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Visual Learning on Mobile Phone for Introduction Basic Programming in Vocational High School

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Contents

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Visual Learning on Mobile Phone for Introduction Basic Programming in Vocational High School

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***Abstract*—This paper purpose how to design the games which are used to introduce basic programming concepts about the sequence, looping and branching statements. This game is used for students who do not have prior programming knowledge, so the gameplay model is drag n drop, the learning method introduced in this game is learn to programme by playing a game and using Android game mobile. This method is very suitable for beginners because it is easy and can cause interest to learn more advanced programming. Based on data analysis, the results of the Satisfaction and Learnability indicator reached 4,325 and 4,35. It means these games are having fun for learning.**

Keywords— basic programming, game mobile, learning.

I. INTRODUCTION

Nowadays, Mobile phone has invaded everyday life, not just for communication. Mobile phones have many uses to simplify one's life, one of the others is used in learning. But not many uses to support formal education in school. This condition is deplorable because many applications that can be utilized for learning. One of them is learning to programme.

Computer learning curriculum or known as Information and Communication Technology in Indonesia is still lagging behind overseas schools, where ICT curriculum is more concerned with how to operate computers and complete office work, whereas, in the era of industrial revolution 4.0, the demand for ICT has been to how to solve problems using a computer, one of them is programming or coding and computer science [1]. Not only programming learning is taught in schools abroad, but also robotic through their mobile phones [2], [3], [4].

Programming learning in vocational secondary schools majoring in Software Engineering Computer and Network Engineering in Bangkalan, Indonesia have difficulties in programming learning. This condition is caused most students do not have prior programming knowledge and still use standard learning methods (i.e., using existing book literature and text-based programming editors).

Programming is a fundamental part of the computer science curriculum. Computer specialists work a central role in our technological infrastructure. They develop hardware, software and other applications for many things, for example, military use, businesses, and average consumers. Computer science services technological innovation and encourages career growth, but waiting until graduate from college to learn the basics of Computer science could mean a missed opportunity. Information Technology expertise needs in the Revolutionary era 4 are now absolute, one of them is computer science.

Learning programming is an essential part of learning computer science by applying the new way of thinking. Because in the learning programming, will be learned problem-solving, logic, data, systems and thinking not only language programs [5],[6].

There are several methods in previous research that are used for programming learning. Using visual programming language environments like Scratch for understanding the fundamental programming concepts. It is more comfortable than Python as the text-based programming language [7]. Using active learning method, the students learn material course by doing problem-solving, through a step-by-step process, and always develop what they already know before. The steps in the active learning method are the trigger, learning activity, discussion and summary [8]. The advantage of learning programming through games and contests make users learn and keep progressing and making programming fun [9]. Visual teaching approach, by visualizing how the program code is executed (execution per line of code) and how the output generated after the code command is executed will facilitate understanding for students [10].

Based on the research educational visual programming concepts for primary school, the environments such as Alice, Scratch, Kodu, and Greenfoot can development of student's HOT(higher-order thinking). And then the result of the visual learning offers better results than traditional learning systems because the skills are increased significantly[11].

This research is purposed by introducing basic learning programming through the game mobile phone for vocational high school. Not a few students at the school are not familiar with programming; therefore mobile game applications are made for the learning method is more enjoyable so that it can generate interest in more programming learning. And this game design is created to support visual learning.

On the Basic Programming book, the materials for 10th-grade Vocational High School for semester one are as follows: basics of algorithms, branching algorithm and looping algorithm[12]. Therefore the learning material implemented in this game are sequence material, looping, and branching.

II. LEARNING PROGRAMMING THROUGH MOBILE PHONE

Last years usage of mobile phones has rapidly grown and become essential to our daily life, especially young students. Regularly, they use their mobile phones as smart communication devices and playing mobile games. Regarding mobile phones are mobile devices, they can be used by students in anytime anywhere. It means they also

provide new opportunities for teaching and learning to programme in education.

Today, the teaching methods almost follow trend existing technology to initiate teaching more effective and providing the students extended opportunity for their later careers with the adaptable technology. Another technology shift: instead of using PCs and laptops, mobile devices such as smartphones available and selected so broadly is becoming more accepted for most everyday computing tasks [13].

The mobile phone has become a media for learning tool with great potential in both classrooms and outdoor learning. Because using mobile technology for teaching and learning purposes will be more effective and efficient. Mobile technology gives the benefit for the students to access content and communicate with instructors and classmates from any location [14].

The teaching of programming can be done directly on students mobile devices, without need PC or laptop for writing code. Programming on mobile devices makes students can show their project to their friends at all times, and it means that the students can do their homework or additional practicing at all times and anywhere.

Learning programming on their mobile devices, with access to personal content (pictures, videos, songs, and sensors such as location and accelerometer) presents a new technique of teaching programming will create a uniquely engaging and fun learning experience for students[13].

