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Research paper

Primary School Students' Experiences during Game Development Project Using Scratch

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Abstract

Scratch is one of the programming software that allows users to create their own interactive stories, games, and animation and sharing through online. This study aims to study students' experiences during their involvement in game development using Scratch. Research participants were 30 years six primary school students from one of the Chinese primary schools in Kuala Lumpur. This study employed a qualitative research design through which in-depth interviews were conducted to gain answers to how their participation in game development activity using Scratch helped them develop problem-solving skills. Data were analyzed using a thematic analysis. Based on the analysis, it was revealed that the activity of games development using Scratch has impacted how students solve their problems. It was also reported that students valued their games development activity as something that is fun but challenging. Participants also cited feeling more interested in learning about Scratch after this project. This paper also discusses the potential of computational thinking skills in enhancing students' ability in creating more creative and fruitful projects.

Keywords: Computational thinking; creativity; critical thinking; Scratch.

1. Introduction

The application of information technology in education is not something new. In line with a rapid progression in technology, classrooms nowadays are integrating various technologies with the purpose of enhancing students' learning, spur their motivation and also help to develop creativity and critical thinking skills [1], [2]. Using various programmes, students are also able to create their own products and at the same time, they were trained to solve the problem-based challenge and use their logical thinking and organizational skills [3]. Whereas Information Technology (IT) literacy is associated with individual's ability to apply current technology [4] in his or her fields and can be seen in the form of one's capability to independently learn and use new technology as it evolves [5]. Apart from that, this also includes the active use of algorithmic thinking (including programming) to solve problems. The most frequent approach to teaching digital literacy has been to gradually encourage the learning of programming, and code-literacy [6], [7], [8].

One of the programming software is Scratch, that enables users to create their own interactive stories, games, and animation and share them through online [9]. Scratch programming is one type of free visual programming learning platform which is easy access for every children or adult around the world without any coding programming knowledge even in online or offline condition [9]. In addition, Scratch had been used formally and informally for many educators K-12 who apply in teaching and learning process for the purpose of helping students to develop the habits of mind described as computational thinking (CT) such as systematic problem solving, iterative design, and abstracting from patterns [10]. According to [11], "computational thinking involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science" (p. 33). Computational Thinking is the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent. A recent study had been revealed by the [5] there have significant challenges to adopting programs originally used in informal contexts to formal schooling on a broader scale.

There is research been done previously on the effect of programming software on students' critical thinking for example on Scratch [12], [13]. There is also past research that focused on other software like Star Logo [14], and Alice [15]. These games are considered among the newest digital pedagogy methodology that can increase students' motivation in learning programming and allow them to develop their critical thinking [16]. However, their real experiences related to their involvement and game developers is seldom documented. This study, therefore, aims to seek understanding of students' experiences during their involvement in game development using Scratch.

2. Methodology

Research informants were 30 years six primary schools students who are enrolled in a Scratch class conducted by one of a Chinese school in Kuala Lumpur, as an initiative to introduce computational thinking among the students. The overall duration of the study took up around six months that involved two phases of implementation. In the first phase, students worked in pairs and decided on the concept, content and the title of the game that they will be developing. During this phase too, they developed a storyboard. In the second phase, students started using Scratch in the computer lab and developed their games in a pair. The overall

project took up about three months to be completed. Once they completed the development, students were then asked to present their products for evaluation by their peers as well as by the Information Technology and Communication teacher. An example of their game product is shown in Figure 1.

