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Development of Spinning Wheel Learning Media with QR Code Material my Dear Earth, my Poor Earth to Improve Science Learning Outcomes of Grade V Students

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Abstract: This development research aims to develop media design and test the feasibility of the rotating wheel learning media with QR Code material on my dear earth, my poor earth for the subject of science. The rotating wheel media with QR Code is one example of interactive media and is able to stimulate active participation of students. QR Code that can quickly and easily access teaching materials and instructions for using the media. This type of research is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The subjects in this study were 25 students of grade V SDN Pati Lor 05, Pati Regency. The data collection techniques used were media expert validation questionnaires, material expert validation questionnaires, teacher response questionnaires, and student response questionnaires. The results of this study indicate that the Development of Spinning Wheel Learning Media with QR Code is feasible to use, based on the assessment of media experts and material experts with a percentage of material feasibility of 84% and a percentage of media feasibility of 94% with the category "very feasible", teacher responses of 93% with the category "very feasible", and student responses of 84.6% with the category "very effective". So it can be concluded that the spinning wheel learning media with QR Code material on my dear earth, my poor earth meets the criteria of being very feasible and very effective to use in the learning process.

Keywords: Learning media; Science subjects; Spinning wheel; QR code

Introduction

Currently, the curriculum in Indonesia has undergone development and refinement from the previous time which was developed based on the needs and demands of developments in the world of education. The Independent Curriculum is a curriculum that is currently being widely introduced by the Ministry of Education, Culture, Research, and Technology (Kemendikburistek) to every educational unit in Indonesia. The implementation of the Independent Curriculum has been regulated in the Ministry of Education, Culture, Research, and Technology Number 162/M/2021 concerning Mover Schools. The implementation of the Independent Curriculum as an education curriculum in Indonesia does show many different things, such as in the Independent Curriculum there are several changes to its subjects, one of which is the Natural and Social Sciences (IPAS) subject, where in the previous curriculum this learning was still separated into 2 different subjects, namely Science and Social Studies.

IPAS is a science with the study of living things and inanimate objects and their relationships (Sommer et al., 2019; Isnaeni & Zulherman, 2024). The purpose of the IPAS subject is so that students in Elementary Schools

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are better prepared to take part in Science and Social Studies learning which is held separately at the next level of education (De Jong et al., 2023). Science learning aims to make students aware that humans as social beings not only need other humans in life but are also very dependent on nature (Yang, 2024; Arola et al., 2023; Lanza et al., 2023). In accordance with the BSKAP decree Number 008/H/KR/2022 concerning the Learning Achievements of the Independent Curriculum, it states that the science subject helps students to increase awareness and curiosity about natural and social phenomena that occur in their environment. Several experts have expressed their thoughts on the science subject (Nur'ariyani et al., 2023; Nasrudin et al., 2021; Haleem et al., 2022).

According to Cahayani et al. (2024), and Pérez-Guilarte et al. (2022), Science (Natural Sciences) and Social Sciences (Social Sciences) in the Independent Curriculum aim to develop a more holistic, multidisciplinary, and contextual education. In this integration, the two subjects are not only studied separately, but are also connected to each other so that students can understand the relationship between natural and social aspects in everyday life. According to Kwangmuang et al. (2021), Science and Social Studies can also increase the relevance of learning to the real world and develop skills needed in the era of globalization such as critical thinking, communication, collaboration, and innovation. In addition, it can help students understand the role of science in solving social and environmental problems and responding to future challenges.

Based on the description above, Permendikbud No. 22 of 2016 concerning Elementary and Secondary Education Process Standards, states that the learning process in educational units must be carried out in a fun, interactive, challenging, inspiring manner, motivating students to actively participate, and providing sufficient space for initiative, independence according to talents, interests, physical and psychological development, and creativity of students. There needs to be fun but effective and efficient learning so that students can understand the material well (Haleem et al., 2022). So a plan is needed in learning such as compiling teaching modules, preparing media and teaching materials, and preparing learning assessment tools. One of the supporting factors for success in learning is the existence of learning media (Fojo & Tesfa, 2020) . Because by using learning media, it can make it easier for teachers to achieve learning goals. To help the communication process between teachers and students to be more effective in learning, a tool in the form of learning media is needed (Marpanaji et al., 2018). This is in accordance with the cognitive learning theory put forward by Piaget. Piaget explained that children aged 7-11 years enter the concrete operational stage, which means that children are able to operate various logics but are still in the form of concrete objects so that in the learning that is carried out it is necessary to use media.

