

Development of MIKiR Teaching Materials Based on Educational Game “Find Me Save Me” to Preserve Plant Diversity in Indonesia

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Abstract

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The current teaching materials are still in the form of books, it makes less attractive to readers. This research makes teaching materials packaged in games that invite prospective teachers to carry out Experiencing, Interaction, communication and Reflection activities in plant taxonomy learning. The purpose of this research is to develop MIKiR teaching materials from the “Find Me Save Me” game containing Indonesian plant biodiversity. This research is a development research which is analyzed descriptively. Purposive Sampling Technique, the subject of this research is the prospective science teacher of State Islamic University of Sultan Syarif Kasim Riau, State Islamic Institute of Kudus and Pattimura University which was held in March-May. The “Find Me Save Me” game was developed using the 4D stages in R and D, namely Define, Design, Develop, and disseminate. The game is installed through the application and data retrieval using google forms. This game uses 50 types of rare Indonesian plants which are used as a source of material for the game Find Me Save Me. The results of the research Game find me save me get proper validation and can be used in learning, and effective in introducing rare Indonesian plants, especially for prospective science teachers who are not only experts in science and technology but also love and want to preserve Indonesian plants that are starting to become rare.

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Introduction

Indonesia is a country rich in flora and fauna. Indonesia is also known as the second mega biodiversity country in the world because of its diversity. The diversity that exists on this earth includes animals, plants, microorganisms, and their ecosystems where these living things carry out life on earth. (Anggraini, 2018). There are 240 Indonesian plants that have been included in the list of rare plants (Diana et al., 2019) and according to the Indonesian scientific institute based on The International Union for Conservation of Nature (IUCN) there are 50 rare plants in Indonesia (LIPI, 2017). Many unique plants come from various regions that not every prospective teacher knows about. Indonesia is a country with very high biodiversity as the center of world biodiversity or mega-diversity country (Sunarmi, 2014).

Biodiversity can be grouped into three, namely species diversity, genetic diversity, and community diversity (Sunarmi, 2014).

Utilization of the potential for large plant diversity encourages conservation activities widely (Njurumana et al., 2014). The decrease in diversity was caused by humans to fulfill their lives, both food, clothing, and settlements. This situation needs to be an understanding of prospective teachers in teaching their students how important to maintain biodiversity (Heriyanto et al., 2019). The biodiversity problems are aspects of utilization, conservation, knowledge, and policies so that prospective teachers must be able to teach these things for sustainable development.

Learning during the pandemic reminds us that prospective teachers are required to possess good skills in the technology field (Chandra, 2017), thus prospective teachers are able to arrange teaching materials according to the characteristics of students and are able to teach anywhere without having to face to face. The emerging learning that students enjoy is the material that is easy to understand, yet challenging and fun (Vitianingsih, 2016). The development of science and technology-based education is growing rapidly. Prospective teachers are able to arrange science and technology-based learning to improve student interest and therefore the learning process is captivating. Learning process shall be conducted with active learning methods. Based on Piaget's constructivism theory, Students are demanded to be active in learning in order to form their own knowledge and the teacher only acts as a facilitator. John Dewey's progressive theory also states that there are several things that can assist students in the thinking process and produce thinking skills or referred to as reflective thinking. Dewey affirmed that cognitive processes will be formed when students are actively involved during the learning process (Arends, 2001).

One active learning model that can be used in the learning process is the MIKiR model. The term MIKiR stands for *Mengalami, Interaksi, Komunikasi, and Refleksi* (experiencing, interaction, communication, and reflection). The MIKiR model is an active learning model introduced and pioneered by the Tanoto Foundation. The formulated steps for implementing the MIKiR learning model are (1) Experiencing, in this step the activities carried out by the students are observing, conducting experiments, conducting interviews and completing projects; (2) Interaction, in this step the activities performed by the students are discussing, asking, asking for opinions, commenting, answering questions, explaining each other's work; (3) Communication, in this step the activities carried out by students are demonstrating, telling stories, reporting and expressing opinions; (4) Reflection, in this step the activities performed by the students are rethinking the results of the work they have done.

The term “*Mengalami*” (Experiencing) in learning involves many senses hence the concept understanding will be more stable. “*Interaksi*” (Interaction) can encourage students to express ideas and reflect on themselves so as to support a good understanding of concepts. “*Komunikasi*” (Communication) can motivate and build courage in students and fluent in expressing opinions and ideas. And the last, “*Refleksi*” (Reflection) raises the attitude to accept criticism and improve ideas, works and attitudes (Pernantah, 2019).