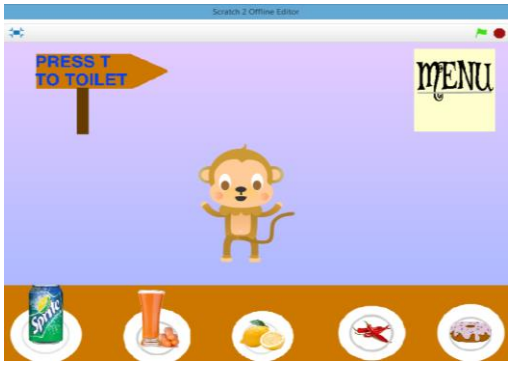

Fig 1. An example of students' game developed using Scratch

This study employed a qualitative research design through which in-depth interviews were conducted to gain answers to how their participation in game development activity using Scratch helped them develop problem-solving skills. The data were analyzed using thematic analysis [17], which allows for careful analysis in finding coherent and distinctive themes. As stated by [18], the goal of coding is to come up with a set of categories that provide a reasonable reconstruction of the data that have been collected. Among the questions asked during the interviews are:

1. How do you feel about the overall project?
2. What kind of difficulties were you facing?
3. How did you solve the problem? What are the sources that helped you to accomplish the task?

3. Results and Discussion

As shown in Table 1, participants were 30 years six students (18 female and 12 male). In terms of their experience in using computers, all of them had more than 10 years behind them (Table 2). From these 30 students, 25 of them had previous experience in playing online games while the rest stated to have a minimal experience.

Table 1. Respondents' gender

Gender	n	%
Male	12	40%
Female	18	60%

Table 2. Respondents' experience with online games

Online games experience	n	%
With experience	25	83.33%
Less experience	5	16.67%

In this study, we wanted to explore how participation in game development activity using Scratch helped to cultivate primary schools' problem-solving skills. Throughout the project, the student worked in pairs and together in a team, they had to think of the game concept, prepared their storyboard, and finally developed their games using Scratch. During the interviews, students were asked several questions so as to gain insights on how the activities helped them to solve problems that occurred throughout the six months project.

Students' feeling about the project

Students revealed varying feelings about this project. Some of them cited feeling excited with the game development activity. Undeniably, their success to complete the game development was something that they were so proud of. This perhaps related to has been highlighted by [19] and [20] who posits that involvement in such activity is closely related to their emotions, curiosity, confusion, and joyfulness [21] when they finally completed the tasks. Example:

> *I am happy to have completed this project. It is something that I am proud of. I think my partner, Gary was so helpful that we finally managed to make it work. I hope that others will like to play our game - My Pet: Monkey's Food! (Chua)*

> *This is my best achievement! (Yong)*

There are also students who found it to be difficult to accomplish.

> *It is undeniable that initially, we were so worried that we wouldn't be able to complete the project. It looked so hard to achieve. My friend and I had a hard time learning to write the correct algorithm (Mellisa)*

However, despite some of them faced the difficulty in completing the task, the whole experience has developed their interest in gaming [22]. Examples of students' answers are as follow:

> *Having this kind of project really spurred my interest in gaming. Although I was a bit blur at first Miss J (teacher) helped me a lot. (Maria)*

> *This project made me fall in love more on Scratch! We can explore a lot of other things, besides what has been taught by our teacher. (Elaine)*

Apart from that, it was detected that the experience also helped them cultivate their cooperative skills although some of them were facing differing thoughts and ideas from their teammate:

> *This is my first time learning about Scratch. It is an interesting programming software. This project also teaches me about to be cooperative and easy to receive different views. (Joshua)*

Difficulties faced during the project

Apart from that, students also shared the challenges they were faced with during the whole project. Some of the students narrated how they face the challenges during the initial phase of their project, particularly in finding the best idea of the concept of the game they wanted to develop. Examples:

> *The toughest part is actually during the initial phase. We had to brainstorm and think aloud of what kind of game we wanted to develop. It was the hardest time ever. (Jimmy)*

Some of them had a quarrel with their friend because of disagreement and changes in their plan:

> *I think, the thing that I dislike the most about this project was the time where we kept changing our game. We ended up quarreling. There were many times we had to re-write the algorithm. It was tough. (Anne)*

To some of them the challenges were too difficult that they felt like quitting:

> *This project is fun but can be demotivating too. I almost gave up when our programming didn't work. We created a 'Maze' game. (Joshua)*

However, their involvement in the project was also seen as a memorable moment for the students although there are times where it really challenged their patience and determination. Despite those nightmares, they admitted that at the end, they had a different feeling. The games they developed was their pride:

