The Perceived Usefulness, Perceived Ease of Use, Behaviour Towards, and Intention to Use Mobile Compilers in Learning Computer Programming

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Abstract. Using mobile learning in different learning institutions provides a lot of possibilities and opportunities for improving the quality of instruction delivered to every student. The concept of Bring-Your-Own-Device (BYOD) is one of the trends which learning institutions are adopting to provide more opportunities for students to learn and collaborate. The use of mobile compilers can be adopted as a technology integrated into the teaching and learning process. This study sought to comprehend information technology students' perceptions of the Technology Acceptance Model (TAM) constructs, which include perceived usefulness, perceived ease of use, attitude toward, and intention to use mobile compilers, at a higher learning institution in Nueva Ecija, Philippines. A descriptive-correlational design was used. The findings revealed that the respondents generally accepted portable compilers in learning computer programming. A significant difference was found between males and females regarding the technology's ease. Other variables showed no significant difference. Based on the findings, recommendations were made by the researchers.

Keywords: BYOD; Computer Programming; Mobile Compilers; Technology Acceptance Model; Technology Integration.

INTRODUCTION

The concept of BYOD, or Bring Your Own Device, in higher education has become the practice of various learning institutions today. BYOD is a technology-based model that requires students to bring their own devices to school [1]. This practice has several benefits not only for the students and teachers but also for the learning institutions. In the classroom, BYOD solidifies communication and collaboration among the students. It contributes to the increase in learning engagement and cooperation between them. Thus, providing real-time production of output and necessary feedback is essential for improving learning. Author [1] further asserted that the BYOD technology model creates a seamless learning environment attributed to the affordances of mobile technologies. However, to make it an effective practice, mediation using a good pedagogical design is necessarily administered by teachers.

By using BYOD, learning institutions can do away with the expense of obtaining the equipment necessary to deliver instruction [2]. The BYOD approach also reduces the cost of buying textbooks, papers, and other educational materials [4]. Students have complete control of BYOD. With their own devices, they can quickly exchange learning resources with their friends, do activities immediately after each learning session, and learn new information whenever and wherever they want [4].

However, potential barriers caused by BYOD were analyzed by [5]. They discovered that potential obstacles might include a digital divide among students, student misuse of technology; hostile school policy; and a negative perception of teachers regarding the use and benefits of technology. Because of this, exploring the acceptance of new technologies integrated into the teaching and learning process from the student's perspective is necessary for the effective implementation and integration of technologies. This gap aims to be addressed by the present study.

Another gap that the researchers aim to fill is the limited amount of available literature focusing on implementing the BYOD approach in the classroom [6], such as using mobile compilers. Thus, this study seeks to contribute to the growing body of literature available.

Further, while several papers investigating the use of mobile compilers in learning programming have been conducted [7–9], exploring it using the Technology Acceptance Model (TAM) constructs is limited. Hence, this study aims to examine the level of agreement among the information technology undergraduate students on their perceptions about the usefulness and ease of use of mobile compilers, as well as the attitude towards and the intention to use portable compilers in learning computer programming. This scholarly undertaking further aims to provide a basis for educators to successfully design classroom strategies to integrate technologies into the teaching and learning process.

Mobile Learning. The BYOD paradigm is a concrete application of mobile learning. Mobile learning (M-Learning) empowers learners to learn anytime, anywhere. The benefits associated with mobile learning include expanding the reach and equity of education, facilitating personalized learning, and providing immediate feedback and assessment [10]. M-Learning increases productivity and maximizes instructional time. It also aids in building new learning communities among learners. M-Learning is a concept that ensures seamless delivery of instruction and supports the learning needs of differently-abled learners in and outside the classroom. Through M-Learning, the quality of education delivered by various learning institutions increases and improves [11].

In learning institutions offering computing courses, the concept of BYOD is suitable since students are required to write computer programs and develop information systems. Laptops, tablets, and smartphones are the standard devices that students have. Author [12] explains that mobile phones and tablets are mobile learning devices that can support collaborative learning in conventional and online environments. In addition, the capacity of mobile devices to provide instant access to information offers more flexibility, allowing collaboration among students [13]. Thus, educational programs and tools using these devices are practical and suitable. Moreover, it allows for flexibility in learning and collaboration among the students.

