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Development of Educational Board Games to Increase Knowledge of Environmental Care Integrated with QR Codes and Applications

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Abstrak
Penelitian ini bertujuan untuk mengembangkan board game sebagai media pembelajaran yang memberikan edukasi pengetahuan kepedulian lingkungan untuk anak sekolah dasar. Untuk mengikuti era society 5.0, board game ini dikembangan dengan kemajuan teknologi berupa kode QR dan aplikasi, serta memenuhi kualitas media pembelajaran yang menarik. Dengan adanya media pembelajaran berbasis permainan ini akan meningkatkan pengetahuan siswa tentang kepedulian lingkungan. Untuk mengetahui kelayakan, efektivitas, dan kemenarikan hasil pengembangan media pembelajaran board game yang terintegrasi kode QR dan aplikasi. Penelitian ini menggunakan metode Research and Development (RnD). Model penelitian ini menggunakan ADDIE yaitu analisis, desain, pengembangan, implementasi, dan evaluasi. Teknik pengumpulan data yang digunakan adalah angket dan tes berupa data deskriptif kuantitatif dan kualitatif. Board games dinyatakan valid oleh ketiga ahli dibuktikan dengan hasil (1) ahli materi mempunyai persentase sebesar 90%, (2) ahli media mempunyai persentase sebesar 98% (3) guru mempunyai persentase sebesar 100%. Setelah dinyatakan valid, media diujicobakan kepada siswa kelas III SDN Bareng 01 Kota Malang. Berdasarkan hasil analisis uji t pretest diperoleh rata rata sebesar 69 dan post test sebesar 91. Kesimpulan yang dapat diambil dari penelitian ini menunjukkan bahwa terdapat pengaruh yang signifikan dari board games sehingga dapat meningkatkan pengetahuan kepedulian lingkungan siswa SDN Bareng 01 Kota Malang.

Kata Kunci: *board game, kode QR, pengetahuan kepedulian lingkungan, sekolah dasar*

Abstract
This study aims to develop a board game as a learning media that provides environmental awareness education for elementary school children. To follow the era of society 5.0, this board game is developed with technological advances in the form of QR codes and applications, and meets the quality of interesting learning media. With the existence of this game-based learning media, it will increase students' knowledge of environmental awareness. To determine the feasibility, effectiveness, and attractiveness of the results of the development of board game learning media integrated with QR codes and applications. This study uses the Research and Development (RnD) method. This research model

uses ADDIE, namely analysis, design, development, implementation, and evaluation. The data collection techniques used are questionnaires and tests in the form of quantitative and qualitative descriptive data. Board games were declared valid by the three experts as evidenced by the results (1) material experts had a percentage of 90%, (2) media experts had a percentage of 98% (3) teachers had a percentage of 100%. After being declared valid, the media was tested on grade III students of SDN Bareng 01 Malang City. Based on the results of the pretest t-test analysis, the average was 69 and the post-test was 91. The conclusion that can be drawn from this study shows that there is a significant influence of board games so that it can increase the environmental awareness knowledge of students at SDN Bareng 01 Malang City.

Keywords: *board game, QR code, environmental awareness knowledge, elementary school*

INTRODUCTION

Environmental pollution due to waste is a worrying problem every year and affects almost all countries, including Indonesia. The National Waste Management Information Data System (SIPSN) of the Ministry of Environment and Forestry (KLHK) throughout 2022 stated that the amount of waste in Indonesia reached 21.1 million tons, 34.29% of which was not managed properly. According to Sompotan and Sinaga (2022), environmental pollution due to waste occurs due to human activities that cannot process and utilize the environment properly. This shows that human awareness of the importance of protecting the environment is low. According to Efendi et al. (2020), many children, teenagers, and adults are still accustomed to littering.

