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DEVELOPING QR CODE INTERACTIVE MULTIMEDIA WORKSHEETS FOR IMPROVING STUDENTS' LEARNING

RESEARCH ARTICLE

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Abstract
This research was conducted to obtain problems and potentials so that considerations are obtained to make alternative policies (product design). This study aims to determine the feasibility of interactive multimedia-assisted LKPD, improving student learning outcomes and student responses to the developed LKPD. The type of research conducted is the type of research and development (RnD) with the ADDIE model (analysis, design, development, implementation, and evaluation). The results of this research include, (1) LKPD assisted by interactive multimedia QR Code of 99.04% is considered very feasible (2) increasing student learning outcomes by using tests before (pretest) and after (posttest) with N-Gain results in the medium category of 0.40 (3) based on student responses to LKPD assisted by interactive multimedia QR Code getting a very good category with a percentage of 81.17%. Based on the results of this study, it can be concluded that the LKPD assisted by interactive multimedia QR Code is very feasible to use on momentum and impulse material. In addition, the use of media can improve student learning outcomes.

Keywords: ADDIE, Interactive multimedia, Learning outcomes, and Momentum and impulse

Introduction

Education is a process of learning activities where students will form their character and potential so that they are able to adapt to the community environment. This is in line with the opinion, Nurholis (2020) stated that education is a process or activity in learning students to know themselves that they have potential in themselves. It should be noted that since humans are born, they already have the character of their own potential, and each human has a different potential. To develop the potential that exists in humans, it is necessary to have education and learning to improve the quality of human resources themselves. Learning is one of the processes that is able to provide knowledge in various fields through subjects so that it can be used as a provision for them in achieving learning goals. So in this case, teachers must be able to create pleasant conditions as an alternative when

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delivering material to students, especially in mathematics subjects. Mathematics itself is known as a subject that students do not like, so there needs to be an alternative to overcome this Rosalina & Egok (2023)

Education, in a broad context, is a conscious and planned effort to create a learning atmosphere and learning process that allows students to develop their potential. It includes the development of the spiritual aspects, personality, intelligence, morals, knowledge, and skills necessary to contribute to society. At this time, Indonesia is in the midst of the era of the industrial revolution 5.0. Educators must adapt to changes in situations like this. The current learning system will definitely be different from the learning system in the previous stage. The learning system in the previous stage had a more conventional approach, and the teacher remained focused on the learning process (Hanum et al., 2021).

In an effort to improve students' understanding and make them active in learning, it is necessary to create an interactive teaching material so that it can help students understand the concept of physics, as for the teaching material, namely interactive multimedia-based Student Worksheets. Multimedia is a variety of computer-based media and communication systems that have a role in storing and receiving information in the form of text, audio, video, graphics and so on, Ritonga et al. (2022) Interactive multimedia is multimedia that consists of an operable controller, in addition to presenting material, it is also equipped with videos and animations so that users can choose according to their needs which can increase students' understanding in learning the material presented Haspen & Syafriani (2022).

Based on the results of this study, there are a lot of difficulties found in the continuous learning process, including teaching materials that are still in the form of ordinary material books written formulas, explanations, sample questions and practice questions, Nurfalah (2019) As for other difficulties, students rarely have the opportunity to use their *cell phones* to look for learning videos related to this material. In addition, the difficulties experienced by students are that this business and energy material is too concrete and difficult to describe directly, so that students are less able to create imagination related to this material in this material.

The difficulties experienced by the students make teachers think about how to make students able to understand this business and energy material more youngly. Therefore, because of this difficulty, the researcher offers a solution to overcome it, namely by developing an interactive multimedia-assisted Student Worksheet, Santoso (2019). Therefore, this worksheet will be packaged in the form of a learning video placed on the Student Worksheet in the form of *a QR Code*. So that with this worksheet, it is hoped that students can more easily understand this business and energy material and can also be reached anywhere.

The interactive multimedia-based Student Worksheet has the advantage of being able to motivate students to understand this business and energy material. In addition, with materials packaged in the form of *QR Codes*, of course, it can provide convenience to students because they do not need to type a search on google but can immediately *censor the QR Code* on the student's worksheet (Ritonga et al., 2022).