III. GAME BASED LEARNING FOR LEARNING PROGRAMMING

Many students find difficulties while learning a program. Therefore an interesting teaching method is needed so that students become motivated to learn, one of them is the game based learning method. There are 3 Game-Based approaches in learning programming, those are Learning programming through playing games, through game development, and by the development of games [15]. Learning programming through playing games is straightforward for students who are just starting to learn to a programme (not know the previous programming before). Because the content of the game being played is the basic introduction to programming.

Using Serious Games to Learn a Programming Language is one of the Game-Based Learning methods. Using this game, students can activate their interest since to be a good player. Students learn how to make strategies to solve a problem with accomplishing a task, and this is what is needed to make a program: good strategy translated into working instructions. Gameplay techniques for beginner learners to learn programming are drag & drop and Point & click [16]. Drag & Drop game elements (code and place them correctly) and then generate a result. Point & click is a gameplay technique based on interactions with elements of the game's environment.

IV. METHOD

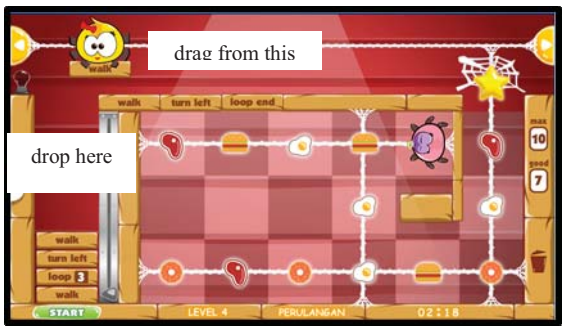
Games are synonymous with entertainment, while learning is synonymous with serious work. Therefore this visual learning media is designed as a serious game, which combines elements of entertainment and pedagogy, namely this media serves to teach the material.

The serious games are designed for learning a basic introduction programming for first-class students in vocational high schools, where they do not have prior programming knowledge (beginners). And they hope they can learn independently not only in the classroom. Therefore the designed game design are:

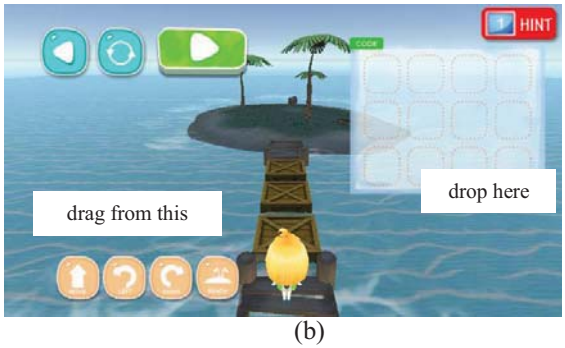
- Drag n drop
- Mobile learning by smartphone
- Systematic approach
- Support material learning
- Active learning through solve a problem with accomplish a task
- Support independent learning by hint
- Learn to programming by playing game

A. Drag n drop

These games are designed in 2 forms, 2D maze, and 3D adventure. 2d maze who adopted code.org, the purpose of this game is that the spider mother wants to help her child to walk to the spider's nest. And the adventure 3d that adopts the island box game, the purpose of this game is a girl who will head to the opposite island. The player is asked to solve each problem and the solution to the problem is helping the main actors in these games (spider children and girls) to reach the goal by arranging programming blocks with drag n drop. Visualization how to drag n drop in those games can be seen in Fig. 1.



(a)



(b)

Fig. 1. Drag n drop gameplay technique at 2D Maze game (a) and 3D Adventure game (b).

B. Mobile Learning by smartphone

Not all students have a PC or laptop, but almost all students have Android-based smartphones. Therefore both of

these games use the Android mobile games platform. Hope that students can study anywhere and anytime.

C. *Systematic approach*

The purpose of these games is a learning approach to promote logical thinking. Logical thinking is one of the most critical aspects of software engineering, and this is where some people struggle. With these games, the students are actively encouraged to come up with solutions to each problem. Several commands are used in both games are walk command, turn right, turn left, loop and if then. Building good programming is one of the goals of these games. Although students can solve problems in those games, there are differences in rewards given if the blocks are arranged more efficiently. This is in accordance with the programming concept systematic approach. If the student can solve the problem with the proper program block arrangement, the student will get a reward.

Not only can solve the problem but an efficient program block is also taken into those games as seen in Fig. 2.

(a)

(b)

Fig. 2. Good block at 2D Maze game (a) and best algorithm at 3D Adventure game (b).

D. *Support material learning*

The basic concepts of programming introduced in these two mobile games are a sequence, looping, and branching statement. With its main features are learning and games.