One of the learning media that can make students feel happy is a media in the form of a game (S. Sari et al., 2019). With game media, children will be invited to play while learning so that they can make the conditions and atmosphere of learning in the classroom more active, effective and enjoyable. In accordance with the results of the research conducted by researchers from observations, interviews, and document data in class V SDN Pati Lor 05 Pati Regency, researchers found several problems in the subject of social studies. The problems found were : the lack of activity and enthusiasm of students when participating in social studies learning due to low interest in learning students in the subject of social studies, the use of media for social studies has not been optimal in making students more active because teachers only use student books, limited learning media available for the subject of social studies. With these problems, it has an impact on the interest in learning and motivation of students in learning activities, resulting in suboptimal results in social studies learning. This is proven based on the results of the PAS of students in the even semester, out of a total of 25 students, 13 students (52%) have not reached the KKTP, while 12 students (48%) have reached the KKTP. So that half of the population of class V SDN Pati Lor 05 has not reached the optimal target in learning social studies.

These problems must be resolved immediately so that students become more knowledgeable in learning science (Bramastia & Rahayu, 2023). One solution to this problem is the development of learning media that can attract students so that students are enthusiastic about learning science. According to most students, one of the interesting learning activities is learning that is done while playing, as Aldalur et al. (2023) and Nadeem et al. (2023), said that learning can be carried out with games, because students feel happy when learning while playing. Previous research that examined the rotating wheel learning media was conducted by Putri et al. (2022), conducted research in 2021 with the title Development of Smart Sticker Rotating Wheel Learning Media in ASEAN Material for Grade VI Elementary Schools. The results of this study obtained expert validation data on the material and presentation aspects of the material obtained an average assessment of 4.14 in the criteria "Very Good" or 82.85% (Very Eligible), and media expert validation on the physical aspects, usage, images, colors, writing and flexibility obtained an average assessment of 4.94 in the criteria "Very Good" or 98.83% (Very Eligible).

Based on these data, the smart sticker rotating wheel learning media is feasible and effective for use in learning ASEAN Class VI material. Based on the description of the problems above, the researcher provides a solution to the problem by developing a rotating wheel media with a QR Code for the material of my dear earth, my poor earth. The specifications of this product use bright and attractive color designs using the Canva application for question cards and answer cards. This media design has instructions for using A4-sized media which are divided into 2 parts. Question and answer cards are placed on the bottom base support. For the design of the large circle on the rotating wheel, bright colors are used, namely red, yellow, green and blue with a variation of 18 parts. The design of the small circle on the rotating wheel is a map of Indonesia. On the bottom base in the middle between the question card and the answer card, there is a QR Code containing teaching materials and instructions for using the media. Based on the background of the problem explained with the results of previous studies and supported by expert opinions, the researcher will conduct a study entitled "Development of Rotating Wheel Learning Media with QR Code for the Material of My Dear Earth, My Malang Earth to Improve the Learning Outcomes of Science Students of Class V SDN Pati Lor 05 Pati Regency"

Method

This study uses the type of development research or Research and Development (R&D). According to Sarpong et al. (2023), the research and development method is a research method used to produce a particular product, and test the effectiveness of the product. The approach used in this study is the development of the ADDIE model which has five stages, namely analysis, design, development, implementation, and evaluation.

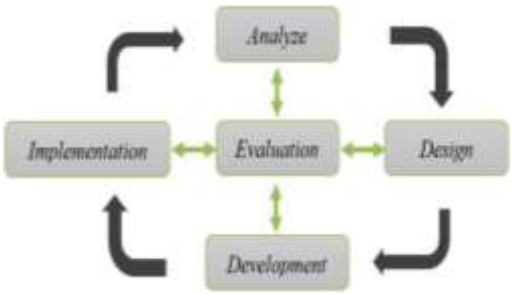

Figure 1. Stages of the ADDIE model (Branch, 2009)

This research was conducted in class V SDN Pati Lor 05 Jl. R. A. Kartini, RT.2 / RW.1, Kaborongan, Pati Lor, Kec. Pati, Pati Regency, Central Java was carried out in the even semester of the 2024/2025 academic year. The subjects in this study included class V teachers, 25 class V students of SDN Pati Lor 05, media expert validators, and material expert validators. In this study, validation questionnaires from media experts, validation questionnaires from material experts, teacher response questionnaires, and student response questionnaires were used to collect data. This collection of development research instruments includes media expert validation sheets, material expert validation sheets, teacher response questionnaire sheets, and student response questionnaire sheets. The data analysis techniques used in this study were expert validation analysis (media experts and material experts), teacher response analysis, and student response analysis. The researcher's validity analysis was based on expert questionnaire responses. The Likert scale was used for the responses to this validation questionnaire, and the measured variables were translated into variable indicators. This questionnaire was intended to determine the validity or feasibility of the material created by the researcher. The percentage of expert responses for each component was obtained using the following formula:

$$\text{Validation Value} = \frac{Total\ Score\ Obtained}{Highest\ Score\ Total} \times 100\% \quad (1)$$

