Journal of ICT in Education (JICTIE)
ISSN 2289-7844 / 10 / 1 / 2023 / 14-24

Game-Based Learning for Basic Programming Courses: Discover Students' Attitudes and Interests

Wei Boon Quah[1,2*], Noraini Mohd Banua[3], Zulhana Zulkifle[3]

[1]*Fakulti Pengajian Pendidikan, Universiti Putra Malaysia, Serdang, Malaysia; skyman823000@yahoo.com*
[2]*Bahagian Pengurusan Sumber Manusia, Kementerian Pengajian Tinggi, Malaysia; skyman823000@yahoo.com*
[3]*Unit Komputer, Komuniti Komuniti Bandar Darulaman, Kedah, Malaysia; noraini.kkbda@gmail.com, zulhana_kkbd@yahoo.com*

**corresponding author*

Abstract

The basic programming course is one of the challenging, difficult, and complex courses for community college students at Kedah State. In this course, students must know the basic concepts and structures as well as the basic syntax of computer programming. The challenge is that students are less interested in learning theoretically and have difficulty creating programming code to solve simple programming problems. In this study, three objectives are pursued: (i) to determine students' attitudes toward the basic programming course, (ii) to determine students' interest in using the C# VENTURE application game, (iii) to determine differences in students' attitudes toward the basic programming course according to gender, and (iii) to determine differences in students' interest in the C# VENTURE application game according to gender. There were 54 participants in this study. In this study, questionnaires were used as instruments, which were distributed through Google Forms. The results show that the mean score of (4.18) for students' attitudes is at a high level. In addition, students' interest in C# VENTURE application games is also high with a mean of (4.47). The results of the independent samples t-test showed that there is no significant difference in the mean attitude of students for male and female student groups. The results of the t-test for independent samples also show that there is no significant difference between the average student interest in the C# application game VENTURE for male and female student groups. In conclusion, community college students are positive towards the basic programming course, although this course is very difficult and complex. Moreover, students showed a great interest in using C# VENTURE application games in teaching and learning (T&L) for this course. It is proposed to conduct a quasi-experimental study to investigate the effectiveness of the C# VENTURE application game in teaching and learning (T&L) for the basic programming course.

Keywords: basic programming, game-based learning, attitude, interest

INTRODUCTION

Every student in the field of information technology and engineering needs fundamental skills in programming (Ahmad & Ibrahim, 2020). Programming courses are introduced not only at the higher education level (Bakar et al., 2018) but are now also offered at the school level (Nelson, 2016) and college level (Zalilah, 2018). Basic Programming courses are highly challenging (Ab Rahman et al., 2017) and can be difficult and complex, especially for students in Community Colleges (Díaz-

Lauzurica & Moreno-Salinas, 2019). In this course, students need to understand abstract concepts and the basic structure of computer programming. Additionally, they need to be able to produce simple program codes and logical control structures to solve problems.

The challenge lies in the fact that Community College students seem to lack interest and face difficulties in grasping the fundamental programming concepts, particularly those involving theoretical learning to complete assignments and theory exams. This is evident from the Course Learning Outcomes (CLO) analysis, where CLO 1 has not achieved an 80% success rate over two (2) semesters.

PROBLEM STATEMENT

Through observation during face-to-face teaching and learning, lecturers have noted that students appear to be weak and lack focus during the teaching and learning process. They often show little interest in comprehending and answering questions related to basic programming theory. This is because many abstract concepts in programming courses are challenging for students to understand. This results in students struggling to complete practical tasks and contributes to unsatisfactory Course Learning Outcomes (CLO). Furthermore, students often receive low marks for exams that include both theoretical and practical assessments.

Research Objectives

Therefore, in response to the issues mentioned above, the C#VENTURE application was developed as a learning aid to generate interest among students in the Basic Programming course. The research objectives are as follows:

a) To determine the level of students' attitudes toward the Basic Programming course.
b) To determine the level of students' interest in the C#VENTURE application.
c) To analyze if there are differences in students' attitudes toward the Basic Programming course based on gender.
d) To analyze if there are differences in students' interest in the C#VENTURE application based on gender.