According to the conducted research, there are numerous challenges in the process of continuous learning, such as the use of instructional materials that are still in the form of standard material books that include explanations, formulas, sample questions, and practice questions. Regarding the other challenges, students are rarely eager to search for instructional videos on their phones that pertain to the subject matter they are studying, Nurfalah (2019) Students struggle because

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the content on motion and impulse is too tangible and hard to explain explicitly, which limits their ability to imagine how this material might be used.

The challenges the pupils faced prompted the teacher to consider how to help the younger children comprehend this content on momentum and impulse. The researcher provides a way to get around this challenge by creating an interactive, multimedia-assisted LKPD, Santoso (2019). After that, this worksheet will be presented as a learning movie and posted as a QR code on the LKPD. It is therefore intended that this worksheet, which is accessible from anywhere, will help students comprehend the business and energy content more readily (Hardila et al., 2021).

Based on the results of the analysis of the student questionnaire at SMAN 3 Bengkulu Tengah, information was obtained based on (1) that students have difficulty understanding physics learning material and are not active during learning, (2) students think that the learning media used by teachers has not made them understand the material being taught, (4) students agree with the development of technology-assisted physics learning media that can be accessed anywhere. The development of technology-assisted physics learning media can help students to learn.

The information gathered from the analysis of the student questionnaire at SMAN 3 Bengkulu Tengah was based on the following findings: (1) students find it difficult to understand the physics curriculum and are not engaged in their studies; (2) students believe that the learning resources used by teachers have not helped them grasp the material; and (3) students support the creation of technology-assisted physics learning resources that are accessible from any location. Students can benefit from the creation of technology-assisted physics learning resources.

Using interactive teaching materials will, of course, pique students' interest in learning more about business and energy materials than only LKPD, as we can infer from some of the aforementioned arguments that kids will be younger to understand momentum and impulse materials. Learning will be more useful and efficient if the materials are presented as QR codes. The purpose of this study is to see the improvement of the learning outcomes of SMAN Bengkulu Tengah students through the development of interactive media.

Literature Review

Learning is defined as the process of creating an environment for learning to occur so as to change the behavior of learners. One of the highlights of learning these days is the video-based learning environment at various levels of education, from primary education to higher education, and covering a wide range of learning subjects, including physics learning, Hafizah (2020), physics is one of the abstract subjects that requires visualization so that learning media is needed so that students are able to understand the concepts learned. One of the learning media that displays visualization by utilizing technology in the form of educational games. LKPD is one of the teaching materials that plays an important role in providing answers that are relevant to the material being taught, to maximize the understanding ability of students in accordance with the indicators in learning. Learning will be easier if accompanied by learning resources in the form of specially designed LKPD. The LKPD designed in this study aims to assist students in developing their critical thinking skills Hasanah & Kamalia Siregar (2023).

Interactive multimedia is a combination of various media (file formats) in the form of text, images (vector or bitmap), graphics, sound, animation, video, interaction, etc. that have been packaged

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into digital (computerized) files, used to convey messages to the public. 10 which have been packaged into digital files (computerized), used to convey messages to the public. Multimedia has the function of clarifying the presentation of material, overcoming the limitations of space, time, and sensory power, and can overcome the passive attitude of students. During the Covid 19 pandemic, its usefulness became very significant because interactive multimedia has advantages that can be used even with distance learning conditions (Manurung, 2021).

Quick Response Code (QR Code) is one of the technology-based learning media. According to Rouillard (Irawan & Adriantantri, 2018) QR Code was developed as a code that allows its content to be translated at high speed. Q`R Code can easily access data quickly, and can be read with a smartphone. The tool used to read the QR Code is called a QR Scanner. Furthermore, in the preparation of the learning process the material to be taught is integrated using the QR Code. (Priyambodo et al., 2020).

Methodology

This type of research is Research and Development (RND) research. According to, Sugiyono (2008), research and development consist of two words, namely research and development. Research and development activities are carried out sequentially, namely conducting research first, then developing. This research was conducted to obtain problems and potentials so that consideration was obtained to make alternative policies (product designs). In this interactive learning media development research, the ADDIE development model is used (Ashsiddieqy et al., 2024).

There are two terms that make up the phrase "research and development." Research is done first, followed by development, as research and development activities are done in that order. The purpose of this study was to identify issues and opportunities in order to gather information for developing alternative policies (product designs). The ADDIE development approach is applied in this study on the creation of interactive learning media. The ADDIE method is a systems approach to learning development and learning development processes. As stated by, Branch (2009) The five phases of the ADDIE development paradigm are analysis (analysis), design (design), development (development), implementation (implementation), and evaluation (evaluation) (Haspen & Syafriani, 2022).

