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Usability, User Experience, Learning Motivation, and Learning Rate Characteristic of Learning Programming Using Game Making on Users with Different Computer Experience

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Abstract
Encouraging young children is an important activity for Sriwijaya University. One way to do this is by training aimed at increasing young children knowledge, skills and awareness. The activities in this training involved students and teachers from the Seventh day Adventist Junior High School in Palembang. The students were given the skills of basic programming in game making using Construct 2. This training will evaluate the usability, user experience, learning motivation and learning rate of Construct 2 to introduce programing to different users with different level of computer experience. The advantage of Construct 2 compared to other game engines lies in its simplicity, easy to understand and adheres to the concept of drag-and-drop so that it is easier and more interesting to be used by junior high school students and teachers who have no programing experience. The study involved introducing the programming and computer game making to junior high school students and teachers so as to create the mindset that making software is not as difficult as imagined. The goal of this study was to observe and compare the usability, user experience, learning motivation and learning rate of Construct 2 as a tool to learn programming by the students and teachers of Seventh day Adventist Junior High School in Palembang. Informatics students with at least 3 years of programming experience will be used as a benchmark to compare the experience to students and teachers. This study shows different levels of score of usability, user experience, learning motivation and learning rate for different type of users with the lowest score belonging to informatics students.

Keywords*: game making, Construct 2, programming, learning rate, usability, user experience, learning motivation, learning rate*

Introduction

One of the main problem faced by the Indonesian government is the quality of its human resources. As a growing country in South East Asia, Indonesia needs a high quality human resources to compete in the global market. To be able to produce high quality human resources, the first step is to have great education. Through education, humans can actualize themselves so that they are not only able to cope with the development of the times but also carry out reforms within. Thus education has a very important meaning in the discussion and overall development of society [1].

One field of study that keeps growing is the field of technology and information where almost everything can be done using computer or smart phones. And one of growing industry of computer and smart phones is computer games. A lot of people use computer and smart phones to play games, but most of them have little or no idea on how to make these games. On contrast, in this day of age there are a lot of tools and programs that make it is easier to build this games. The computer games could be sold at the online market with almost no cost using Steam or google play store.

But to be able to create and sell games one area that needs to conquer is the field of programming. Programming may look challenging nevertheless it is important and using tools to create game it will attract children at an early age to learn programming [2]. In order to be able to do this the usability, user experience, learning motivation and learning rate characteristic of the program used to build games must be observed to determine factors that will affect the learning experience.

Programming is a technique used for construction in the world of computing. When children learn to program, it expands the range of what they can design, create with computers. In addition, this gives them an experience in using and manipulating formal systems-experiences that can be important in many other domains from such as mathematics, grammar to law [3].

One popular tools that can be used to teach programming and create game is Construct 2. Construct 2 is a game engine that is used to build HTML5-based games/applications on several platforms. By using Scirra Construct 2, the game that had been created could be used in platforms such as Web Browsers, Android, Windows, Mac OS, and Linux[4]. Construct 2 is a software that could be used free of charge, in contrast to some similar software such as Adobe Flash which has a 30 day trial

option, but once the trial period is over we have to buy the license [5].
By introducing programming and game making to junior high students using Construct 2, it was expected these junior high students would gain knowledge of basic programming and grow their interest in learning programming that will increase their skills and increased the quality human resources[6]. As a comparison the same material used in this training will be given to the junior high teachers to evaluate their experience compared to the students. As a benchmark informatics student will be used to assess their experience as user with programming experience.

Training Game Making Using Construct 2

The training is held at Computer Science Department in Sriwijaya University. The first step in this training is to introduce the basic of computer and logic. The junior high school student (JHSS) were introduce to the program and how programming works. The students then introduce to a computer game which was called "Rabbids Coding!" (Figure 1). This game was a perfect example on how to program an object to reach a goal. By using this game, the students were introduced to the world of programming in an interesting way.
The next step is to introduce the basic function of Construct 2 to create a game. To do this the first step is to explain to main interface of Construct 2 and the functions that Construct 2 has to offer. The second step is to guide them in creating parts of a game and running it which explained to them on what they have created and happens for each instruction when the game was executed. The last step was to let them play and enjoy the game that has been created to encourage them to increase their self-confidence.