LITERATURE REVIEW

Game-based learning can be defined as "learning facilitated through the use of games" (Whitton, 2012). This method consists of digital and non-digital games (Mydin et al., 2021). Digital game-based learning is a combination of entertainment and education using digital games for educational purposes (All et al., 2017). The use of games can be intrinsic or extrinsic, played face-to-face with physical objects or online, or on a computer.

Besides, game-based learning in the teaching and learning process can help lecturers engage students and improve their performance in the classroom (Ngadengon et al., 2021). It is stated that the use of

games as a teaching aid in programming courses can significantly improve student performance and motivation (Priyaadharshini et al., 2020). In addition, game-based learning activities can enhance student interest, especially in programming courses, and increase their motivation to learn (Wong et al., 2018).

Zalilah's (2018) study also found that the use of games in learning is more effective because game activities are realistic. The research further showed that game-based learning is not only effective in achieving learning outcomes but also enhances students' motivation and learning experience in Community Colleges. Additionally, game-based learning is effective in achieving learning outcomes and motivating students through emotions.

In addition, research by Maskur et al. (2020) indicates that students' attitudes are essential for improving student achievement in programming courses, as students' attitudes are significantly related to their achievement in programming courses. This statement is supported by Johan et al. (2021), who explain that students need to be interested in doing programming assignments so that they do not find it difficult to make more attempts to complete them. Students will also dedicate more time to exploring the learned programming concepts, which ultimately enables them to produce higher-quality program codes.

Basic Programming Course

The Basic Programming course offered at Bandar Darulaman Community College has several learning outcomes. These include:

a) Explaining the fundamental concepts and structures of computer programming and C# programming syntax. (C2, PLO1)
b) Reproducing the main concepts of basic programming in simple coding. (P3, PLO2)
c) Reproducing the main concepts of basic programming logical control structures in simple problem-solving. (P3, A2, PLO2, PLO3)

There are three topics that students need to learn in this course:

a) Topic 1.0 Introduction to Basic Programming
b) Topic 2.0 Variables, Data Types, and Arithmetic Operators
c) Topic 3.0 Control Statements, Collections, and Databases

The assessment involves seven assessments with marking schemes and rubrics. Continuous assessment for this course includes:

a) Assignment 1
b) Test 1
c) Practical Exam (PE1, PE2, PE3)
d) Mini Project
e) Presentation

Received: 1 February 2023; Revised; 12 March 2023; Accepted: 3 April 2023; Published: 1 June 2023

In this course, students need to understand the basic concepts and structures of computer programming. They also need to be able to reproduce basic programming in simple code, as well as the logical control structure in solving simple programming problems. This Basic Programming course uses the C# programming language and Microsoft Visual Studio software for practical exercises and exams, provided by Microsoft as open source.

C#Venture Application

The innovative C#Venture application incorporates the game-based learning method where students assume the role of players. Players need to answer questions related to the fundamental concepts of computer programming during their adventurous journey. Questions are created using various digital learning applications such as quiz makers, Zappar, Zip Grade, Google Forms, Google Docs, QR Code Reader, QR Code Generator Monkey, WhatsApp, Decision Roulette, and Jigsaw Planet. To answer questions at each stage, players need to scan QR codes using smartphones or tablets, and relevant questions will be displayed. The questions are constructed based on the player's level.

Students are divided into teams, with each team consisting of five (5) players, including a team leader. Each player assumes the role of an Avenger team member based on the identity card provided to add excitement to the activity. Each identity holder has their responsibilities. Teams start their journey in C#Venture by following the provided clues and instruction cards within their kits. Players must collaborate as a team to complete the tasks successfully. The tasks cover various topics related to basic programming. The game not only tests students' understanding of the course content but also promotes teamwork and problem-solving abilities, leading to successful Course Learning Outcomes.