Techniques for gathering data included literature reviews, observations, interviews, questionnaires, pretests, and posttests. Data collecting tools included pretest, posttest, expert validation questionnaires, student answer questionnaires, observation sheets, and teacher and student interview sheets. Pretest and posttest sheets are created using metrics for better learning results. Three components of the cognitive realm are among the cognitive domains that serve as the indications. Understanding (C2), Application (C3), and Knowledge (C1) (Pazah et al., (2024).

In this study, the first stage carried out is the analysis stage, which is to analyze the need for new product development (models, methods, media, teaching materials) and analyze the feasibility and conditions of product development. The second stage, namely design, is a systematic process that starts from designing the concept and content in the product. The third stage is development, which contains activities to realize product designs that have previously been made. The fourth stage is Implementation, which is the application to obtain feedback on the product made/developed. And the fifth stage, namely Evaluate, is to give feedback to product users, so that revisions are made in accordance with the results of the evaluation or needs that cannot be met by the product. The final

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goal of the evaluation is to measure the achievement of development goals. The product produced in this study is in the form of student worksheets with the help of interactive multimedia QR Code to improve student learning outcomes.

In this study, the ADDIE model is used specifically to develop multimedia learning based on science literacy. At each stage of multimedia development, it must have a peculiarity that reflects the existence of scientific literacy domains. This is because the purpose of the multimedia development is oriented to the development of students' science literacy and the multimedia design also contains science literacy. Based on this, this article describes the stages of the ADDIE model in the development of science literacy-based learning multimedia (Latip, 2022).

In this study, the sample of students consisted of 30 students who had variations in the level of thinking, namely low, medium, and high. Students with low-level thinking tend to have difficulty understanding basic concepts and often need more guidance to complete academic tasks. Meanwhile, students with an intermediate level of thinking showed better abilities in comprehending the material, although they still needed support to develop critical thinking skills. On the other hand, students with a higher level of thinking are able to analyze information in depth and apply their knowledge in complex situations, so they often become leaders in group discussions.

The Independent Curriculum provides space for students to develop their potential independently and creatively. In this context, students with low-level thinking are encouraged to engage in more interactive and contextual learning activities, so that they can understand the material in a more enjoyable way. Students with medium thinking can be given appropriate challenges to improve critical and collaborative thinking skills through group projects. Meanwhile, high-minded students are given the opportunity to explore new ideas and conduct independent research, so they can hone their analytical and innovative abilities. With this diverse approach, the Independent Curriculum strives to create an inclusive learning environment and empower all students. The purpose of this study is to see the improvement of the learning outcomes of SMAN Bengkulu Tengah students through the development of interactive media. The results of learning implementation, student assessments administered to enhance learning outcomes, expert validation of media viability, and student response questionnaires to the created learning media served as the research's data sources. The following are the data collection methods employed in this study:

Research site and participants

Samples are some characteristics possessed by a population, researchers can use samples taken from the population (Sugiyono, 2018). Researchers took a sample of 30 students and physics teachers of class X11 SMAN Bengkulu Tengah who had high, middle and low-level abilities. This sampling is intended to collect information about the research population and can provide an overview of the population.

Feasibility Analysis of Learning Media

Using the measuring instruments, this feasibility test was conducted to determine whether or not the data collected following the investigation was valid. This study's validity test was conducted using methods for analyzing validity sheets that contained both qualitative and quantitative data.

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While the Likert measurement scale provided quantitative data, expert replies and recommendations provided qualitative data. To ascertain the media eligibility category, in accordance with, Sugiyono (2018) Equation 1 is then used to get the feasibility percentage. From the results of the validity that have been carried out, the percentage can be matched with the percentage in Table 1.

Table 1. *Media eligibility percentage*

Percentage	Category
81% -100%	Highly Worthy
61% - 80%	Proper
41% - 60%	Quite Decent
21% - 40%	Less Worthy
0% - 20%	Not Eligible

Learning outcome analysis

To ascertain whether utilizing the product has improved student learning outcomes, the data gathered from the student learning outcome exam will either be assessed quantitatively or transformed into qualitative data. The average score earned by every student is then determined. To find out the ability of student learning outcomes towards the LKPD that is developed. The gain points obtained are then analyzed using the criteria in Table 2.

