

Students experience in learning Fundamental Programming: An analysis by gender perception

Noor Azizah Mat Isa ¹, Siti Rosminah MD Derus ²

¹Electrical Engineering Department, Polytechnic Sultan Azlan Shah, Behrang, Perak.

² Faculty of Art, Computing & Creative Industry, University Pendidikan Sultan Idris, Tanjung Malim, Perak

ARTICLE INFO

Article history:

Received : June 2015

Accepted : August 2015

Available online : January 2017

Keywords:

Programming, programming difficulties, gender

ABSTRACT

Programming courses have been used as one component of the curriculum to be learned not only in the field of Information Technology, but also needed in most areas of the program such as Science, Mathematics, and Engineering at the tertiary level. However, this course was difficult and complex and it is categorized as one of the seven major challenge in educational computing. The aim of this study was to explore the views of female and male students regarding their experiences and difficulties while learning courses Programming. This study used questionnaire survey method to the 114 students who took the subject of Fundamental Programming (EC201) at the Polytechnic Sultan Azlan Shah. Data were analyzed using SPSS and results shown by the mean and standard deviation. Overall, the level of students' understanding content of the subjects are moderate and the most difficult topics for the male and female students are Array Data Structure (M = 2.99, SD = 0.97 for male and M = 2.89, SD = 0.83 for female). Both gender agreed an activity such as understanding the structure of programming (M = 3.58, SD = 0.92 for male and M = 3.53, SD = 0.89 for female) was the most difficult programming activities. The second difficult activity for males student are using program development environment (M = 3.70, SD = 0.78) while for female students are finding bugs from program code (M = 3.53, SD = 0.89). Factor such as the computers that do not work (M = 3.67, SD = 0.90 for male and M = 3.68, SD = 0.93 for female) was leading to poor students to master in programming.

INTRODUCTION

Polytechnic education system designed to meet the semi-skilled worker as targeted under the Economic Transformation Programme (ETP) to encourage the Malaysian economy towards a high-income country status by 2020. As a leader in the field of technical education and vocational training, polytechnic responsible for producing graduates who have technical skills, especially in the engineering industry. However, the industry needs now is not only demanding workforce with skills and knowledge in technical, but also need to have knowledge about information technology. To meet this need, the Department of Polytechnic Education (JPP) always offers courses in information technology-based

programs that are offered in line with the needs of industry. For example, Fundamental Programming (EC201) was used as core courses to students in the second semester Diploma level in all the programs of Electrical Engineering. Fundamental Programming is the basis of other subjects such as Embedded System, Micro Controller, Robotic Embedded and several other subjects according to their respective areas of specialization during the 5th and 6th semester. If the students failure mastered the basic programming will be difficult for lecturers to continue teaching in specific topics for related courses. Lecturers sometimes had to repeat the lessons in programming before continuing instruction in subjects such engineering. Therefore, it is critical students have mastered the Basic programming to facilitate their study and master other engineering courses related to the field of programming.

RESEARCH BACKGROUND

Programming course is a course that involves understanding abstract concepts and student must be proficient in translating the real world problem to program code [1], [2]. However, students are found it difficult to master this programming skills. Past research revealed that the students are facing problems in writing [3], reading [4] as well as designing [5] an even a simple program code. In fact, the findings from Mohamad Gobil, Zarina, & Itaza Afiani [6] showed that students fail to identify the rules according to operator precedence rules arithmetic. This leads to difficult for them to generate information on arithmetic expressions in programming language. Therefore, it is important to investigate the factors that lead to students learning difficulty in programming. The difficulties need to be identified in order to be able to aid them learning in an effective manner. Hence, this study intends to carried out for identifying the perception and difficulties faced by male and female students when they have finished their Fundamental Programming course . It is because, they might be a gender differences in experience and confidence levels in programming subject [7], [8]. Male and female students have a different, learning style, attitude and interest in science, mathematics and engineering field. However, lately the achievement of female students in programming is better compared to male student [9]. A survey conducted by Murphy, Richard & McCauley [10] show that females generally considered the programming concepts to be no more difficult than did the male.

RESEARCH OBJECTIVES

This study aims to explore the views of students and the difficulties they experience while learning Fundamental Programming courses by gender. In particular, the objectives of the study are as follows:

1. To know the level of understanding of different topics of the Fundamental Programming course.
2. To investigate the nature of difficulties while learning Fundamental Programming course.
3. To investigate the factors that lead to perform poorly in Fundamental Programming course.

