

Needs Analysis Research For Programming Education Program

Noraini Talib ^a, Siti Fatimah Mohd Yassin ^b & Mohd Khalid Mohd Nasir^b

^a Information Technology Center, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

^b Faculty of Education, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

*Corresponding Author:

E-mail address: nt@ukm.edu.my

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ABSTRACT

This study was conducted to analyse the needs of computer programming education. The research design used was a case study and a total of 30 participants has taken part in this study. All participants are among programming coach, teachers and lecturers. Data collection has been analysed using thematic analysis techniques. The findings show that each dimension of the needs analysis, research succeeds in obtaining specific themes and could be used as a foundation to develop teaching and learning programming module. The results of the analysis find that two essential elements still need further research and need to be done separately. The first requirement element requiring further and separate study is how to produce assessment rubrics that contain benchmarks equivalent to the expertise thinking of the programmer. Research that needs to be done is to explore the creative processes that occur in the programmer's mind. The second requirement element is how the instructors develop coaching skills based on technology knowledge, pedagogy and teaching content as well as the issues and challenges faced.

Keywords: *Needs Analysis, Programming Education, Computer Programming, Case Study.*

Introduction

Nowadays, computer programming may be a significant education to everybody although it is always considered difficult. To carry out the educational program of computer programming, it's require needs analysis research an earliest studies that should be done to ensure that improvements to current problem of education (Watkins et al. 2012). In addition, the need analysis is also to determine if the appropriate approach is used for a new education program, is there any possibility that there is already a demand for a more effective teaching and how the credibility of the education program will be built (McCawley 2009). Needs analysis has

various dimension to explore but this article focusing on several dimension that suit to the nature of the current issue of programming education.

Needs Analysis Dimension

There are eight dimension of needs analysis has been done namely learning content, learning environment, support resources, targeted students, teaching method, assessment, instructor and research interest. The question that arises of why the eight dimensions of the needs analysis research should be done according to Watkins et al. (2012) is as in the following table.

Table 1. Eight Dimension of Needs Analysis

Dimension of Needs Analysis	The Question Arises of Why Needs Analysis should be done
Learning Content	What is the appropriate instructional content to use for the purpose of achieving the learning goal of solving the problems of students such as lack of creative problem solving skills, unsatisfactory achievements and lack of motivation and student interest in programming?
Learning Environment	How does the environment fit to be the target of the research area to prove that the programming education program has been developed effectively solves the problems identified?
Support Resources	What is the most important resources to support programming education program?
Targeted Students	What are the criteria of the students who are fit to follow the computer programming education?
Teaching Method	How is the teaching method appropriate to the teaching content of programming education?
Assessment	How to evaluate the impact of learning on the students who participated in this programming education?
Instructor	What is the readiness needed as an instructor of computer programming education?
Research Interest	How the education program will become an important resource for solving the identified problems.

Creative Problem Solving

Creative problem solving skills (CPS) are important elements in understanding the concept of computer programming and application development. This is because computer programs are designed to solve a problem by using the computer as a tool to solve the problem (Hassitt 2014). In this regard, the process of developing a program resulting in a computer application encompassing creative processes, identifying problems, designing solutions ideas and solving real-world problems (Dale & Weems 2010; DiPaola 2014). The final phase in computer programming is to test the resulting computer applications to be acceptable to the user (Milková 2015; Zhang et al. 2013). The whole process is also known as the process of building a programming algorithm that requires creative ideas throughout its implementation (Kobsiripat

2015). Hence, effective programming education should also improve the CPS skills among students.

Methodologies

The purpose of this study is to analyse the needs of computer programming education. The research design used in this study was a case study and the data collection was analysed using thematic analysis technique. A total of 30 participants take part in the study consisting of programming coach, teacher and lecturer.

Thematic Analysis

The thematic analysis is the qualitative data analysis technique to achieve the objectives of the study. The steps of implementing the thematic analysis as proposed by Guest et al. (2012) covers six things namely;

Step 1: Collect and familiarizing yourself with your data.

Step 2: Generate initial codes.

Step 3: Generate theme.

Step 4: Defining themes that have been generated

Step 5: Renaming and organizing theme

Step 6: Generate report by theme generated as research finding.

The six steps listed above are used to analyze the raw data obtained from the interviews conducted with the research participants.