The process of instilling awareness of the importance of protecting the environment is perfect if it is implemented through education (Efendi et al., 2020). According to Efendi et al. (2020), character education should be instilled from an early age, especially in elementary schools which are the main educational places for children to increase awareness of the surrounding environment by not damaging and misusing it. In the context of environmental education, students' environmental awareness is very important, where environmental awareness includes knowledge, values, and environmental behavior (Raab & Bogner, 2021). However, strengthening environmental character education has not been implemented optimally in schools (Haul, 2021).

According to Ekayani (2017) the quality of education is highly dependent on the quality of teachers and learning. Advances in science and technology will affect the mindset of educators in facilitating the learning needs of their students, one of which is the use of learning media. According to Ekayani (2017), learning media is anything that can convey messages, can stimulate the thoughts, feelings, and desires of students so that it can encourage the creation of a learning process in students. According to Audie (2019), learning media can make it easier for educators to deliver material to students and can encourage student interaction during learning. Therefore, teachers should seek new media to support learning (Boeve-de Pauw et al., 2019). The selection of appropriate media has a very important role in teaching and learning activities (Chabib, 2017).

According to Jordi (2017), the quality of learning becomes low when educators only focus on conventional teaching materials without any innovative development of these teaching materials. For example, the nuances of environmental material in the book still

state that our natural conditions are fine without providing a description of the series of events that will follow behavior that does not care about the environment (Riwanto & Budiarti, 2021). According to Yetri (2017), limited facilities and infrastructure can hinder the strengthening of character education. Thus, to start instilling environmental awareness character education, adequate learning media facilities are needed, one of which is to develop learning media that contains environmental awareness character education.

According to Jordi (2017), a very interesting method to use is playing while learning, children aged 7 and 12 years, children will enjoy learning through games. Play is something that cannot be separated from a child, because play is a motor activity to stimulate children's knowledge of something. In particular, the types of social interactions that arise from group and organized play, and that involve play in everyday life make educational programs based on such play appropriate for encouraging desired behaviors. Importantly, children can recognize whether prosocial norms apply in a given situation (Blake et al., 2015).

Games that are innovated and then used for learning are called game based learning. Game based learning is learner-centered learning that uses digital games for learning purposes (Prasetya et al., 2013). The media used in delivering learning uses games. Apart from that, this game is also used to improve understanding skills and knowledge, generate interest to improve understanding abilities and increase knowledge, apart from that, also to evaluate or assess a scientific discipline. A study shows that children's academic performance increases and their behavior tends to change when game-based learning is implemented (Vu & Feinstein, 2017).

Board games can train children to solve problems, strategize, and think creatively and critically. Previous research related to this study according to Jordi (2017) states that board games have several advantages that are not available in other games where children learn to obey existing rules and learn discipline, trigger social interactions between players, and train children how to live social life, and so on. Game-based learning media in the form of board games to increase knowledge about environmental care has previously been carried out by previous researchers. Research conducted by Ismail (Ismail et al., 2023) states that board game-based learning media can increase children's understanding and awareness of environmental issues, such as global warming and ecosystem concepts. Research conducted by Maulidina et al. (2024) regarding knowledge and attitudes about sorting and using board games showed that board game learning media can improve elementary school children's knowledge and attitudes about waste sorting.

The lack of knowledge of the character of environmental care, which is none other than the lack of learning media innovation to support character education, will be quite difficult to instill knowledge of environmental care. Based on this, the researcher developed a board game that contains environmental care integrated with a QR code and application. Knowledge of the types of garbage is the initial stage of children in understanding the differences in garbage and landfills. The difference with previous research, this board game contains material, comics, and simple games about sorting waste using the 2013 curriculum reference which is integrated with QR codes and applications. The purpose of this research is to develop learning media in the form of educational board games about environmental care knowledge which includes sorting waste, the benefits of waste, the characteristics of healthy schools, efforts to prevent dengue fever, types of waste processing, and produce board game learning media integrated with QR codes and applications that are valid, practical, and attractive.