Figure 1 Rabbids Codding! Running an instruction to reach a goal

During this training 3-4 JHSS was assisted by 1 computer science student (CSS) from the department of Informatics Faculty of Computer Science Sriwijaya University. While this was happening, each CSS assisted and collected the information on how the JHSS were able to learn to use Construct 2 to create games. Challenges and difficulty were noted for discussion on how well the JHSS performs. Besides the JHSS two of the teacher also attended and did the observation to see on how the JHSS learn the programming skills compared to other students.

Game Making Process in Construct 2

The first step was to ask the JHSS to create an Empty Project. The second step was to ask the JHSS to set the ID, Version, Description, Author, Orientation, Full screen in Browser. The third step to ask the JHSS to adjust the layout according to the desired size. Then, create a background by uploading the asset files to be used and then adjusting the layout. After the background has been determined, the JHSS were asked to enter the objects that would be used in the game such as: players, enemies, object obstacles and also decorative objects. The fourth step was to asked the JHSS to determine the nature of the object, player input and the output of the interaction between objects. The summary of this step was shown on Figure 2.

Figure 2 Main interface of Construct 2

Using Adobe PhoneGap to Create Smart Phone Game

One of the strength of Construct 2 is its easiness to transform the game that has been created in Construct 2 into an android smart phone game by using Adobe PhoneGap. Adobe PhoneGap is a website that allows the creation of android smart phone game by uploading the source code of the game that has been created in to the website and downloading an 'Apk' file which could be installed in to the android smart phone[7].
The process is relatively easy, the JHSS participants would be asked to press the export project in the file tab in the Contruct 2. Then choose Cordova, after that choose the destination folder of the game to be saved, then choose the platform on which the game will be released. Then press the export button. After the export is complete, the JHSS participants would edit it from the config.xml, then adjust the ID, Version, Description, Author, Orientation, Full screen in Browser according to what device the JHSS were using. After that, the game folder is compressed into the .zip format and is named 'UploadFIle.zip '. It is then uploaded the PhoneGap website, it aims to process the file

into the '.apk' format which downloaded and installed on a mobile device.

EVALUATON INSTRUMENTS

Usability and user experience (UX) are highly relevant and interlinked topics in Human computer experience(HCI) [8]. Learning motivation and learning rate is also important to gouge how effective the training of programming using game making. To evaluate this a questionnaire is created to analyses each factor. The factors included in this questionnaire are Usability, user experience, learning motivation. Learning rate will be evaluated by comparing how fast each games are created. To do this the Constuct2 will evaluated using characteristic proposed by Hassenzahl[9]

Figure 3 Program Characters Based On

Assenzahl Combination Of Pragmatic And Hedonic Attributes

Data collection were performed by asking the respondent to fill a questioner with several question (Table 1). Each question will be used to assess each factor of the Construct 2. There was 23 question issued to the students. 15 questions were used to determine the level of computer experience of the user. And the other 7 were used to determine usability user experience and learning motivation. Out of the 7 question the last question was split into 5 parts to evaluate the user experience of each part of the programs. One question was used to determine the living condition of the students. The teachers and informatics students were given a similar questionnaire by adding some other question for the teacher to get information based on their background and experience.

During training a visual observation will be used to evaluate the user experience in using Construct 2 to learn programming. This will be done by assessing each participants level of interaction with the program by each mentor.

Table 1. Questionnaire questions with its factors

No	Question	Factors
1	Have you ever created a computer game?	Computer experience
2	Do you live in a dormitory?	Living condition
3	Do you own a computer?	Computer experience
4	What computer program can you use?	Computer experience
5	How many hours in a week do you use computers?	Computer experience
6	Have you played any computer game?	Computer experience
7	When is the last time you played a computer game?	Computer experience
8	Do you own a smart phone?	Computer experience
9	Have you ever played a game on your smart phone?	Computer experience
10	When was the last time you played a game on your smart phone?	Computer experience
11	How many hours in a week do you play games on your smart phone?	Computer experience
12	How easy is it to use Constrct 2?	Usability
13	Have you ever played a flappy bird game?	Computer experience
14	have you ever created a flappy bird game?	Computer experience
15	How hard is it to learn to create the flappy bird game using Construct?	Usability
16	Have you ever played snake game?	Computer experience
17	Have you ever created snake game?	Computer experience

18	How hard is it to create the snake game?	Usability
19	Have you ever created an android game?	Computer experience
20	How hard is it to make a constuct game in to and android game?	Usability
21	Is this training important to you?	Learning motivation
22	Would you like to attend training to continue learning to make games in the Future?	Learning Motivation
23	Rate your experience in	
a	Construct Indroduction	User Experience
b	Creating flappy bird game	User Experience
c	Creating Snake game	User Experience
d	Creating android game from Construct 2	User Experience
e	Rabbids Coding	User Experience