Results and Discussion

The findings obtained based on the eight dimensions of the needs analysis are as follows;

Learning Content

The results found that object-oriented programming (OOP) are best suited for teaching and learning programming based on creative problem solving skills. This is because OOP do not burden students with long syntax writing, have libraries available and can continue to focus on teaching goals to improve students' CPS skills. In addition, the use of OOP is also easier and savvy as many OOP software are licensed as open source software. In fact, most participants also point out that OOP software has been developed with a variety of unique and interesting elements and can be downloaded for free. Examples of OOP programming are Ruby On Rails, Cakephp, CodeIgniter, Laravel and more.

As a result, interviews with research participants continued with scaffolding questions to further deepen how best to integrate CPS into programming education and further identify the advantages of technology in teaching and learning programming. In addition to OOP, findings find more themes as the most appropriate programming content OOP based on artificial intelligence (AI) environment that is available on the internet. Without having to write long syntax and make software installations, students can continue to learn programming through the available environment. Some suggestions on the available AI environment are provided by the research participants as in Table 2. To explore deeper into each of the proposed

environments, the researchers themselves have been testing by ensuring how CPS taught can be done as an element of integration into the programming education. The results of the observation and experience of the researcher are summarized as in Table 3 as a comparison between the types of programming environments that have the potential to be the content of programming education.

Table 2. OOP Environment that has been suggested by participants

Participants Code	OOP Environment
O1-R1	Ruby Warrior, Game Salad, Turtle, CodeMonkey
O1-R2	Ruby Warrior
O1-R3	Ruby Warrior
O1-R4	CodeMonkey, Ruby Warrior
O1-R5	Rails For Zombies
O1-R6	Rails For Zombies
O1-R7	Ruby Warrior
O1-R8	Ruby Warrior
O1-R9	Ruby Warrior
O1-R10	Ruby Warrior
O1-R11	CodeMonkey, Ruby Warrior
O1-R12	CodeMonkey
O1-R13	Rails For Zombies
O1-R14	Rails For Zombies
O1-R15	Rails For Zombies, CodeMonkey
O1-R16	Rails For Zombies, CodeMonkey
O1-R17	Rails For Zombies, CodeMonkey
O1-R18	Ruby Warrior, CodeMonkey
O1-R19	Ruby Warrior, CodeMonkey
O1-R20	Turtle
O1-R21	Stratch
O1-R22	Stratch, Ruby Warrior
O1-R23	Stratch, Ruby Warrior
O1-R24	Ruby Warrior
O1-R25	Ruby Warrior
O1-R26	Lego, Ruby Warrior
O1-R27	Lego, Stratch
O1-R28	Lego, Ruby Warrior
O1-R29	Lego, Ruby Warrior
O1-R30	Lego, Ruby Warrior

Table 3. The Type of OOP Environment

Learning Content	Licensing	Cost Needed	CPS Element	Frequency Suggestion by participants
Ruby Warrior	Open Source	No	Ada	19
Game Salad	Copyright © 2016 GameSalad, Inc.	Yes	Ada	1
Turtle	Open Source	No	Ada	2
CodeMonkey	Open Source	No	Ada	9
Stratch	Open Source	No	Ada	4
Rails For Zombies	Open Source	No	Ada	7
Lego	Open Source	No	Ada	5

The findings have succeeded in determining the most suitable learning content for the programming education namely Ruby Warrior, CodeMonkey and Rails For Zombies.

Learning Environment

Almost participants suggested that an appropriate learning environment for programming education was an original learning environment. The originality is meant to be the place of learning commonly used by students who are targeted and easy for them to attend even though the concept of online learning through GITHUB is also used. In addition, learning environments should also support the use of Bring Your Own Device (BYOD)'s conceptual modern concept of that is highly relevant to the culture of receiving and transmitting information nowadays as almost everybody can afford a smartphone other than personal computers.

Support Resources

As mentioned earlier, the use of the BYOD concept is the most appropriate platform to support a modern learning environment in the context of programming. Therefore, the proposed resource of support is a computer lab room that has fast internet facilities as well as suitable computers and devices. Additionally, students can also be connected to each other via telegram messaging software that can be accessed from various devices and it also included in BYOD concepts. Hence, the necessary support resources can be linked to the learning environment as well as the teaching content as illustrated in Figure 1.