> *Yes, we admitted that there were times where we couldn't reach an agreement. I remember that we didn't talk to each other (laughed) because nobody wanted to listen to each other. Anyway, I am so proud that we made it through. (Anne)*

What made the project more meaningful to the students was the fact that they were developing educational games, through which positive messages were conveyed, as can be seen from one of the examples:

> *Although we created a game, it has a message for education. That's what our teacher said. For example, our game teaches us about healthy food selection. I will remember this moment. (Hannah)*

Students' sources for problem-solving

Apart from asking the students about their feeling and hurdles they faced during the project, we also seek the understanding of how they solved their problems. Based on the analysis, we conclude a few main sources that helped them to solve their problems; (a) Internet, (b) Friends, (c) Family, and (d) teacher.

Referring to the internet, many students reported having better ideas to develop their games. The internet sources did not only give them new ideas but also helped them to write the algorithm correctly. In this case, YouTube was mentioned as a vital source for them to learn and do their exercises in writing algorithm. Examples of the answers are as follow:

> *The most important resource that my friend and I referred to as the Internet. We surfed the Internet to look for ideas about the game we wanted to develop. (Hannah)*

> *YouTube! I watched YouTube to learn the algorithm. There are also lots of games that I can play and from there I developed my idea. Of course, our teacher helped us to make it work. (Jimmy)*

The project was done in the pair. Therefore, we received many answers from the students indicated the significance of their friends' roles in making their project a success. Some of them express their gratitude to their friends without hesitation, for example:
This is a tough work. But luckily we worked in pairs. My partner Gerard is wonderful. I think because we were in the same group, we managed to do it together. (Joshua)

Undeniably, family members are the significant others who contributed to the success of their projects. Some of the students cited to the thankful for their family members who gave constructive feedback and suggestions. Example:

> *Our group's game is on environmental awareness. My friend and I read a lot of magazines and educational books to gain ideas to develop our game. My dad suggested to include a helicopter in the game. It turned out well. (Maria)*

> *We developed a PCman game. It was inspired by Pacman game my sister used to play a long time ago. (Rudy)*

Without a teacher, the project can be meaningless. From the answers, students also mentioned how their teacher played a role in motivating the students although the project was run over a long duration. Examples of their answers are:

> *I love to explore things on my own. In Scratch, I managed to change all the zombies into thundershocks and change its color to white. I am so happy that my creativity was acknowledged by my teacher and fellow friends. They love to play our games. I think Scratch really give a space for us to be more creative. Thanks to my teacher! (Joshua)*

> *There is no other way to solve the problem other than giving it a try. As for our team, we had 6 trials before the program works. We have to think logically and play around the algorithm. Although we failed a few times, the failure made we even better. Thanks, Miss J for having a trust in us. We are glad that our product also won the First Prize and was selected to represent our school in games competition. (Jimmy)*

From the overall findings, students showed varying feelings about their participation in the project. However, most of them indicated positive feelings.

4. Conclusion

This study seeks understanding of students' experiences during their participation in game development project using Scratch. Based on the results, although it is not undeniable that some of the students were faced with challenges such as the difficulties to write proper algorithm and disagreement among team members, the findings also revealed that the project was considered something that they appreciated. It was not only fun, engaging, educating but also helping them cultivate the values the cooperative value. This is in line with what other research such as on [12] and [13]. An interesting finding is seen from their answers related to the sources they referred to while working on the whole project. Students in this study were given a freedom and empowerment to finish their tasks, while the teacher in charge didn't interfere much in their decisions and creativity. Rather, the teacher was just playing a role as a facilitator to the students and only stepped in whenever needed. Overall, students were taking advantage of the different sources surrounding them; Internet, families, friends, and teacher. These findings demonstrated that, via such project, younger students like primary school students, just like university students, can cultivate their independence and create their own learning [15]. Thus, the evidence from this study suggests that projects like game development using programming software can be expanded to a larger group of students in primary schools so as to develop their creativity and self-satisfaction [22].

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