To carry out an active learning process, teaching materials and learning media are necessary, thus it becomes captivating and fun, one of which can be used in the form of educational games. Learning using educational games has several advantages such as

motivating the students' interest, learning while playing, independent learning resources, solving problems, and improving the students' self-confidence (Winarni et al., 2020).

Based on such obvious reason, the educational game “*Find Me Save Me*” was developed to introduce various levels of species and plant families in Indonesia in the form of games, so that they can activate students (Rahman & Tresnawati, 2016). By playing the game “*Find Me Save Me*”, students can more understand about Indonesian's biodiversity. MIKiR teaching materials are teaching materials in which prospective science teachers can experience directly, communicate, interact, and activate reflection. This research makes teaching materials packaged in games that invite prospective teachers to carry out Experiencing, Interaction, Communication and Reflection activities in plant taxonomy learning. The purpose of this research is to develop MIKiR teaching materials from the “*Find Me Save Me*” game containing Indonesian plan biodiversity.

Method

The research and development (R&D) of 4D development consists of (1) define, (2) design, (3) develop and (4) disseminate (Thiagarajan et al., 1974). Define includes observation and analysis of abstract material. The design includes designing MIKiR teaching materials and educational games to increase understanding of biodiversity conservation. Develop includes testing on material experts and media experts on teaching materials that have been made and will then be tested on a small and large scale. This trial was conducted on prospective science teachers at State Islamic University of Sultan Syarif Kasim Riau, State Islamic Institute of Kudus and Pattimura University. This research was conducted at State Islamic University of Sultan Syarif Kasim Riau, State Islamic Institute of Kudus, and Pattimura University to see students' understanding of rare plants in Indonesia represented by students in western, central, and eastern Indonesia. Disseminate is the stage where MIKiR-based teaching materials and educational games “*Find Me Save Me*” are disseminated to a wider audience.

This research was conducted in April-May 2022, with research sites at the State Islamic University of Sultan Syarif Kasim Riau, State Islamic Institute of Kudus, and Pattimura University. The research subjects were 28 students from IAIN Kudus, 10 students from UIN Sultan Syarif Kasim Riau, and 10 students from Patimura University. Retrieving data online using Google Forms. While the research subjects were prospective science teachers of the State Islamic University of Sultan Syarif Kasim Riau and the State Islamic Institute of Kudus. The analysis used is media validation by interviewing prospective science teachers as expert judgment. The validation instrument serves as a data collector regarding the feasibility of the media from the material and media aspects. validation from material experts covers aspects of software including Maintainable components, ease of use, compatible media, Operational learning media, and Reusable. while the visual communication aspects include communication, following the message and can be received with the wishes of the target, navigation in media operation, audio (narration, sound effects, back sound, music, visuals (layout design, typography, color), and animation and images in media.

This game contains 100 types of plants in Indonesia with the following tribes *Cycadaceae*, *Gingkoaceae*, *Podocarpaceae*, *Araucariaceae*, *Pinaceae*, *Cupressaceae*, *Taxodiaceae*, *Ephedraceae*, and *Gnetaceae*. At this development stage there are 3 stages,

namely (1) The Familia stage is where the prospective teacher identifies plants according to the plant taxonomy at the familia level; (2). The geographical stage where the prospective science teacher identifies the plant according to the origin of the plant; (3) The conservation stage which contains plants by matching efforts to conserve plants in Indonesia. These stages are all made with educational game models such as “*Find Me Save Me*” where if they are correct in matching they get a score, and if they can't, the game can not move. With the Indonesian plant identification game, science teacher candidates are getting richer with plants in Indonesia and easy to learn. Actions in maintaining biodiversity include save, study, and use (Sunarmi, 2014).

Results and Discussion

Learning using games is learning that describes the student's environment in solving problems, increasing student curiosity, student skills and student activities with an achievement (Qian & Clark, 2016). Games as learning media are very interesting. Game is a game system that is determined by rules, interactivity, feedback that raises one's emotions (Brull & Finlayson, 2016). Games as instructional games provide indirect experiences for students and penetrate the limitations of space and time in learning (Plump & LaRosa, 2017). Games in the world of education add enthusiasm for students to learn with pleasure and interest, while for teachers it is easier to teach and for game developers to increase enthusiasm for innovation.

Instructional experts Gagné and Discroll 1988 explained that the important elements in interesting student learning are color, music, and fun so that students become excited about learning. Educational games add educational elements, cognitive material, appropriate activity contexts, meaningful challenges and appropriate feedback (Plump & LaRosa, 2017). Game is one of the interactive learning media that uses advanced technology to maximize education (Noemí & Máximo, 2014).