Mobile Compilers. Authors [8] in a study explored the use of an Android-based C/C++ compiler in learning computer programming courses by university students. They found that mobile learning was the preferred mode of understanding among the students. They further stated that learning institutions might use available mobile applications to supplement students' learning to deliver instruction effectively.

Another study was conducted to examine the usefulness of mobile compilers for learning computer programming, led by [7]. The researcher emphasized that portable compilers significantly contributed to the learning of undergraduate students in computer programming. Further, mobile compilers benefitted the students in the following ways: improved programming skills, increased learning flexibility and enjoyment, participation, and self-study [7].

Mobile compilers provide flexibility in learning computer programming because they can be installed on mobile devices such as tablets and smartphones. In this manner, students can conduct programming practices and exercises at any time. The technology also empowers them to expand their knowledge and develop advanced skills in computer programming by enabling them to use other relevant and available resources while using mobile compilers.

However, only a few available papers examine mobile compilers' use. In this regard, researchers seek to add to this growing field of study to understand the implications and acceptance of portable compilers in teaching and learning.

Technology Acceptance Model. The Technology Acceptance Model (TAM) is a paradigm for analyzing information technology adoption and user adoption of emerging technologies. According to the theory, a person's intentions to use technology and their behaviour while using technology are determined by how beneficial they perceive the particular technology to be, as well as how simple it is to use. TAM has the following constructs: perceived usefulness, perceived ease of use, attitude towards, and intention to use [14, 15, 16].

Perceived usefulness refers to the extent to which a technology is expected to improve a potential user's performance. On the other hand, the perceived ease of use refers to the effort re-

quired to use a technology [17] effectively. Meanwhile, the attitude towards using technology is the degree to which an individual looks at how technology affects their performance in the job [18]. Lastly, the intention to use is the individual's subjective probability that they will perform a specified behaviour using the technology [17].

Using a TAM is critical to user acceptance and establishing a solid foundation and confidence for the further progress and development of new technology [19]. Thus, users must understand and accept a technology to be more effective and beneficial. Using TAM is a good foundation for creating web portals, especially in the Business-to-Business (B2B) area, because it ensures a more functional and easier-to-use system.

In the education sector, many research projects have been conducted focusing on applying TAM in integrating new technologies into the classroom to understand its implications for teaching and learning better.

This study adds to the growing number of literature available to provide more insights, better understanding, and a deeper perspective on the acceptance of new technologies for the effective delivery of instruction.

Statement of the Problem

In general, this study aims to determine IT students' perceptions of mobile compilers' usefulness and ease of use and their attitude towards and intention to use the technology in learning computer programming.

Specifically, it sought to answer the following:

1. What is the level of agreement among the respondents based on the following constructs of the Technology Acceptance Model: perceived usefulness; perceived ease of use; attitude towards; intention to Use?

2. Is there a significant difference between the perceived usefulness, perceived ease of use, and attitude towards and intention to use mobile compilers based on sex?

Hypothesis

H_0: There is no significant difference between the perceived usefulness, perceived ease of use, attitude towards, and intention to use mobile compilers based on sex.

H_A: There is no significant difference between the perceived usefulness, perceived ease of use, attitude towards, and intention to use mobile compilers based on sex.

METHODOLOGY

Research Design. A descriptive-correlational research design is a quantitative research method used in this study. The researchers aimed to systematically describe the population to clearly understand and answer the research problem while identifying significant differences among the variables. By employing a descriptive-correlational research design, the researchers could identify and differentiate the perceived usefulness, perceived ease of use, attitude towards, and the intention of the students to use mobile compilers in learning C++ programming to their sex.

Research Respondents and Locale of the Study. The respondents for this study were first-year students enrolled in the Computer Programming 1 course during the first semester of the Academic Year 2022–2023 in a higher learning institution in Nueva Ecija, Philippines. The total number of first-year students enrolled in the college was 454. The researchers calculated the total number of samples based on the population. With a 98% confidence level and a 3% margin of error, the computed sample size was 350. The researchers were able to collect responses from 364 respondents. It was composed of 62.64% males and 37.36% females. The number of male students is more significant than that of female students, as supported by a study conducted by [20] in a similar locale. Therefore, the number of collected responses exceeded the number of needed samples. This suggests that the model for this study was statistically significant in describing the overall view of the population.

