Learning Batik through Gaming

1st Hestiasari Rante
Department of Creative Multimedia Technology
Politeknik Elektronika Negeri Surabaya
Surabaya, Indonesia
hestiasari@pens.ac.id

2nd Mohamad Safrodin
Department of Creative Multimedia Technology
Politeknik Elektronika Negeri Surabaya
Surabaya, Indonesia
safrodin@pens.ac.id

***Abstract*—Making batik is not easy and takes a long time. Until today, batik artisans are still dominated by the elderly, and very few young people are interested and eager to be involved in this industry. There is an urgent need to transfer batik skills to the younger generation to ensure its sustainability. The young generation, especially the children, whom today are never leaving the technology in their daily lives, will be more interested and more easily understand the process of making batik when using game technology as learning medium, such as game-based learning. This paper presents the development of game-based learning that addresses the fundamental issues on how to translate or transfer physically and batik processing into a digital space that children may consider as meaningful visualisation and interaction. The game was developed using Flash platform, showing several tasks that represent every step of the process of making batik. Through the game, the knowledge and skills transfer of making batik can be continued to the young generation.**

Keywords—batik, children, game-based learning, learning

I. INTRODUCTION

Batik Tulis, mostly just called as batik, is a patterned fabric that is traditionally made in Indonesia using a manual wax-resist dyeing technique [1, 2]. Batik has been known widely as one of the Indonesian culture heritages. Rante et al. [3] stated that there is no exact time to mention how long it needs to produce a piece of batik. For sure, it takes quite a long time; sometimes it needs three months, six months, or even one year; it depends on the patterns, colours, and length-width of the fabric. Generally, the process for multi-colouring batik has 12 steps. 1) *Nyungging* – Using a pencil to sketch and draw the pattern on a paper. 2) *Njaplak* – Moving the drawn pattern from paper to fabric. 3) *Nglowong* – Waxing pattern on fabric using *canting* filled with hot wax. 4) *Ngiseni* – Drawing *isen-isen* (fills) to the main pattern. 5) *Nyolet* – Colouring some parts of the pattern using a paintbrush. 6) *Mopok* – Covering parts that have been coloured with wax using a paintbrush. 7) *Ngelir* – Colouring the whole fabric by putting the fabric into coloured water. 8) *Nglorod* – Removing wax by dipping fabric into the boiling water. 9) *Ngrentasi* – Drawing dots to *klowongan* patterns. 10) *Nyumi'i* – Covering some parts with the wax. 11) *Nyoga* – Dipping fabric into brown or *sogan* coloured water. 12) *Nglorod* – Removing wax (once again) by dipping fabric into boiling water.

Furthermore, Rante et al. explained that the steps of processing batik must be carried out very carefully and need high endurance. During the process, some constraints may happen and it adds more time to finish. This phenomenon leads to the fact that young people and also children are not that enthusiastic about learning the process of making batik using the traditional technique, regardless they love to wear batik [3].

The role of technology in creative processes is continuously changing, given the technological advancements of recent years [4]. So does on the cultural heritage learning, the rapid growth of the technology has given a significant impact. Children as the young generation need to learn the culture through methods that appropriate to their affection. It is no doubt that technology has a powerful influence in enhancing children's learning on culture [3].

Batik needs to be introduced to children in a different platform. As we have known, playing computer games is a viral leisure activity for children now in the digital era. It is universally known that children will be delightedly devoting the considerable amounts of their time to play games. Based on the popularity and strong motivational effect of computer games among children, the process of making batik considered to be developed as a game that can be used in educational settings [5, 6].

This paper will describe the latest development of the game that is designed to support delivering the knowledge and skills of making batik to children. The game was developed with ActionScript3 in Flash platform. There is no intention of this game to replace the learning process that can be gained through batik workshop conducted by local institutions—including batik museums, but it is to support and enhance the learning process in the real procedure.

