

INFLUENCE OF GENDER ON LEARNING AND BEHAVIOURAL PERFORMANCES OF UNDERGRADUATE PRE-SERVICE TEACHERS USING MOBILE ASSISTED INSTRUCTION

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ABSTRACT

This study examines the influence of gender on the learning and behavioural performances of undergraduate pre-service teachers using mobile-assisted instruction. The study employed a Quasi-experimental design, using a pretest-posttest, non-equivalent, non-randomized control group. One hundred and sixteen pre-service teachers were sampled using stratified random sampling techniques. The data were collected using the treatment instrument (MAI), treatment instrument-course material (BCSM), Test instrument (CSPT), and Validation Test Questionnaire (MAIQ) for field trial validation. Pilot testing was conducted on thirty students, and a reliability coefficient of 0.87 was obtained. The data were analyzed using mean and standard deviation, while the Analysis of Covariance (ANCOVA) test was used to test the stated hypotheses at a 0.05 level of significance. The findings showed that: Hypothesis one was not rejected, the result shows that the medium of instruction produced no significant difference in the posttest reaction scores of students when the covariate effect (pretest) was controlled. Hypothesis two was rejected; there was a significant difference in the learning performance of male and female students. Also, Hypothesis three was rejected; the result shows that there was a significant difference in the behavioural performance of male and female students. Based on the findings, the following recommendations were made: Lecturers in higher institutions should be encouraged to use mobile learning to support their teaching. To achieve this, workshops/seminars should be organized specifically for the purpose of facilitating the use of mobile technology devices in teaching and learning; emphasis should be placed on making learning learner-centred.

Keywords: *Mobile learning, mobile assisted instruction, gender, learning & behavioural performances, pre-service teachers.*

INTRODUCTION

Technology is rapidly growing in all aspects of modern societies, and education is no exception (Muhammadi et al., 2020). Universities face an increasing number of students, leading to increasing lecture size and decreasing interaction and cooperation, which are important factors for learning success and satisfaction (Lehmann & Söllner, 2014). For large-scale classes, a teacher cannot handle learning activities and respond to students' questions and problems promptly, so students' satisfaction with learning will decrease (Lehmann & Söllner, 2014). Teachers' failure to respond to students' problems in

time may affect students' learning and satisfaction negatively. The use of IT and mobile devices provides potential for improving the interaction in lectures via transferring interactive data between students and instructors in real-time (Teoderescu, 2015). By using mobile technology, students can easily and quickly access and use learning resources anytime, anywhere (Gezgin et al., 2018).

Mobile devices are particularly preferred for data storage or access to information through course materials, e-books, etc. (Sarrab, 2015). Due to its prospects in education, scholars in the field of learning, instructional design, and technology are still working on developing theoretical conceptions of the potential of mobile devices to inspire new forms of learning and engagement. Increased interest in mobile devices and their use for instructional purposes can be credited to several factors, as Milosevic *et al.* (2015) listed, including the expansion of wireless networks, ever-improving power and capacity of next-generation mobile phones, and infiltration of mobile phones into our daily lives as communication devices. These social and technical attributes come to the fore with studies underlining that mobile learning typically occurs outside the classroom, particularly in higher education (Hilao & Wichadee, 2017). Mobile devices and their applications enable users not only to search and discover content but also to create it.

Demir and Akpinar (2018) posited that, as part of the characteristics of mobile technology to facilitate education, portability and mobility have already made mobile technology an attractive tool. Ally (2007) predicted that today's learners demand course content delivered on mobile devices, accessible anytime from anywhere. Hence, mobile learning is a strong element of education to facilitate learning experiences and has an increasing role in higher education. Mobile learning motivates both cooperative and individualized learning experiences and provides opportunities for those learners who are not comfortable with formal learning styles. Although mobile learning systems are well developed for students to acquire their education, researchers reported that they could be further enhanced to achieve better results if there were systematic approaches that could be put forward for these systems. Hence, it is of utmost importance to develop strategies that could help with mobile learning processes (Teoderescu, 2015).

The National Policy on Education (Federal Republic of Nigeria, 2013) posited the need to adopt ICT at all levels of education. Shehu et al. (2015) claimed that ICT has increasingly become the critical determinant of educational success in the 21st century. AbdulRaheem (2018) corroborated the claim of Shehu et al. (2015) that due to the interactive and ubiquitous nature of ICT networks, which are accessed through various devices. Mechanisms, especially mobile technology, have given credence to the ICTs' increasing usage in daily lives without gender bias. Gender has also been identified as a factor influencing teachers' perceptions.

