Interactive learning media development in Purwokerto city: cognitive aspects of school basketball
Desarrollo de medios interactivos de aprendizaje en la ciudad de Purwokerto: aspectos cognitivos del baloncesto escolar

Akbar Kusuma Abadi, Indah Sari Dewi,Syahrizal Islam, Okky Putra Alwin Pratama, Aljawahir Agus Kristiono, Muhammad Budi Wijaya
Universitas Negeri Semarang (Indonesia)

Abstract. Teachers' learning methods for sports and health are still conventional, such as lectures, discussions, and assignments, but teachers have not yet applied learning using interactive learning technologies, especially in basketball games. The aim of this research is to produce effective interactive learning media to enhance the knowledge of students. The research method used is Research and Development (RnD) using the Borg and Gall model. The subjects in this study included validators, physical education teachers, and grade XI students from all public high schools in Purwokerto City (Public High Schools 1, 2, 3, 4, and 5). Data analysis techniques use quantitative descriptive analysis. The product test suffered audio constraints overcome through improvements and showed a score of 86.20%. After improvements, the usage test of 62 students and five teachers showed very high scores, reaching 95.72% of students and 96.40% of teachers. The results of the effectiveness test showed that interactive learning media has a significant influence on students' cognitive abilities.
Keywords: Development, Interactive Learning Media, Cognitive Aspects, Basketball

Resumen. Los métodos de aprendizaje de los profesores en deportes y salud siguen siendo convencionales, como conferencias, discusiones y asignaciones, pero los profesores aún no han aplicado el aprendizaje utilizando tecnologías interactivas, especialmente en los juegos de baloncesto. El objetivo de esta investigación es producir medios efectivos de aprendizaje interactivo para mejorar el conocimiento de los estudiantes. El método de investigación utilizado es Investigación y Desarrollo (I+D) utilizando el modelo de Borg y Gall. Los sujetos de estudio incluyeron validadores, profesores de educación física y estudiantes de undécimo grado de todas las el bachilleratoen la ciudad de Purwokerto (el bachilleratoen 1, 2, 3, 4 y 5). Las técnicas de análisis de datos utilizan análisis descriptivo cuantitativo. La prueba del producto enfrentó limitaciones de audio superadas mediante mejoras y mostró una puntuación de 86.20%. Después de las mejoras, la prueba de uso realizada con 62 estudiantes y cinco profesores mostró puntuaciones muy altas, alcanzando el 95.72% de los estudiantes y el 96.40% de los profesores. Los resultados de la prueba de efectividad mostraron que los medios de aprendizaje interactivo tienen una influencia significativa en las habilidades cognitivas de los estudiantes.
Palabras clave: Desarrollo, Medios de Aprendizaje Interactivo, Aspectos Cognitivos, Baloncesto.

Introduction

The world of 21st century education has entered a modern learning system. The education system must provide students with the skills needed to succeed in the 21st Century, given the rapidly evolving technology. (Varas et al., 2023). 20th century skills include learning and innovation (Kaya et al., 2023). Learning media is at the primary position in the process of teaching activities because in the learning media can be used as an intermediary of information given from the teacher to the student. In connection with the use of learning media, there must be a variety of types and forms so that can be considered in the selection of media that is considered appropriate in the achievement of learning objectives. (Ewing & Seale, 2023). One of the media that can be used in media selection is multimedia based.

Multimedia definition means a project that focuses on the development of interactive programs (Zhao & Zhang, 2020). Examples include creating an interactive CD, making a touch screen presentation, and so on. Of course there's a lot of other multimedia content. Graphic design, animation, video processing, sound production, and so on. So multimedia is a useful computer application to mix and present images, sounds, texts, videos and animations using a tool connection so that users can operate and interact freely. Multimedia also has the power to transform student

learning experiences (Grando, 2022) and (Jang & Suh, 2022). Chang et al. (2021) they say that interactive multimedia effectively enhances knowledge. Multimedia is generally divided into two types: linear and interactive. (Halimatusyadiah et al., 2020). Linear multimedia is a multimedia that does not have a tool to control the media so that the media is running continuously. For example, it can be: TV and movies (Frick & Schüler, 2023). While interactive multimedia has a tool that is already available in such multimedia, a tool in interactive media serves as the operation/ control of the media, so that users can choose which will be chosen by the interactive multimedia user for the next process, for example, can be applications in the form of games and interactive CDs (Li et al., 2023).

Bond & Bedenlier (2019) stated that interactive learning multimedia is a medium that can be used in presenting learning material to students effectively and efficiently. According to the cognitive theory of multimedia learning, multimedia learning follows three assumptions (Mayer, 2021). The first is a double-channel assumption. In the duodenum people have two processing channels: the visual channel and the hearing channel. The visual channel processes information from the eye, like static images, whereas the hearing canal processes voice information from your ear, like music. In other words, the child will be easier to understand the story when text and picture are presented

simultaneously.