II. WHAT IS GAME-BASED LEARNING?

In 2004, Salen and E. Zimmerman defined "a game as a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" [7]. Then Plass et al. argued that "games are a complex genre of learning environments that cannot be understood by taking only one perspective of learning" [8]. They explained, furthermore, that there are many of the critical concepts in the context of games that need to be considered as learning perspective, such as motivation, have aspects relating to different theoretical foundations—cognitive, affective, motivational, and sociocultural. In order to achieve the potential for learning through games, all these perspectives have to be taken into account, with specific emphases depending upon the intention and design of the learning game.

Meanwhile, definitions of game-based learning mostly emphasise that it is a type of gameplay with defined learning outcomes [9]. Usually, it is assumed that the game-based learning is a digital game, but this is not always the case. Kelle et al. [10] stated that for making digital games that work for learning purposes, it is necessary to combine both aspects of gaming and learning and the standards relevant to them. As a result of this concept, it can be concluding that the development process of games designed for learning must involve the balancing of the needs to cover the desired subject matter to prioritise gameplay [11]. This shows the points of

978-1-5386-8079-7/18/$31.00 ©2018 IEEE

the characteristic of game-based learning that involves the utilisation of game elements, such as incentive systems that used to motivate the users to be engaged in a task that they probably find not attractive [8].

In practice, most of the game designers use behaviourist elements, cognitivist elements, and constructivist elements, and often various combinations of them as well, in the design of game-based learning. Instead of a comprehensive theory of learning, Plass et al. [8] therefore considered a simple model that describes the basic structure of all games fundamentally appear to have. This model is presented in Figure 1, consists of three essential elements: a challenge, a response, and feedback. When the feedback, as the last phase in the model, establishes a new challenge or prompts the user to give a different response to the original challenge, another loop is produced. The model shows how game design features are at the centre of the learning experience, permeating how challenge, response, and feedback are designed. The playful character of each of these critical elements transforms the learning experience in different modes [8].

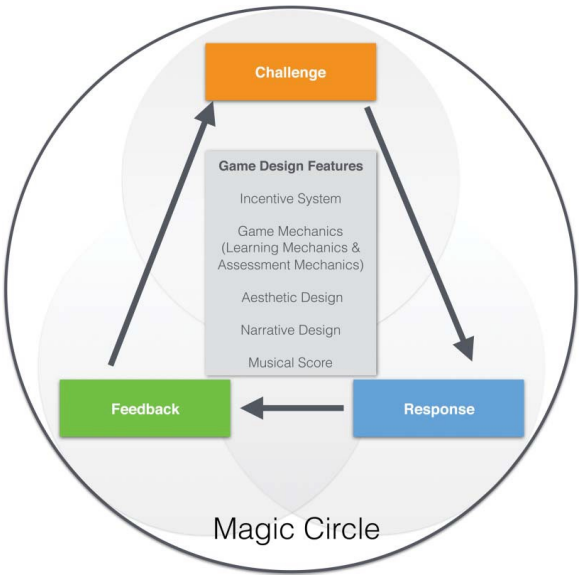

Fig. 1. Model of game-based learning [8]

III. Trial-and-error Cycle of the Game Development

Von Hippel [12] has defined a trial-and-error cycle of product development as shown in Figure 2. This trial-and-error method is divided into a four-phase cycle that will be repeated several times during the development of the product.

In the first phase, a problem and a related solution would be conceived based on the best knowledge and insight with referring to the design requirements. In the second phase, a physical or virtual prototype of different possible solutions is built, according to what has been envisioned. During the third phase, the experiment is run, which means the prototyped solution is operated and it is the time to see what happens. Fourth and finally, the result is analysed to understand what evolved in the trial, then assess the outcome 'error information'. In the learning process, for a trial-and-error formulation, an error is new information or knowledge derived from an experiment by an experimenter: it is the aspect(s) of the outcome that the experimenter previously did not predict. This new learning is then used to modify and improve the solution under development before building and running another new trial [12]. These four phases will be iterated until achieving the optimal product that useful for the user.