Gender is said to have an impact on the use of technology; men are likely to be more task-oriented than women. Also, according to Hilaohilao and Wichadee (2017), women are said to be influenced by others' opinions; hence, women's intention to use a technology is influenced by others. Jaradat and Faqih (2014) found that individuals' tendency is expected to be driven by their gender to adopt, accept, and use mobile technology in Jordan.

Gender refers to those characteristics of males or females that are biologically determined (Okeke, 2008; Omwirhim, 2015). The influence of gender on students' academic performance has not been concluded. For instance, Sung et al. (2016) opined that e-learning embraces the active participation of male and female students. Similarly, Moreira et al. (2018) investigate the factors affecting learning in a blended e-Learning course for Mathematics; the results revealed no significant difference between male and female students in the aspects of examination scores, learning attitudes, and learning portfolios. In another study, Demir and Akpinar (2018) found a significant difference between female and male students exposed to blended learning. Contrarily, Koohang (2004) reported that male students perform better than their female counterparts when taught using a Blended learning strategy. Similarly, Abidin and Tho (2018) reported a significant difference between male and female students who experienced Blended learning courses.

Few studies investigated the performance as a result of mobile device usage based on gender (Omede & Achor, 2015). As for mobile phones, the gender difference in conventional telephone use seems to have extended. Also, perceptions about integrating the use of mobile phones in teaching are an issue for gender analysis, and when observing communication habits, it is important to be aware of the different ways in which males and females view mobile phone devices. Some studies have shown very significant differences in the use of mobile technology with regard to gender.

In research by Demir and Akpınar (2018), men tend to use mobile devices as an instrument to do business (teaching included) while women tend to make social calls, and men make use of them more than women do. Males are more concerned about price than females are (Moreira et al., 2018). In addition, women have more attachment to their mobile phones than men do, especially to text messaging (Sung et al., 2016). Hilao and Wichadee (2017) reported that there is a gender difference in technology adoption practices, and there is also a gender difference in technology preferences. Females have a lower rate of use for audio and video creation and multi-user gaming than males, to the extent that twice as many males as females use video creation and multi-user gaming.

According to Teoderescu (2015), technologies are not utilised in identical ways by males and females, resulting in observable differences in certain contexts. Previous research suggests that females are more inclined to develop higher levels of mobile device engagement (Omede & Achor, 2015; Moreira et al., 2018). However, several studies have reported no significant differences between males and females in their use of mobile phones for learning purposes (Hilao & Wichadee, 2017; Teoderescu, 2015), highlighting ongoing inconsistencies in the literature. In terms of attitudes toward mobile learning, Oluwafemi and Hammed (2019) found that female college students exhibited more positive attitudes than their male counterparts, whereas Muhanna and Abu-Al-Sha'r (2009) reported the opposite. Conversely, Wishart and Thomas (2015) observed no significant influence of gender on learners' reactions, attitudes, or performance. These mixed findings underscore the need for further empirical investigation that can provide a definitive reference point for understanding the role of gender in mobile learning adoption and outcomes.

STATEMENT OF THE PROBLEM

In Nigeria today, various types of mobile devices are widely available. However, students often underutilize these technologies for educational purposes, with the majority using them primarily for entertainment and social media (Edet & Aranuwa, 2017). Yet, mobile devices hold significant potential for instructional delivery and training, capable of enhancing teaching and learning both within and beyond the classroom (Soetan et al., 2017). Despite this potential, existing research in Nigerian institutions and research centres has not fully explored the integration of mobile learning beyond isolated classroom activities, nor has it examined the effective use of students' mobile devices as educational tools. These gaps highlight the need for innovative solutions. Consequently, this study was designed to develop a mobile-assisted instruction package to assess the impact of gender differences on learning outcomes and behavioural performance among students taught through mobile learning.

RESEARCH QUESTIONS

This study sought to answer the following research questions:

1. What are the differences between the influences of gender on students' reactions towards the use of mobile learning packages?
2. (What are the differences between the learning performance of male and female students using a mobile learning package?
3. What are the differences between the behavioural performance of male and female students using a mobile learning package?

RESEARCH HYPOTHESES

- Ho₁ There is no significant difference in the reaction of Male and Female students taught using a mobile learning package.
- Ho₂ There is no significant difference in the learning performance of male and female students taught using a mobile learning package.
- Ho₃ There is no significant difference in the behavioural performance of male and female students taught using a mobile learning package.