Research Instrument. The research instrument used in this study was based on the work of [17]. The researchers modified the device to suit the context of this study. It covers the assessment of the likelihood of using mobile compilers for C++ programming based on the constructs of the Technology Acceptance Model.

Table 1 presents the response mode and the questionnaire scoring guide. In analyzing the col-

lected data, the researchers computed the weighted mean using Software Packages for the Social Sciences (SPSS) version 26.

Table 1 – Response Mode and Scoring Guide

Numerical rating	Range	Verbal description
4	3.25–4.00	Strongly Agree
3	2.50–3.24	Agree
2	1.75–2.49	Disagree
1	1.00–1.74	Strongly Disagree

To ensure that the instrument was valid, the researchers sought the help of other researchers to review its content and face validity. The reviewers provided vital feedback to improve the items written in the instrument and to suit the questions in the context of this study. The researchers also conducted a reliability analysis using SPSS. Table 2 presents the results of the reliability analysis.

Table 2 – Reliability Analysis

Scale	Cronbach's alpha	Items
Perceived Usefulness	0.858	4
Perceived Ease of Use	0.812	4
Attitude Towards	0.851	5
Intention to Use	0.870	5

The computed Cronbach's Alpha for the perceived usefulness scale with four items is 0.858, perceived ease of use with four things is 0.812, attitude towards five items is 0.851, and intention to use with five items is 0870. These computed Cronbach's Alphas indicate that the instrument was excellent and reliable. Further, results suggest that the device consistently reflects the construct it is measuring.

Data Gathering Procedures. In the conduct of data gathering, the researchers identified the background of the problem by reviewing related literature and studies. Afterwards, the researchers devised the instrument based on the reviewed materials to answer the issues identified for this study. The researchers sought approval from the college to conduct the research and perform the data-gathering activities. In performing the data gathering activities, the researchers explained the purpose of this study, its objectives, and its implications to the respondents. The researchers

also ensured the respondents that the survey would not cause any harm to them.

Furthermore, researchers ensured compliance to research ethics norms, data confidentiality, and the respondents' anonymity. The instrument was administered using Google Forms. This tool was used to conform to the guidelines of ensuring the safety of the respondents in following health protocols during the pandemic.

RESULTS AND DISCUSSION

Technology Acceptance Model Constructs. In Table 3, the results of the assessment of the perceived usefulness of mobile compilers are presented. The development of the evaluation made on the respondents' perception is that using portable compilers can improve their academic performance.

Table 3 – Perceived Usefulness

Item statements	Weighted mean	Verbal description
Using the mobile compiler will help me to understand how to write C++ programs better.	3.223	Agree
Using the mobile compiler will contribute to the improvement of my academic performance.	3.206	Agee
I find using mobile compilers very useful in my computer programming class.	3.208	Agree
With the use of mobile compilers when discussing computer programming, it is easier to catch the attention of every student.	3.314	Strongly Agree
Overall Grand Mean	3.238	
Verbal Description	Agree	

According to the respondents, using mobile compilers is useful when discussing computer programming lessons. They strongly agree that using portable compilers helps catch their attention (WM=3.314), thus increasing learning engage-

ment and active participation in the classroom. With mobile compilers, the students agree that the technology is helpful in their programming classes (WM=3.208). Further, they also agree that it can help them to quickly write C++ programs using mobile compilers (WM=3.223) and that the technology contributes to the improvement in the academic performance of the students (WM=3.206).

Meanwhile, table 4 shows the assessment of mobile compilers' perceived ease of use.

Table 4 – Perceived Ease of Use

Item statements	Weighted mean	Verbal description
It will be easy to become skilful in computer programming when using mobile compilers.	3.044	Agree
I find it very easy to apply the learning I gained in the computer programming lessons when using the mobile compilers to practice the skill	3.082	Agree
The use of mobile compilers is easy to use and easy to understand.	3.038	Agree
Using mobile compilers provides flexibility because learning and practising the skills may happen anytime, anywhere.	3.189	Agree
Overall Grand Mean	3.088	
Verbal Description	Agree	

Findings indicate that students agree that using mobile compilers offers flexibility in learning, as depicted in the computed weighted mean rating of 3.189. Students also agree that they find it easier to apply the things they have learned in different lessons related to computer programming when using mobile compilers based on the computed mean rating of 3.082. Because of the technology, they agree that it is easy to use and easy to understand the lessons, as shown in the computed mean rating of 3.008. Lastly, with the use of mobile compilers, the students agree that they are confident that they can quickly develop vital computer programming and problem-solving

skills essential for the future profession, as presented in the computed weighted mean rating of 3.044.

