Participatory Design in Developing Gamification on Introducing Renewable Energy to Teenage Students

Rifa'atul Mahmudah Burhan[1], Hestiasari Rante[2], Nu Rhahida Arini[3], Abir Hasnaoui[4]

rifa.amb@gmail.com, hestiasari@pens.ac.id, arini@pens.ac.id, abir.hasnaoui@univ-usto.dz

[1,2,3] Politeknik Elektronika Negeri Surabaya

[4] University of Sciences and Technology of Oran-MB.Oran, Algeria

Article Information	Abstract
	The Covid-19 pandemic has had an impact on all sectors, including the world of education. Learning that has been done using traditional methods such as books has turned to virtual media such as zoom, google meet, and social media. This makes students less interested and feel bored. In addition, the current use of energy sources continues to increase which results in the depletion of energy sources. this is due to a lack of knowledge and awareness regarding renewable energy and energy sources. In this study, we used a participatory design method that involved teachers and students in collecting data that was relevant to everyday life. We also conducted interviews and asked students and teachers about their study habits and the meaning of renewable energy and their daily life related to energy, the impressions they have of attending classes, and any opinions for further improvement.This method is proven to help provide outstanding results in decision-making to build gamification applications as learning media that can attract interest and motivation to learn for students, especially junior high school students. As a result of the analysis of students' understanding and concern about renewable energy, it was analyzed as "enough" with a percentage of 57.1%. Based on the results of research and student opinions, we would like to suggest that there must be the development of learning methods or alternative media such as gamification for junior high school students.
Keywords	
Alternative Media, Educational Media, Interactive Media, Questionnaire, User Research	

A. Introduction

Nowadays, the Covid-19 pandemic has impacted almost all aspects of life [1]. Not only does impact economics the world of education but also politics [2], which forces schools to innovate and change learning methods following regulations set by the government. The pandemic currently has modified learning methods in Indonesia dramatically from traditional learning to online learning [3]. Taking education as example, it has been done using virtual classes such as Google Classroom, Edmodo, Zoom Meeting, and WhatsApp application [4], making the learning system more passive and less attractive to students and causing students to be bored unmotivated, and disinterested [5]. Hence, it needs to be creative and innovative learning media to deliver the point of subject, build motivation, and increase student's enthusiasm in learning [6]. In addition, the advances in technology develop rapidly where a method or application appears as an alternative [7] in education which can be used by teachers and students in learning during a pandemic, namely gamification [8].

Gamification is a form of technological advancement which has appeared in recent times [9]. Technological advances also affect the world of service, business, health care, organizational management, politics, and even education [10]. Using the gamification method, it means creating a pleasant experience for the user with game mechanics in a nongame context [11]. Gamification was introduced in 2002 and used in 2008 before documentation in use, and 2010 began to be widely adopted [12]. The desire to strengthen engagement, support innovation, and change user behaviors [13], especially for students, makes gamification quickly adopted [14] in the world of education with creative elements to increase student motivation [15] in education and lead to attractive procedures and it can be better to create outcomes of learning [16]. Nowadays, computer and digital games have been part of human being live particularly students [17], consequently they have become a strong motivator to implement the gamification method in an educational environment [18]. Thus, gamification is becoming the next-generation method for marketing and user engagement in popular discussions [19]. In designing this gamification, a process stage in user research is needed to understand user behaviors, needs, and behaviors through a series of observations and other collection methods or recognize the user needs for a product [20]. Some stages in this research bring the steps objectively to identify the study's objectives or activities. Moreover, there is a need for a hypothesis with essential questions to meet user needs. In this stage, collecting and choosing the type of data used are also determined. Data which has been obtained and processed can later be adopted as a basis for concluding research. Thereby, we seek the improving of the best methods related to the gamification design process. In this study, we will build gamification about renewable energy by implementing speech command on Construct 3 in developing renewable energy gamification for kids. This writing was conducted in junior high school / MTsN, with the target users being students at levels 7-9, approximately 13-16 years. Students completed in the questionnaire related to energy sources, energy-saving, and daily activities such energy-efficient implementation. The purpose of this process is to get an evaluation of participatory design in gamification.