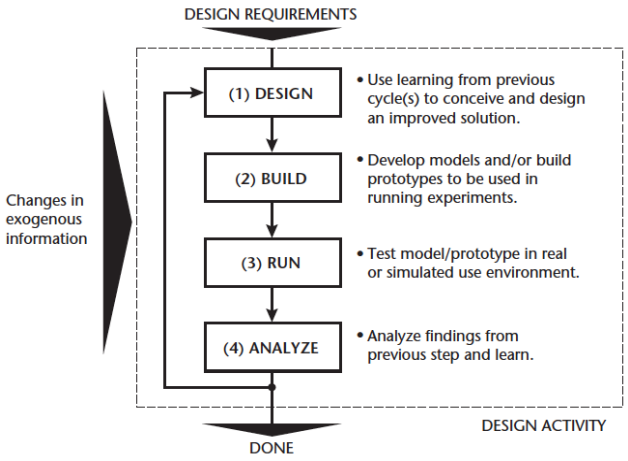

Fig. 2. The trial-and-error cycle of product development [12]

A series of the development process of this game-based learning adopted the concept of the trial-and-error cycle of product development by Hippel. When an analyse in one cycle of development was completed, new learning or another finding was coming so that the new iteration was started again.

IV. Game-based Learning for Batik

Since children in elementary school, aged 7-12 years old, are the target user in this game, it needs to consider how the digital environment can influence the cognitive development of children. In this research, there are two key issues need to be considered in designing for children: 1) deciding how to translate physical environments into digital space, and 2) translating each step of the process of making batik into what children might consider a meaningful visualisation.

Another point related to the uniqueness of batik that has to be noticed carefully is that batik is not only about drawing the patterns but including the technique and the whole process of producing batik. This has to be an integral part of the tool to be designed.

Before starting to develop the game, the learning objectives must be formulated first. By having these since the beginning, the designers will have a roadmap that keeps the work on the right track.

Rante et al. [13] had defined the learning objectives that supposed to be the goals when the user finished the task on this game. The game has four primary learning objectives: i) to motivate user to learn the real process of making batik; ii) to assist user to understand the philosophy of the batik patterns; iii) to teach user how to mix colours, and iv) to teach hand movements user in relation to the use of *canting* in the real process.

A. Characters

The character is one of the essential parts of a game. Moreover, children love the character. Many of the classic characters are familiar to us through cartoons, movies, and advertising looks simple. However, that simplicity usually belies the many hours of work that have gone into their development because character design can be a tricky beast to tackle [14]. Burgerman has defined several tips to design a

character that inspires the design of characters for this batik game.

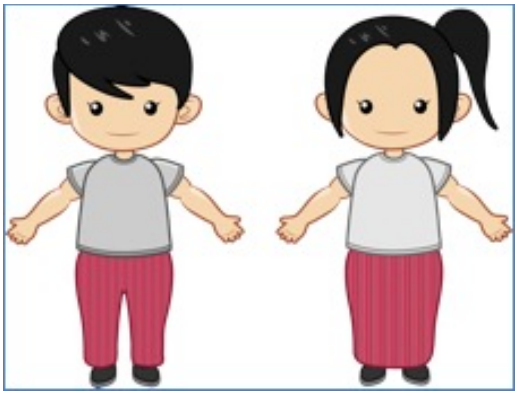

Fig. 3. Characters for batik game

This game is about batik, one of Indonesian cultural heritage. Thus, the character for the game must have strong visual identities and personalities that present Indonesian children style. After some trials and by refiguring the hair, eyes, costume and shoes, the characters were created, shown in Figure 3. The characters are wearing one of the happening Indonesian styles today: pants and skirt made from lurik hand-woven.

B. *Scenario*

The scenario in game design is the screenplay plot of the game comprised of several tasks. The scenarios in the serious game should be designed in such a way that the game's goal can be achieved. Scenario covers the description of a person's interaction with a system, from a user perspective. A good scenario must be understood easily by people who do not have any technical background. Scenarios can be derived from data gathered during contextual enquiry activities, such as data collected from the fieldwork. If there is no access to such data, scenarios can be written based on prior knowledge or even 'best guess'. A scenario should be written in simple language, describing the interaction that needs to take place.