Table 1. Percentage of Validity Results

Percentage (%)	Validity Criteria
76- 100	Valid
56 – 75	Quite Valid
40 – 55	Less Valid
0 – 39	Not Valid

The analysis of the student response questionnaire shows the validity of the rotating wheel media with QR Code based on the responses given by students. From the student answer questionnaire, researchers can determine whether students can understand the material when using the rotating wheel media with QR Code in learning. The percentage of student responses for each component is obtained by the formula:

$$P = \frac{f}{N} \times 100\% \quad (2)$$

Description:
P = Percentage of student responses
f = Total scores obtained
N = Highest or maximum score

Table 2. Percentage of Student Responses

Percentage (%)	Validity Criteria
0 - 25	Very Ineffective
26- 50	Ineffective
51- 75	Effective
76– 100	Very Effective

Result and Discussion

This research produces a product in the form of a rotating wheel with a QR Code material for my dear earth, my poor earth. This rotating wheel with a QR Code was developed based on the stages in the ADDIE development model. The following are the stages carried out in the development of a rotating wheel with a QR Code, namely:

Analysis

The first stage carried out by researchers to be able to develop a rotating wheel media with a QR Code begins with analysis. Analysis is the stage of collecting information that is used as a reference in developing a product. This aspect is evaluated so that researchers can determine the needs required by the school and provide advice to researchers whether the media developed is in accordance with the needs. This information is collected through material analysis and analysis of student characteristics. Material analysis, the material to be studied is my dear earth, my poor earth as in the student book which will be displayed on the rotating wheel media with a QR Code. Student analysis will help determine the needs of the media to be created. Students can understand the material for my dear earth, my poor earth and the enthusiastic attitude of students who are interested in utilizing the rotating wheel with a QR Code after being given an explanation of the material on the rotating wheel media with a QR Code.

Design

In the second stage, namely the design of the rotating wheel media with the QR Code that was developed, starting with compiling the basis for making the rotating wheel media with the QR Code, the researcher made a media creation plan. The researcher then collected the necessary materials and equipment. Among them are wood, wood paint, clock hands, and paper pins. While the tools are in the form of saws, rulers, pencils, nails, and bolts. The design of this media uses bright and attractive colors. Canva is a tool used to design rotating wheel media with QR Code which functions as a support system, and is needed at this design stage to develop learning media. The design of the rotating wheel media, namely a wheel that can rotate, consists of 18 segments containing four colors including red, yellow, blue, and green. On the small wheel section, there is a display of images that have been adjusted to the existing material, has instructions for using A4-sized media, question and answer cards, making validation sheets for media experts and material experts, and making teacher response questionnaires and student response questionnaires.

Development

The next stage is development, where the researcher continues the design that was made in the previous stage. Researchers start making media by determining the material, selecting materials, making or designing a rotating wheel, and collecting images that will be used on the media. The following is an explanation of the rotating wheel media with QR Code:

Display of Instructions for Use

The instructions for using the rotating wheel media with QR Code use matching colors and attractive designs. Printed on A4 ivory paper. These instructions for use are divided into two parts.

Figure 2. Instructions for using the rotating wheel media with QR code

Rotating Wheel Media Display with QR Code

The large circular design of the rotating wheel is designed using attractive bright colors with a variation of 18 images. The large circular design has a diameter of 35 cm. The small circular design contains a map of Indonesia. This media is made of wood with a thickness of 3 cm and painted in dark blue. The QR Code contains teaching materials and how to use the media under the circle.

Figure 3. Rotating wheel media with QR code

Question Card Display

Question cards are designed using the Canva application measuring 9.5 cm x 8 cm. Students spin until one of the colors on the wheel stops, then take a question card based on the color determined from the results of the spin.

Figure 4. Rotating wheel media question card with QR code

Answer Card Display

The answer card is designed using the Canva application with a size of 9.5 cm x 8 cm. The answer card is used to find the answer if students can answer the existing question.

After the media was created, the researcher validated it with media and material experts to obtain input, criticism, and suggestions. To determine the quality of the product and the suitability of the media and materials for use in schools, validation was carried out by expert validators. There were 2 validators who validated the media and validated the materials. The data from the media expert assessment results were used to determine the level of suitability of the rotating wheel media with QR Code in terms of media. In the media suitability test, a 12-item assessment instrument was used and a Likert scale of 1 to 5 was used.