In table 5, the results of the assessment on the attitude toward using mobile compilers are presented.

Table 5 – Attitude Towards

Item statements	Weighted mean	Verbal description
Using the mobile compiler is good in class.	3.151	Agree
My experience using the mobile compiler in class is favourable.	2.972	Agree
It positively influences me to use a mobile compiler in class.	3.060	Agree
I think it is valuable to use a mobile compiler when learning computer programming in class.	3.107	Agree
I think it is a trend to use mobile compilers in class.	2.923	Agree
Overall Grand Mean	3.043	
Verbal Description	Agree	

Results show that the respondents agree that using mobile compilers is good in class (WM=3.151). They also agree that it is valuable for them to learn their computer programming lessons (WM=3.107). Further, respondents expressed that they agree that technology positively influences their learning (WM=3.060) and that it is essential to use technology to learn in class (WM=3.107) effectively. Lastly, respondents believe using mobile compilers is one of the trends today (WM=2.923).

Table 6 shows the respondent's assessment of the intention to use mobile compilers in learning computer programming.

Findings suggest that the respondents are interested in using mobile compilers to learn computer programming (WM=3.137) and that the technology increases their interest in the subject (WM=3.126).

Table 6 – Intention to Use

Item statements	Weighted mean	Verbal description
I intend to use a mobile compiler in my computer programming class.	2.991	Agree
I increase the occurrence of using the mobile compiler in class.	2.992	Agree
Using a mobile compiler helps to increase the learning interests of the students.	3.126	Agree
I am very interested in using mobile compilers to learn computer programming.	3.137	Agree
I use the mobile compiler to have multiple platforms for learning computer programming.	3.054	Agree
Overall Grand Mean	3.060	
Verbal Description	Agree	

Also, the use of mobile compilers allows the respondents to learn computer programming using different platforms available to them (WM=3.054), and they intend to use it frequently in class (WM=2.992) in learning computer programming (WM=2.991).

Difference between Male and Female on the TAM Constructs. Table 7 presents the difference test between males and females on the different constructs of the Technology Acceptance Model.

Table 7 – Test of Difference between Male and Female on the TAM Constructs

Variables	Male Mean	Female Mean	Mean difference	T-test
Perceived Usefulness	3.165	3.239	-0.074	0.105
Perceived Ease of Use	3.050	3.152	-0.102	0.030*
Attitude Towards	3.023	3.076	-0.053	0.244
Intention to Use	3.028	3.113	-0.085	0.079

Notes: statistically significant at less than 5% level based on two-tailed tests.

The hypothesis investigates whether male and female perceptions of the usefulness, ease of use, attitude toward, and intention to use mobile compilers differ. Levene's perceived usefulness statistic is insignificant, as shown in the computed p-value of 0.226. Thus, equal variance is assumed. Meanwhile, Levene's statistic p-value for perceived ease of use is 0.490. Also, equal variance is considered. Regarding the attitude towards using mobile compilers, the computed p-value for Levene's statistic is 0.246, indicating equal variances assumed. Lastly, the intention to use has a calculated p-value of 0.358 for Levene's statistic, meaning equal variances are also considered.

As presented in table 7, the mean difference for the perceived usefulness is –0.074 with a p-value of 0.105 and the attitude towards it with a mean difference of -0.053 and a p-value of 0.244. The intention is to use it with a mean difference of –0.085 and a p-value of 0.079. These results indicate no significant difference between males and females. Thus, the researchers accept the null hypothesis.

However, in terms of the perceived ease of use, results show a significant difference between males and females, as presented in the mean difference of –0.102 and p-value of 0.030. Therefore, rejecting the null hypothesis.

The overall mean ratings for mobile compilers' usefulness and ease of use in learning computer programming are 3.238 and 3.088, respectively. This corresponds to an "agree" verbal description among the respondents. Based on the assessment, the students have confidence that using mobile compilers will enable them to understand every lesson quickly. This is important in mobile learning because the technology allows learners to acquire new knowledge and develop necessary skills in the discipline. Similarly, using portable compilers empowers students to have better academic performance because of their capability to be utilized anytime and anywhere. Learning acquisition can happen anytime when tools are available for the students in an "on-demand" scheme.