In the C#Venture game, there is a Quest Master (QM) who oversees the adventure. At the end of the game, each team must find the QM to complete the final task, symbolizing the end of the game. Winners are determined based on the team that completes all the assigned tasks first and will receive rewards. The game can be played outside the classroom in any suitable location to complete the assigned tasks. This gamified learning session sparks students' interest, indirectly enhancing their understanding of the Basic Programming course. The game can be played within a 45-minute to 1-hour timeframe.

Figure 1: C#Venture Application

Figure 2: Learning Tools Used in the C#Venture Innovation Kit

METHODOLOGY

This study is quantitative research conducted using a survey method. A questionnaire was employed as the research instrument. The questionnaire consisted of three sections: (A) Respondent Background, (B) Student Attitudes Toward Basic Programming Courses, and (C) Student Interest in the C#VENTURE Application. The items in sections B and C were adapted from previous research by Abdul Talib et al. (2019) and modified to suit the current research context. The items in sections B and C were assessed using a Likert scale with five points ranging from 1 (strongly disagree) to 5 (strongly agree). Students attended Computer Systems and Networking classes, after which the instructor provided learning materials for group play in class to assess students' understanding. A total of 54 students participated in the study. All 54 students pursuing the Certificate in Computer Systems and Networking at Bandar Darulaman Community College were selected as the study sample because they

had all taken the Basic Programming course and used these learning aids in class. The questionnaire was distributed to the students using Google Forms after they finished playing. Descriptive and inferential analyses were conducted to analyze the data.

RESULTS

IBM Statistical Package for the Social Sciences (SPSS) version 27 was used to analyze the data. Descriptive statistics were employed, including mean scores and standard deviations. The interpretation of the minimum scores on the Likert scale was divided into three levels: high (3.68 – 5.00), moderate (2.34 – 3.67), and low (1.00 – 2.33).

Respondents' Demographics

The findings in this study show that 64.8% of male respondents are 35 individuals, while 35.2% of female respondents are 19 individuals. A total of 39 respondents (72.2%) are aged between 18 to 20 years, while 14 respondents (25.9%) fall into the age range of 21 to 23, and only one respondent (1.9%) is aged 23 and above.

Research Objective 1: To determine the level of students' attitudes toward the Basic Programming course.

In Table 1, the overall score for the level of students' attitudes toward the Basic Programming course is at a high level (M = 4.18), except for item 3, which is "The Basic Programming course is not boring," which falls into the moderate level (M = 3.50). Meanwhile, item 2 - "The Basic Programming course is easy to learn" (M = 3.98) and item 9 - "I always read additional reading materials related to the Basic Programming course" (M = 3.89) are two items with scores below 4.00. The highest score is associated with three items: item 5 - "The teaching of the Basic Programming course lecturer is easy to follow" (M = 4.57), item 11 - "I always read additional reading materials related to the Basic Programming course" (M = 4.48), and item 1 - "I enjoy learning the Basic Programming course" (M = 4.41).

Table 1: Level of Students' Attitudes Toward Basic Programming Course

No.	Item	Mean	Std. Deviation	Level
1	I enjoy learning the Basic Programming course.	4.41	0.599	High
2	The Basic Programming course is easy to learn.	3.98	0.765	High
3	The Basic Programming course is not boring.	3.50	1.24	Moderate
4	Discussing the Basic Programming course with peers is frequent.	4.13	0.825	High
5	Teaching by the Basic Programming course lecturer is easy to follow.	4.57	0.633	High
6	If there are problems related to the Basic Programming course, I always ask the lecturer.	4.35	0.756	High

7	I always look forward to the Basic Programming course.	4.11	0.744	High
8	I am happy to learn the Basic Programming course.	4.33	0.727	High
9	I always read additional reading materials related to the Basic Programming course.	3.89	0.839	High
10	I always take notes and summaries while learning the Basic Programming course.	4.20	0.877	High
11	I always read additional reading materials related to the Basic Programming course.	4.48	0.693	High
	Total Mean	**4.18**	**0.531**	**High**

Research Objective 2: To determine the level of students' interest in the C#VENTURE Application.