RESULTS AND DISCUSSION

The training was held on October 20th 2019 with an attendance of 22 students and 2 teachers from Seventh day Adventist Junior High Palembang. Based on the survey none of the students or the teacher had ever build a computer game and only 7 of the students has a computer at home. All students have basic computer skill in Microsoft Office programs and spend around 1-2 hours a week on a computer mostly during computer lab. All of the student has played computer games but some of them have not played computer games in over a year. Out of 22 students, 16 own their own smartphone but all of the students has played games on a smartphone and in contrast of computer games they played it recently as earliest as an hour before the training has started.

The total attendees in this training 24 person, twenty two of them were junior high school student from 7th grade to 9th grade with 2 junior high school teachers. For the training there were 8 computer science students who assisted the training and 1 computer science lecturer who leads this training. With this every 3 students would be assisted by one mentor or a ratio of 3:1.

At the start of the training, 30 minutes was used to explain basic logic and computer. There were some problems occured because some of the JHSS were not fluent in most computer concept such as full screen, copy and paste, right click, etc. While showing the basic of logic using "Rabbids Coding!" most students were showing interest and enjoying answering the correct instruction to make an object to reach the goal. But after that most students had a hard time understanding instruction given to them to create a game. It took 4 hours to finish the first game. That game was based on the hit game flappy bird. It took another hour to instruct transform their game in to an android Apk using PhoneGap.

The next game took 2.5 hours to create. The second game that was created was based on the popular snake game. The second game took less time because the students had a better understanding on what needs to be done to create a game using Construct 2. Based on the survey all of the students have played flappy bird and snake. And on a score from 1-5 rank the difficulty of learning the basis of Construct 2 was 3.6 and the difficulty to create the game bird was 3.2 and the difficulty to create the snake game is 3.6. Even though most of the student feel that this training had a difficulty of above average every student except one said that they would like to attend a training that would continue the material in creating game in Construct 2 and every student feels that this training benefited them.

The teacher that attended the training also had difficulty understanding the instruction in using Construct 2 to create games but after the training said that they would be able to teach other student if they were given the instruction. They also agreed that they would attend another training to create more games in Construct 2. It also said in the survey that every student agree that this training would help them learn more and one of teacher express her concern that teaching game making in school might have a negative side in distracting the student's studies.

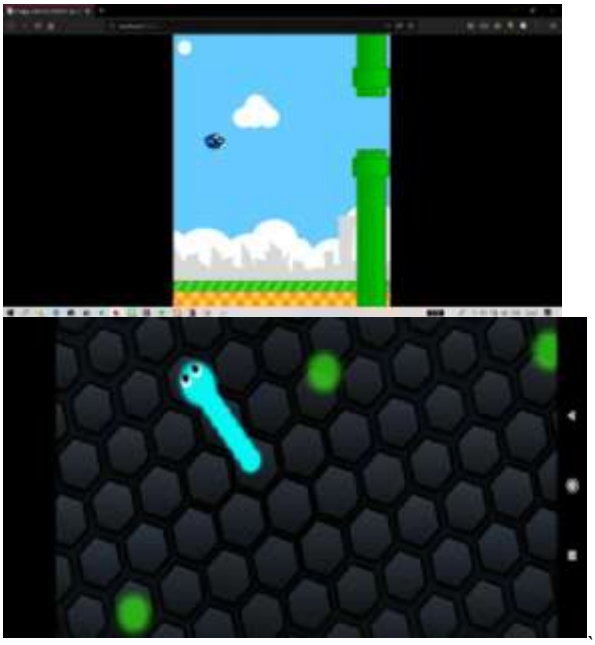

Figure 4 Game Bird and the left running on a computer browser and snake on the right running on a smart phone

The computer science students that assisted this training all said that it was difficult for them to pass the knowledge to the JHSS. Most of them express that the main problem was even though every JHSS knew how to use basic Microsoft Office program, most of the students did not understand simple computer terms that comes as second nature for the computer science students who assisted this training. Another problem that was encountered is the language barrier. Construct 2 like most other programming language is based on English and all its menu and function are done in English. This made it difficult to explain certain terms such as opening a picture.