METHOD

The development research model that is used as a reference in developing this environmental education board game is the ADDIE model. Branch & Branch (2009) mentions that there are five stages in this method, namely analysis, design, development, implementation, and evaluation (Branch & Branch, 2009).

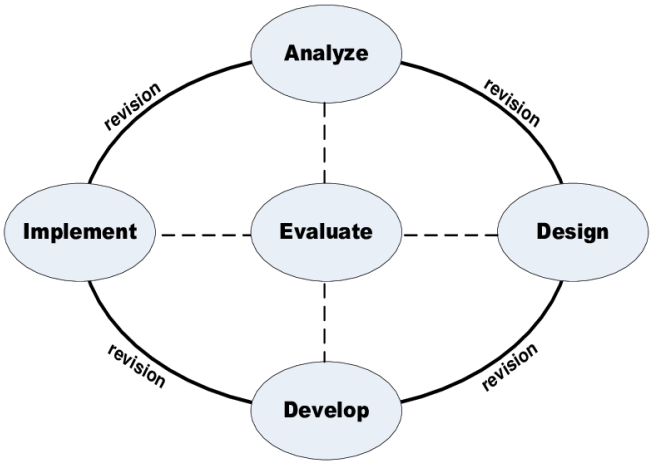

Figure 1. ADDIE development model

This research focuses on the design and feasibility of developing learning media in the form of board games integrated with QR codes and applications to increase environmental awareness. The data collection techniques used in this research are interviews, questionnaires and tests.

This research begins with an analysis of students' learning needs. At this stage, the first step that must be taken is to observe learning activities, interview the class teacher about the difficulties that students often experience during learning. After asking several questions regarding needs, information was found that students still did not understand how to sort waste. This is important because sorting waste is a form of environmental knowledge whose material is always included in learning activities. After further analysis through interviews, it was found that students tend to get bored in class because environmental learning is delivered by means of lectures. The information provided by the teacher, the lack of interesting learning media makes learning activities less effective and tends to be boring. After finding some of this information, the researcher analyzed the material on related learning and designed learning objectives that were appropriate to the needs of the problems faced by students.

The second stage is the design of learning media to be developed. From this stage begins with determining the name of the learning media, identifying basic competencies, preparing the sources of material needed. The next step, researchers began designing validation instrument sheets for media experts, material experts and teachers, as well as making assessments for pre-test and post-test for respondents. Then proceed with designing the game field and its components which include board games, flashcards, comics, application UI design, guidebooks, and packaging of learning media. At this stage the researcher begins to design the content that will be included in the learning media. This content is in the form of learning material, practice questions on flashcards, comics and simple games on the application. At this stage the researcher sketches the game field and all its components.

The third stage is the development of learning media, at this stage starting to realize product development activities that have been designed such as applications and filling application content which includes comics, materials, games, button descriptions, and others. Filling in QR codes and question content on flashcards, filling out guidebook directions, determining the design of board games, pawns, and learning media packaging. At this stage, media testing is also carried out to determine the validity of the product through expert testing which includes material experts and media experts. After getting criticism and input from the validators, revisions were made according to the experts' suggestions. The learning media developed must be validated first to check all components of the media being developed. In this research there are 3 validators, namely for validation of media experts, validation of material experts, and validation of learning practitioners. The expert validation instrument is in the form of a questionnaire. After that, revisions are made if the validator has provided assessments, comments and suggestions for improvements to the media developed before it is tested on students.

The fourth stage is the implementation of learning media. The media is implemented with a large-scale trial with a total of 25 students. The initial step at this stage is that the researcher must prepare the media in the planned theme and explain the rules of the game to the students. At this stage, the results of the environmental awareness knowledge assessment in the form of pre-test and post test, and the effectiveness test determine the practicality of learning media. The subjects in the large-scale test were third grade students of SD Negeri Bareng 1 Malang City. After implementing and distributing questionnaires, at this stage the researcher also processed the results of validation from material experts, media experts, teachers, and student responses to the board game.