Figure 5. Answer card for rotating wheel media with QR code

Table 3. Media Expert Assessment Results

Feasibility aspects	Score obtained	Maximum score	Percentage (%)	Criteria
Media aspects	30	30	100	Very Worth It
Display aspect	35	40	87.50	Very Worth It
Aspects of use	20	20	100	Very Worth It
Total score	85	90	94	Very Worth It

The validation results of the rotating wheel learning media with QR Code were declared very feasible with an overall result of 94%, based on data obtained from media experts who provided an assessment of the media's feasibility.

$$\text{Validation value} = \frac{raw\ score\ obtained}{overall\ maximum\ score} \text{ x } 100\% \quad (3)$$

$$\text{Validation value} = \frac{85}{90} \text{ x } 100\%$$

$$= 94\%$$

The results of the material expert assessment are used to measure the level of material feasibility in the rotating wheel learning media with QR Code. In the material feasibility test, an instrument with 12 assessment items was used and a Likert scale of 1 to 5.

Table 4. Results of Material Expert Assessment

Feasibility aspects	Score obtained	Maximum score	Percentage (%)	Criteria
Material Suitability	17	20	85	Very Worth It
Completeness of materials	12	15	80	Very Worth It
Material suitability	8	10	80	Very Worth It
Competence	13	15	87	Very Worth It
Total score	50	60	84	Very Worth It

Based on the data obtained from material experts who provided an assessment of the feasibility of the media, the data obtained was that the results of the material validation were very feasible with an overall result of 84%.

$$\text{Validation value} = \frac{raw\ score\ obtained}{soverall\ maximum\ core} \text{ x } 100\% \quad (4)$$

$$= \frac{50}{60} \text{ x } 100\%$$

$$= 84\%$$

Implementation

The fourth stage is the implementation stage which aims to assess the feasibility of the rotating wheel media with QR Code from the perspective of teachers and students. Several stages of product implementation are as follows:

Question Trial

Table 5. The Results of the Trial Questions to Take Valid Questions that will be Used for the Pretest and Posttest

Question number	R count	R Table	Variance	Conclusion
Question 1	0.405	0.396	0.25	Valid
Question 2	0.197	0.396	0.227	In Valid
Question 3	0.552	0.396	0.36	Valid
Question 4	0.533	0.396	0.25	Valid
Question 5	0.442	0.396	0.25	Valid
Question 6	0.316	0.396	0.26	In Valid
Question 7	0.0555	0.396	0.24	In Valid
Question 8	0.3785	0.396	0.26	In Valid
Question 9	0.3962	0.396	0.25	Valid
Question 10	0.569	0.396	0.257	Valid
Question 11	-0.129	0.396	0.227	In Valid
Question 12	0.353	0.396	0.257	In Valid
Question 13	0.548	0.396	0.257	Valid
Question 14	0.27	0.396	0.24	In Valid
Question 15	0.531	0.396	0.24	Valid
Question 16	0.288	0.396	0.24	In Valid
Question 17	0.57	0.396	0.227	Valid
Question 18	0.602	0.396	0.26	Valid
Question 19	0.5131	0.396	0.2267	Valid
Question 20	0.233	0.396	0.257	In Valid
Question 21	0.323	0.396	0.25	In Valid
Question 22	0.3231	0.396	0.25	In Valid

Initial research was conducted by conducting a trial of questions that were processed into pretest and posttest questions. This research was conducted in class V, so the trial question stage was conducted in a class that had previously received learning about the material of Science Chapter 8 My Dear Earth, My Malang Earth, namely class VI SDN Pati Lor 05 with a total of 20 students.

With these data, the results of 50 trial questions given to 20 grade VI students of SDN Pati Lor 05 were obtained, valid questions and could be reprocessed in the pretest and posttest, namely 21 questions. After being analyzed based on the level of interpretation, the researcher obtained 20 valid questions to be used as pretests and posttests.

Small Group Trial

At this stage, a trial of the learning media was carried out to determine the effectiveness of the media to be implemented. This small group trial was carried out on grade V students of SDN Pati Lor 05 Pati Regency with a total of 10 students. This stage was carried out by using the rotating wheel learning media with QR Code by answering the student response questionnaire to the rotating wheel learning media with QR Code. The student response questionnaire was compiled by considering several assessment criteria (Schellekens et al., 2024; Andrade, 2019; Gao et al., 2024), and with an alternative assessment using a Likert scale of 1 - 4. The results are as follows in the table 6.

Table 6. Small Group Trial Results

Respondent	Question (item number)																Amount
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Respondent 1	3	3	4	4	4	4	4	3	3	4	4	4	4	4	4	4	59
Respondent 2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	64
Respondent 3	3	4	3	3	3	3	3	3	4	3	3	3	4	4	4	4	54
Respondent 4	4	4	3	4	4	4	3	4	4	4	3	4	4	4	4	3	60
Respondent 5	4	4	4	3	3	4	3	3	4	3	4	3	4	3	4	3	56
Respondent 6	3	3	4	4	4	4	3	4	4	4	4	4	3	4	3	4	54
Respondent 7	3	4	4	3	3	4	4	3	4	4	3	3	4	4	3	5	57
Respondent 8	4	3	3	4	4	4	4	4	4	4	3	4	4	4	4	3	60
Respondent 9	3	4	4	3	3	4	4	3	4	4	4	4	4	4	4	4	60
Respondent 10	4	4	4	4	3	4	4	4	4	4	3	4	3	3	3	4	60
Total score																	584
Eligibility Percentage																	91.25 %

With the total score of 10 students, namely 584, which after being processed with NP = R / SM x 100% as follows NP = 584 / 640 x 100%, a feasibility percentage of 91.25% was obtained indicating that the media category after being tested in small groups was very feasible.