Multimedia in the world of education is used as a medium of teaching, which is used either in classroom/classic or autodidactically. The importance of multimedia as an effective learning tool compared to conventional learning approaches (Ongor & Uslusoy, 2023). In teaching and learning, multimedia solutions are intended to solve the pedagogical content of topics of interest as well as the audience using such solutions (Abdulrahaman et al., 2020). Many interactive multimedia maker software one software/ application that can be used in the creation of learning media is Adobe Flash CS6, issued by one of the Adobe companies (Sukariasih et al., 2019).

Researchers have found that multimedia messages of a certain quality can change knowledge, attitudes, and behavior most effectively (Occa & Morgan, 2022). This advantage can be explained by a variety of evidence-based theories (Mayer, 2021). First, multimedia messages help connect mental models better because they take advantage of visual and verbal features. Second, these connections require less cognitive resources than non-multimedia messages, and third, visual and verbally stimulated learning improves by reducing the amount of information provided through the hearing and visual channels.

Delivery of materials used by educators, in addition to being charged with mastery of submitted topics, also needs to think creatively about the presentation techniques used. Learning media are supporters in delivering material (Afriana & Prastowo, 2022). According to Harahap & Siregar, (2020) one of them is Adobe Flash. Based on the opinion above, it can be defined that interactive media is a tool that can display information from teacher to student in which there is active two-way communication between multimedia with the user or aimed at facilitating the learning process.

Wibanto (2017) says that the software called Adobe Flash was previously called Macromedia Flash. This software is an application that is used as a professional authoring tool that is then used for the creation of interactive applications. The animation or video generated by this application has an extension "swf", besides that Adobe Flash also has its own programming language that is Action Script used in the creation of animations and gives motion effects to the animation (Samosir et al., 2021). Creating interactive media using Adobe Flash needs to know about the basic concepts of creating buttons, programming, inserting audio, video, text, and images (Abdullah et al., 2021).

Curriculum and physical education materials in Indonesia there are many materials that support the development of students, one of which is basketball learning materials. Like the kind of sports games in general, students must learn the basic techniques that are found in basketball. Basketball learning material consists of two kinds of short history and basic techniques (Prasetyo, 2021). Basketball is one of the sports games that has very complex movements in mastering basic techniques (Apifa et al., 2020). These games require good skills to obtain effective and efficient

movements, as well as the ability to think critically. Abidah et al. (2022) suggested that through critical thinking skills, knowledge would continue to flourish and innovation related to the problems faced would emerge.

A basketball is played by two teams each consisting of five players who compete against each other to score points by putting the ball into the opponent's basket (Ramadhan et al., 2023). The sport is intermittent, combining short, high-intensity motor movements such as movements, passes, shots, and jumps with short recovery periods, so each player can perform more than 100 times during a match (Rodríguez-Cayetano et al., 2023). The physical requirements of basketball include rapid acceleration, deceleration, explosive directional changes, and jumps, all of which can lead to both acute and accumulated chronic fatigue during games and exercises (Hernández-Mosqueira et al., 2023).

In addition to demanding high physiological burdens on athletes during competitions (Assis Lauria et al., 2023), basketball also requires the development of basic physical qualities and motor skills that are essential for the moral and volitive development of children as well as the improvement of general physical condition in adulthood (Polevoy et al., 2024). Basketball advances the principles of offensive play such as keeping the ball in control, progressing towards the goal, and shooting with a low opposition level (Práxedes et al., 2021). This sport is widely used in the physical education of schoolchildren, contributing to individual development from childhood to adulthood.

According to Wang et al. (2023) Students are happier and more motivated to learn in multimedia learning environments. A study conducted by Zou & Teng (2023) shows that the majority of participants consider learning with multimedia annotations to be interesting and effective. According to Park et al. (2019) the perception of user suitability to learning is influenced by multimedia technology, which has a positive impact on the adoption of multimedia technology in learning.

The writer finds a critical problem in one of the high schools that deserves attention. Of the 30 students observed, as many as 26 students obtained academic results under the minimum accessibility criteria related to basketball material. The number of students who have not reached these standards indicates the need to improve learning methods in order to be more effective and support students' understanding of the material.

Field observations showed that teachers of physical education at the school have not yet used interactive multimedia in teaching learning activities. As a result, the methods applied are still traditional, such as lectures, discussions, and assignments. This condition can be a contributing factor to poor access to student learning outcomes. Therefore, special attention and improvement measures are needed to integrate interactive learning media in order to improve the effectiveness and learning outcomes of students on basketball material.