The final stage in the ADDIE development model is evaluation, where this stage aims to assess product quality so that this stage can occur at each of the 4 previous stages. Evaluation is carried out in two forms, namely formative evaluation and summative evaluation (Slamet, 2022). In formative evaluation, researchers carry out evaluations and revisions at each stage of development to obtain the expected criteria. For summative evaluation in the form of pre-test and post-test to obtain responses from users of the learning media being developed. At the evaluation stage, researchers processed the results of the pre-test and post-test of environmental awareness knowledge to determine the level of effectiveness of the board game developed in increasing environmental awareness knowledge. Data processing uses JASP 0.19.0 for Windows by conducting a Paired Sample t-test to obtain data on whether the board game learning media integrated with QR codes and this application can increase students' awareness knowledge. This research consists of feasibility tests to determine the validity, practicality, and effectiveness of board game media integrated with QR codes and applications. In this research, researchers used formative evaluation which was carried out at the development stage after being validated by experts and summative evaluation in the form of a response questionnaire to the media being developed. The developer uses a formula from Arikunto (2010) to process data per item and as a whole, the formula is as follows.

$$\mathbf{P} = \frac{\sum X}{\sum Xi}\ x\ 100\%$$

Information:

P = Percentage
∑X = Total number of answers
∑Xi = Total score

100% = Constant

After obtaining the results from data processing using the formula above, the next step is to calculate the level of validity using the criteria presented in Table 1.

Table 1. Eligibility Level Criteria

Category	Percentage (%)	Value	Validation Criteria
A	76%-100%	4	Valid
B	51%-75%	3	Fairly Valid
C	26%-50%	2	Less Valid
D	0%-25%	1	Not Valid

(Source: Arikunto, 2010)

RESULTS

Needs Analysis

The curriculum currently implemented in class III is the 2013 Curriculum. The problematic material is found in Theme 4 Subtheme 2 concerning My Obligations and Rights at School where the material also discusses the obligations or roles of students in maintaining the cleanliness of the school environment. The environmental knowledge material contained in theme 4 includes types of waste such as organic and inorganic waste and their benefits. About the characteristics of a healthy school to reduce sources of disease that can occur. How to prevent dengue fever with the 3M strategy (cover, drain, bury) and 3R (reduce, reuse, recycle). Based on the results of interviews with class III teachers at SDN Bareng 01 Malang City, data was obtained that children still have difficulty distinguishing between types of waste, some children still throw rubbish carelessly, during learning the teacher has not developed learning media to increase awareness of environmental knowledge. Teachers only use methods, simple media and learning books. There are also not many learning media available in schools, because teachers more often use books in learning activities. Teachers are still lacking in utilizing a variety of technology-based media related to play activities. It was also found that there were problems with students who were less active and often did not focus during learning because the one-way learning method seemed boring. Researchers also conducted interviews with several students. Based on the results of the interview, students know and are familiar with the concept of board games. Seeing the problems that occur at the elementary school level, researchers designed environmental awareness learning objectives through learning media in the form of educational board games integrated with QR codes and applications. After analyzing the material, the researcher implemented it in practice questions placed on blue flashcards and red flashcards. Where the blue flash cards function to train students' cognitive abilities, while the red flash cards train students' skills and affective skills. The red flashcards focus on steps or activities that students must take related to caring for the environment. The practice questions contained in the flashcards are taken from material sources including Theme 4 Subtheme 2 which explains knowledge of environmental awareness which is linked as a form of students' rights and obligations at school. That way, students can begin to recognize the types of waste, the benefits of organic waste, promote a clean school culture, know the causes of dengue fever and how to prevent it, and know how to process waste properly.