In short, this batik game offers two levels of play. It is strongly suggested that children aged 7-9 years take Level 1 first before continuing to Level 2. For children aged 10-12 years, they could go straight to Level 2. The distinction scenarios between Level 1 and Level 2 is presented in the following Table 1.

TABLE I. Two levels in BatiKids

Level 1	Level 2
Step 1: Interactive visualisation of the process to begin making batik	Step 1: Interactive visualisation of the process to begin making batik
Step 2 (*Ngiseni*, *Nyolet* and *Mopok*): 1. Drawing the pattern by following dots on the object 2. Mixing colours 3. Colouring patterns with mixed colours 4. Removing the colour if they do not like it and change it with another (mixed) colour 5. Saving the work and getting the batik pattern ready for the next steps	Step 2 (*Nglowong, Ngiseni*, *Nyolet*, *Mopok,* and *Ngelir*): 1. Drawing the pattern by following the instruction shown on the screen (could be in the form of storytelling) 2. Mixing colours 3. Colouring patterns with mixed colours 4. Removing the colour if they do not like it and change it with another (mixed) colour 5. Modifying the pattern: resizing, rotating, et cetera 6. Choosing a background colour for the batik 7. Saving the work and getting the batik pattern ready for the next steps
Step 3 (*Nglorod*): Interactive visualisation of the final process of making batik	Step 3 (*Nglorod*): Interactive visualisation of the final process of making batik

C. *Drawing part*

Making batik is mainly about drawing. From the very first step, batik artisans draw the pattern on paper, then move it by redrawing it on the fabric. When they are colouring and waxing the pattern, it is all also about drawing.

This game-based learning presents several tasks that represent what people have to do when making batik in the real process. Children have to complete the tasks in order to achieve the goal of the game. One of the tasks is drawing the pattern that they select. Figure 4 is showing three batik patterns offered on the game: *gurdo*, plant, and the combination of *gurdo* and plant. When children put the cursor on a pattern, a description of the pattern philosophy appears so that children will have an understanding of the pattern. This concept will lead children to choose the pattern as they desire.

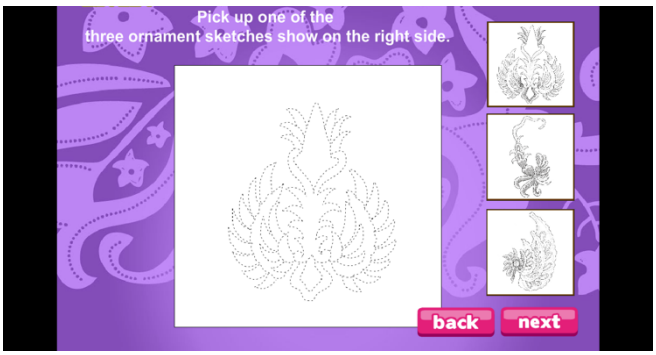

Fig. 4. Selecting pattern on the batik game

Figure 5 is showing the process of drawing on the game. Children have to draw the pattern following the dots. Dots are presented in different colours; green as the first dot to start the drawing, then orange as the second, and some yellows for the next dots. This task aims to intrigue children that drawing batik in the real process is not as severe as they might have imagined. However, it also can be very challenging and motivating children to try it again.

Once they completed drawing with the dots, the whole pattern will show up and ready to be coloured.