METHODOLOGY

Research Design

The research design adopted for this study is a quasi-experimental design using a pre-test, post-test, non-equivalent, and non-randomized control group. The study involved two groups (an experimental and a control group). The two groups were given the achievement pre-test, post-test, learning, and behaviour performances. The experimental group was subjected to treatment using Mobile Assisted Instruction, while the Control group was exposed to the Conventional Teaching method. The independent variables in the study are the teaching methods. These are (i) Mobile Assisted Learning Instruction and (ii) the Conventional Teaching Method. The dependent variables are the post-test learning and behavioural performances of the two groups. The Moderating variable is gender and was measured at two levels (male and female). Table 1.1 below shows a summary of the group's analysis for the study.

Table 1. Summary of The Group's Analysis for The Study

Groups	Pretest	Treatment	Posttest	Behavior Test
Experimental group	O ₁	X	O ₂	O ₃
Control group	O ₄		O ₅	O ₆

Note. Key:

- O₁ = Pre-test for the experimental group
- X = Treatment for the experimental group
- O₂ = Post-test for the experimental group
- O₃ = Behaviour test for the experimental group
- O₄ = Pre-test for the control group
- O₅ = Post-test for the control group
- O₆ = Behaviour test for the control group

Population

Undergraduate Pre-service teachers across Nigerian Universities are the population for this study. The entire population is 1177. The target population is 367 undergraduate pre-service teachers from selected universities (source: Record officers of the Universities, 2025).

Sample and Sampling Techniques

A multistage sampling technique was adopted to address the diverse variables involved in the study. Initially, purposive sampling was used to identify the overall pool of participants. This was followed by stratified random sampling, which allowed the researcher to divide the sample into two groups: the experimental group and the control group. Finally, simple random sampling was applied to select 116 pre-service teachers from the target population of 367 students. The use of simple random sampling ensured that every member of the population had an equal chance of being selected, thereby reducing selection bias and enhancing the representativeness of the sample.

Table 2. *Distribution Of Sample Sizes in The Two Groups Based on Gender*

S/N o	Samples	Gender		Total
		Male	Female	
1	Experimental group	53	19	72
2	Control group	32	12	44
	Total	85	31	116

Table 2 presents the distribution of participants across the two study groups, comprising a total sample of 116 students. In the experimental group (n = 72), 53 participants (73.6%) were male and 19 participants (26.4%) were female; all were exposed to treatment using Mobile-Assisted Instruction. In the control group (n = 44), 32 participants (72.7%) were male and 12 participants (27.3%) were female; these participants were taught using the conventional method.

Research Instruments

Development of Treatment Instruments

Treatment Instrument. This is a developed Mobile Assisted Instructional (MAI) used as a medium for teaching undergraduate university students computer science course content. The MAI contents were drafted mainly on a computer science networking course outline for undergraduate university students' curriculum. The MAI consisted of two topics, which were subdivided into four modular classical lessons. The package was developed using Android Studio (IDE) and Java. The main menu of the package consists of a background introduction, a dropdown menu, a list of lessons such as lesson 1, 2, 3, 4, a clicking button, etc. The contents of the package were presented to learners to interact with and respond promptly. The package presents information and displays animation to the learners in the experimental group through the screens of their mobile devices for each of the lessons, after which the students attempt multiple-choice objective questions. Students must have at least one hundred percent mastery of one lesson before proceeding to the next lesson.

Treatment Instrument – Course Material: Basic Computer Science Module (BCSM). The BCSM consists of two topics, which were subdivided into four units of lessons. The topics on computer networking were extracted from computer science textbooks, handouts, internet tutorials, and materials, and it is a core course for all undergraduate students offering computer education courses and vocational technology courses. In addition, the course contents were prepared on paper using traditional methods by the researcher with reference to the recognized textbooks, materials on the internet, and contributions from some lecturers handling the course. The course material is also the same as the contents of MAI. The course material was used for teaching only students in the control group through traditional methods in the classroom.

Development of Test Instruments

Performance Test Instrument. The instrument used in collecting data for this study was a researcher-adopted Computer Science Performance Test (CAPT). The CSPT consisted of multiple-choice objective test items drafted from the computer science course material module, which was the same as the content of the MAI. The CSPT contains two parts. Part A: deals with Bio-data of the students, such as the name of the student, level, gender, and specialization, and Part B: consists of 40 multiple-choice objective questions. Each of the items of the CSPT had four options (A - D) as possible answers to the question. Students were required to indicate their correct answers by ticking one of the letters (A - D) that corresponded to the correct option in each item. This instrument (CSPT) was administered to both experimental and control groups as a pre-test and again for the post-test after it had been reshuffled. On the scoring of the multiple-choice items, '1' was awarded for each correct answer and '0' for each wrong answer. The items were validated by computer science lecturers, computer science specialists, computer science programmers, and test and measurement experts. It was tested for reliability using

30 randomly selected undergraduate computer science university students. The test was administered once on the pilot samples. A reliability test using the Kuder-Richardson (KR-21) revealed a reliability of 0.87, which was considered adequate for the research study.