METHODOLOGY

The study employs a survey questionnaire which was adapted from existing instruments of the [11] and [12]. The items of the instrument consist of two main part which is Part A and Part B. Part A covering the general background information from a respondent, including programming experience. Part B contains items related to level of understanding of topics of the Fundamental Programming course, the nature of difficulties while learning Fundamental Programming course and the factors that lead perform poorly in learning Fundamental Programming course.

Respondents were about 114 second semester students from three programs in Electrical Engineering Department at Polytechnic Sultan Azlan Shah (PSAS) as in Table 1.

Table 1: Number and percent distribution of respondent according to program

Program		Num of Respondent	Percent of Respondent
DTK	Diploma in Electronic Engineering (Computer)	38	33.3%
DET	Diploma in Electrical Engineering	44	38.6%
DEP	Diploma in Electronic Engineering (Communication)	32	28.1%
TOTAL		114	100%

RESULT AND DISCUSSION

Instrument's Reability

To get the internal variable consistency, reliability test scale (Cronbach Alpha) was conducted. In this study, all values of Cronbach Alpha internal variable consistency for all variables exceed 0.7. According to Babbie [13], Cronbach Alpha value is classified into four categories: very high values are from 0.90-1.00, 0.70-0.89 is high, 0.30-0.69 is moderate and 0.00-0.30 is low. Therefore, the analysis results in this study have shown Cronbach Alpha for all variables in high classification. The analysis results of Cronbach Alpha value (Table 2) are in the classification of high and very high, whereby all are higher than 0.70.

Table 2: Alpha Cronbach values for the variables

Variables	Num of items	Cronbach Alpha Value
Level of understanding of different topics of the Fundamental Programming Course	6	0.843
The nature of difficulties while learning Fundamental Programming course	5	0.826
The factors that lead to perform poorly in Fundamental Programming course.	7	0.825

The Results

Of the 114 respondents who answered the questionnaires, 67% (n = 76) are male and 33% (n = 38) are females. Meanwhile, 94% of respondents had no experience with computer programming. This shows the Fundamental Programming courses (EC201) is their first experience in the programming development environment. [14] stated that respondents who do not normally have experience in programming will face some difficulty to understand and learn the language. This is because respondents need to understand syntax codes for writing programs[15] and usually they are difficult to visualize how a computer processes each program code for solving problems [16].

Below is the results of the analysis based on the research objectives:

ROI : To know the level of understanding of different topics of the Fundamental Programming Course.

The results as indicated in Table 2 and Table 3 shows mean value of the level of students' understanding of the topic of Fundamental Programming courses by gender. The item is designed with 5-point Likert scale (1, not understand at all; 2, not understand; 3, sometimes understand; 4, understand, and 5, very understand). The sequence of topics understanding in the table is listed from the lowest mean value. The result found that topic of Array Data Structure was the hardest topic for both gender. An array data structure involves in manipulating many variables that contain or similar forms of data [17] and is closely related to respondents' ability to describe or visualize the movement of data within a computer memory [12].

Table 2: Level of understanding on different topic on programming course (male)

Tajuk	Mean	SD
Array Data Structure	2.99	0.97
Function	3.14	1.03
Looping Statements (e.g : while , do-while, goto)	3.16	0.99
Selection statement (e.g: if-else, switch)	3.20	0.88
Variables, constants and data types.	3.49	0.93
Input/Output statements (e.g: prints, scanf)	3.62	.92

Table 3: Level of understanding on different topic on programming course (female)

Tajuk	Mean	SD
Array Data Structure	2.89	0.83
Looping Statements (e.g : while , do-while, goto)	3.08	0.88
Selection statement (e.g: if-else, switch)	3.16	0.79
Function	3.26	0.92
Input/Output statements (e.g: prints, scanf)	3.68	0.87
Variables, constants and data types.	3.71	0.87

Next, for male respondents having less understanding the topic Function compared to female respondents. A Function is an is a segment of a program code that can be invoked from elsewhere within the list of program code and respondents should acquire this skill to prevents the possibility of errors caused by copying the code from one place to another [18]. While for female respondent, they are having less understanding for topic Looping Statement and Selection Statement compared to Function. These topic are vital to mastered because this two topics is the basic of the programming structure where respondents should have an ability to comprehend these structure that could affect the logical aspect of the program and consequently will increase the difficulty to provide the best solution for the problem given [6].