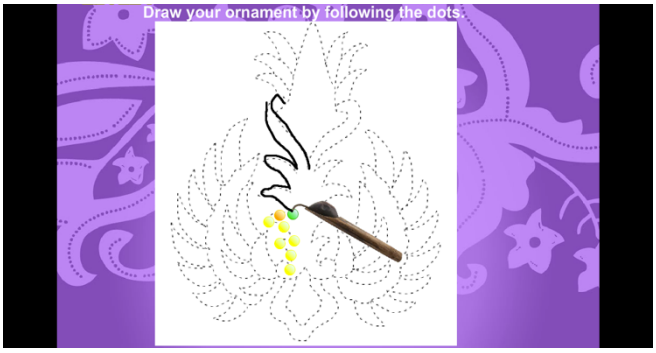

Fig. 5. Drawing the pattern on the batik game

Developing this drawing part is an essential phase in building this game. Using the ActionScript3 with support from the codes of Code Snippets panel on Flash can help the process of developing the interactive game becomes easier. Figure 6 and 7 show part of the codes that generated the drawing task on this batik game.

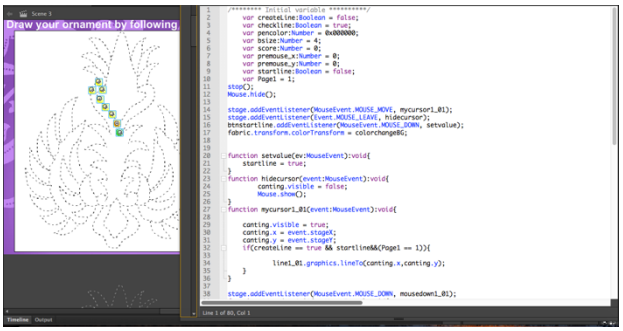

Fig. 6. Codes to generate the drawing task_1

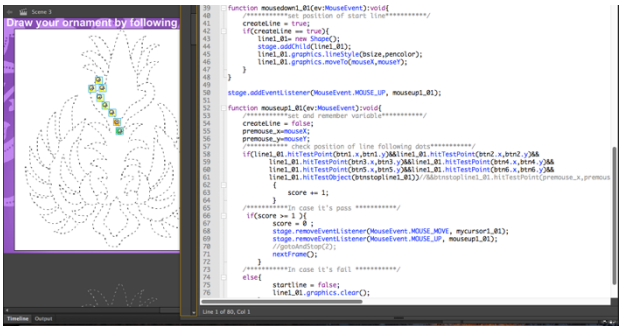

Fig. 7. Codes to generate the drawing task_2

D. *Video of batik processing*

In the early version of this game, videos were not included. The game presented the process of making batik through text narrative and graphics, both pictures and animations.

Wishart [15] stated that visualising the critical concept is relevant to understand it better and the video content of visual nature and audible serves as an integral learning tool. Based on this knowledge, video tutorials were prepared to be embedded into the game.

The videos for this batik game present the whole real process of making batik; eight steps of the real process of batik production. With the present of this video tutorials, it can help students who have never seen or experienced the real process of making batik to understand better the process.

The videos were recorded in the workshop of two batik artisans in Sidoarjo, East Java. Since making a piece of batik takes time; therefore the recording process takes time as well. It needed around six weeks to take all scenes in the field. Some processes of making batik had to be done in a dark room and that resulted in a poor quality of the images. Figure 8 shows one of the videos that presented in the game.

Fig. 8. One of the videos on the batik game

To finalise the video production, one of the most critical phases is the editing phase. When it refers to editing, it is not only about cutting out necessary footage, but it is also covering the value-adding aspect of the editing process such as managing brightness and contrast, arranging saturation value, placing text, controlling audio level, and so on. Without good editing, stories will not fully come alive on screen. The videos were edited and finalised using Adobe Premiere Pro.

E. *Voice-over*

Since old time until today, when we play games, we often coach each other or give pointers by talking with other players. Nowadays, several digital games for entertaining provide voice-overs and audio directions. Digital games must be having sounds, music and other auditory elements that give hints and clues for players to incorporate during the game [16]. These 'hearing-related' game elements are also essential for game-based learning. In a game with learning purpose, the voice-over is considered to teach content, explaining a particular item, and giving instruction.

After several iterations in developing the game, the latest version is presented along with the voice-overs, both in English and Indonesia. The voice was recorded using Audacity, a free and open source audio software for multi-track recording and editing. Actually, no specific editing given to this audios recording since the quality of sounds was good, besides cutting or trimming at the beginning and end of each audio file.