Achievement Validation Test Instrument. Mobile Assisted Instruction Achievement Questionnaire (MAIAQ): This is the instrument that was used for a field trial to collect data to measure their behavioural performances towards the use of mobile-assisted instruction. The questionnaire was divided into two sections. Section (A) dealt with the biography information of the students, while Section (B) contained questionnaire items. Section B consists of 20 item statements generated to elicit responses from the experiences that students acquired while taught computer science using the package. The items were used to generate responses from the students on behavioural performances towards acceptance, adoption, and corroboration of mobile packages as an instructional medium for learning using mobile devices. After the questionnaire was administered to the students, it was retrieved immediately. Some students were also orally interviewed to determine other preferences, interests, and performance styles in the package. The students' responses were analysed using the mean and standard deviation. This instrument was rated on a four-point Likert Scale as strongly agree (4), agree (3), disagree (2), and strongly disagree (1).

Validation of Research Instruments. The validation of instruments was done in four stages: (a) expert & specialist validation (computer programmers & educational technology specialists); (b) content validation (computer science specialists); (c) Performance Test Instrument Validation, and (d) Field trial validation (learners' Validation).

Expert and Specialist Validations. The MAI package was validated by four computer programmers to determine the appropriateness of the package in terms of wireframe, language, typography, legibility, navigation, interface, animations, functionality, packaging, and durability. Their suggestions and commendations were used for modifying the package. Similarly, three educational technology specialists were requested to validate the package in terms of its suitability for instruction, simplicity, unity among illustrations, emphasis on key concepts, colour used, and text. The experts' comments were used to correct some mistakes, while their suggestions were used to improve the package. Based on the experts' and specialists' suggestions, some text font sizes were increased, and some background colours that were seen to be distracting were changed. The package was transferred to their mobile device via the Xender flash share smartphone application tool.

Performance Test Instrument Validation - The Computer Science Performance Test Validation (CSPV). The sequence of forty multiple-choice objective question sets from the course material and the package contents was given to four computer science specialists and measurement & evaluation experts from two universities and one polytechnic. These experts assessed the face and content validity of the instruments against the background of the pre-service teachers. In addition, the experts were requested to critically examine all the question items in the test instrument with reference to: appropriateness of the questions, the extent to which the questions cover the topics they were meant to cover, and many other factors. Finally, the comments, opinions, and suggestions of the experts were used to make necessary amendments to the instrument.

Content Validation. The content validation of the Mobile Assisted Instructional (MAI) on computer science was conducted using the Content Validation Questionnaire. Ten specialists in computer science which include four computer science facilitators from other higher institutions, four computer science university lecturers and two computer science experts on programming from IT organization, also, three computer science experts from Ahmadu Bello University Zaria, two computer science specialist from Kaduna State University, three computer education specialists from Kaduna Polytechnic and two computer science technology expert from Ra'olat Institute of information technology respectively before and after the package was developed. They were requested to carry out the content validation of the instrument by ensuring that all items were derived from the content that would be presented to the students using a mobile learning package. The face and content validity of the background of the students were also considered. The course material and content of the package adequately and

sufficiently covered the expected topics on computer networking and the computer science curriculum. The result obtained strongly agreed with every statement in the questionnaire. However, some minor errors and observations were made, which were later corrected. They all agreed that the content of MAI and the course material modules covered the computer science undergraduate course curriculum. Other statement items of the questionnaire were strongly agreed and agreed, respectively. Their comments, observations, and suggestions on the contents were noted and fully implemented. These include typographical errors such as spelling errors, misrepresentation of superscripts and subscripts, punctuation marks, etc.

Field Trial Validation Instrument. The package was validated by computer programmer experts, educational technology specialists, computer science specialists, and field tested on a sample representative similar to the students used for the final study. The instrument used for field trial validation of the package was a researcher-developed questionnaire, and all the items in the instrument were constructed to elicit responses from various validators with respect to the use of the package. After installation of the package, a one-week pre-implementation training was organized for the students before the conduct of the actual validation of the field trial. The questionnaire consists of 20-item statement questions. The 4-point Likert scale was used, namely, 1 as Strongly Disagree, 2 as Disagree, 3 as Agree, and 4 as Strongly Agree.