The “*Find Me Save Me*” game application is a puzzle game that is used by matching the same images. This application contains 50 rare Indonesian plants with pictures that are equipped with scientific names, descriptions of extinction, distribution, and how to preserve them. When the image is clicked on the same image it will open and an album will appear from the description of each plant, and if the image is not the same it will not open. The crop album will appear when a new crop image is opened. In addition, this game is equipped with music, music is very effective in improving learning outcomes (Purwacandra & Nainggolan, 2019). Music in learning is very effective because it increases children's emotions in learning, and makes children relax in learning. This game is equipped with challenges in the form of time duration, the higher the level of the game the less time and the more cards that appear. Picture card media is very effective in stimulating prospective science teachers to think critically, and is also effective in stimulating students to solve problems (Sukri & Indriani, 2018). The duration of time in games makes prospective science teachers excited, and games are also effective in improving learning outcomes as class games are very effective for increasing interest and learning outcomes in living things classification material

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Teaching materials are learning resources that must exist. In developing teaching materials, an analysis of a material and an approach is needed. MIKiR is an approach that invites students to develop teaching materials. There are several stages to start, namely:

1. Define includes observation and analysis of abstract material.

In the define stage, it is obtained from plant taxonomy material that is obtained by prospective science teachers in basic biology learning. Characteristics of this material contains the taxonomy of plants. There are 70 plants that are obtained and then analyzed so that they become 50 plants which are used as the basis for compiling the game. The “*Find Me Save Me*” game underwent a name change from Onet after being communicated with the developer to Find Me Save Me. The teaching material in the form of this fine me educational game contains 50 Indonesian rare plants based on the LIPI version and their threat status follows the 2013 IUCN Red List category and criteria.

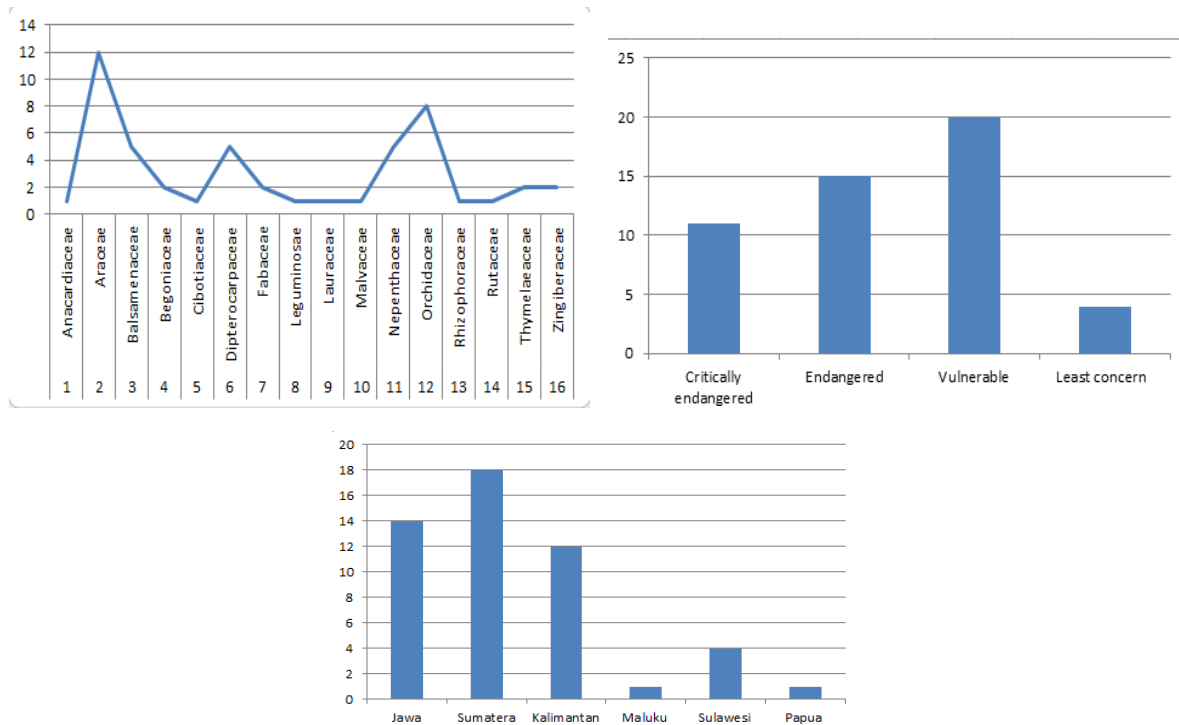


Figure 1. Indonesia's rare plants

Figure 1 shows that there are 16 plant families, each of which is experiencing scarcity. It is also known that there are rare plant species in three categories, namely critical, critical, and vulnerable, with the highest distribution of rare plants in Indonesia in the provinces of Sumatra, Java, Kalimantan, Sulawesi, Papua, and Maluku. This data is used as teaching material for making games.