Large Group Trial

Table 7. Pretest and Posttest Result Data

Name	Pretest	Postest
Allyssa Elvaretta Putri	20	90
Alya Masha Ananta	66	70
Anindya Rizki Dwiyanti	88	95

Name	Pretest	Postest
Anisa Putri Kirania	22	80
Aryzka Sita Okta Putriana	36	85
Axelle Janeto Widionda	50	90
Bambang Adi Nugraha	46	90
Bondan A Varo El Kenanns	74	85
Clarissa Aaulia Mega	84	80
Delvano Abdan Noviantara	52	90
Dino Andre Ansyah	36	90
Ellmeisy Jean Adena	82	90
Fatima Shinta Az Zahra	40	90
Febrina Wulan Sari	80	95
Fiorentina Laula Febrina	58	80
Hudzaifah Ubaid Dhiyaulhaq	58	90
Holifatus Suroh	68	95
Ivana Meira Anindya Putri	60	95
Jihan Elda Mumtazah	38	85
Lanang Pratama Firjatullah	54	80
Lathifa Yuri Rahmawati	64	85
Mohamad Choirul Nizam	62	85
Mohamad Rizki Fadikkah	68	100
Putra Akbar Alamsyah	50	90
Putri Yulianti	66	80

In the large group trial stage, it was carried out in class V SDN Pati Lor 05 with a total of 25 students. The trial was carried out by implementing the teaching module that had been created and validated by material experts which also included the media that was developed, namely the rotating wheel media with QR code (Widarini et al., 2022). The first is the work on the pretest questions as an initial step in student knowledge before the start of learning and before the implementation of the developed media. Then the learning is in accordance with the design in the teaching module with a time of 2 meetings or equivalent to 4 x 35 minutes. In it there is work on LKPD, evaluation questions, and then ends with the work on the posttest which will later be used as a comparison of student learning outcomes before and after media implementation (Sari & Tyas, 2024; Sukardi et al., 2020). With the results of data processing as in table 7.

By obtaining this data, the data can be processed by looking for normality with the results as in the table 8.

Table 8. Normality Data

		Kolmogrov-Smirnov			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Result	Pretest	.084	25	.200	.974	25	.757
	Postest	.21	25	.005	.929	25	.084

Table 9. Homogeneity of Variance Data

		Levene statistic	df1	Df2	Sig.
Pretest	Based on mean	.242	311.850	19	.866
	Based on median	.148	3	19	.930
	Based on median and with adjusted df	.148	3	15.858	.929
	Based on trimmed mean	.148	3	19	.872

Table 10. Anova Data

	Sum of Squares	df	Mean Square	F	Sig.
Between group	20.75.484	5	415.097	1.331	.294
Within Groups	5925.156	19	311.850		
Total	8000.640	24			

Based on the data above, the homogeneity test uses One Way Anova. The basis for decision making is if the significance value <0.05, then it is said that the variance of two or more groups of data populations is not the same. If the significance value> 0.05, then it is said that the variance of two or more groups of data populations is the same. So, the data above obtains a significance value of 0.294 which means it is greater than 0.05 which means that both pretest and posttest data have different variances.

Table 11. Paired Sample Data

		Mean	N	Std. deviation	Std. Error Mean
Pair 1	Pretest	56.8800	25	18.25815	3.65163
	Postest	87.4000	25	6.63325	1.32665

Table 12. Sample Correlation Data

		N	Correlation	Sig.
Pair 1	Pretest-Postest	25	.113	.592

Table 13. Paired Test Sample Data

		Paired differences			95% Confidence Interval of the differences			
		Mean	Std. deviation	Std. Error Mean	Lower	Upper	t	df
Pair 1	Pretest-Postest	-30.52000	18.71078	3.74216	-38.24343	--22.79657	-8.156	24

In the decision making of Paired Sample T-Test whether the hypothesis is accepted or rejected, namely if Sig. (2-tailed) <α / T count > T table = There is a significant difference between the 2 score variables. Based on the data above, the Sig. (2-tailed) value is less than 0.05, meaning that the hypothesis is accepted because there is a significant difference between the 2 score variables. So, it can be concluded that there is a difference in the average between the pretest and posttest values before and after using the rotating wheel media with QR Code (Lindblom & Alenljung, 2020; Widiyati et al., 2024).