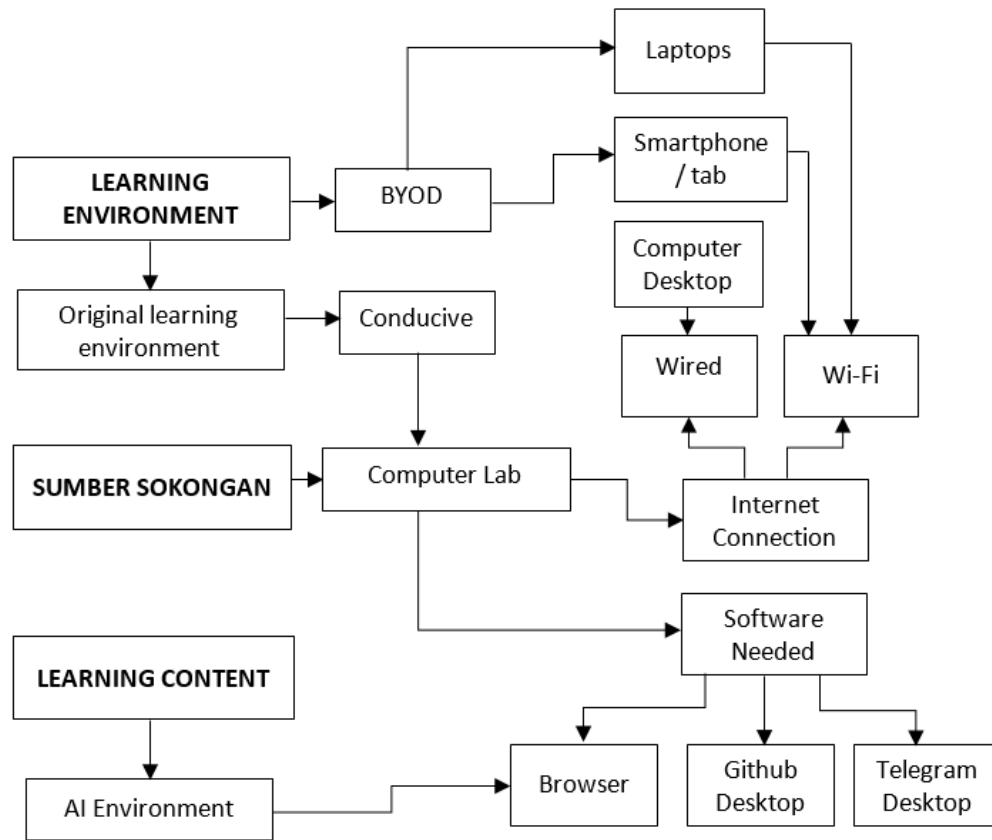


Figure 1. Support Resources Needs Analysis

Targeted Student

The needs analysis of targeted student found that the learning content should be used by all levels of society. This means the programming education must be flexible and can be used as a non-formal education. A suitable targeted students for a programming education is very important to ensure the suitability of the content and the teaching methods to be used. In fact, different student characters also influence how the lesson should be done (Dabbagh 2007). Furthermore, the difference in student backgrounds differentiates the student's need for teaching content and teaching methods (Elisha-Primo et al. 2010). Subsequently, the comments made by (Serafini et al. 2015) on requirements analysis studies conducted between 1984 and 2014 on English education found that determining populations and groups of students who really needed intervention in teaching were very important when conducting research aimed at improving teaching practices. Similarly, studies conducted at an educational institution in Taiwan when planning flip learning based learning (FL), the students' targets were first examined in terms of their readiness and knowledge of FL before the lesson plans were set up (Hao 2016). Therefore, an analysis of the needs of the students' targets is important to ensure that the programming education's goals are not missed from the context of the problem to be resolved.

Teaching Method

The findings show that the method of teaching based on gamification is best suited to the context of the computer programming education program as it saves time and it is also much easier when using visual support like AI environment. Additionally, gamification also allows students to focus on CPS skills as well as learn the concepts of syntax and algorithms. Furthermore, finding out the characteristics of teaching methods based on gamification are using OOP language, game-based, web and student experience. In fact, gamification also allows student-centred learning to occur and encourage the involvement of students in the learning process. By developing a learning assessment equivalent to teaching content, gamification is also said to be able to produce active learning among students. Examples of analyses on the proposals provided by the participants are as in Table4. While the results of the analysis are shown in Figure 2.

