTs' ICT skills, ICT knowledge (achievement), engagement, and self-efficacy. Therefore, there is a need to conduct more FL studies, particularly in Africa, to extend the evolving body of FL research from the perspectives of developing countries. The FL model allows interactive group-based learning and computer-based personal instruction outside the class (Bishop & Verleger, 2013), offers adequate time for in-class activities (Samaila et al., 2021), gives room for students to re-watch video lectures from time to time, and helps students participate actively in the learning process (Xu & Shi, 2018).

Despite the advantages of the FL model, some studies identified and reported challenges associated with the model. For instance, students could not complete their pre-class learning activities in flipped classroom model (Lai & Hwang, 2016; Zainuddin et al., 2019). There is a need to have clear teaching strategies during in-class activities. Intensive steps are needed to overcome these challenges (Araujo et al., 2017). Therefore, the researcher developed an SSQ-based FL model to overcome the limitations and challenges of the conventional FL model and traditional lecture-based method.

Regarding gender, there are different attitudes toward education, especially toward science and technology education across gender (Namaziandost & Çakmak, 2020). Previous and existing studies on gender in association with ICT skills, ICT knowledge, engagement, and self-efficacy reported mixed findings in science and technology education (Kaarakainen et al., 2018; Mustafa, 2014; Siddiq & Scherer, 2019). Moreover, this study uses the theoretical foundations of social constructivist theory, Bloom's taxonomy, and the cooperative learning model to improve the efficacy of the FL model. Consequently, the study investigated the effect of the SSQ-

based flipped learning model and gender on PTs' ICT skills, ICT knowledge, engagement, and self-efficacy. The SSQ-based flipped learning approach helps the students to have more time and opportunity for hands-on activity, problem-solving, in-depth discussion, and presentation, thereby improving their learning achievement, skills, self-efficacy, and engagement. The findings of this study might assist flipped educators, curriculum designers, and policymakers by providing a new researched-based foundation for improving PTs' academic achievement.

1.4 Objectives of the Study

The main objective of this study is to investigate the effect of the study-summary-quiz (SSQ) based flipped learning method and gender on pre-service teachers' ICT skills, ICT knowledge (achievement), self-efficacy, and engagement in Nigeria.

The objectives are as follow:

1. To examine the effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers'
    a) ICT skills when learning ICT in Education course
    b) ICT knowledge (achievement) when learning ICT in Education course
    c) Self-efficacy when learning ICT in Education course
    d) Engagement (behavioural, agentic, cognitive, and emotional) when learning ICT in Education course
2. To examine the effect of gender on pre-service teachers'
    a) ICT skills when learning ICT in Education course
    b) ICT knowledge (achievement) when learning ICT in Education course

c) Self-efficacy when learning ICT in Education course

d) Engagement (behavioural, agentic, cognitive, and emotional) when learning ICT in Education course

3. To examine the interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] and gender on pre-service teachers'

a) ICT skills when learning ICT in Education course

b) ICT knowledge (achievement) when learning ICT in Education course

c) Self-efficacy when learning ICT in Education course

d) Engagement (behavioural, agentic, cognitive, and emotional) when learning ICT in Education course

1.5 Research Question

To examine the effect of study-summary-quiz (SSQ) based flipped learning method and gender on pre-service teachers' ICT skills, ICT knowledge (achievement), engagement, and self-efficacy, the specific research questions were formulated as follow:

1. Is there any significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers'

a) ICT skills when learning ICT in Education course?

b) ICT knowledge (achievement) when learning ICT in Education course?

c) Self-efficacy when learning ICT in Education course?

d) Engagement (behavioural, agentic, cognitive, and emotional) when

learning ICT in Education course?

2. Is there any significant difference between gender (male and female) in pre-service teachers'

   a) ICT skills when learning ICT in Education course?

   b) ICT knowledge (achievement) when learning ICT in Education course?

   c) Self-efficacy when learning ICT in Education course?

   d) Engagement (behavioural, agentic, cognitive, and emotional) when learning ICT in Education course?

3. ICT Is there any significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] and gender on pre-service teachers'

   a) ICT skills when learning ICT in Education course?

   b) knowledge (achievement) when learning ICT in Education course?

   c) Self-efficacy when learning ICT in Education course?

   d) Engagement (behavioural, agentic, cognitive, and emotional) when learning ICT in Education course?