2. Design includes designing MIKiR teaching materials and educational games to increase understanding of plant diversity conservation. The material is compiled into a script and ready for an application.



Figure 2. The game development script of Find Me Save Me

The game script contains the flow of the game that will work, starting from the initial appearance to the final display. In the initial screen is presented with information on the title, how to play, and the name of the player. Games are applications that can be installed on mobile phones. “*Find Me Save Me*”, installed then the initial screen will appear, players can enter their name to directly start the game. At the start of the game, it contains the title, how to play, settings, close button, and start button. In the settings there is a volume setting which gamers can adjust.

In the how-to view, players can skim through the in-game instructions. In the instructions explained how to play, there are several levels in the game, and in one game there are several stages of three stages of the game. In addition, there is also time that players use to limit finding the key to the game. The game find me save me is a game of finding by connecting horizontal or vertical lines. If the image shown is correct, then the image will open and will get the additional value obtained. In one game display there are 20 pairs of cards that can be opened. Cards that can be opened can be seen in the almanac album which includes a picture of a plant accompanied by the scientific name, taxonomy of the plant, the status of the plant, the origin of the plant and how to protect the plant. Album almanac will appear when the player finds a new type of plant.

In one level of the game there are 3 stages, each stage has a different level of difficulty. Players can complete the levers in sequence up to stage three with the last playing stage. At level one there are 20 Indonesian plants, with the background of the hero Pattimura, while at stage two and so on, they will change according to the region in Indonesia.



Figure 3. (a) initial game view (b) game play instructions



Figure 4. (a) initial game view (b) rare plant album display

3. Develop includes testing on material experts and media experts on teaching materials that have been made and will then be tested on a small and large scale. The media that has been created is validated by media experts from other lecturers, as material expert and other biology lecturer. The validation results are in table 1.

Table 1. The validation results

No	Aspect	Indicator	No Item
1	Software	a. Maintainable (can be maintained / managed easily)	3
		b. Usable (easy to use and simple to operate)	2
		c. Compatible (learning multimedia can be installed or run on various existing hardware and software)	3
		d. Learning multimedia operations (clear installation instructions and instructions for using media are available)	3
		e. Reusable (part or all of the learning media program can be reused for the development of other learning media)	3
2	Visual communication	a. Reusable (part or all of the learning media program can be reused for the development of other learnCommunicative, in accordance with the message and can be received with the wishes of the targeting media)	2
		b. Navigation in media operation (with instructions/navigation buttons that allow students to learn independently, with the opportunity to choose the correct answer)	3
		c. Audio (narration, sound effects, background, music)	3
		d. Visuals (design layout, typography, colors)	3
		e. Animations and images in media	3
Total score			28

Based on table 1, it can be seen that the find me game is easy to use, simple, compatible, has clear instructions for use, and is reusable. This makes it easy for prospective science teachers who want to teach by looking at the various statuses of rare plants in Indonesia to continue to conserve. In addition, the game application can be played by anyone who likes games at the age level. This game introduces Indonesian plants whose status is critical, precarious, and vulnerable. While the assessment according to media experts, the results of the media game validation that were carried out, got a score of 28 both from material experts and media experts who showed high results. As for input from media experts and material experts, when it was opened there were still bugs that couldn't be opened, then there were some cell phones that didn't support installing the game application, fine me save me, writing descriptions using clear letters, there were still typos, and alignment of terms used in determining the status of Indonesian rare plants. The results of media expert validation can be seen in Table 2

Table 2. Media Expert Validation Results

No	Aspect	Indicator	No Item
1	Learning Design	Match the image with the real image	2
		Compatibility of image presentation with species status	3
		Contextuality	3
		Accurate mention of the family of the species	3
		Ease of game to understand	3
		Game difficulty level according to material	3
		Game variations from stage to stage	2
		Adequacy of the number of species in Indonesia	3
		Games provide reinforcement	3
		The content of learning media as a whole can motivate students in learning	3
Total score			28

The next stage is repairs and trials are carried out on prospective science teachers at Department of Natural Sciences Educations State Islamic University of Sultan Syarif Kasim Riau, Department of Natural Sciences Educations State Islamic Institute of Kudus, Pattimura University. The first trial was fifteen prospective teachers and the second trial was eighty students. The trial was to see the student's response to the “*Find Me Save Me*” game.