Table 2 shows the level of students' interest in the C#VENTURE application. Overall, the scores are at a high level, which is 4.47. Item 5 - "The C#VENTURE application game can strengthen and connect the knowledge of the Basic Programming course," and item 6 - "The C#VENTURE application game can actively engage students in learning the Basic Programming course" are two items with equally high scores (M = 4.50). Meanwhile, item 3 - "Learning basic programming concepts is more enjoyable through the C#VENTURE application game" has the lowest score (M = 4.43).

Table 2: Level of Students' Interest in the C#VENTURE Application

No.	Item	Mean	Std. Deviation	Level
1	My understanding of basic programming concepts can be improved through the C#VENTURE application game.	4.46	0.719	High
2	Learning using the C#VENTURE application game can facilitate understanding of basic programming concepts.	4.46	0.794	High
3	Learning basic programming concepts is more enjoyable through the C#VENTURE application game.	4.43	0.767	Moderate
4	The C#VENTURE application game can strengthen my memory of basic programming concepts.	4.44	0.769	High
5	The C#VENTURE application game can strengthen and connect the knowledge of the Basic Programming course.	4.50	0.720	High
6	The C#VENTURE application game can actively engage students in learning the Basic Programming course.	4.50	0.720	High
	Total Mean	**4.47**	**0.703**	**High**

Research Objective 3: To identify the differences in students' attitudes toward the basic programming course based on gender.

An independent sample t-test in this study shows that there is no significant difference in the level of student attitudes between male students (n = 35, M = 4.19, SD = 0.50) and female students (n = 19, M = 4.22, SD = 0.60), t(52) = -1.73, p = 0.417. These findings also demonstrate that male and female students have the same attitude towards the Basic Programming course. Thus, the null hypothesis fails to be rejected. This indicates no significant difference in gender in terms of student attitudes towards the Basic Programming course.

Table 3: Independent Sample t-Test for Student Attitudes

Variable	Gender	N	Mean	Standard Deviation	t-Value	Significance Level
Student Attitudes	Male	35	4.19	0.50	0.863	0.417
	Female	19	4.22	0.60		

Research Objective 4: To identify the differences in students' interest in the C#VENTURE application based on gender.

An independent sample t-test in this study shows that there is no significant difference in the level of student interest between male students (n = 35, M = 4.54, SD = 0.67) and female students (n = 19, M = 4.42, SD = 0.73), t(52) = -595, p = 0.430. These findings also demonstrate that male and female students have the same interest in the C#VENTURE application game. Thus, the null hypothesis fails to be rejected. This indicates no significant difference in gender in terms of student interest through the use of the C#VENTURE application game.

Table 4: Independent Sample t-Test for Student Interest

Variable	Gender	N	Mean	Standard Deviation	t-value	Significance Level
Student Interest	Male	35	4.42	0.73	0.554	0.430
	perempuan	19	4.54	.67		

DISCUSSION

The findings indicate that students' attitude scores towards the basic programming course are high. Out of the 11 items examined, it was found that 10 items had high scores. These items include: "I like learning the Basic Programming course," "Basic Programming course is easy to learn," "Discussing the Basic Programming course with friends is a regular occurrence," "The teaching by the Basic Programming course lecturer is easy to follow," "If there are problems related to the Basic Programming course, I always ask the lecturer," "I always look forward to the Basic Programming course," "I am happy to learn the Basic Programming course," "I always read additional reading materials related to the Basic Programming course," "I always make notes and summaries while studying the Basic Programming course," and "I always read additional reading materials related to the Basic Programming course" are at a high level. However, the item "Basic Programming course is not boring" has the lowest score. This indicates that the majority of students are aware that the Basic Programming course is important to be learned as part of the Computer Systems and Networks Certificate. The study conducted by Azhar and Adnan (2022) also supports the findings in this study. In their study, they showed that students are aware of the importance of the Basic Programming course in the Computer Systems and Networks Certificate and can build a strong foundation if students understand Basic Programming. Nevertheless, there are still students who find the Basic Programming course boring. This may be because the Basic Programming course is difficult and complex, as stated by Ab Rahman et al. (2017). Learning advanced programming courses will become more difficult and challenging if students have a poor understanding of programming concepts and fundamentals.