Generally, the topic such as Array Data Structure, Function, Looping Statements and Selection Statement require considerable skill of respondents to understand the abstract concept involving the position of the variable values. According to [12], the reason's students having problems in learning programming is they are less familiar with the role of a variable position in the computer memory when the program code executed such as how the variables are stored and the relationship between the variables in the computer memory. Therefore, using the visualization tools to depict the position of the variables that occur when the program code executed may help the student understand the role of variables in computer memory [19].

RO2. To investigate the nature of difficulties while learning Fundamental Programming course.

For the second research objective, respondent's needs to respond to the difficulties faced by them while learning fundamental programming course where they need to evaluate the level of agreement with the questionnaire item given. 5-point Likert scale (1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree) is used for the items. The sequence of topics in the table is listed from the highest mean value. Table 4 and table 5 shows the level of understanding on topic on programming course by gender. The result found that both genders had facing the highest difficulty in understanding basic concepts of programming structure. These findings clearly show that respondents have difficulty in getting the programming skills.

Table 4. Difficulty while learning programming (Male)

Nature of difficulty	Mean	SD
Understanding basic concepts of programming structure	3.72	0.78
Using program development environment	3.70	0.78
Finding bugs from my own program	3.67	0.79
Designing a program to solve certain tasks	3.62	0.82
Learning the programming language syntax	3.55	0.82

Table 5. Difficulty while learning programming (Female)

Nature of difficulty	Mean	SD
Understanding basic concepts of programming structure	3.58	0.92
Finding bugs from my own program	3.53	0.89
Learning the programming language syntax	3.39	0.86
Designing a program to solve certain tasks	3.29	0.87
Using program development environment	3.21	1.07

From the result also, it's found that the male respondent having less difficulty in understanding the programming language syntax compared to female respondent. A programming language syntax is the knowledge are very important to mastered because it is the characteristics of language or grammatical of a programming language. For example, use a semicolon which is placed at the end of each statement of C programming language. Besides that, if the respondents are not comfortable with the programming syntax, they intend to facing difficulty to identify the syntactic barriers exist during compiling and debugging process [20].

Generally, the problem often faced by students who do not have the programming background is to apply the abstract concepts of programming with the programming structure [21], and also an additional skills such as management training, editing, compiling and debugging program code [22]. Programming process involves two phases, namely the problem solving and implementation phase [23]. Before writing program, respondents have to go through phases of problem solving, which at this stage respondents should have an ability to analyze a problem to determine the data input, the processes involved and then the expected output. In addition, respondents should also be skilled to convert data input, process and output in the form of an algorithm. Usually the algorithm represented by the pseudo code and flowchart [17]. The next phase, which is the implementation phase, at this stage the respondents will convert a flowchart or pseudo code built into the software code syntax. This stage, the respondent should be able to handle writing or designing the program as well as the skilled use of the software. In addition, most respondents also face additional problems in the skills development process programming such as editing, compiling and debugging code program[22]. Therefore, students need to master both of these phases to develop a program. Thus, the teaching aids are appropriate to the stage of novice students are required to address these issues.

RO3. To investigate the factors that lead to perform poorly in Fundamental Programming course.

For the third research objective, respondent's needs to respond the level of agreement the factors that made them perform poorly while learning basic programming course. 5-point Likert scale (1, Strongly Disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Strongly Agree) is used for the items. The sequence of topics in the table is listed from the highest mean value. Table 6 and 7 shows the analysis made of the factors which affect the poor performance in programming by gender. Both gender agreed that computers in laboratory conditions that do not work is a key factor in students weak in programming. If the computer does not work, the students had to share a computer with other students. Therefore, this situation led to a chance for students to create practical training during the practical sessions is less. Programming should involve practical and intensive training due to its dynamic [24]. By implementing the programming activities in the laboratory, can help students overcome the perception that are difficult to understand the terminology of program code as well as stimulate their interest in the field of programming through activities undertaken [25]. The situation may get worse if the computer is shared with more than two students.