Table 14. N – Gain Test Data

	N	Min	Max	Mean	Std. Deviation
N Gain	25	-25	1.00	.6506	.27072
Valid N (Listwise)	25				

The N-Gain score criteria have 3 intervals, namely if the N-Gain value ≥ 0.7 then it is categorized as high, the second category if 0.3 ≤ N-Gain <0.7 then it is categorized as medium, and the third if N-Gain <0.3 then it is categorized as low. Based on the data above, the gain score value in this data meets the first interval because the gain value of 0.6506 which is rounded up to 0.7 is categorized as high. So, it can be concluded that there is a high increase in assessment between the pretest and posttest values.

Evaluation

The last stage is evaluation. Evaluation is a process that involves analysis and assessment of the media developed after the implementation stage (Reed et al., 2021; Whitsel et al., 2024). This evaluation procedure is carried out to ensure the feasibility of the learning media product created. These steps are carried out by obtaining data from expert media validators and material experts who then provide validation sheets. If there are still obstacles after collecting information from experts, the media will be changed according to suggestions and input from the validator until it is ready to use. In addition, a review of the revision and development of the rotating wheel media product with QR Code was also carried out (Keith et al., 2017). As an effort to correct the errors found in the media, the evaluation of this media was carried out based on the suggestions and comments given by the media expert and material expert validation (Rukoyah & Bektiningsih, 2024). The suggestions and input given by the media expert validator were to improve the QR Code section so that the color matches the media color, which is blue, complete the author's profile on the teaching materials, and export the teaching materials file as a PDF (Ajanovic et al., 2022; Liu et al., 2021). Meanwhile, the suggestions and input given by the material expert validator were to better adapt the examples to the life around the students (Nicastri et al., 2024; Tan et al., 2024; Gunawardena et al., 2024).

Conclusion

Based on the results of the research and development of the rotating wheel learning media with QR Code for the material of my dear earth, my poor earth, it can be concluded that the researcher has succeeded in developing the rotating wheel learning media with QR Code for the material of my dear earth, my poor earth through the steps or stages of potential and problems, data collection, product design, design validation, design revision, product trials, and final products. The development of the rotating wheel learning media with QR Code includes product manufacturing planning and design creation. Product manufacturing planning includes material selection and media design planning. The media has several components, including: rotating wheel; question cards; answer cards; stars; teaching materials; instructions for using the media. Then the media is validated by material experts and media experts. The rotating wheel learning media with QR Code that has been developed is stated to have very feasible criteria or categories by material experts and media experts with an average percentage of the material content feasibility component of 84% from material experts, and the media presentation component of 94% from media experts and given a positive response by class teachers with a percentage of 93% and students with a percentage of 84.6%. So the rotating wheel learning media with QR Code is very feasible and very effective to use as a medium in learning.

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Author Contributions

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and tools; conducting research; analyzing data; and drafting the article. All authors reviewed the results and approved the final version of the manuscript.

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The authors declare no conflict of interest.

References

Ajanovic, A., Sayer, M., & Haas, R. (2022). The economics and the environmental benignity of different colors of hydrogen. *International Journal of Hydrogen Energy*, *47*(57), 24136–24154. https://doi.org/10.1016/j.ijhydene.2022.02.094

Aldalur, I., & Perez, A. (2023). Gamification and discovery learning: Motivating and involving students in the learning process. *Heliyon*, *9*(1), e13135. https://doi.org/10.1016/j.heliyon.2023.e13135

Andrade, H. L. (2019). A Critical Review of Research on Student Self-Assessment. *Frontiers in Education*, *4*, 87. https://doi.org/10.3389/feduc.2019.00087

Arola, T., Aulake, M., Ott, A., Lindholm, M., Kouvonen, P., Virtanen, P., & Paloniemi, R. (2023). The impacts of nature connectedness on children's well-being: Systematic literature review. *Journal of Environmental Psychology*, *85*, 101913. https://doi.org/10.1016/j.jenvp.2022.101913

Bramastia, B., & Rahayu, S. (2023). Study of Science Learning Based on Scientific Literacy in Improving Critical Thinking: A Scoping Review. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 499–510. https://doi.org/10.29303/jppipa.v9i8.5667

Cahayani, N. L. P., & Suastra, I. W. (2024). Implementation of Independent Learning Curriculum In The Perspective Of Progressivism Philosophy. *Indonesian Journal of Educational Development (IJED)*, *4*(4), 538–545. https://doi.org/10.59672/ijed.v4i4.3379

De Jong, T., Lazonder, A. W., Chinn, C. A., Fischer, F., Gobert, J., Hmelo-Silver, C. E., Koedinger, K. R., Krajcik, J. S., Kyza, E. A., Linn, M. C., Pedaste, M., Scheiter, K., & Zacharia, Z. C. (2023). Let's talk evidence – The case for combining inquiry-based and direct instruction. *Educational Research Review*, *39*, 100536. https://doi.org/10.1016/j.edurev.2023.100536