B. Related Works

In 2017, Sailer examined problems related to the hypothesis that gamification was ineffective, but certain game design elements had specific psychological effects. Implementation of game design elements in a real-world context for non-game purposes encouraged motivation and human performance concerning a particular activity. Previous research had often treated gamification as a generic construction, ignoring that many game design elements could produce diverse applications. They analyzed the effect on the fulfillment of primary psychological needs. The results show that badges, leader boards, and performance charts positively affect competency needs satisfaction and that teammates affect the experience of social connectedness. The method used in sample collection is a questionnaire method selected online. The questionnaire can be performed after completing the game, including items that can assess the satisfaction of the psychological participants while they are playing. From this research, Michael and his colleagues focused more on discussing research gaps on the lack of experimental design and the effects of individual or group game design elements [10], [21].

In addition, Morschheuser also focused his research on understanding best practices related to the gamification design process. This research applied science design with current literature, gamification design methods, interview with 25 gamification experts and also, developed methods for gamification design based on the accumulated knowledge. The method was carried out by interviewing ten gamification experts. This research aimed to provide a comprehensive overview of the gamification method and improve insights regarding the development and design of gamification [14]. Ismail also carried out the participatory method in his research. The researcher identified the way of designing educational games which involved students, or children centrally in the process of data collection, design, and implementation. In his research, it was mentioned that the participatory design method (PD) was relevant to this situation. With this method, the user will be involved in every stage of the process to discover the design preferences of students or children by practically designing a gamification prototype. Therefore, the results of the application created will follow the user's needs [22].

C. Materials and Methods

In identifying the method of gamification [23], involving and centralized students or children in the design process [24], the participatory design (PD) method is relevant to this situation. Participatory Design (PD) is a creative approach involving and being creative with the community to solve a problem [25]. The essence of this method is the participants [26]. Their involvement can range from passively informing about project development to actively sharing roles and responsibilities in decision-making [27]. Researches include children as the participants in the participatory design process [28]. Children participate in the process of designing, negotiating, and making a decision [29]. Children are actively involved in the design process, and objectives should be focused on the children's needs and contexts. A hypothesis can prove that participatory processes provide or produce more opportunities for experience to users, especially students [30]. In this paper, we describe the design of an effective technology through a

participatory design process. This process is carried out to obtain participants' ideas, habits, and knowledge, which will become the basis for decision-making and evaluation. The core characteristics of the participatory design are enabling users to participate in the design process, increase capabilities, gain ownership of results, increase confidence, and provide them a voice in decision making. Therefore, the specific purpose of this article is to apply the participatory action research methodology as consideration for decision-making in building gamification.

D. Parcipatory Design Process

At this stage of the participatory design process, several stages of data collection are carried out, such as user researchers, study literature, study exiting, making questionnaires, distributing questionnaires, and data processing. After the data collection stage, then it is proceed with the design stage with the following steps: storyline writing, asset creation, and mock-up.

a) User Research

User research which was supported by data collection related to research subjects was carried out. Questionnaire and interview methods were used as media to collect data. This method was applied to obtain information following actual conditions. In this study, interviews and questionnaires were conducted on teachers who compose the curriculum and junior high school students in Padang determine students' material, level of knowledge, and understand regarding renewable energy. Interviews and questionnaires were conducted to 1 teaching teacher and 30 students. Due to the Covid-19 pandemic, the interview process and filling out questionnaires were carried out using a google form distributed to junior high school students. Teacher Desriwan, as a teaching teacher and curriculum compiler, explained that:

1) The curriculum was used the 2013 curriculum, and the curriculum contained renewable energy subjects.
2) Renewable energy subjects were included in science subjects and were studied by grade 2 junior high school students.
3) The students learned the basic knowledge on renewable energy, so it was still a lack of understanding and implementation every day.
4) The learning media, such an educational game that introduced renewable energy, would significantly assist students in learning, especially about renewable energy.
5) The material used would be adjusted to the student's textbook.
6) The color used was adjusted to the color of the energy source and refered to the textbook.
7) The selection of writing fonts was expected to remain neat and attractive for children, especially junior high school students.