Table 6: Factors that lead to poor performance in programming (Male)

Factors	Mean	SD
Computers provided in labs are not functioning well	3.67	0.90
Syllabus focuses too much on theory	3.62	0.86
Students' lack of interest to learn	3.55	0.94
Teaching methodology is less effective	3.54	0.94
Presentation of instructors and their attention on students	3.50	0.84
Less examples of practical use are shown	3.41	1.01
Learning environment that is not conducive	3.39	0.97

Table 7: Factors that lead to poor performance in programming (Female)

Factors	Mean	SD
Computers provided in labs are not functioning well	3.68	0.93
Students' lack of interest to learn	3.68	1.02
Syllabus focuses too much on theory	3.61	0.86
Less examples of practical use are shown	3.55	0.80
Presentation of instructors and their attention on students	3.53	0.89
Teaching methodology is less effective	3.53	0.86
Learning environment that is not conducive	3.32	1.17

From the result also, we found that female respondent have lack interest to learn programming compared to male respondent. This possibility due to they have less confident of their own abilities in programming especially those who do not have programming background [9], [26]. However, past research has found that there is no statistically significant gender in programming scores[27], [28]. From the result of both gender, it seems that the instructional strategy of lecturers are such as presentation and teaching methodology might help them to acquire the programming knowledge. Instructional technique and strategies are vital in the delivery of educational information. In order to help students to master the basic problem solving skill, the teaching method used should be applicable to the content of programming with different paradigms and to make sure the active involvement of students in programming practical session [29].

CONCLUSION

Programming courses closely related to the ability to convert an abstract real-world problems to the program code that can be interpreted and executed by a computer. However, this course was said as difficult and complex. This is because students who do not have programming experience requires a proper understanding to acquire something an abstract and difficult concept that difficult to imagination. Difficulty to illustrates the flow execution of the program code is one of the main factors of students difficult to acquire the concepts of programming. In this regard it is important to provide an aids learning support such as visualization program to help students gain an understanding of programming concepts. However, factors such as lab facilities and teaching methods should also be noted for improving student achievement in programming.

REFERENCES

- [1]D. A. Kranch, "From Novice to Expert : Harnessing the Stages of Expertise Development in the Online World," no. 1996, pp. 52-62, 2009.
- [2]M. McCracken, V. Almstrum, D. Diaz, L. Thomas, M. Guzdial, I. Utting, and D. Hagan, "A multi-national , multi-institutional study of assessment of programming skills of first-year CS students," ACM SIGCSE Bull., vol. 33, no. 4, pp. 125-180, 2001.
- [3] R. Lister, "Ten years after the McCracken Working Group," ACM Inroads, vol. 2, no. 4, p. 18, Dec. 2011.
- [4]R. Lister, E. S. Adams, S. Fitzgerald, W. Fone, J. Hamer, M. Lindholm, R. McCartney, J. E. Moström, K. Sanders, and O. Seppälä, "A multi-national study of reading and tracing skills in novice programmers," in ITiCSE-WGR '04 Working group reports from ITiCSE on innovation and technology in Computer Science education, 2004, pp. 119 - 150.
- [5]J. Tenenberg, S. Fincher, K. Blaha, D. Bouvier, T. Chen, D. Chinn, S. Cooper, A. Eckerdal, H. Johnson, R. McCartney, A. Monge, J. E. Moström, M. Petre, K. Powers, M. Ratcliffe, A. Robins, D. Sanders, L. Schwartzman, B. Simon, C. Stoker, A. E. Tew, and T. Vandegrift, "Students Designing Software : a Multi-National , Multi-Institutional Study," Informatics Educ., vol. 4, no. 1, pp. 143-162, 2005.
- [6]A. R. Mohamad Gobil, S. Zarina, and M. Itaza Afiani, "Novice difficulties in selection Structure," in 2009 International Conference on Electrical Engineering and Informatics, 2009, no. August, pp. 351-356.
- [7]S. Beyer, K. Rynes, J. Perrault, K. Hay, and S. Haller, "Gender differences in computer science students," SIGCSE Bull., vol. 35, no. 1, pp. 49-53, 2003.
- [8]P. Ventura and B. Ramamurthy, "Wanted: CS1 students. no experience required," ACM SIGCSE Bull., vol. 36, no. 1, p. 240, Mar. 2004.
- [9]J. Carter and T. Jenkins, "Gender and programming: What's going on?," ACM SIGCSE Bull., vol. 31, no. 3, pp. 1-4, 1999.
- [10]L. Murphy, B. Richards, R. McCauley, B. B. Morrison, S. Westbrook, and T. Fossum, "Women catch up: gender differences in learning programming concepts," in Technical Symposium on Computer Science Education, 2006, p. 17.