Table 2. *N-Gain Index Criteria*

N-Gain	Criterion
g > 0.7	Tall
g ≤0.4	Keep
g ≤ 0.3	Low

Student response analysis

Because this study used a questionnaire to collect student response data, students selected responses that were marked with checklist items. Questions concerning students' answers to the LKPD that has been used are included in the given questionnaire. Students' answers to the generated LKPD were examined by data analysis. Data from offline questionnaires completed by students served as the basis for the analysis. The percentage of responses based on the score determined by equation (3) was used to analyze the response data. In order to determine the eligibility requirements for the interactive LKPD, the percentage of replies that were received was converted to an evaluation statement based on the table. The evaluation scale for the proportion of student answers in Table 3 is as follows.

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Table 3. *Student response percentage*

Category	Score
R > 80%	Excellent
61% < R ≤ 80%	Good
41% < R ≤ 60%	Pretty Good
21% < R ≤ 40%	Not Good
R ≤ 20%	Very Not Good

Results

This research produces learning media for students' worksheets with the help of interactive multimedia QR Code. This LKPD is in the form of a hard file, where in this LKPD there are two barcodes, one barcode to access the phet simulation and another barcode to access the quiziz available on nearpod. This research uses the ADDIE model as a guide in the process of creating learning media. The following are the steps in implementing media development.

Analysis

From the analysis of student needs, 52% of students have difficulty in learning physics. In the analysis of LKPD needs to improve student learning outcomes, a percentage of 69% was obtained, stating that students need learning media that can later support physics learning in class. Then in the analysis of the needs of interactive multimedia physics learning media QR Code assisted by nearpod, 83% of students need learning media. Analysis of learning activities from physics teacher interviews shows that SMAN 3 Bengkulu Tengah has implemented the Merdeka curriculum since one year ago. In this teaching and learning activity I applied momentum and impulse material in the 2024/2025 school year. In the independent curriculum, LKPD which is good to use is IT-based learning media (Science Technology) as a learning resource. From the results of the interview, it was also found that the teacher had used the problem base learning model in physics learning, but the media used in physics learning had not used IT-based media.

Based on these problems, the solution that can be done is to develop IT-based learning media. One of them is developing physics learning media assisted by nearpod technology, which can help students to be more active during learning. The advantage of developing this software is that students can study at home using this nearpod application through a QR Code or link shared with students. At the evaluation analysis stage regarding the addition of science understanding indicators where before conducting trials on students conduct an evaluation of the analysis of student needs, therefore the need for improvement at this stage of the analysis. From this evaluation, we need to make improvements to each indicator that has been given suggestions for improvement from the validator.

Design

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During this design phase, researchers create assessment tools to evaluate the final product and decide on the components of storyboards and learning media. The cover, content, and introduction all incorporate the product design. Phones with a strong internet connection can access the student worksheet media that has been provided which is assisted by an interactive multimedia QR Code. Interactive media can be accessed via the link:https://www.canva.com/design/DAGV0KlpvW0/m5E_IrbrTTtz4tYOPcPOdw/edit?utm_content=DAGV0KlpvW0&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton

On the media view there is a cover, initial view, and core followed by instructions with steps on how to use it, a barcode that students can scan, and then they can enter the code or password from their respective Gmail accounts to log in. Once logged in, the main menu display displays initial instructions for using the media. The following learning videos can help students understand the content that will be taught. Then there is the material that will be taught after the material is taught, followed by quizzes that can help students understand the material about momentum and impulses, and finally practice questions that combine the knowledge that has been gained and the teacher's lessons.

Development

Media development is being done in its totality at this point. The learning section of the media is divided into three sections: learning objectives, learning outcomes, and learning objectives. Data analysis, evaluation, experimental steps, and experimental findings are all included in the content section. Students can use the QR Code that has been provided to complete a Quiziz that is connected to the area in the final step. Following the completion of the media development process, the media created by linguists, media experts, and material specialists must be validated. One physics teacher and two physics-focused lecturers make up the validator. Table 4 displays the findings from the three validators.