Fojo, G. A., & Tesfa, A. (2020). The khat dilemma in Jimma area: The socio-economic analysis of benefits and harms associated with kath use. *Harmoni Sosial: Jurnal Pendidikan IPS*, *7*(1), 9–21. https://doi.org/10.21831/hsjpi.v7i1.30289

Gao, R., Merzdorf, H. E., Anwar, S., Hipwell, M. C., & Srinivasa, A. R. (2024). Automatic assessment of text-based responses in post-secondary education: A systematic review. *Computers and Education: Artificial Intelligence*, *6*, 100206. https://doi.org/10.1016/j.caeai.2024.100206

Gunawardena, M., Bishop, P., & Aviruppola, K. (2024). Personalized learning: The simple, the complicated, the complex and the chaotic. *Teaching and Teacher Education*, *139*, 104429. https://doi.org/10.1016/j.tate.2023.104429

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Isnaeni, Y. L. & Zulherman. (2024). E-Modules of Natural and Social Sciences (IPAS) "Changes in Energy Forms" with FlipHTML5 to Improving the Student Motivation of Elementaray School. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5687–5693. https://doi.org/10.29303/jppipa.v10i8.8067

Keith, R. E., Crosson, J. C., O'Malley, A. S., Cromp, D., & Taylor, E. F. (2017). Using the Consolidated Framework for Implementation Research (CFIR) to produce actionable findings: A rapid-cycle evaluation approach to improving implementation. *Implementation Science*, *12*(1), 15. https://doi.org/10.1186/s13012-017-0550-7

Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. *Heliyon*, *7*(6), e07309. https://doi.org/10.1016/j.heliyon.2021.e07309

Lanza, K., Alcazar, M., Chen, B., & Kohl, H. W. (2023). Connection to nature is associated with social-emotional learning of children. *Current Research in Ecological and Social Psychology*, *4*, 100083. https://doi.org/10.1016/j.cresp.2022.100083

Lindblom, J., & Alenljung, B. (2020). The ANEMONE: Theoretical Foundations for UX Evaluation of Action and Intention Recognition in Human-Robot Interaction. *Sensors*, *20*(15), 4284. https://doi.org/10.3390/s20154284

Liu, Y., Ma, W., Guo, X., Lin, X., Wu, C., & Zhu, T. (2021). Impacts of Color Coding on Programming Learning in Multimedia Learning: Moving Toward a Multimodal Methodology. *Frontiers in Psychology*, *12*, 773328. https://doi.org/10.3389/fpsyg.2021.773328

Marpanaji, E., Mahali, M. I., & Putra, R. A. S. (2018). Survey on How to Select and Develop Learning Media Conducted by Teacher Professional

Education Participants. *Journal of Physics: Conference Series*, *1140*, 012014. https://doi.org/10.1088/1742-6596/1140/1/012014

Nadeem, M., Oroszlanyova, M., & Farag, W. (2023). Effect of Digital Game-Based Learning on Student Engagement and Motivation. *Computers*, *12*(9), 177. https://doi.org/10.3390/computers12090177

Nasrudin, D., Fitriyanti, N., Muhtar, S., Dalimunthe, R. N. R. P., Nandang, A., Hidayat, W., & Kurnia, A. (2021). Introducing physics in early childhood: Logic, language, and literacy. *Journal of Physics: Conference Series*, *1806*(1), 012024. https://doi.org/10.1088/1742-6596/1806/1/012024

Nicastri, M., Dincer D'Alessandro, H., Anderson, K., Ciferri, M., Cavalcanti, L., Greco, A., Giallini, I., Portanova, G., & Mancini, P. (2024). Cross-Cultural Adaptation and Validation of the Listening Inventory for Education-Revised in Italian. *Audiology Research*, *14*(5), 822–839. https://doi.org/10.3390/audiolres14050069

Nur'ariyani, S., Jumyati, J., Yuliyanti, Y., Nulhakim, L., & Leksono, S. M. (2023). Scientific Approach to Learning Science in Elementary Schools. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6659–6666. https://doi.org/10.29303/jppipa.v9i8.3680

Pérez-Guilarte, Y., Armas-Quintá, F. X., & Macía-Arce, X. C. (2022). Social Sciences Teaching: Building a Holistic Approach from Student Teachers' Social Representations. *Social Sciences*, *11*(7), 307. https://doi.org/10.3390/socsci11070307

Putri, M. A. N., Sya'roni, I., Krisnaningsih, E., & Devianti, W. (2022). Development of Arduino-Based Rotating Wheel as a Physics Learning Media of Circular Motion. *Jurnal Pendidikan MIPA*, *23*(2), 821–831. https://doi.org/10.23960/jpmipa/v23i2.pp821-831