The Learning Feature is the concept of material learning that will be introduced in these games. This feature is divided into two parts, which are static material slides and game animations to show how to solve problems. Fig. 3. for 2D Maze and Fig. 4. for the 3D Adventure game.

E. *Active learning through solve a problem with accomplish a task*

The steps completing the game are students are invited first to prepare whatever blocks are needed to complete the challenges in the games, arrange the blocks that have been developed to help game actors to solve problems and then compile them for running program.

The more three stages the player goes through, they are sequence material, looping, and branching. Each stage is focused on teaching one programming skill. The following pictures are design stages each of game. Fig. 5. for the game feature at 2D Maze and Fig. 4. for the game feature at 3D Adventure game.

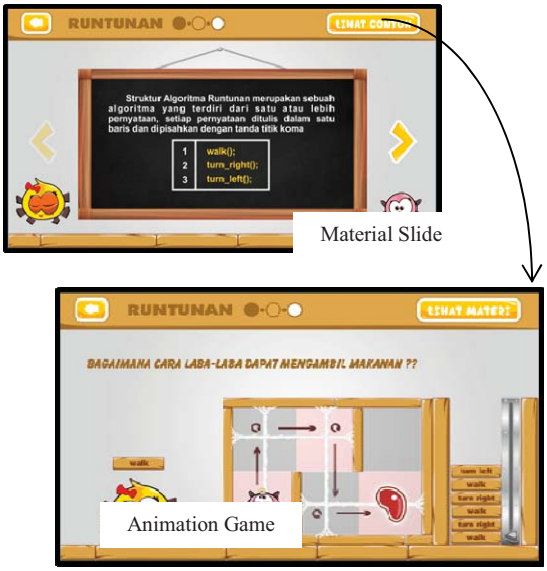


Fig. 3. Learning feature at 2D Maze game.

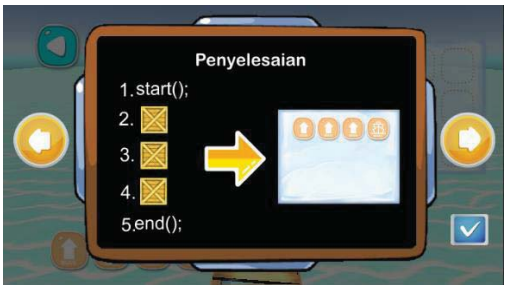
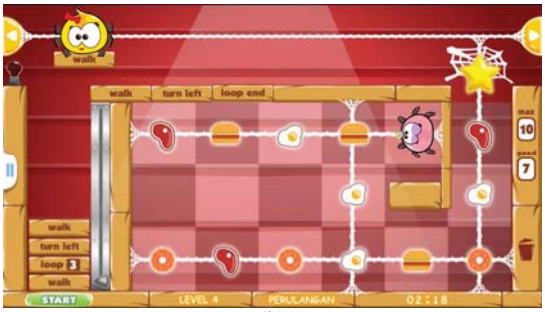


Fig. 4. Learning feature at 3D Adventure game.

(a)



(b)

(c)

Fig. 5. Game feature at 2D Maze game consists of a sequence (a), looping (b), and branching (c).

(a)

(b)

(c)

Fig. 6. Game feature at 2D Maze game consists of a sequence (a), looping (b), and branching (c).

F. Support independent learning by hint

If the students find difficulties to solve the problem, those games are equipped with a hint that is used for more helping until they get more familiar with the concept of program logic. Design hint for both these games can be seen in Fig. 7.

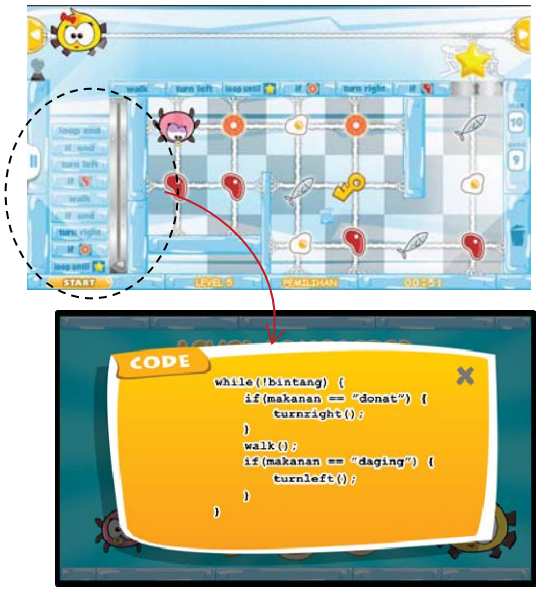
(a)

(b)