Design

The first step in the design stage, researchers determined "RETRO" as the name of this board game which stands for "Our Planet Hero" because this board game focuses on efforts to increase environmental awareness. The basis of reference for the learning material in this board game is the 2013 Curriculum. A series of environmental awareness materials in grade III SD are contained in Theme 4, Subtheme 2 about My Obligations and Rights at school and are in the subjects of Indonesian Language and Civics. At this stage the researcher prepares the material content and questions that will be placed on the application and flashcards. The content refers to the sub-themes that will be included in the development of learning media because the selection of material is in accordance with existing problems. After that, the researcher made a sketch of the media before finally developing it into a product that could be used directly by students. The basic competencies are listed in Table 2.

Table 2. Basic Competencies

Subject	***Basic Competencies***
Civic Education	3.2 Identify obligations and rights as family members and school citizens.
Bahasa Indonesia	3.8 Understand the forms and benefits of rest and leisure to maintain health.

Because the 2013 Curriculum is an integrated curriculum, researchers identified learning objectives that are in line with environmental awareness. In learning 3 and 4 in Subtheme 2, it discusses the types of waste, the benefits of organic waste, the characteristics of a clean school, dengue fever and how to prevent it, and how to process good waste within the school scope which will be used as subtheme material that will be attached to the application and flashcards. To prepare for validation, researchers designed a lattice of validation instruments for media experts in Table 3 and material experts in Table 4.

Table 3. Media Expert Instruments

Variable	***Indicator***	***Item Number***
QR Code and App Integrated Board Games	Media Aspect (Attractiveness, practical, educational)	1,2,3,4,5
	Display Aspect (Proportional, aesthetics, typography, color, navigation)	6,7,8,9,10,11, 12,13,14,15
	Usage Aspect (Durability and safety)	16,17,18

Table 4. Learning Material Expert Instrument

Variable	***Indicator***	***Item Number***
QR Code and App Integrated Board Games	Appropriateness of material content (Suitability and coverage of material)	1
	Language of the material (accuracy of writing, readability and clarity of information)	2
	Presentation of material	3

After being tested and validated by experts, the next product is tested directly to teachers and students. To provide assessment and input on the board game, teachers and

students will fill out an instrument in the form of a questionnaire with the lattice listed in Table 5 and Table 6.

Table 5. Instruments For Teachers

Variable	***Indicator***	***Item Number***
QR Code and App Integrated Board Games	Content aspect (Suitability of material with KD, material coverage)	1
	Language aspect (Accuracy of writing, accuracy of sentences, clarity of sentences)	2
	Presentation Aspect	3
	Environmental Care Character	4

Table 6. Instruments for Students

Variable	***Indicator***	***Item Number***
QR Code and App Integrated Board Games	Waste Management	1,6,8,
	Reforestation	7,9
	Knowledge of hazardous materials that should be avoided to preserve nature	2,3,4,5,
	Hunting endangered animals	10

After the idea of making media has been obtained, then the researcher designs the media according to the needs in the field. The design of board game media and its components uses *Adobe Photoshop* Application to design flashcards and enter the content, *Adobe Illustrator* Application to create board game designs, comics, guidebooks, pawns, and board game packaging, *Unity Engine* Application to create applications, and Figma Application to create application interface designs. The board game media component in one package contains: 1 game board, 50 guessing cards, 50 command cards, 1 guidebook, 4 pawns, 1 hourglass and dice packed in a practical container.

Development

The learning media that has been designed is then realized. Researchers began to insert content into flashcards, comics, media packaging, and application content. The media was printed using thick paper and not sharp so as not to hurt students when using the board game. The media that has been designed is then submitted to material experts and media experts to be tested for validity. The development results that will be described first are the appearance of the RETRO board game presented in Figure 2.

Figure 2. Retro Board Game Product

The flow of the board game is made like a snakes and ladders game, starting from the start and ending at the finish. The game begins with an agreement on the order of play, then player 1 can roll the dice to get the dice eyes. Then the player steps according to the number of dice eyes. If the player stops at a red mark, it means that the player must take a red card. If the player stops at a blue mark, then the player must take a blue card. If the player stops at the stop sign, the player must stop one round. And if the player stops on a footing that has no sign, then the player does not need to take a card or stop one round. If the player stops on a step with a picture of a ladder, then the player has the right to jump towards the ladder. The winner in this game is the player who has the most scores when all players have reached the finish line. Next, the design of the red and blue flashcards is presented in Figure 3.