Table 3. Student responses to the game Find Me Save Me

Statement	Small Scale Trial	Big Scale Trial
I am interested in learning about plant conservation materials using this educational game	75.68 %	97.30 %
The media used is in accordance with the learning objectives	78.38 %	100.00 %
The media used is easy to operate	75.68 %	97.30 %
The media used can help understanding in studying plant conservation materials	81.08 %	97.30 %
The display of images and animations in this media is interesting.	86.49 %	94.59 %
I am happy to be able to play these educational games and learn so that I can get new information	75.68 %	97.30 %
I am more motivated to learn to use game media in this media independently	78.38 %	94.59 %
I feel learning using educational games is more effective and efficient	83.78 %	94.59 %
I am interested if this learning is carried out with educational games and can be applied to other materials	81.08 %	94.59 %
Can add insight about rare plants in Indonesia.	75.68 %	97.30 %
Able to apply ways of preserving plants in the surrounding environment.	86.49 %	94.59 %
It is easier to understand the types of rare plants in Indonesia.	78.38 %	100.00 %
Have a higher memory after getting the materials in the game	86.49 %	81.08 %
There is an increase in interest in learning	72.97 %	94.59 %
There is a high desire for mastery and involvement with learning activities.	72.97 %	91.89 %
There is a desire to increase knowledge about biodiversity	70.27 %	89.19 %
Can apply in the community by providing insight into plant conservation	75.68 %	94.59 %
Average	78.54 %	94.75 %

Participants were very interested in the Find Me Save game as seen when participants filled out a response questionnaire after using the game and it is clearly seen in Table 3. In general, in Table 3 the game response is very good because it is interesting, in accordance with learning objectives, easy to operate, helps to understand the preservation material plants, interesting animated pictures, get new information, practice self-study. The arrangement of this puzzle game is very simple, easy to remember but able to generate intuition from the players to solve problems (Cardozo et al., 2016). From the material aspect of rare plant biodiversity, students gain insight into rare plants, how to preserve them, and the status of these plants, so that they find it easy to understand rare plants in Indonesia. The ease of using games also attracts students' interest to use them in other materials, repetition at stages 1,2 and

3 makes prospective science teachers remember rare plants in Indonesia. Learning using games is better than regular materials (Admiraal et al., 2014). It is hoped that the rare plant material will make students more responsible for the plants around them and this conservation game will make students understand how to manage resources and be responsible (Barr, 2018).

This “*Find Me Save Me*” game provides education for game lovers about learning. Providing convenience for prospective science teachers related to the ease of learning so that they are enthusiastic in learning because the media is interesting. Practicing love in preserving Indonesian plants. With this “*Find Me Save Me*” game, players will know the status of its rarity, and its distribution in any area and from any family. This game can increase students' participation, interaction, and motivation in identifying material details and students' spatial understanding and a very broad visual environment (Wang et al., 2018). This can train a caring attitude towards Indonesian plants. With this game, it is easy for players to recognize, learn, and have a passion for preserving rare plants in Indonesia and learning focuses on students so that the teacher only acts as a facilitator (Cózar-Gutiérrez & Sáez-López, 2016). In addition, repetition of the game from the first to the third stage will also provide other skills for students, both technological skills, and material mastery skills so that the use of games can bring up skills (Butt et al., 2018). Another aspect of the importance of games in the world of education is to make students active in constructing the knowledge of prospective science teachers themselves, to be critical, to train to make decisions, to increase satisfaction in learning, and to create a happy atmosphere (Cardozo et al., 2016), (Vlachopoulos & Makri), (2017), (Braghirolli et al., 2016)

4. Disseminate is the stage where the MiKIR-based teaching material products and the educational game Find Me Save Me are disseminated to a wider audience. This disseminate process is carried out through the publication of research results through international seminars organized by Department of Natural Sciences Educations, State Islamic University of Sultan Syarif Kasim Riau and State Islamic Institute of Kudus, and the results of writing are in the form of outputs that are submitted in articles indexed by Sinta.

MiKIR is an acronym for Experiencing, Communication, Interaction, and Reflection. This approach is expected to enable students to be more creative, able to collaborate in teams, and be critical during the learning process. Game teaching materials with the MiKIR approach are arranged to stimulate the cognitive abilities of prospective students as well as technological skills. Progressive developments must stimulate prospective science teachers to always be up to date on the latest teaching materials, teaching methods, and learning technologies. In addition, the use of games with the MiKIR approach has advantages including: 1). teaching materials for the game find me save me can be installed on the web or mobile phones, 2). The teaching materials of this game are very dancing because they are equipped with music, clear color images, and are challenging, 3). This game teaching materials are equipped with 50 types of plants with information in them, 4). Can be repeated at any time to be played. The existence of this game media must be able to stimulate prospective science teachers to always innovate in creating learning media, because the success of learning is also determined by the media used. The implementation of the MiKIR approach can be seen from the concept of Table 4:

Table 4. The MiKiR Concept in the “*Find Me Save Me*” game

Statement	Competence in the Game delivered	Competencies expected from prospective science teachers
Experience	<ul style="list-style-type: none"> Observing the rules of the game find me save me. Make observations regarding the same game icon, and then match the image icon. 	<ul style="list-style-type: none"> As a prospective science teacher, you must observe appropriate learning methods according to the curriculum that make students more active and innovative
Communication	<ul style="list-style-type: none"> Understand and convey the characteristics of the icon in each game image. Clarifying, discussing and exchanging ideas about the information in each plant picture in the available album. 	<ul style="list-style-type: none"> Prospective science teachers must have skills in formulating questions in order to encourage students to build their own ideas, think creatively, think alternatively, to make observations, and investigate based on the information in the game.
Interaction	<ul style="list-style-type: none"> Accuracy in first matching the icon image to be selected, and setting the time so that it doesn't run out. 	<ul style="list-style-type: none"> Prospective science teachers can encourage students to ask questions, be active, think creatively and critically regarding the information contained in the image of the plant game icon.
Reflection	<ul style="list-style-type: none"> There is a level of play for each stage level. The final scoring value in the game describes the mastery and the number of albums that can be unlocked. 	<ul style="list-style-type: none"> Convey the reinforcement of what is understood, the process and how to learn.

Table 4 describes the MiKiR concept in the game and the expected mastery in the game. The “*Find Me Save Me*” game is experienced directly by matching the appropriate icon images, this will improve the memory of prospective science teachers and increase the collection of plant albums in a shorter time. This as expressed in an online game research will make understanding faster, and short, and make online teaching materials as online learning references (Hsu & Wang, 2018). With the concept of interaction and reflection in games, science teacher candidates have high cognitive skills from the process of playing games that continue to increase at each level, this is in accordance with the game having power and confirmation in every game so that prospective teachers are able to improve cognitive skills and abilities through reflection in combining games and learning (Vlachopoulos & Makri, 2017).

The response of prospective science teachers to the use of this game is very interesting because the usual science teacher candidates use books as teaching materials, now they use applications that are easy to carry, more interesting, more interactive than books as teaching materials. The use of game media will make players diligent, motivated and create a sense of creativity and enthusiasm in getting value (Huizenga et al., 2017). In addition, teaching materials in the form of games teach the ability to think creatively and quickly as stated that the ability to think creatively is the basis of skills and also includes the ability to think highly (Rudyanto, 2016). Learning with games arranged using the MIKiR method is also effective in increasing effectiveness in observing, investigating and reflecting this is reflected in the activities of the existence of levels in the game level as the MIKiR-oriented learning design

activates students (Elfrianto et al., 2020). The use of games also provides great innovation in the field of education because of its innovation in delivering material so that prospective science teachers are easy to understand, so the emergence of games in education is an innovation in the world of education (Brull & Finlayson, 2016)

Learning with games will also construct the thinking of prospective science teachers as well as carry out conservation in understanding rare species that exist in Indonesia without having to study directly so that they can threaten indirectly. So that the game media is said to be able to provide the exact same model, there is more additional information than direct learning and there is indirect protection against rare plants (Wang et al., 2018). Education is a process to change a person's attitude and behavior through regular training and coaching, so that with education a person lives well from his education and experience. As in games containing game content with dense information, packaged in a more relaxed manner, and can refresh prospective science teachers in obtaining information (Rahman & Tresnawati, 2016).

In games, it is always emphasized that motivation is an important factor to show competence, freedom, and in building cooperation (Kwon & zpolat, 2021). Collaboration is an important component now in the game world. The game also regulates the pattern of learning construction so that prospective science teachers associate learning with the curriculum (Nousiainen et al., 2018). Learning using games makes students and teachers happy. The teacher will act as a facilitator as well as a planner as well as be oriented to the success of learning, so the role of the teacher is very varied. Learning with games will train in solving problems (Winarni et al., 2020) and also make it easier for teachers to evaluate (All et al., 2016).

This study uses 50 types of balustrades based on LIPI and The International Union for Conservation of Nature (IUCN). in the game contains the taxonomy of the plant, the type of rarity, the origin of the distribution area, the method of conservation. use the game by matching similar plants and information about these plants will appear. This game can be used for learning science teacher candidates and the general public at all levels because there is a lot of educational information.