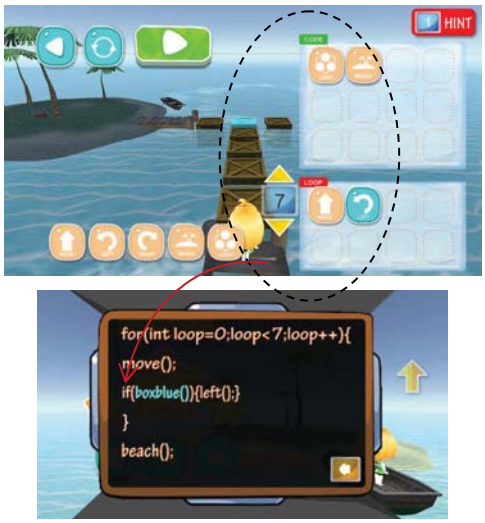
Fig. 7. Design hint for helping the user to complete the task at the 2D Maze game (a) and 3D Adventure game (b).

G. Learn to programming by playing game

While the game features as a practice for the student to the skills of the logic program then after they complete the task and the goal of the game is reached. Those mobile games also display the code layout to introduce pseudocode of programming languages according to the programming blocks arranged. The code layout for both these games is seen in Fig. 8.



(a)



(b)

Fig. 8. The code layout at 2D Maze game (a) and 3D Adventure game (b).

V. RESULT AND DISCUSSION

The prototype trial evaluation of those games was taken from the first class in a vocational high school majoring in Computer Engineering and Network Engineering Software in Bangkalan, Indonesia, as many as 20 students for each game. Then, they were asked to complete the questionnaires. Since the 5 points Likert scale, suggested these response classifications:

- If the response is 1, it is classified as highly low
- If the response is 2, it is classified as low
- If the response is 3, it is classified as moderate
- If the response is 4, it is classified as high
- If the response is 5, it is classified as highly high

The results are shown in Table 1. Taking indicator to analyze User Experience both those games are based on educational playability[17]. These indicators are :

- Satisfaction: expectation in gaining the pleasure of playing the game.
- Learnability: the ability of the player to understand the content of the game (learning programming).
- Effectiveness: the objective of the game is achieved.
- Immersion: To engage the player with the game world.
- Motivation: the excitement for the players to finish playing the game until the last level.
- Emotion: involvement the player's feeling towards the game while they are playing, the positive feeling will motivate players to continue to play the game.

TABLE I. SUBJECTIVE EVALUATION BASED ON EDUCATIONAL PLAYABILITY.

Indicator	Question	Score		Average	Mean
		2D Maze game	3D Adventure game		
Satisfaction	Did you have fun playing the game?	4,6	4/05	4.325	high
Learnability	Do you think the game has merit in enhancing users' learning of programming?	4.5	4.2	4.35	high
Effectiveness	Did you finished the game until to the end	4.35	4.25	4.3	high
Immersion	Did you exciting with the world (enviroment) of game	4.41	4.01	4.21	high
Motivation	Were you motivated to finish this game to the end	4.2	4.1	4.15	high
Emotion	Were you happy while playing the game?	4.4	4.15	4.275	high
Average				4.27	high

The higher the value from those indicators is Satisfaction (4,325) it means students are having fun playing this game. And the next high score is Learnability (4,35) it means while students are playing those game the learning content is highly informative, understandable, easy to learn and in accordance with learning material. Because this indicator is important for learning objective is learning to programme. The playability of the game is counted as the average of total average all indicators of the responses gained for the six indicators. The average playability of those games is 4.27. It means those games can not only be used as entertainment media but also as learning media, namely by showing the learnability indicator.

Overall those games were well received, and the majority of the students believed they had fun playing it, the feedback was useful, the controls were easy to use and that the game has merit in enhancing students programming knowledge. We received very positive comments, for example, *It is exciting, fun, can be made to learn, This is nice and interesting game because it is quite fun and beneficial for learning, This game is nice and fun for students who are lazy to learn, This game is suitable for learning media.* Some recommendations were also made for further improvement.

The purpose of making this game is to introduce students to the concept of basic programming logic and to enhance motivation in learning programming. So that the assessment for improving learning outcomes on students' ability in programming material was not included in this research. Through this media, the students get new experiences in learning programming with more fun. And there is an independent learning process about the basic concepts of programming logic that can improve students' knowledge.

VI. CONCLUSSION

In this paper, we have purposed design the games for introduction basic programming for the students that no have knowledge programming before. We argued that mobile game-based learning needs an effective integration of both pedagogy and entertainment which offers excellent opportunities for strengthening motivation among students and helping them to learn programming easier and more fun.

In the emerging field of design mobile game-based learning, this paper using Learning to program by playing games approaches. Based on data analysis, the results of the Satisfaction and Learnability indicator reached 4,325 and 4,35. It means those games are having fun to play for students in a vocational high school majoring in Computer Engineering, and Network Engineering Software in Bangkalan, Indonesia and those games can help students to introduce basic programming concept for the sequence, looping, and branching.

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