1.6 Hypothesis

Null hypotheses (H0) were considered since the researcher does not have prior knowledge of the difference between flipped learning groups. The null hypotheses help the researcher test the significant alpha level at 0.05 and conclude to accept or reject the hypothesis. The proposed hypotheses are as follows:

$H_0$1a. There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' ICT skills when learning ICT in Education course.

$H_0$1b. There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' ICT knowledge (achievement) when learning ICT in Education course.

$H_0$1c. There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' self-efficacy when learning ICT in Education course.

$H_0$1d(i). There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' behavioural engagement when learning ICT in Education course.

$H_0$1d(ii). There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' agentic engagement when learning ICT in Education course.

$H_0$1d(iii). There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' cognitive engagement when learning ICT in Education course.

$H_0$1d(iv). There is no significant difference between instructional methods [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model (CFLM)] on pre-service teachers' emotional engagement when learning ICT in Education course.

$H_0$2a. There is no significant difference between gender (male and female) on pre-service teachers' ICT skills when learning ICT in Education course.

$H_0$2b. There is no significant difference between gender (male and female) on pre-service teachers' ICT knowledge (achievement) when learning ICT in Education course.

$H_0$2c. There is no significant difference between gender (male and female) on pre-service teachers' self-efficacy when learning ICT in Education course.

$H_0$2d(i). There is no significant difference between gender (male and female) in pre-service teachers' behavioural engagement when learning ICT in Education course.

$H_0$2d(ii). There is no significant difference between gender (male and female) in pre-service teachers' agentic engagement when learning ICT in Education course.

$H_0$2d(iii). There is no significant difference between gender (male and female) in pre-service teachers' cognitive engagement when learning ICT in Education course.

$H_0$2d(iv). There is no significant difference between gender (male and female) in pre-service teachers' emotional engagement when learning ICT in Education course.

$H_0$3a. There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' ICT skills when learning ICT in Education course.

$H_0$3b. There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' ICT knowledge (achievement) when learning ICT in Education course.

$H_0$3c. There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' self-efficacy when learning ICT in Education course.

$H_0$3d(i). There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' behavioural engagement when learning ICT in Education course.

$H_0$3d(ii). There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' agentic engagement when learning ICT in Education course.

$H_0$3d(iii). There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' cognitive engagement when learning ICT in Education course.

$H_0$3d(iv). There is no significant interaction effect of the instructional method [study-summary-quiz based flipped learning model (SSQ FLM) and conventional flipped learning model CFLM)] and gender on pre-service teachers' emotional engagement when learning ICT in Education course.

1.7 Research Significance

This study introduces a flipped learning model for teaching ICT in education courses in Nigerian universities. The study develops lesson plans that teacher educators and other lecturers can use while implementing flipped learning strategies. This might contribute to the body of knowledge by developing an SSQ based flipped learning model to overcome the challenges and limitations of the conventional flipped learning model.

The SSQ based flipped learning model might give opportunities for PTs to learn in multiple dimensions and enhances their ICT skills and knowledge. It improves PTs' engagement and confidence toward technology integration. Furthermore, this study demonstrates a scientific procedure for training PTs to have a good foundation for their future practice and become effective teachers in the twenty-first century. This study helps PTs recognize the need to acquire ICT skills that can encourage them to improve their ICT knowledge; it helps them understand that teaching in the information age needs to include cooperative learning/activity-oriented and student-centred approaches.

For teacher-educators, the research can enhance their understanding of different types of FL strategies, improve their awareness of the advantages and disadvantages of implementing the flipped model. The lesson plan guides the teacher on how to implement the FL model. It assists the teacher-educators to learn not only

how to use group-based learning strategies but student-centred learning approaches. The study can serve as a foundation for university dons' pedagogical reorientation, particularly about courses presumed to be hard to teach due to their large volume of content and practical activities. Moreover, this study provides evidence that supports and encourages ICT lecturers to use the FL model. The lecturers could use the model to motivate their students and get involved in the learning processes.

This study helps the University management and department of teacher education to understand that teaching 200 level ICT in education courses in Nigerian Universities has not made a significant impact on preparing PTs to integrate ICT in education; it helps the management and department to recognize the best way to teach ICT in education course in Nigerian teacher training institutions. Recommendations were made to help the University management and Faculty of Education how to redesign their curriculum for effective teaching and learning of ICT-related courses.