Reliability of the Instrument. A pilot test was conducted on 30 computer science students in two selected universities using the Guttman split-half coefficient method of analysis, which determined the appropriateness, suitability, and reliability of the instrument for the learning purpose. The students were randomly selected to participate in pilot testing. Students spent between 45 minutes and 60 minutes responding to all the questionnaire items with a very marginal interruption.

The MAIP was pilot-tested on 30 computer science students from two selected universities in Nigeria. Thirty computer science undergraduate university students installed the package onto their mobile devices for instructional purposes so as to determine the reliability coefficient for the performance tests of the students when using the package. A questionnaire containing 20 items was administered to 30 students, and their responses were scored and computed using the Kuder-Richardson (KR-21) to determine the internal consistency. A reliability coefficient of 0.87 was obtained, which was considered adequate for the study.

Procedure for Data Collection

After installing the package on the mobile devices of the sampled students, pre-training was later organized for them on how to use the package for one week. Lectures commenced on subsequent days for treatment using the package for teaching the experimental group, as well as using a face-to-face conventional teaching method with paper-based handout course material module for teaching the control group for six weeks, respectively. The multiple-choice objectives test item was administered as a pre-test and post-test to the pre-service teachers who taught computer science using the package. After an hour, the instruments were retrieved and analysed.

Data Analysis Techniques

The analysis and interpretation of data collected through the test items and questionnaire were done using inferential and descriptive statistics. The frequencies were converted to means, standard deviations, and percentages to answer research questions. The questionnaire items were ranked 4 as Strongly Agree, 3 as Agree, 2 as Disagree, and 1 as Strongly Disagree for questionnaire items that were positively expressed and vice versa for the negatively expressed items. To test the hypotheses, the data obtained from the study were analysed using the Statistical Package for Social Sciences (SPSS) version 21 and Analysis of Covariance (ANCOVA) for the three hypotheses. The significance of the various statistical analyses was ascertained at the 0.05 alpha level. Graphical representations were also drawn to indicate the mean gains and mean gain scores of the students.

RESULTS

Hypothesis One: There is no significant difference in the reaction of Male and Female students taught computer science using a Mobile Assisted Learning Package.

To test the hypotheses, data were analysed using the Analysis of Covariance (ANCOVA) in the Statistical Package for the Social Sciences (SPSS) version 21 at the 0.05 alpha level. Before the analysis, the key assumptions for ANCOVA were examined and met. These included: normality of data distribution (verified using the Shapiro–Wilk test), homogeneity of variances (confirmed through Levene’s test), and the homogeneity of regression slopes (tested by assessing the interaction between the covariate and the independent variable). Meeting these assumptions justified the application of ANCOVA for the analysis. The results are presented below based on the research hypotheses.

Table 3. ANCOVA Result of Post-test Mean Scores of Male and Female Students’ Reaction towards Mobile Technology Assisted Learning Package

Source of Variation	Sum of Squares	df	Mean Square	F	p-value
Covariate (Pre-test)	0.000	1	0.000	0.007	0.936
Main Effect (Gender)	0.001	1	0.001	0.024	0.877*
Model	0001 ^a	2	0.000	0.12	0.988
Residual	1.519	41	0.037		
Total	461.408	44			

Note. NS: Not Significant at 0.05.

Table 3 shows the ANCOVA comparison of Post-test Mean Scores for the reaction of male and female Students taught Computer Science using Mobile Assisted Instruction. With $F(1, 41) = 0.024, P > 0.05$, the results of the analysis revealed that there was no significant difference between the reaction of the main effect. On the basis of this, the hypothesis was not rejected. The result shows that the medium of instruction produced no significant difference in the post-test reaction scores of students when the covariate effect (pre-test) was controlled. The result indicates that the treatment using a mobile technology-assisted learning package accounted for no difference in the post-test reaction scores of the male and female students. This implies that no significant difference exists between the reaction of male and female groups taught computer science using a mobile mobile-assisted learning package. To further show their reaction and improvement in learning via the mobile-assisted package after treatment, the reaction and the mean gain scores between the pre-test and post-test mean scores of the male and female experimental group taught using the mobile learning package are shown in Table 4 and Figure 1.