V. Usability Test

A very effective usability evaluation method that is widely used is the usability test; sometimes also referred to as user tests [17, 18]. The usability test is an opportunity to evaluate many dimensions of the user experience of a product, service, or technology to understand user behaviour and identify problems. It assesses how user-friendly the overall functionalities of the system are. It aims to evaluate the product by defining a realistic task scenario for product usage involving the prospective users [19].

Several workshops, in the form of the usability test, have been conducted for the previous version of this game-based learning. In the workshop, we prepared scenarios for running the test and divided the workshop into four phases:

introduction, pre-test questionnaire, usability test, and post-test questionnaire. In general, children were excited when doing the tasks provided in the game. The learning objectives of the game were also delivered well to the children. However, we observed hand movements are an integral part of the batik process that could be better learned when children tried to mimic the hand movements of the artists displayed in the video tutorials [18]. Details of the test results are described by Rante et al. [13, 18,].

Another usability test must be conducted for the latest version of the game. As it has been experienced before, the usability test needs optimal effort to conduct; as of it also resulted in a better user experience. This usability test will lead to further improvement of the game.

VI. Summary

Based on the current research outcomes, it can be seen that an interactive game for children, especially for learning purpose needs attractive visualisation such as characters and graphics animation to make it more enjoyable. It is believed that the practical use of visualisation in videos can help the learner to decrease learning time, improve comprehension, enhance retrieval, and increase memorising. By retrieving a visual cue presented on the screen, a learner can retrieve the content associated with the visual accurately. The goal and learning objectives are also can be delivered better through the visualisations.

This game-based learning developed to support children in learning and experiencing the process of producing batik in a fascinating way and within a short time when using computers instead of doing it traditionally. The game even gives the children the opportunity to easily modify their work if needed; whereas this is not possible to do traditionally. The game also offers a safer environment for children, as they do not need to intersect with hot wax, hot water and also fire that are used for the real process. The supremacy of digital media technology is not only showing the traditional handcraft in a better way, but it can give the specific aesthetic concepts embedded in cultural game-based learning as well. This model of approach will be a support to deliver the knowledge and skill of producing batik.

Lastly, this game and the other game-based learning that have sophisticated contents will never be able to replace the role of a teacher. A teacher in the school has the more influence to build interaction with the learners, rather than any technologies. Therefore, this game will be more optimal to use with if there is a teacher accompanies the children during the play.

Apart from the positive results of the game, there are some technical parts need to be improved, for instance, the pattern that needs to be drawn should be possible to zoom in. Several parts that related to children cognitive development also must be considered, for example, colour sign on dots on patterns will be easy for children to follow if they are presented in numbers.

Loo mentioned that users' experience could be tailored based on their performance and preferences [20]. The game can be adjusted to present more difficult challenges if users complete the tasks and solve the problems correctly. On the contrary, if they struggle with completing a task, the game can provide the same concept in a different context or decrease the difficulty level until the user gets it. So does for this game, the level of playing can be added and tailored more, perhaps for children with age above 12 years old. In addition, to implement the supervised learning method to the learning process, an artificial intelligence concept could be added into the learning process [21].

Acknowledgement

The development of this game-based learning is longitudinal research. We are very grateful to Politeknik Elektronika Negeri Surabaya for supporting part of the final phase of the research, including the process of writing this publication.

References

[1] S. Doellah, “Batik: The Impact of Time and Environment”, Danar Hadi Solo, 2002.

[2] J. Achjadi, “The Glory of Batik: The Danar Hadi Collection”, 1st Edition, Central Java: PT. Batik Danar Hadi, 2011.

[3] H. Rante, M. Lund, and H. Schelhowe, “A Digital Batik Tool – Supporting children in understanding and constructing traditional batik patterns within a museum context”, International Journal of Multidisciplinary Education and Research (IJMER), Vol. 1, No. 2.