Conclusion

From the research results, the development of thinking teaching materials based on the educational game Find Me Save Me to preserve plant diversity in Indonesia was developed using the R & D stages with 4D namely Define, Design, Develop, and disseminate. At the define stage, there are 50 types of rare Indonesian plants that are used as a source of material for the game fine me save me. At the design stage, the game fine me was obtained, with 20 types of plants at each stage, with three stages for each stage and completed with a collection album with scientific names, taxonomies, photos, rarity status, conservation methods, and regional origins. At the develop stage, it has been validated by media experts and material experts with categories suitable for use in learning. The “*Find Me Save Me*” game invites players to see so that they carry out the process of experiencing, communicating, interacting, and reflecting so that subconsciously players learn about plant taxonomy. In addition, this game is also effective in introducing rare Indonesian plants, especially for millennials who are not only experts in science and technology but also love and want to preserve Indonesian plants that are starting to become rare.

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References

- Admiraal, W., Huizenga, J., Heemskerk, I., Kuiper, E., Volman, M., & Dam, G. Ten. (2014). Gender-inclusive game-based learning in secondary education. *International Journal of Inclusive Education*, 18(11), 1208–1218. <https://doi.org/10.1080/13603116.2014.885592>
- All, A., Nuñez Castellar, E. P., & Van Looy, J. (2016). Assessing the effectiveness of digital game-based learning: Best practices. *Computers and Education*, 92–93, 90–103. <https://doi.org/10.1016/j.compedu.2015.10.007>
- Anggraini, W. (2018). Biodiversity in Supporting the Community Economy of East Oku Regency. *AKTUAL Journal*, 16(2), 99. <https://doi.org/10.47232/aktual.v16i2.24>
- Arends, R.I. (2001). *Learning to Teach* (Fifth Edition). New York: Mc Graw-Hill
- Barr, M. (2018). Student attitudes to games-based skills development: Learning from video games in higher education. *Computers in Human Behavior*, 80, 283–294. <https://doi.org/10.1016/j.chb.2017.11.030>
- Braghirolli, L. F., Ribeiro, J. L. D., Weise, A. D., & Pizzolato, M. (2016). Benefits of educational games as an introductory activity in industrial engineering education. *Computers in Human Behavior*, 58, 315–324. <https://doi.org/10.1016/j.chb.2015.12.063>
- Brull, S., & Finlayson, S. (2016). Importance of gamification in increasing learning. *Journal of Continuing Education in Nursing*, 47(8), 372–375. <https://doi.org/10.3928/00220124-20160715-09>
- Butt, A. L., Kardong-Edgren, S., & Ellertson, A. (2018). Using Game-Based Virtual Reality with Haptics for Skill Acquisition. *Clinical Simulation in Nursing*, 16, 25–32. <https://doi.org/10.1016/j.ecns.2017.09.010>
- Cardozo, L. T., Miranda, A. S., Moura, M. J. C. S., & Marcondes, F. K. (2016). Effect of a puzzle on the process of students' learning about cardiac physiology. *Advances in*