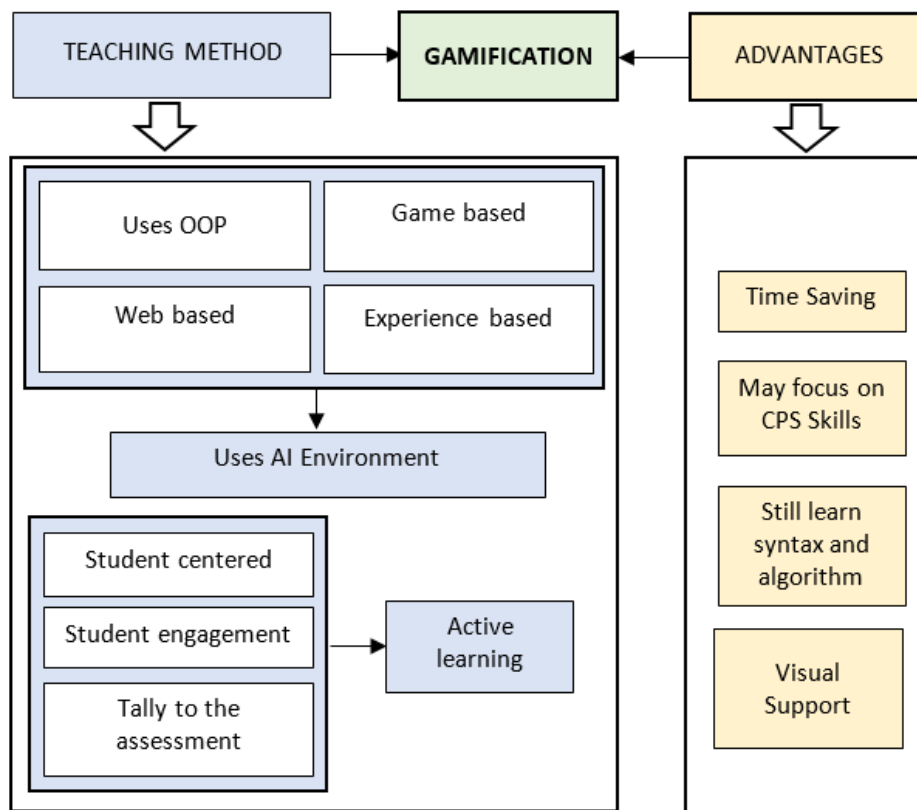


Figure 2. Teaching Method Need Analysis

Assessment

Need analysis research on the assessment method found that the formative assessment is most appropriate to identify the effect of learning programming among students. One of the characteristics of the formative assessment found through the analysis of this requirement is the assessment based on the criteria of student achievement in detail which illustrates the elements in learning domains namely cognitive, psychomotor and affective domains. Additionally, the benchmark for learning effectiveness also needs to be built through

instruments that are capable of measuring the various dimensions of effectiveness as set out in the research goal. However, the development of valuation instruments according to the dimensions of the assessment requires guidance such as assessment rubrics which also need to be created to match the learning content.

Instructor

Through the analysis conducted, the findings illustrate that the instructors of the program must master the full contents of the teaching together with the methods of teaching and technology used. In fact, the analysis found that programming instructors needed intensive training on programming education before they started teaching. This finding signals that more in-depth study needs to be done to explore issues related to programming teachers, especially the challenges that are often encountered.

Research Interest

The findings show that the participants support the programming education includes the assessment to determine the relationship between CPS skills and student achievement. In fact, the analysis of findings also addresses the problems faced by the industry, which is the lack of programming experts that should be met by the younger generation. Because of that, the computer programming education program is very important as a non-formal learning resource that can be used by schoolchildren, colleges and universities to improve CPS skills in programming. Additionally, the results of the findings also found that the development of the required learning assessment in this study was crucial to contributing to the development of knowledge in computer education, especially programming. This is a starting point to the suggestions and support provided by the research participants to the detailed formative learning assessment and has the appropriate benchmark for producing an expert in programming.

Conclusion

In conclusion, each dimension of the needs analysis research succeeds in obtaining specific themes to be used as the next study inputs that are the development of teaching and learning programming module. Nevertheless, the results of the analysis find that two essential elements still need further research and need to be done separately. The first requirement element requiring further and separate study is how to produce assessment rubrics that contain benchmarks equivalent to the expertise thinking of the programmer. Research that needs to be done is to explore the creative processes that occur in the programmers mind. The second requirement element is how the instructors develop coaching skills based on technology knowledge, pedagogy and teaching content as well as the issues and challenges faced.

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