Figure 1. Interview and Questionnaire Distribution for Teacher and Student

b) Questionnaires

After the user research stage had been completed, the next step was a questionnaire, where previous interviews were conducted with teachers who handled the curriculum. Interviews and questionnaires were distributed to 36 junior high school and MTs students in Padang, which were conducted online using google forms or paper. In the questionnaire, three answer options are given to facilitate data collection; among the choices are a) know; b) do not know; c) maybe.

The following were questions and result in the questionnaires on users:
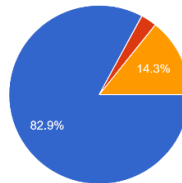- The student knows what the sources of energy are

Figure 2. Result Question Number 1

The first question given had the aim of measuring students' knowledge related to understanding energy sources. The questionnaires given had the results of 82.9%, and those students already knew energy sources, and 14.3% said that they may already know.
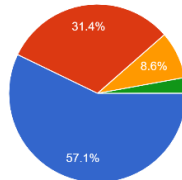
- The student already knows what renewable energy is

Figure 3. Result Question Number 2

The second question was given as a level of measurement of students' understanding of renewable energy knowledge. At this stage, the results obtained 57.1% stated that students already knew, 31.4% of students said that they did not know, and 8.6% felt doubtful.
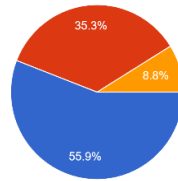
- The student understands what energy saving is

Figure 4. Result Question Number 3

The third question related to energy saving resulted in 55.9% for those who knew, 35.3% that they did not know, and 8.8% felt doubt about saving energy.
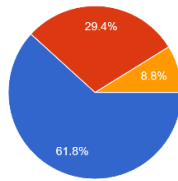
- Saving energy has been learned in school.

Figure 5. Result Question Number 4

The fourth question stated that 61.8% energy-saving had been studied in school, 29.4% felt that it had not been studied, and 8.8% doubted that it had been studied or not.
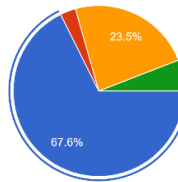
- Energy saving is significant to implement

Figure 6. Result Question Number 5

The fifth question stated that 67.6% were essential for energy-saving implementation, 23.5% felt doubtful, 2.9 felt no need for implementation, and 5.9 did not provide a response
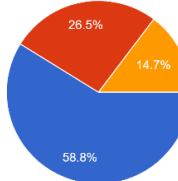
- The student knows the impact of saving energy.

Figure 7. Result Question Number 6

In the sixth question, students stated that they knew the impact of saving energy with 58.8%, 26.5% said that they did not know, and 14.7% had doubts about the impact of saving energy

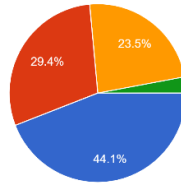• The student knows how to save energy and has practiced it in daily life.

Figure 8. Result Question Number 7

The seventh question got a lower score related to implementing energy saving in daily life, with a percentage of 44.1% saying they knew, 29.4% did not know, 23.5% felt doubtful, and 2.9% did not provide an answer.

• Learning media such as games will be very helpful in understanding renewable energy.
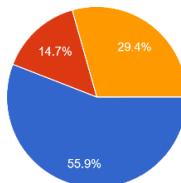

Figure 9. Result Question Number 8

With a result of 55.9%, the eighth question stated that there was a need for a learning media related to renewable energy, 14.7% said that it was not necessary, and 29.4% still doubted whether it was necessary or not.

c) Visual Concept

After completing the stages of literature study, user research, and data collection and processing, the concept creation stage is carried in the application. The concept of creation shown in this gamification includes Participatory Design in Developing Gamification on Introducing Renewable Energy to Teenage Students the icons, colors and typography, characters, and the in-game appearance of the background.

1) Theme

Energy is one of elements produced from natural resources and functions to meet all needs, especially for humans carrying out their daily activities [31]. The utilization of energy is intended as a form of human effort to maintain its existence and improve the welfare and prosperity of life [32]. Unfortunately, the utilization of energy by humans is dominated by the use of fossil energy whose availability is minimal and is applied continuously, and it causes scarcity or even causes the exhaustion of energy [33]. Hence, in this application, we will discuss the theme of renewable energy related to renewable energy and energy sources and the impact of using renewable energy.