Figure 3. Retro Flashcard for Integrated to Application

The flashcard design is loaded with QR codes and questions. After stopping at the blue marked step, the player must take a blue card, which contains a question about environmental awareness. In this case, RETRO board games support children's cognitive development about environmental awareness. After getting the card, players scan the code through the RETRO application, because the answer options and scores received will appear on each player's cellphone. While the player answers the question, the opposing player must turn the hourglass to give a duration of answering the question of 1 minute.

If the player stops on a red colored step, then the player must pick up a red colored card. This red card contains a command that the player must do. Be it sorting waste, disposing of organic waste, or even answering questions out loud in front of all players. If the player can do the command within the specified duration, then the player can give a mark on the application if they have successfully carried out the mission. If the player can do the command on the red card, or answer the question on the blue card then the player is entitled to additional points, but if the player cannot do it then the points will be deducted. Next is the display of the application presented in Figure 4.

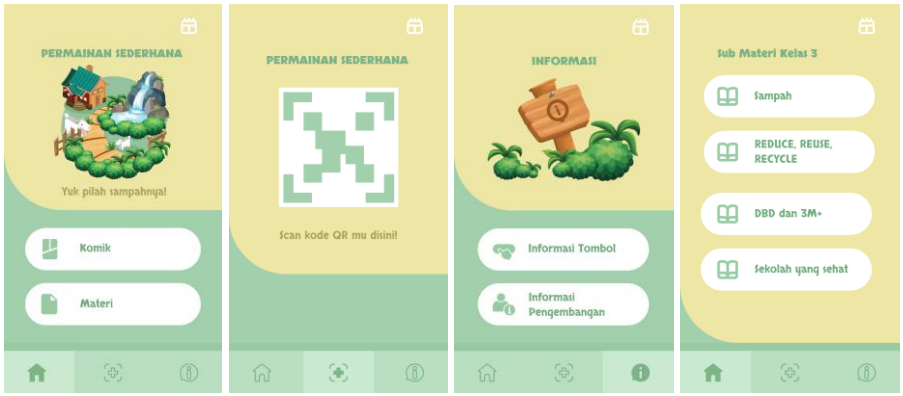

Figure 4. User Interface of Retro Application

The home page is the main page of the application. On this page there are simple games, namely games to sort types of waste, then there are comics, and environmental awareness material sourced from internet books. In addition to learning through flashcards, the RETRO board game also provides learning through comics about environmental awareness, games to sort types of organic, inorganic, and B3 waste. The next is the page to scan the QR code on the blue and red flashcards. At he second page is a place where players can scan the QR code contained in the flashcard. On the flashcard, the button located in the upper right corner is the button to see the score that the player has. On the third page players can get help understanding buttons or application navigation.

Figure 5. Comics in Application

The comics presented can be seen in the RETRO application. This comic tells the story of 3 dwarves who do not take care of the environment which causes the forest to dry up. Then came a tiger who advised and helped the 3 dwarfs take care of the environment together. The purpose of this comic itself is to provide environmental awareness learning through visual comics, and introduce the mascot of the board game, a tiger. The next is the design of the board games guidebook.

Figure 6. Guidebook and Board Games Retro Packaging

This guidebook contains a series of how-to's for using board games. On the home page is a QR code to help players download the RETRO app which will be used to scan the codes on the flashcards and other benefits of the app. On the back page there is an answer key and all blue flashcards, this guidebook should be kept by the teacher after all players can download the RETRO application. And the last is the packaging design of the RETRO board games presented to the right. The board game packaging is printed with thick paper to preserve the components inside. The packaging design contains the board game name, edition name, logo, mascot, and age suggestion. The packaging design was made to match the main board game and match the name of the edition.