Based on the observation of the JHSS in creating games using Construct 2 took a significant effort on their part. Even though the JHSS were able to Construct 2 games it was difficult to conclude that they would be able to create a third game without direct guidance. This was shown while making the second game which was the game snake. Eventhough they were able to follow the instruction faster than the first game, most of the JHSS still did not know what the instruction does for their game. A good example was collision detection, the students were able to create the function for when an object collide with another object it would detect the collision and make them lose the game. But when ask if they understand what they were doing most answered no and said they were only following the instruction. This gives an indication that while the JHSS could follow the instruction to create a game, but creating a new game without instruction using Construct 2 would be very difficult.

Another challenge that was faced and learned from this study was the rate of learning from the attendee. Each CSS who assisted in this training could create a Construct 2 game in 10 to 15 minutes each and it was assume that it would take 3 to 4 times as long for the JHSS to complete one game of around 1 hour for each game. The total time for the first game took 4 hours to complete and the second game took 2.5 hours. This data showed that the rate of learning was slower than expected. Out 5 games that were planned to be created only 2 were created. But this data also showed that the students learning rate improve greatly from taking 4 hours for the first game to only taking 2.5 hours for the second game or 160% increase.

One factor that was recognized was the learning rate was not based on age but by prior knowledge of the computer. This was seen by comparing the two teacher who accompanied the students. The time for them to create the first game was similar to the JHSS and some time they asked their junior high students for help. From this we studied that even people with a bachelor degree would have a hard time learning game making and computer programming if they have no prior knowledge in this area. Based on this questionnaire given to the JHSS we can conclude that no students have ever created a computer game and all have played the game that were created and know the basics uses of computer and smartphone. The score for usability, user experience and learning motivation can be seen in table 2.

Table 2. Score of Usability, User Experience and Learning Motivation on a Scale of 1 -5 for Junior High Students

Factors	Score
Usability	1.93
User experience	3.59
Learning Motivation	4.89

The questionnaire given to the teachers so a different score this may be because the computer experience of the teachers. Both teachers own a computers and smart phone but in contrary to the junior high students they have not used their devices to play games on it for more than a year. They do use the computer more often than the junior high students. The score for usability, user experience and learning motivation can be seen in table 3.

Table 3. Score of Usability, User Experience and Learning Motivation on a Scale of 1 -5 for Junior High Teachers

Factors	Score
Usability	3.75
User experience	5.00
Learning Motivation	5.00

The questionnaire given to the informatics students showed data that was unexpected for students majoring in informatics. Only half have ever created a computer game and the hours spent on a computer a week average is 14. The questionnaire score of the informatics students is shown in table 4.

Table 4. Score of Usability, User Experience and Learning Motivation on a Scale of 1 -5 for informatics students

Factors	Score
Usability	2,1875
User experience	3,5
Learning Motivation	4,4375

Based on the score above construct 2 usability to be used as programming tools in game making is below average for users who have little or no programming background. But it has an above average score of user experience for junior high students and a high mark of 5 out 5 for junior high teachers. On the positive side the learning motivation of the users were high and that inform Construct 2 even though it is hard to use as a beginner it is interactive enough to motivate the users to learn more.

The "Rabbids Coding" program we use to introduce the concept of computer logic was received highly by the JHSS. They were also able to finish a few problems with almost the same time it took by the CSS who assisted the training. By looking at this it highly likely that if they were taught the basic of Construct 2 more in-depth rather than just showing instruction they will be able to create games on their own.

CONCLUSION

Introducing basic programming to JHSS using the Construct 2 was a challenging task especially if participants had little knowledge in computer. But it has a great advantage in introducing programming and computer logic that would help them to increase their skill. Eventhough most of student felt that the training is challenging, based on the post-test, most them would like to learn more. The teacher also expressesed their excitement in learning to program and said that the training had a great benefit in their student's skill. But they also expressed that there would be a negative side from this training which was the game making might disturb the study time of the students.

Rate of learning shown by the junior high student was a lot faster after the teaching tof the first game. But by comparing it to their teacher it could be assumed that the lenght of time needed to create the first game was not based on age but by prior knowledge of computer logic and skill in construct 2. The information that could be drawed by this study could be used by the lecturers who teach first semester computer science students who most likely have little or no prior knowledge of computer logic and programming.

Construct 2 is a tools that makes programming games easier. But without basic computer programming skills its usability is below average. In contrast with that the user experience is above average for students and high for teachers this may be one of the factors that makes it learning motivation high. Ask a benchmark the informatics students felt that the usability of construct is below average and user experience is lower than the junior high students and a learning motivation that is also lower than the students and teachers even though they can create games faster than the students and teachers. This unexpected outcome might be based that most informatics students makes their program on different type of user interface.

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