Table 4. Mean Gain Scores of Male and Female Students’ reaction towards Computer Science using Mobile Assisted Learning Package

Gender	Pre-test	Post-test	Reaction	Mean Gain
Male	15.65	34.90	3.24	19.25
Female	12.46	27.77	3.23	15.31

Table 4 reveals that the reaction of both males and females had no significant difference when taught using the mobile-assisted learning package, which signifies that both males and females benefited from the treatment. The table further shows that the male students with a mean gain score of 19.25 had a

higher reaction score of 3.24 than the female students with a mean gain score of 15.31, who had a lower reaction score of 3.23. This shows that both the male and the female groups benefited from the treatment, with male students having slightly better reaction scores and mean gain than the female students. The comparison in the mean scores between their pre-test and post-test is graphically shown in Figure 1.

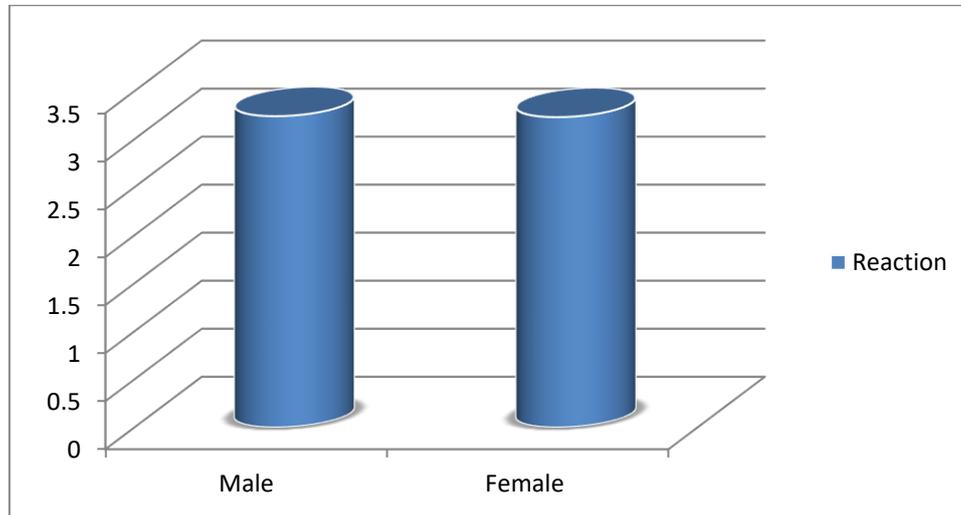


Figure 1. Mean Gain Scores of Male and Female Student Reactions towards Computer Science using Mobile Assisted Learning Packages

Hypothesis Two: There is no significant difference in the learning performance of male and female students taught computer science using a mobile learning package.

Table 5. ANCOVA results of Male and Female Students' Learning Performance taught Using Mobile Assisted Learning Package

Source of Variation	Sum of Squares	df	Mean Square	F	p-value
Covariate (Pre-test)	26.125	1	26.125	0.200	0.657
Main Effect (Gender)	2310.299	1	2310.299	17.716	0.000*
Model	2975.698 ^a	2	1487.849	11.409	0.000
Residual	5346.848	41	130.411		
Total	305492.000	44			

Note. NS: Significant at 0.05 level

Table 5 shows the pre-test mean scores of male and female students taught computer science using a mobile mobile-assisted learning package as a covariate for the analysis of Covariance. The F value of 17.716 was significant at the 0.05 alpha level, i.e., $F(1, 41) = 17.716, P < 0.05$. The result shows that there was a significant difference in the learning performance of male and female students taught computer science using a mobile learning package. On this basis, hypothesis two was rejected. To affirm this, the mean gain scores of the pre-test and post-test between the males and females in the experimental group were tabulated and graphically illustrated as shown in Table 6 and Figure 2.

Table 6. Mean Gain Scores for Learning Performance of Male and Female Students taught Computer Science Using Mobile Assisted Learning Package

Gender	Pre-test	Post-test	Mean Gain
Male	15.65	34.9	19.25
Female	12.46	27.77	15.31

Table 6 identifies that both male and female pre-service teachers benefited from the treatment. The male students with the higher post-test score of 34.90 had the higher mean gain scores of 19.25, while the female students with the lower post-test score of 27.77 had the lower mean gain scores of 15.31. This shows that both the male and the female achieved greatly from the treatment, with male students having better learning performance and mean gains higher than those of female students. The comparison in the mean gain scores between their pre-test and post-test is shown in Figure 2.