In addition, this study assists the policymakers and stakeholders of education industries in achieving National objectives such as facilitating teaching and learning processes, promoting lifelong learning, and enhancing the teaching and learning strategies by using a technology-based teaching strategy (SSQ based flipped learning model). This study emphasizes the importance of incorporating the FL strategy into the teacher education curriculum at Nigerian Colleges of Education and Schools of Education in Nigerian Universities. Faculties and fellow researchers may apply the SSQ based flipped learning model in another context to reduce the challenges of pre-class learning activities of conventional FL.

1.8 Theoretical Framework

Figure 1.1 represents the theoretical framework of this study. It explains how flipped learning model is being supported by the learning theories. The theories include social constructivist theory, Bloom's taxonomy, and cooperative learning.

Flipped Learning Model

The flipped classroom model has recently been recognized as a good strategy for improving students' learning outcomes and experience in schools and universities worldwide (Bergmann & Sams, 2012). Flip educators adopt different types of flipped classroom models such as standard inverted classroom (referred to as flipped learning model in this study), discussion-oriented flipped classroom, demonstration-focused flipped classroom, faux-flipped classroom, group-based flipped classroom, and virtual flipped classroom. Each of the models has exclusive features that make it adaptable and acceptable. For instance, the discussion-oriented flipped classroom is a model where teachers assign instructional videos and other reading materials before the class hour, and class time is devoted to discussing and exploring the subject. This model suits art and humanity courses like English, History, or religious studies (Zhang, 2018). Demonstration-focused flipped classroom model sometimes uses screen recording software to demonstrate the activity in a way that permits learners to follow along in their ways. It is commonly used in mathematics classes (Lai & Hwang, 2016).

Faux-flipped classroom model benefits kids who cannot concentrate on watching lecture videos at home. In this case, the model recommends that those students watch lecture videos in class. The teacher should also move from student to student to offer support during in-class activities. This type of model has yet to be

common in previous studies. Group-based flipped classroom model is one of the models adopted by many researchers. In this model, lecture videos and other learning materials are shared before class; during the in-class activities, students work in a group, learn from one another and ask questions about why a particular answer is right or wrong. It has less effect on practical courses where one-on-one interaction is highly needed (Jump, 2013). The virtual flipped classroom model is for older students. Professors and some educators use this model to share lecture videos for learners to view online and later ask them to attend office hours for one-on-one instruction based on their individual needs. This happens in some developed countries and is not suitable for practical courses.

The course's nature and technology infrastructure availability always determined the model type to be used. In this study, students need to have basic knowledge before the class hour and have enough time for practical activities, one-on-one interaction, and group discussion during the in-class learning activities. Therefore, this study adopted standard inverted classroom (flipped learning model). The model allows the teacher to share the lecture videos and other learning materials before the class hour. During class, students practice what they have learned at home with their teachers and peers, engaging in one-on-one interaction and group discussion (Bergmann & Sams, 2012). This type of instruction is suitable for practical courses such as ICT in education course. The flipped learning model has three sections: firstly, the pre-class section, where lecture videos, learning materials, and study-summary-quiz (SSQ) activities were assigned to students via the learning management system (Edmodo). Secondly, in-class section, where in-class activities such as individual learning, group discussion, and think-pair-share (TPS) activities

take place. Thirdly, in the post-class section, in this section, evaluation and presentation occur.

Social Constructivist Theory

Lev Vygotsky is popularly known as the founder of social constructivist theory. He opposed the idea of Piaget that learning could be separated from its social context. Vygotsky advocates that the knower should construct knowledge through social interaction. The theory beholds the epistemological opinion of knowledge acquisition that learners should be part and parcel of the learning process (Pundir & Surana, 2016). The theory further believes that learning takes place at two levels. 1) at the level of actual development where students can learn on their own and 2) at the level of potential development where students can only learn or master through the help of their colleagues or teachers (this is called the zone of proximal development – (ZPD). The idea of social constructivist theory is applied in the FL environment to spell out the role of the teachers and the students. For example, the role of the teacher is to organize, plan, guide, and facilitate the learning process. In contrast, the student's role includes active participation in the learning process, taking control of the learning activities, and seeking assistance at the level of ZDP (Akingbemisilu, 2017). This teaching strategy occurs during the in-class session of the FL model (see, Figure 1.1). It allows the students to interact with learning content, thereby improving their engagement level, which leads to high learning achievement.

The reason for implementing social constructivist theory in this study is to define student and teacher's roles in the flipped model, particularly during in-class activities. Under the guidance of this theory, the teacher should allow the student to