- Physiology Education, 40(3), 425–431. <https://doi.org/10.1152/ADVAN.00043.2016>
- Chandra, A. (2017). Design and Build Educational Games as Learning Media for Digital Engineering Practice Courses. *Journal of Electrical Education*, 1(1), 92–98. <https://doi.org/10.21831/jee.v1i1.15121>
- Cózar-Gutiérrez, R., & Sáez-López, J. M. (2016). Game-based learning and gamification in initial teacher training in the social sciences: an experiment with MinecraftEdu. *International Journal of Educational Technology in Higher Education*, 13(1). <https://doi.org/10.1186/s41239-016-0003-4>
- Dewi, C. I. A. A. (2021). Penggunaan Kartu “Game Class” Sebagai Upaya Peningkatan Minat Dan Hasil Belajar Ipa Siswa Kelas Vii1 Smpn 1 Singaraja Tahun Pelajaran 2018/2019. *Jurnal IKA Undiksha*, 19(2), 116–124. <https://doi.org/10.23887/ika.v19i2.37778>
- Elfrianto, E., Nasution, I. S., Siregar, E. F., & Yuhdi, A. (2020). Implementasi Pembelajaran Aktif Berorientasi Mikir (Mengamati, Interaksi, Komunikasi, dan Refleksi) di SD Muhammadiyah 12 Medan. *Pelita Masyarakat*, 2(1), 9–16.
- Heriyanto, N. M., Samsudin, I., & Bismark, M. (2019). Biodiversity of flora and fauna in the forest area of Datuk Dumai hills, Riau Province. *Sylva Lestari Journal*, 7(1), 82–94.
- Huizenga, J. C., Ten Dam, G. T. M., Voogt, J. M., & Admiraal, W. F. (2017). Teacher perceptions of the value of game-based learning in secondary education. *Computers and Education*, 110, 105–115. <https://doi.org/10.1016/j.compedu.2017.03.008>
- Hsu, C. C., & Wang, T. I. (2018). Applying game mechanics and student-generated questions to an online puzzle-based game learning system to promote algorithmic thinking skills. *Computers and Education*, 121, 73–88. <https://doi.org/10.1016/j.compedu.2018.02.002>
- Kwon, H. Y., & zpolat, K. (2021). The dark side of narrow gamification: Negative impact of assessment gamification on student perceptions and content knowledge. *INFORMS Transactions on Education*, 21(2), 67–81. <https://doi.org/10.1287/ITED.2019.0227>
- Njurumana, G. N., Marsono, D., Sadono, R., Research, B., Kupang, K., Untung, J., No, S., Box, P., & Ntt, K. (2014). Conservation of Plant Biodiversity in the Kaliwu System on Sumba Island (Plant Biodiversity Conservation On Kaliwu System at Sumba Island). *Journal of Humans and the Environment*, 21(1), 75–82. <https://doi.org/10.22146/jml.18514>
- Noemí, P.-M., & Máximo, S. H. (2014). Educational Games for Learning. *Universal Journal of Educational Research*, 2(3), 230–238. <https://doi.org/10.13189/ujer.2014.020305>
- Nousiainen, T., Kangas, M., Rikala, J., & Vesisenaho, M. (2018). Teacher competencies in game-based pedagogy. *Teaching and Teacher Education*, 74, 85–97. <https://doi.org/10.1016/j.tate.2018.04.012>
- Pernantah, P. S. (2019). Desain Skenario Pembelajaran Aktif Dengan Metode “Mikir” Pada Mata Kuliah Pendidikan IPS. *Indonesian Journal of Social Science Education (IJSSE)*, 1(2), 145–155.
- Plump, C. M., & LaRosa, J. (2017). Using Kahoot! in the Classroom to Create Engagement and Active Learning: A Game-Based Technology Solution for eLearning Novices. *Management Teaching Review*, 2(2), 151–158. <https://doi.org/10.1177/2379298116689783>
- Purwacandra, P. P., & Nainggolan, O. T. P. (2019). Sampling Suara Instrumen Musik sebagai Strategi Peningkatan Hasil Belajar Mahasiswa dalam Pembuatan Film Scoring. *Rekam*, 15(1), 61–70. <https://doi.org/10.24821/rekam.v15i1.3232>
- Qian, M., & Clark, K. R. (2016). Game-based Learning and 21st century skills: A review of recent research. *Computers in Human Behavior*, 63, 50–58. <https://doi.org/10.1016/j.chb.2016.05.023>
- Rahman, R. A., & Tresnawati, D. (2016). Development of Educational Game Recognition of Animal Names and Their Habitats in 3 Languages as Multimedia-Based Learning

- Media. Journal of Algorithms, 13(1), 184–190.
<https://doi.org/10.33364/algorithm/v.13-1.184>
- Rudyanto, H. E. (2016). Discovery Learning Model With A Scientific Approach With Character To Improve Creative Thinking Ability. *Premiere Educandum: Journal of Basic Education and Learning*, 4(01), 41–48. <https://doi.org/10.25273/pe.v4i01.305>
- Sukri, Y. F., & Indriani, F. (2018). Media Permainan Kartu Gambar Dengan Teknik Think Pair Share. *Prosiding*, 3(1), 356.
- Sunarmi, S. (2014). Preserving Biodiversity Through Out-of-Class Learning And Challenging Assignments. *Journal of Biology Education, State University of Malang*, 6(1), 117974.
- Vitianingsih, A. V. (2016). Educational Games as PAUD Learning Media. *INFORM Journal*, 1(1), 1–8.
- Vlachopoulos, D., & Makri, A. (2017). The effect of games and simulations on higher education: a systematic literature review. In *International Journal of Educational Technology in Higher Education* (Vol. 14, Issue 1). *International Journal of Educational Technology in Higher Education*. <https://doi.org/10.1186/s41239-017-0062-1>
- Wang, P., Wu, P., Wang, J., Chi, H. L., & Wang, X. (2018). A critical review of the use of virtual reality in construction engineering education and training. *International Journal of Environmental Research and Public Health*, 15(6). <https://doi.org/10.3390/ijerph15061204>
- Winarni, D. S., Naimah, J., & Widiyawati, Y. (2020). Science Adventure Educational Game Development To Improve Students' Problem Solving Skills. *Indonesian Journal of Science Education*, 7(2), 91–100. <https://doi.org/10.24815/jpsi.v7i2.14462>