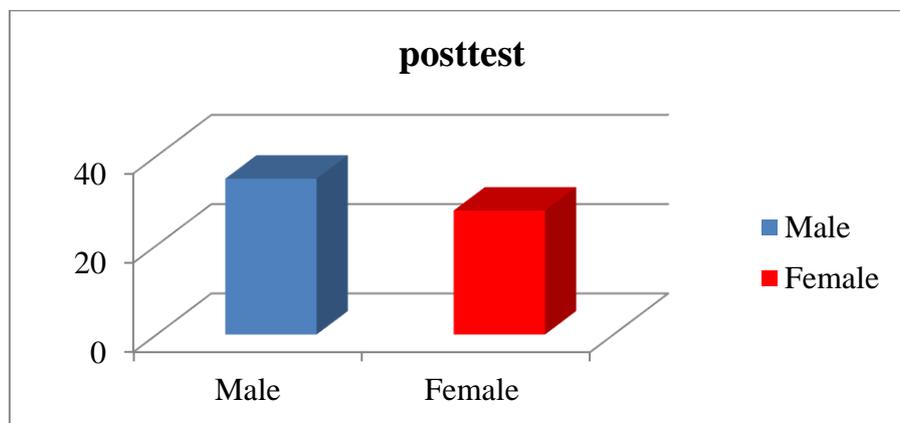


Figure 2. Graph of Mean Gain Scores for Learning Performance of Male and Female Students Taught Computer Science Using Mobile Assisted Learning Package

Hypothesis Three: There is no significant difference in the behavioural performance of male and female students taught computer science using a mobile mobile-assisted learning package.

Table 7. ANCOVA result of Mean Behavioural Performance Scores of Male and Female Students Taught Using Mobile Assisted Learning Package

Source of Variation	Sum of Squares	df	Mean Square	F	p-value
Covariate (Pre-test)	74.392	1	74.392	1.213	0.277
Main Effect (Gender)	704.347	1	704.347	11.489	0.002*
Model	707.665 ^a	2	353.832	5.772	0.006
Residual	2513.494	41	61.305		
Total	289803.000	44			

Note. Ns: Significant at 0.05 level

Table 7 shows the result of hypothesis five using the pre-test mean scores of behavioural performances of male and female students taught using a mobile mobile-assisted learning package, which was used as a covariate for the analysis of Covariance. The F value of 11.489 was significant at the 0.05 alpha

level, i.e., $F(1, 41) = 11.489, P < 0.05$. The result shows that there was a significant difference in the behavioural performance of male and female students taught computer science using a mobile learning package. On this basis, hypothesis three was rejected. To confirm this, the mean gain scores and behavioural performance scores between the males and females in the treatment group were tabulated and graphically illustrated as shown in Table 8 and Figure 5.

Table 8. Mean Gain Scores for Behavioural Performance of Male and Female Students Taught Using Mobile Technology Assisted Learning Package

Gender	Pre-test	Post-test	Behavioural Performance	Mean Gain
Male	15.65	34.9	33.16	19.25
Female	12.46	27.77	29.85	15.31

Table 8 shows that the male students had the highest scores of 33.16 with a mean gain score of 19.25, while the female students had the lowest behavioural performance scores of 29.85 with a mean gain score of 15.31. This implies that both male and female students exhibited high behavioural performance in the treatment post-test retention scores. The comparison in the mean gain scores between their pre-test and post-test, as well as that of the behavioural performance test, is graphically shown in Figure 3.

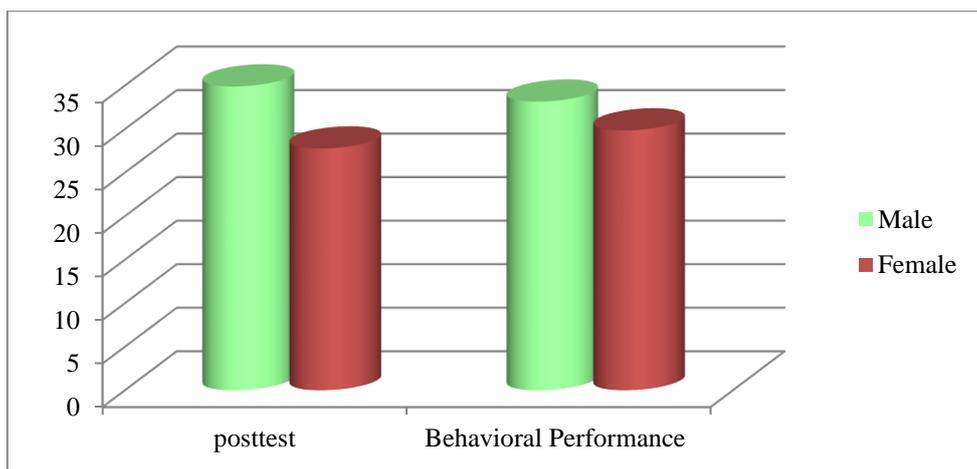


Figure 3. Graph of Mean Gain Scores for Behavioural Performance of Male and Female Students taught Using Mobile Assisted Learning Package