The research findings also found that students' interest in the use of the C#VENTURE application is high for all six items. This indicates that students' interest in the basic programming course can be increased through the use of this application. The results of this study are supported by Zalilah's (2018) study, which the study showed that the teaching and learning process can not only be conducted smoothly, but also the use of games in learning has been successful in improving students' learning experience and motivation. The results of this study are also supported by previous studies, such as Ngadengon et al. (2021), who stated that games as teaching aids can attract students' interest in programming. Furthermore, using games as a teaching aid in programming courses can produce better performance and motivate students to learn it (Priyaadharshini et al., 2020). Moreover, Wong et al.'s (2018) study also supports the findings of this study by stating that learning activities that use game-based methods can attract students' interest, especially in programming courses. Furthermore, the findings of this study are supported by Perumal et al. (2019) who have shown that the learning approach is a very important element in motivating students to learn. When students are interested in programming assignments, they allocate more time to explore programming concepts and produce much higher-quality code (Johan et al., 2021). Among all the items, students agree that the C#VENTURE application game can strengthen and relate their knowledge of the Basic Programming course and can actively engage students in learning the Basic Programming course. This is because the application involves five players, and each player must work together as a team to successfully

complete each task. Every task assigned includes topics related to Basic Programming in general. This game not only tests students' understanding of the course they are studying but also fosters teamwork among players in groups to complete each instruction given to win this adventure.

CONCLUSION

In summary, students have shown a positive attitude towards learning the Basic Programming course. Although students are aware that this course is very challenging (Ab Rahman et al., 2017) and is difficult and complex (Díaz-Lauzurica & Moreno-Salinas, 2019) to learn. Especially, English is widely used in this course. Through the use of the C#VENTURE application game method, students' interest can be increased because the student's interest in the use of the application has a high minimum score. Therefore, the use of the C#VENTURE application game needs to be continued by lecturers, and improvements need to be made to ensure that students are always interested in learning the Basic Programming course. Further research is recommended to conduct quasi-experiments to study the effectiveness of using the C#VENTURE application game in teaching and learning for the Basic Programming course.

REFERENCES

Ab Rahman, N. F., Kasbun, R., Khalid, N., & Aziz, S. A., & Mohamed, H. (2017). Penggunaan aplikasi visual dalam pembelajaran konsep dan asas pengaturcaraan. *National Pre University Seminar 2017 (NpreUS2017*), 246-251.

Abdul Talib, N. S., Abdul Ghani, K., & Yusuff, N. A. (2019). Kaedah pembelajaran sejarah berasaskan lawatan ke muzium. *International Online Journal of Language, Communication, and Humanities*, *2*(1), 45-57.

Ahmad, A., & Ibrahim, A. B. (2020). Pembelajaran pengaturcaraan: Faktor kegagalan pelajar dan pendekatan pembelajaran efektif. *Journal of Social Science and Humanities, 4* (3), 1-4. https://doi.org/10.26666/rmp.jssh.2020.3.1

All, A., Plovie, B., Nuñez Castellar, E. P. & Van Looy, J. (2017). Pre-test influences on the effectiveness of digital-game based learning: A case study of a fire safety game. *Computers & Education, 114*, 24–37. https://doi.org/10.1016/j.compedu.2017.05.018