Table 4. *Validity test on content, presentation, language, and authoritarianism*

Name	Content Aspects	Aspects of Presentation	Language Aspects	Graphics Aspects
Validator 1	77,5%	80%	70%	94,28%
Validator 2	77,5%	80%	70%	94,28%
Validator 3	80%	80%	80%	84,44%
Average		**77, 067%**		

According to the findings of the three experts' evaluation, the percentage values for the content, presentation, and language aspects were 78.33%, 80%, 75%, and 99.04%, respectively. The three validators received an average percentage of 77.067% based on this statistic. because each question is evaluated by the three validator specialists in a pertinent manner. Thus, the proportion indicates a respectable category. As a result, this product is considered appropriate for use in educational activities. According to the qualitative evaluation, the media that is created in accordance with the recommendations and enhancements of the three validators has to be improved in a number of areas. Table 5 shows some recommendations and enhancements.

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Table 5. *Product improvement advice according to experts*

Aspects	Suggestions for Improvement
Eligibility	Formula writing improved
Serving	Add a learning video before the quiz
Graphic Qualifications	Add an illustrative image of the state after the collision
Language Eligibility	The cover is repaired according to the theme of LKPD
	Layout/margin is customized
	Improve writing

Three validators, two physics specialist lecturers, and one high school physics teacher conducted the media feasibility assessment. A percentage of 77.067% was provided by the validators, placing it in the viable category. This indicates that, given validators' recommendations and enhancements, the created media is appropriate for use as a teaching tool. The assessment of the media used in educational activities is now underway. Following the three experts' validation, the media must be updated. This includes adding instructional films prior to quizzes, updating the cover to reflect the theme, adding pictures, and adjusting the margin.

Implementation

Thirty-one students in grade XI Physics 2 participated in the implementation stage. A test was administered during the deployment phase to assess students' learning outcomes regarding momentum and impulse materials. Students can utilize equation 4 to observe how learning outcomes have improved. The pretest and posttest findings show that student learning outcomes have improved. In order to determine student learning outcomes on momentum and impulse materials, the collected student learning outcome data was examined by looking for n-gain pretest and posttest scores. Table 6 displays the data.

Table 6. *N-gain pretest and postest results*

Average Earnings		N-Gain	Categories
Pretest	Postest		
55.33	73.3	0.40	Medium

Table 6 shows that learning results for momentum and impulse items have increased. The medium category yielded an N-Gain of 0.40. This suggests that the amount of material on momentum and impulse increased from the pretest to the posttest. The percentage on the display indicator representing the student response test results to the LKPD produced was 82.83%. The percentage for the material's presentation was then 80.66%, while the percentage for the language component was 80.88%. With a very good category, the total aspect receives an average percentage of 81.17%. Table 7 displays the responses from the students.

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Table 7. *Results of student response test to media*

Display Indicator	Material Presentation Indicators	Language Aspects	Average
82,83%	80,66%	80,88%	81,17%

According to the chart, the media has grown, and as a result, the average percentage received overall is 81.17%, earning it a very good rating from students. The three validators—two from the physics lecturer and one from the physics teacher validate the improved posttest and pretest questions during the implementation stage of the evaluation. The picture must be clear, and the C3 question has been changed to the C4 question. As a result, it is necessary to validate first and assess any errors in the question's writing before beginning the teaching process.

Evaluation

The evaluation stage represents the final step in the media development process. Every ADDIE stage is where this step is completed. The goal of this assessment phase is to reduce errors at every ADDIE model step. At this point, the product's use and the validator's data findings are gathered and evaluated. It is a formative assessment. To determine the most effective teaching methods, formative evaluation is used during the learning process. As stated by, Zaim (2018) Formative evaluation is used to help teachers identify the different flaws in the learning strategies they employ so that the best one can be selected (Soleha et al., 2023). Observing the learning process while the content is applied is how formative evaluation is done during the implementation stage. Student responses to the content may be used for this assessment. By completing the provided response questionnaire, students will contribute to making the learning process more efficient and maximizing learning. Formative evaluation is still done as a step in continuous improvement, but the evaluation stage concentrates on the summative evaluation. Reflecting on the entire ADDIE process, determining what needs to be improved in terms of planning and execution, and making sure that the procedure employed at each stage is functioning at its best and can be used to the following iteration are all examples of formative assessment. At this point, a summative assessment is also necessary to determine the impact of using the created learning materials.