DISCUSSION OF RESULTS

In this study, the researcher developed Mobile Assisted Instruction (MAI) on computer science and taught pre-service teachers (experimental group) using handheld mobile devices and compared the results with those taught using a conventional method (control group). The researcher sought to find out which of the two instructional strategies used could be most effective for teaching computer science. The data obtained and analysed in this study were based on the academic performance of the experimental and the control group. These were analysed according to the demand of the researcher's questions, hypotheses formulated, and the design of the study. The discussion of the results is as follows:

There is no significant difference in the post-test reaction mean score of the male and female pre-service teachers in the experimental group taught computer science using a mobile mobile-assisted learning package. The finding indicates that mobile learning has a positive effect on students' academic performance in computer science. The finding further shows that males had a slightly better reaction towards performance in mobile learning than females. The findings in the research questions and hypothesis 1 are in line with the work of Baya'a and Daher (2009) on the influence of gender on the

attitude towards mobile learning. Their finding revealed that the undergraduate students have positive attitudes towards the learning environment of the cell phone.

There is a significant difference between the post-test learning performances of the experimental group and those of the control group. The analysis of the results in this table showed that the experimental group had higher mean gain scores than the control group in the post-test. The finding indicates that the mobile-assisted instruction had a positive effect on the academic learning performance of the experimental group taught using mobile devices compared to the control group taught using a conventional method. This research study agrees with the findings of the work of Tam (1992) in Copley (2000), which discovered that mobile learning improves students' academic performances and helps them become active participants in their learning and make meaningful connections between prior knowledge, new knowledge, and processes involved in learning. According to Ogwo (2005), the use of m-learning principles will equip students better for the unknown.

There is a significant difference between the post-test performances of the experimental group and the control group. The analysis and the result of hypothesis 3 in this study indicate that the experimental group had a higher mean gain score and behavioural performance than the control group. This implies that content delivery using mobile technology-assisted learning is more effective than the conventional method. This finding is in line with the findings of Pouezevara and Khan (2007a, 2007b) who found that mobile phones allowed the trainer to diffuse reminders, motivational messages, and assessment questions to the trainee via SMS, as well as allowed trainees to communicate with the trainer to pose questions, request materials, or respond to assessment questions.

There are significant differences in learning performances and behavioural performances of males and females in the experimental group taught computer science using MTALP. The results show that both males and females benefited in their learning and behavioural academic performance when taught computer science using MTALP. The findings of the research questions and the hypotheses 2 & 4 are in line with the findings of Oynilola, which is consistent with Aminu (2012) in their study, discovered that males and females have equal opportunity, potential, and ability to pursue any course of study when given the desire, motivation, encouragement, and reinforcement when using mobile learning. This implies that the use of mobile learning is gender friendly. This finding agreed with the work of Abaegbu (1999), whose research indicated that there is no significant difference in the academic performance of male and female students. It also corroborates the studies of Ochogor (1993) and Eze (1999), who, in their separate studies, concluded that boys and girls, when taught together in the same medium under the same conditions, show comparatively equal performance levels.

CONCLUSION

The use of a mobile learning package proved more effective for teaching computer science students than conventional instructional methods in higher education. This mode of instruction has been shown to promote effective learning by providing easy access to educational resources anytime and anywhere. The mobile learning package offers equal learning opportunities to both male and female students, regardless of their ability levels in computer science. However, students' ability levels still vary in terms of academic performance when the mobile learning package is used as the medium of content delivery. The moderating variables of gender and academic performance level do not significantly influence learning capacity when instruction is delivered through the mobile learning package.

RECOMMENDATIONS

Concerning the findings of this research, the following recommendations are made:

1. Mobile learning packages should be integrated into higher institutions' curriculum to foster both male and female students' reactions and enhance their academic performance.
2. Students should be encouraged to adopt mobile technology devices as learning tools to enhance their learning performance and behaviour.

3. Females should be encouraged to develop positive attitudes towards learning computer science using a mobile learning package.
4. The low-abled learners should be encouraged and motivated through the use of a mobile learning package to improve their performance, knowledge retention, and attitude to learning.

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