[4] D. Shaffer, “How computer games help children learn”, 1st Edition Palgrave Macmillan, New York, 2006.

[5] H. Rante, H. Schelhowe, and M. Lund, “A preliminary design of BatiKids: A game-based learning to support children learning the process of producing traditional batik in museum context”, in the proceedings of the International Conference on Information Technology (ICIT 2015), Singapore, 2015.

[6] J. Robertson and J. Good (2004), “Children’s narrative development through computer game authoring”, in the Proceedings of the 2004 Conference on Interaction Design and Children: Building a Community (IDC2004). Pages 57 - 64, ACM New York, NY, USA. ISBN:1-58113-791-5. doi>10.1145/1017833.1017841.

[7] K. Salen and E. Zimmerman, “Rules of play: Game design fundamentals”, p. 80, Cambridge, MA, MIT Press, 2004.

[8] J. L. Plass, B. D. Homer, and C. K. Kinzer, “Foundations of Game-based Learning”, Educational Psychologist, 50(4), 258–283, 2015. DOI: 10.1080/00461520.2015.1122533.

[9] D. W. Shaffer, R. Halverson, K. R. Squire, and J. P. Gee, “Video games and the future of learning”, (WCER Working Paper No. 2005-4), Madison: University of Wisconsin–Madison, Wisconsin Center for Education Research (NJ1).

[10] S. Kelle, R. Klemke, M. Gruber, and M. Specht, “Standardization of Game-based Learning Design’. Online https://pdfs.semanticscholar.org/9abc/fe4bf0ae07c9a925b9b3567759a82e90c8d5.pdf (retrieved 10 August 2018).

[11] J. L. Plass, K. Perlin, and J. Nordlinger, “The games for learning institute: Research on design patterns for effective educational games. Paper presented at the Game Developers Conference, San Francisco, CA, 2010.

[12] E. von Hippel, “Democratizing Innovation”, 2014. Online http://mitpress.mit.edu/sites/default/files/titles/free_download/9780262720472_Democratizing_Innovation.pdf (retrieved 14 August 2018).

[13] H. Rante, M. Lund, and D. Caliz, “The Role of Tangible Interfaces in Enhancing Children's Engagement in Learning”, MATEC Web of Conferences Volume 164, 23 April 2018, 3rd International Conference on Electrical Systems, Technology and Information, ICESTI 2017; Bali; Indonesia.

[14] J. Burgerman, “20 Character Design Tips”, 2017. Online http://www.creativebloq.com/character-design/tips-5132643 (retrieved 12 August 2018).

[15] J. Wishart, “Using the cameras on mobile phones. iPads and Digital Cameras to Create Animations in Science Teaching and Learning Mobile Learning and STEM: Case Studies in Practice”, 17 (1), p. 18-26, 2016.

[16] A. Miller, “Games Support Multiple Learning Styles”, 2013. Online https://www.edutopia.org/blog/games-support-multiple-learning-styles-andrew-miller (retrieved 14 August 2018).

[17] J. Nielsen, “Usability Engineering”, Morgan Kaufmann Publishers, 1994.

[18] H. Rante, L. de Araújo, and H. Schelhowe, "Usability Testing with Children: BatiKids Case Study", in the Proceedings of the 18th International Conference on Computer Supported Education and Information Technology (ICCSEIT 2016), New York, 10-11 October 2016.

[19] A. Sonderegger, S. Schmutz, and J. Sauer, "The influence of age in usability testing", Applied Ergonomics Volume 52, January 2016, Pages 291–300.

[20] K. Loo, "7 Ways Video Games Will Help Your Kids in School", Updated 4 January 2015. Online http://www.huffingtonpost.com/kara-loo/7-ways-video-games-help_b_6084990.html (retrieved 14 August 2018).

[21] F. Pasila and R. Alimin, " Applications of artificial intelligence control for Parallel Discrete-Manipulators", 4th IGNITE, the 2016 International Conference on Advanced Informatics: Concepts, Theory and Application (ICAICTA 2016), Penang, 30 December 2016.