Discussion

Media eligibility

The research team used a needs analysis questionnaire, observations, and interviews with physics teachers to examine the data from the analysis stage. This suggests that LKPD, aided by interactive multimedia QR Code, can be applied to classroom instruction. It is created during the design stage for every learning activity, including experiments, tests, and materials on momentum and impulse. Three validators—two physics education professors and one physic teacher—performed validation during the development stage. Following validation, the validators offer recommendations and enhancements, which can subsequently be implemented and utilized as a teaching tool in the classroom.

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According to the findings of the product feasibility test, which was conducted by three validators consisting of two physics experts and one physics teacher, the media is appropriate for use in classroom learning activities because it is appropriate in terms of content, presentation, language, and graphics, This is in line with the research of Arini & Lovisia (2019) which said that interactive learning media received a good response from students where according to students the media used was very practical.

Learning outcomes

One of the learning resources that can support instructors and students in the teaching and learning process is interactive multimedia-based LKPD on momentum and impulse content, which has been deemed feasible for use in high school physics classes. With teachers serving as facilitators and students taking a more active role in the teaching and learning process—creating problems, developing hypotheses, investigating the subjects under study, and effectively communicating the outcomes of their research—it is hoped that this LKPD will enable student-centered learning. Regarding curiosity, it is believed that students will be more curious in line with what is expected of them as they study the autonomous curriculum. Teachers and students will benefit from this LKPD as well (Sitohang & Megalina, 2021).

Additionally, pretests were administered throughout the deployment phase to assess students' learning results prior to the use of LKPD. activities that use the PBL approach (problem-based learning) in the classroom. After utilizing the interactive multimedia-assisted LKPD QR Code, students' learning results are assessed through a posttest. The LKPD created can enhance students' learning outcomes on momentum and impulse content, according to the posttest results. This demonstrates that the pupils' reaction to the LKPD-produced media is excellent. Students responded favorably to the educational media. As stated by Rostikana et al. (2022) Using the QR Code to support problem-based learning (PBL) has increased student learning achievement. Utilize the QR Code for Problem-Based Learning Methods (PBL). It has an impact on raising learning achievement among students. According to, Huda (2019) According to learning can be carried out optimally if the learning components involve students, teachers, learning media, situations, conditions and environments that support learning activities.

Student response to media

The outcomes of the students' reactions to the media are excellent; it is evident that the media may be easily understood, accessible safely, and assist students in the process of learning activities in the classroom. As stated by, Mardianto et al. (2022) Students learn more easily and do not just know when learning is conducted through a contextual method. In order to fully comprehend the subject matter, students engage in and directly perform learning activities as personal experiences that they will never forget. Formative and summative assessments are conducted during the evaluation phase. Every stage of formative evaluation looks for areas that need change. Formative evaluation is used at the analysis step to learn more about the needs of the students. Formative assessments are conducted during the design phase to see what changes the validators have made to enhance the media produced. To improve the media based on the outcomes of the design stage revision, formative evaluation is done throughout the development stage. Formative evaluation is done at the implementation stage by watching how students learn in the classroom. Although the formative assessment is done as a

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modification process for the created learning materials, the evaluation stage is mostly focused on summative evaluation. The purpose of the summative assessment was to observe the learning outcomes resulting from the application of the established LKPD.

Conclusion

The following conclusions can be drawn from the information provided by the research findings and discussions: (1) A 99.04% LKPD with interactive multimedia QR Code is regarded as highly feasible (2) pretest and posttest results were used to improve student learning outcomes with an N-Gain of 0.40 (3) based on student responses, LKPD with interactive multimedia QR Code received a perfect category score with an 81.17% percentage result. The study's findings indicate that the LKPD with interactive multimedia QR Code support is highly practicable for use with momentum and impulse items. Additionally, media use can enhance student learning results.

According to the findings of the study, LKPD with interactive multimedia QR Code support is deemed viable for usage in the educational process. Student learning outcomes improved with the use of LKPD, as seen by the intermediate category N-Gain scores. We may conclude that LKPD can enhance student learning outcomes on momentum and impulse materials with the help of interactive multimedia QR codes. Additionally, pupils responded very well to the use of LKPD in the learning process. Suggestions for further research to be able to research the development of LKPD to see an increase in student learning motivation. The development of LKPD is also recommended to use a project-based learning approach. This can assist students in applying the concepts learned in real-life contexts and improving their collaborative skills.

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