Reed, M. S., Ferré, M., Martin-Ortega, J., Blanche, R., Lawford-Rolfe, R., Dallimer, M., & Holden, J. (2021). Evaluating impact from research: A methodological framework. *Research Policy*, *50*(4), 104147. https://doi.org/10.1016/j.respol.2020.104147

Rukoyah, S., & Bektiningsih, K. (2024). Development of Interactive Learning Media Based on Smart Apps Creator to Enhance Elementary School Students' Science Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *10*(10), 8127–8135. https://doi.org/10.29303/jppipa.v10i10.8046

Safitri, E., & Purnamasari, L. (2024). How Effective is the Use of Digital Evaluation Media in Learning Student: A Review. *Journal of Digital Learning and Distance Education*, *3*(1), 897–901. https://doi.org/10.56778/jdlde.v3i1.303

Sari, P. M., & Tyas, D. N. (2024). Development of Lectora Inspire Based Learning Media to Improve Learning Outcomes of Light and Its Properties. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 9200–9207. https://doi.org/10.29303/jppipa.v10i11.7406

Sari, S., Safitri, I., & Farida, I. (2019). Design of educational games oriented to chemical literacy on petroleum material. *Journal of Physics: Conference Series*, *1402*(5), 055032. https://doi.org/10.1088/1742-6596/1402/5/055032

Sarpong, D., Boakye, D., Ofosu, G., & Botchie, D. (2023). The three pointers of research and development (R&D) for growth-boosting sustainable innovation system. *Technovation*, *122*, 102581. https://doi.org/10.1016/j.technovation.2022.102581

Schellekens, L. H., Van Der Schaaf, M. F., Baartman, L. K. J., Van Der Vleuten, C. P. M., Kremer, W. D. J., & Bok, H. G. J. (2024). Students' perceptions of the assessment programme's impact on self-regulated learning: A multiple-case study. *Assessment & Evaluation in Higher Education*, *49*(8), 1074–1090. https://doi.org/10.1080/02602938.2024.2343317

Sommer, K., Nielsen, M., Draheim, M., Redshaw, J., Vanman, E. J., & Wilks, M. (2019). Children's perceptions of the moral worth of live agents, robots, and inanimate objects. *Journal of Experimental Child Psychology*, *187*, 104656. https://doi.org/10.1016/j.jecp.2019.06.009

Sukardi, Mayefis, R., & Usmeldi. (2020). Effectiveness of Mobile Learning Media on Computer Assembly at Vocational High School. *Journal of Physics: Conference Series*, *1594*(1), 012012. https://doi.org/10.1088/1742-6596/1594/1/012012

Tan, Y. J., Ong, S. C., Goh, S. P., Chen, G., Yong, V. S., Khor, W. W., Kan, Y. M., Choong, Y. Y., Zameram, A. M., Tan, L. Y., Voo, J. Y. H., Lam, K. K., Yen, C. H., Wahab, M. J. A., & Abdulla, Z. B. (2024). Translation, cross-cultural adaptation, and psychometric validation of the Malay version of the Assessment of Quality of Life—6 Dimensions (Malay-AQoL-6D) instrument among Malaysians living with chronic heart failure. *Journal of Patient-Reported Outcomes*, *8*(1), 79. https://doi.org/10.1186/s41687-024-00763-3

Whitsel, L. P., Honeycutt, S., Radcliffe, R., Johnson, J., Chase, P. J., & Noyes, P. (2024). Policy implementation and outcome evaluation: Establishing a framework and expanding capacity for advocacy organizations to assess the impact of

their work in public policy. *Health Research Policy and Systems*, *22*(1), 27. https://doi.org/10.1186/s12961-024-01110-0

Widarini, N. K. L., Margunayasa, I. G., & Rati, N. W. (2022). Pop-Up Book Media Assisted By QR Code For Second-Grade Elementary School Students. *Journal for Lesson and Learning Studies*, *5*(3), 439–447. https://doi.org/10.23887/jlls.v5i3.47223

Widiyati, E., Kibtiyah, A., & Bahrodin, A. (2024). Teacher Accompaniment in Improving Digital Literacy Through Metamorphosis Props Training QR-Code. *Soeropati: Journal of Community Service*, *6*(2), 183–198. https://doi.org/10.35891/js.v6i2.4949

Yang, W. (2024). Evidence-based social science: Why, what, and future implications. *Humanities and Social Sciences Communications*, *11*(1), 1024. https://doi.org/10.1057/s41599-024-03535-y

Yanti, F. (2022). Innovative Learning Media in Era 4.0: Review. *Journal of Digital Learning and Distance Education*, *1*(4), 125–130. https://doi.org/10.56778/jdlde.v1i4.30