Author [7] explains that mobile compilers significantly benefit students learning computer programming. Benefits include improved programming knowledge, flexibility in learning, enjoyment, and increased active participation and motivation. These benefits of mobile learning contribute to the overall learning experience of un-

dergraduate students. Today, Generation Z learners are more actively engaged in using different technologies integrated into their education to acquire and develop new knowledge. When new knowledge is properly utilized, it contributes to more effective delivery of instruction. For instance, when used to deliver education, platforms like social media become effective because they allow students more flexibility in learning and collaborating with their peers. The same goes for the use of mobile compilers. It offers a new way for students to interact with their classmates while having a better learning experience for their holistic development [21–22].

Further, mobile compilers were found to be a necessary tool in effectively learning how to write computer programs because they promote active engagement and increase student interest because of their several features. Ensuring active engagement promotes collaboration among learners. Active engagement in the classroom can also lead to improved communication skills among the students, nurture their creativity, and enhance their academic performance [23]. When learners are highly interested, motivated, and engaged, learning new things is seamless and productive. Thus, contributing to the holistic development of the students.

Regarding the attitude towards and the intention to use mobile compilers, the computed overall mean ratings were 3.043 and 3.060 with verbal descriptions of "agree," respectively. It is noteworthy to mention that students have a positive attitude towards technology. Thus, increasing the probability of accepting it for the improvement of the teaching and learning process. Also, the intention to use the technology is very much possible, as depicted in the assessment made by the respondents. This implies that the respondents are willing and intend to use mobile compilers to improve knowledge acquisition and develop new skills in the computer programming course.

The ability of the students to recognize the importance of mobile compilers in learning computer programming is one indicator that they are aware of the use and relevance of different ICT tools in the delivery of instruction. According to [24], the ICT awareness of students was very high, and students possessed the necessary skills to use these tools for learning purposes. Thus, mobile compilers are essential for effectively integrating technology into teaching programming courses.

In understanding the assessment between the males and females, the evidence presented that these variables varied only in the TAM's perceived ease of use construct. A significant difference was found, as reflected in the computed p-value of 0.030. In the remaining variables of the model, no significant difference was found. Based on the findings, it can be noted that since males differ from females in their views about the perceived ease of use of mobile compilers, gender-based preference may be a significant factor. Typically, in computing programs, the number of males is greater than the number of females [25] because of the nature of the discipline. However, it is noteworthy that a study by [26] found that females have better academic performance than males in a computer programming course, though they have experienced higher levels of programming anxiety. Thus, how females perceive how easy it is to use a tool can contribute to a better learning process for them.

CONCLUSIONS

This study assesses the respondents' perceptions of mobile compilers' usefulness and ease of use in learning computer programming courses. Also, the attitude towards and the intention to use the technology were examined. These variables were based on the Technology Acceptance Model. A descriptive-correlational research design was employed in this study. Results suggest that the respondents generally agreed with the items included under perceived usefulness, perceived ease of use, attitude towards, and the intention to use mobile compilers. Also, a significant difference was not found in the correlation analysis between sex.

Based on the findings of this study, the following recommendations are given:

1. Computer programming course teachers may use mobile compilers to deliver instruction to students to improve their academic performance, increase their active engagement and participation, and provide alternatives using the BYOD technology model.

2. Teachers may clearly explain the relevance and use of mobile compilers to students for them to profoundly understand the use of the technology and view it as a tool and a valuable resource for learning.

3. Learning institutions may use the results of this study as a basis for crafting instructional policies related to BYOD and technology integration.

4. Future researchers may look at the qualitative assessment of different respondents as to how relevant, effective, and productive the use of mobile compilers in learning computer programming is to the student's academic performance.

The implications of the results on the assessment of the perceived usefulness, perceived ease of use, attitude towards, and intention to use mobile compilers in learning computer programming provide an understanding and basis for educators to craft and design instructional strategies involving technology integration in the classroom. When technologies are properly integrated into the teaching and learning process, improvement in the academic performance of students can be achieved. Additionally, improved learning experiences may be observed, and enhancement of pedagogical strategies for teaching programming courses can be attained.

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