Azhar, N. H., & Adnan, N. H. (2022). Mengkaji kelemahan dan kekuatan dalam pdp pengaturcaraanC#: Satu kajian kes. *Jurnal Dunia Pendidikan*, *4*(2), 280-293. https://doi.org/10.55057/jdpd.2022.4.2.25

Bakar, M. A., Esa, M. I., Mukhtar, M., Latih, R., Jailani, N., Mohd. Ali, N., Mohd. Salleh, S., & Mohd. Zin, A. (2018). Kerangka bagi persekitaran pembelajaran berpusatkan pelajar untuk latihan pengaturcaraan kendiri. *ASEAN Journal of Teaching & Learning in Higher Education, 10*, 24-38.

Che Abd Razak, N. S., & Ismail, N. W. (2018, May 2). Persepsi pelajar dan pensyarah terhadap kegagalan pelajar dalam kursus pengaturcaraan. *National e-Learning Conference (NeLCon 2018)*, Politeknik Port Dickson, Negeri Sembilan.

Díaz-Lauzurica, B., & Moreno-Salinas, D. (2019). Computational thinking and robotics: A teaching experience in compulsory secondary education with students with higher degrees of apathy and demotivation. *Sustainability, 11*, 5109. https://doi.org/10.3390/su11185109

Johan, E. J., Wan Mohammad, W. A., Mydin, A. M., & Mohamed Yusoff, S. A. (2021). Pelajar 'mati kutu' dengan tugasan pengaturcaraan: Bagaimana mengatasinya? *SIG: e-Learning@CS*, 35-44.

Maskur, H., Abdul Mutalib, R., & Abdullah, N. (2020). Hubungan sikap pelajar dan pengajaran pensyarah terhadap pencapaian kursus pengaturcaraan di kalangan pelajar politeknik. *Proceeding International Multidisciplinary Conference (IMC 2020)*, 273-279.

Mydin, A. M., Abu Mansor, S. N., Wan Mohammad, W. A. Omar, M., Kechil, R., & Saad, S. M. (2021). InCeS: Pembelajaran berasaskan permainan. *SIG: e-Learning@CS*, 45-53.

Nelson, M. (2016). Computer science education in the age of CS for all. *HuffPost*. https://www.huffingtonpost.com/acm-the-association-for-computing-machinery/computer-science-educatio_1_b_9373808.html

Ngadengon, Z., Rahmat, F., &Zawawi, N. S. M. (2021). Keberkesanan gamifikasi dalam pembelajaran teknologi rekabentuk web. *International Journal of Modern Education, 3*(10), 48-61. https://doi.org/10.35631/IJMOE.310004

Perumal, A., Latih, R., Abu Bakar, M. (2019) MyJavaSchool: Persepsi dan motivasi pelajar terhadap pengaturcaraan komputer. *Asia-Pacific Journal of Information Technology and Multimedia, 8* (2), 71-78. https://doi.org.doi.org/10.17576/apjitm-2019-0802-05

Priyaadharshini, M., Dakshina, R., & Sandhya, S. (2020). Learning analytics: game-based learning for programming course in higher education. *Procedia Computer Science, 172*, 468-472. https://doi.org/10.1016/j.procs.2020.05.143

Whitton, N. (2012). Games-Based Learning. In: Seel, N.M. (eds.), *Encyclopedia of the Sciences of Learning* (pp. 1337–1340). Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-1428-6_437

Wong, Y. S., Yatim, M. H. M., & Tan W. H. (2018). Learning object-oriented programming paradigm via game-based learning game- Pilot study. *International Journal of Multimedia & Its Applications (IJMA), 10*(6), 181–187. https://doi.org/10.5121/ijma.2018.10615

Zalilah, M. A. T. (2018). Penjelasan Identiti Asas Pengaturcaraan dan Perubahan Konseptual Melalui Adegan Permainan Basic Programming. *Journal of ICT in Education (JICTIE), 5*, 48-57. https://doi.org/10.37134/jictie.vol5.6.2018