2) Materials and Quiz

The material is prepared based on the 2013 curriculum used by the school and taken from the LKS and the first book on energy and its

changes. The material will be divided into three sub-points, namely; the first point introduces sun, water, wind, natural gas, ocean/waves, and biomass as available energy sources. The second point will discuss renewable energy technology based on energy sources. The third sub-point will provide the point of views on the positive impacts of using renewable energy technologies. For each material, there will be a quiz which is given for the energy source material with the most accessible level, namely true and false. Students must choose the correct answer based on the suitability of the image and the information displayed. For renewable energy technology material, a drag, and drop quiz is given where students need to drag and paste pictures of energy sources based on their renewable energy technology. Moreover, multiple-choice is the last quiz, where students need to understand the previous material and give the correct answer among of choices. The number of examinations given is 5, and students will get 100 points if all of answers are correct.

3) Icon

Icons or assets in the application are taken or designed based on existing energy sources and renewable energy technology from these energy sources, such as sun, water, wind, natural gas, sea, waves, and biomass. For renewable energy, the icons of wind and water, turbines and solar panels, and other energy technologies are chosen. For the operation action, the use of standard icons is such (X) to close, arrow to the right to continue, and arrow to the left to return. The icon or asset displayed in the gamification application is the 2D image, where some icons and assets are selected from free pick media and using Adobe as a media editor.

4) Colour

Colour serves as an identity or distinction, conveys information, and evokes emotions or moods, making it easier for students to recognize objects [34]. Following suggestions of teaching staffs and curriculum makers, the colors used in this application apply bright, beautiful, and playful colors which are dominated by green and blue. It refers to the LKS book, the first book on energy and its changes, and the color of energy sources on daily life. Where the color provides renewal, refreshment and is friendly and educative [35], the green color symbolizes nature, growth, harmony, freshness, and fertility, while blue is the sky and the ocean [36]. This application is designed to help students recognize renewable energy related to natural resources, the colors used will always be adjusted to the delivery content, and the content delivered.

5) Typography

The typeface that will be used has also been discussed with the teaching staff with several choices of typefaces, including Times New Roman, Calibri, Cambria, Burbank Big Condensed Black, Adam Bold,

Roboto-Light, and Bahnschrift Light. From among these choices, it was agreed to use the Burbank Big Condensed Black and Roboto-Light fonts. The font used as the application's title uses the Burbank Big Condensed Black typeface and for content or material using the Roboto-Light typeface. Because Burbank Big Condensed Black and Roboto-Light typefaces have neatness and emphasis, the readability level is higher and seems more child-friendly.

E. Result and Discussion

The results of the testing phase will be analyzed immediately. This is to determine the effect of alternative learning media on knowledge about energy sources and students' awareness of energy saving. Questionnaire of respondents' knowledge about energy sources, renewable energy and energy saving made through trials (before gamification application). There are 8 statements related to students' understanding and daily activities in energy utilization. respondents chose the assessment on the questionnaire with a value of yes, no or maybe.

According to the user research process carried out on 30 students and teachers in junior high school. Participatory design is an appropriate method for solving educational game design problems, especially for students and child users. Completing this research, it turns out that there are still many students who do not know about energy sources, renewable energy, and also the lack of energy-saving applications in everyday life. Participatory design has a very important role to obtain data that is in accordance with the daily life of users as the basis for application development plans.

F. Conclusion

Based on the application of the participatory method, it can be seen that the level of students' knowledge about renewable energy and energy sources is still low, so there is a need for learning methods that can help students increase motivation, interest in learning and knowledge. and awareness of the importance of energy. Using participatory design methods in research helps the process of making gamification. The participatory design method will make users directly involved in each stage of the process to find design preferences that adapt students or children in designing prototypes. This stage conducts user research through interviews and questionnaires related to the theme to be raised, interface design, materials used, colors, and type selection. The participatory method also shows the results that students and teachers agree that alternative media such as gamification are very helpful in learning.

For this reason, gamification is an appropriate learning method as a service improvement process with the ability (motivation) to call for a pleasant experience.

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H. Reference

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