Implementation

At this stage, the product has been developed and has been submitted for validity testing by several experts. After conducting trials at SD Negeri Bareng 1 Malang City, researchers analyzed questionnaires from media experts, material experts, teachers, and students. The results of the validity questionnaire analysis by media experts are presented in table 6.

Table 7. Media Expert Validation Results

Validator	***Score***	***Percentage***	***Category***
Material Expert 1	70/72	97,2%	Best Qualification
Material Expert 2	71/72	98,6%	Best Qualification

From the validation results presented in Table 6, it shows that the score obtained from media expert 1 was 70 with a percentage of 97.2% and media expert 2 was 71 with a percentage of 98.6%, the validation results from these two media experts are in the very valid category. This category has fulfilled the aspects of media, appearance, and usage. There are comments from media experts regarding the size of letters and images in the application that need to be enlarged to be better than before. Meanwhile, this material validation test assesses the aspects of the feasibility of the material content, language, and presentation of the material. The results of the material validation test by material experts are listed in Table 7.

Table 8. Validation Results of Learning Material Experts

Validator	***Score***	***Percentage***	***Category***
Material Expert	18/20	90%	Best Qualification

Based on the validation test of the material expert, it is known that the assessment of the feasibility of the content of the material, language, and presentation of the material received a score of 18 points out of 20 total points that can be obtained, for a large percentage of 90%. This level of validity is included in the category of very valid media.

Next, the results of the analysis of the questionnaire given to teachers regarding aspects of content, language, presentation, and environmental awareness material, the results of the validation test are listed in table 8. The score obtained by the teacher was 16 points out of 16 total points that could be obtained, for a large percentage of 100%.

Table 9. Validation Results by Teachers

Validator	***Score***	***Percentage***	***Category***
Teacher	16/16	100%	Best Qualification

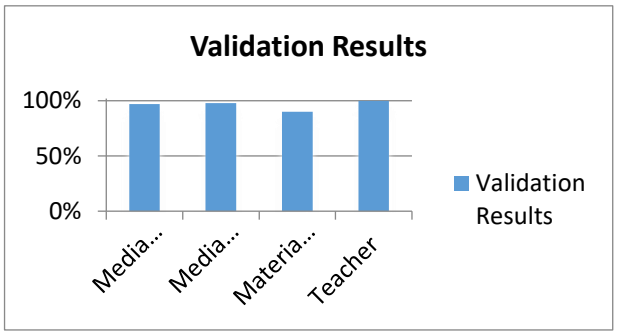

Figure 7. Validation Results

Furthermore, the analysis of the student response questionnaire from the results of the large-scale trial, the results of the analysis of the student response questionnaire are presented in Table 9.

Table 10. Practicality Test by Students

No.	***Statement***	***Score***
1.	Is this board game media interesting?	15
2.	Is this board game media easy for you to use?	15
3.	Are the instructions for using this board game easy for you to understand?	15
4.	Are the components of this board game media interesting?	15
5.	Is the language used clear and easy for you to understand?	13
6.	Can you understand the material on maintaining environmental cleanliness through this board game media?	15
7.	Does this board game media make it easier for you to learn?	14
8.	Can this board game media motivate you to learn?	15
9.	Is this board game media useful for you?	15
10.	Do you enjoy learning using this board game media?	15
	Total	147
	Percentage	98%

Based on the results of the student response questionnaire, a percentage of 98% of students were able to use board game media, so it can be said to be practical.

Evaluation

After conducting a trial implementation of the board game media and processing the validation results by experts, the researcher processed the results of the pre-test and post-test of environmental awareness knowledge with JASP 0.19.0 for Windows to conduct a Paired Sample t-test. The test aims to determine whether there is an increase in environmental awareness knowledge after learning to use board game media integrated with QR codes and applications. The results of the increase test through the Paired Sample t-test are presented in table 10.