- [11]T. Phit-Huan, T. Choo-Yee, and L. Siew-Woei, "Learning difficulties in programming courses: Undergraduates' perspective and perception," 2009 Int. Conf. Comput. Technol. Dev., vol. 2, pp. 42–46, 2009.
- [12]I. Milne and G. Rowe, "Difficulties in learning and teaching programming — Views of students and tutors," Educ. Inf. Technol., vol. 7, no. 1, pp. 55–66, 2002.
- [13]E. R. Babbie, "The practice of social research." Wardsworth Publishing Company, California, 1992.
- [14]L. Mannila, M. Peltomäki, and T. Salakoski, "What about a simple language? Analyzing the difficulties in learning to program," Comput. Sci. Educ., vol. 16, no. 3, pp. 211–227, 2006.
- [15]L. Ma, J. Ferguson, M. Roper, and M. Wood, "Investigating and improving the models of programming concepts held by novice programmers," Comput. Sci. Educ., vol. 21, no. March 2011, pp. 57–80, 2011.
- [16]M. D. Siti Rosminah and M. A. Ahmad Zamzuri, "Integration of visualization techniques and active learning strategy in learning computer programming: A proposed framework," Int. J. New Trends Educ. Educ. Their Implic., vol. 5, no. 1, pp. 93–103, 2014.
- [17]A. B. Marini, J. Norleyza, and I. Sufian, Pengaturcaraan C. Prentice Hall Pearson Malaysia Sdn.Bhd., 2002.
- [18]M. Ben-Ari, Understanding Programming Languages, vol. 17, no. 2. John Wiley & Sons, Inc, 1996.
- [19]T. Rajala, T. Salakoski, M. J. M. Laakso, and E. Kaila, "Effects, experiences and feedback from studies of a program visualization tool," Informatics Educ. Int. J., vol. 8, no. Vol 8, pp. 17–34, 2009.
- [20]M. C. Jadud, "Methods and tools for exploring novice compilation behaviour," in Proceedings of the 2006 international workshop on Computing education research ICER 06, 2006, pp. 73–84.
- [21]E. Lahtinen, K. Ala-Mutka, and H.-M. Järvinen, "A study of the difficulties of novice programmers," ACM SIGCSE Bull., vol. 37, no. 3, p. 14, Sep. 2005.
- [22]I. T. C. Mow, "Issues and difficulties in teaching novice computer programming," in Innovative Techniques Technology, E-learning, E-assessment and Education, 2008, pp. 199–204.
- [23]I. Govender, "Experiences of learning and teaching: Problem Solving in computer programming," African J. Res. Math. Sci. Technol. Educ., vol. 11, no. 2, pp. 39–50, 2007.
- [24]A. Gomes and A. J. Mendes, "Learning to program-difficulties and solutions," in International Conference on Engineering, 2007.
- [25]J. R. Parham, "An assessment and evaluation of Computer Science education," J. Comput. Sci. Coll., vol. 19, no. 12, pp. 115–127, 2003.
- [26]L. Beckwith and M. Burnett, "Gender: An Important Factor in End-User Programming Environments?," in Visual Languages and Human Centric Computing, 2004 IEEE Symposium on, 2004, pp. 107–114.
- [27]C. McDowell, L. Werner, H. E. Bullock, and J. Fernald, "The impact of pair programming on student performance, perception and persistence," in 25th International Conference on Software Engineering, 2003. Proceedings., 2003, pp. 3–8.
- [28]W. W. F. Lau and A. H. K. Yuen, "Exploring the effects of gender and learning styles on computer programming performance: implications for programming pedagogy," Br. J. Educ. Technol., vol. 40, no. 4, pp. 696–712, Jul. 2009.

[29]I. Mohd Nasir, N. Nor Azilah, and U. Irfan Naufal, "Instructional strategy in the teaching of computer programming : A need assessment analyses," TOJET, vol. 9, no. 2, pp. 125-131, 2010.