Table 11. Paired Sample t-test Result

Measure 1	*Measure 2*	*t*	*df*	*p*
Pretest	Posttest	-11.619	15	<.001

Table 12. Mean Result

	N	*Mean*	*SD*	*SE*
Pretest	16	69.375	12.375	3.091
Posttest	16	91.875	6.551	1.638

Through the results in table 11, the mean or average value shows that there is a difference in the pre-test and post-test results regarding knowledge of environmental care, namely the pre-test results show an average of 69.375 and the post-test results show an average value of 91.875. Therefore, a p-value <0.001 was obtained, which means (<0.05), this shows that QR codes and the implementation of integrated board games have a significant effect on the average pre-test and post-test scores regarding knowledge of environmental awareness. The media developed can achieve validity, practicality and effectiveness because the media has been validated first by three experts, namely media experts and material experts. After that, a media trial was carried out to determine the level of effectiveness by giving pre-tests and post-tests to students. This test is to test students' knowledge about types of waste and their benefits, how to manage waste using 3R (reduce, reuse, recycle) to prevent disasters or even diseases that might occur if we do not take steps to care for the environment. From the test results, it was found that there was a significant increase in aspects of knowledge about the environment, which includes knowledge starting from knowledge about types of waste, how to manage waste using the 3Rs and disasters that might occur if we don't do this. maintain and preserve the environment well. This is because the board game itself carries various material about environmental awareness contained in its components. As in the blue flashcards and red flashcards, these cards contain practice questions to improve students' cognitive, psychomotor and affective skills in order to increase students' environmental awareness. Not only is this board game providing several questions, but the application also contains materials, comics and simple games about waste sorting, all of which contain reinforcement of related material to increase students' knowledge of environmental awareness.

At the evaluation stage, improvements were also made according to suggestions from expert validators and teachers. Although the module has been categorized as very valid, improvements are still made to the board game to improve its quality. Based on suggestions from expert media validators, namely the font size, image size, and image unity

in the application should be enlarged and combined so that children are more interested when they first see the material section in the application.

DISCUSSION

This study produces a game-based learning media product in the form of board games integrated with QR codes and applications. This study uses the ADDIE model to develop board games so that environmental awareness learning becomes interesting and fun for students. The learning media developed by this researcher is not like other learning media, because this media can increase environmental awareness knowledge through components included in board games. Based on the results of the study, board games media can increase environmental awareness knowledge. This is because students get learning through concrete questions. This is in line with Lestari's statement (2019) which states that the application of media has had a positive impact on students in carrying out daily activities both at school and at home.

The development of board games has been widely carried out, one of which was by Aryani (2014) with the title Developing an attitude of environmental concern through playing Ecofunopoly. The success of board game media to increase environmental awareness knowledge is also influenced by the learning materials that have been presented. Learning that uses examples from everyday life is certainly a supporter so that children are able to understand and solve problems related to environmental awareness in a more effective way. This is in line with Novianti (2022) that the learning process will be more meaningful because students find their own knowledge and can be applied in everyday life.

Students can have increased knowledge of environmental awareness if they get the same opportunity. Therefore, learning through games in board games media integrated with QR codes and applications is quite practical and effective to do. Because learning activities while playing will increase children's interest in participating in learning. This is in line with one of the functions of learning media, namely creating a fun, relaxed, and interesting learning atmosphere so that learning objectives can be achieved (Saifuddin, 2014).

CONCLUSIONS

This study successfully developed board games integrated with QR codes and applications to improve environmental awareness knowledge using the ADDIE model. The stages in the ADDIE model include need analysis, design, development, implementation, and evaluation. From the results of the validation of material experts, the percentage results were 90%, while the average results of the validation of media experts were 98%, the results of validation by teachers were 100%, and large group trials were 98%, this shows that board games integrated with QR codes and applications are valid and suitable for use as learning media. This development also produces applications that contain materials, comics, and simple waste sorting games to support environmental awareness learning. Further research can apply board games with different editions but still within the scope of environmental awareness. Further research can implement the development of board games for higher age levels.

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