Based on the description, the study was carried out in

the form of creation of learning media basic basketball techniques to improve cognitive aspects of students using software adobe flash cs6. It is expected that learning media created by the researchers can help students to understand related basketball material. Creation of the learning media is done on basketball learning materials using software Adobe flash cs6 because in the media adobe Flash cs6 can be filled with writing, images, animation, video, and sound. The cognitive aspect is chosen because it refers to the classification on the bloom taxonomy in the cognitive realm is the most basic area to be mastered before going to the next realm.

Method

Research approach

This research is a Research and Development approach aimed at developing basketball learning media in high school. Research and Development methodology is used to investigate critical steps in interactive media development, including design, implementation, and evaluation. In addition, the study will also explore the impact of the use of interactive learning media on the learning process, by examining student responses to material understanding to provide in-depth insights into the effectiveness of the media. Thus, the research focuses not only on the development of learning technologies, but also on their evaluation and impact in the context of higher secondary education, especially on the cognitive aspects.

Research design

The research aims to develop interactive learning media for basketball game materials in high school and test their effectiveness. The Research and Development Paradigm is used because it can provide real experiences of development participants and the impact of media use on physical education learning in schools. The research targets two upper secondary schools in Purwokerto to test and produce a learning medium that is worthy of use. The researchers used Adobe Flash media to create basic basketball technical material in a format (.exe) for laptops and computers and (.apk) for Android. This format was selected so that students can access interactive learning media without requiring additional applications, allowing flexible learning anywhere and anytime.

Sample

This research and development involve two main subjects. The first subject is a validator, consisting of three experts; material, media, and language experts. The selection of validators is carefully selected according to the criteria of competence in the fields of media, material, and languages. It aims to ensure that the views and judgments of the experts can make a significant contribution to the development of media learning basketball in high school. The second subjects are teachers of physical education and students of the eleventh grade throughout the city of Purwokerto

which consists of State High School 1, State High school 2, State high school 3, State Highschool 4 and State High School 5 Purwokerto. These five schools will be the subject of the production and testing phase of this interactive learning multimedia.

Data collection instruments

The data capture instrument consists of media expert instruments, material experts, linguists, teachers, and students. The media expert validator sheet tool consists only of an aspect of the display. Media validator instruments created before being tested will be consulted with the media expert in advance so that the instrument will be evaluated according to what should be assessed.

The material validation instrument created must also be consulted with the material expert in advance so that the instrument to be evaluated is in accordance with what should be assessed. The instrument of media expert validation can be seen in table 1.

Table 1.
Media Expert Validation Instrument

Aspect	Indicator
View	Learning Media Content
	Learning Media Button
	Learning Media Voice
	Learning Media Image
	Learning Media Video

The media expert's assessment consists of content and evaluation aspects. The media expert instrument can be seen in table 2.

Table 2.
Materials Expert Validation Instrument

Aspect	Indicator
Content	Learning Materials
	Learning Pictures
	Learning Video
Evaluation	Question Formulas on Learning Media
	Learning Media Content

The language expert validation sheet instrument consists only of the writing aspect. The instrument can be seen in table 3.

Table 3.
Linguistic Validation Instrument

Aspect	Indicator
Writing	Font size accuracy
	Clearly read
	Phrase placement compatibility
	Phrase Effectiveness
	Phrase compatibility

Instruments teacher assessment sheet competence and evaluation aspects. The instrument can be seen in table 4.

Table 4.
Instrument for the Evaluation of Teachers of Physical Education

Aspect	Indicator
Competence	Formulation of core and basic competences
	Indicator formulation clarity
	Content, image, and video compatibility
Evaluation	Compatibility of matters with matter

Table 4.
Instrument for the Evaluation of Teachers of Physical Education

Aspect	Indicator
	Question calculation accuracy

The student assessment sheet instrument consists of appearance, content and interest. The instrument can be seen in table 5.

Table 5.
Student Assessment Instrument

Aspect	Indicator
View	Operational ease
	Celebrate animation
	Image clarity
Quality/ Contents	Usefulness in learning
	Language is easy to understand
	Images and videos clarify
	Helps to understand
Interest	Learning motivation
	Multimedia helps learn

Data collection procedure

Data collection procedures using Borg and Gall development models involve problem identification, information gathering, design creation, expert validation, product trials, revisions, usage trial, end product revision, effectiveness testing, and product dissemination of development results. Identification of problems involves field studies and techniques such as interviews and observations. The gathering of information also involves the study of literature. Design creation involves steps such as flowchart creation, storyboards, and media design, including the creation of subjects for interactive learning media. The product was tested by media experts, materialists, and linguists, then revised. Once qualified, a product test is carried out with students. The results are evaluated, and if necessary, revised. Effectiveness tests are conducted through pretests and posttests to evaluate student cognitive improvement. The final stage is the dissemination of products. Here's a summary of the design flow diagram for the development of interactive learning media using the Borg and Gall model. (figure 1).
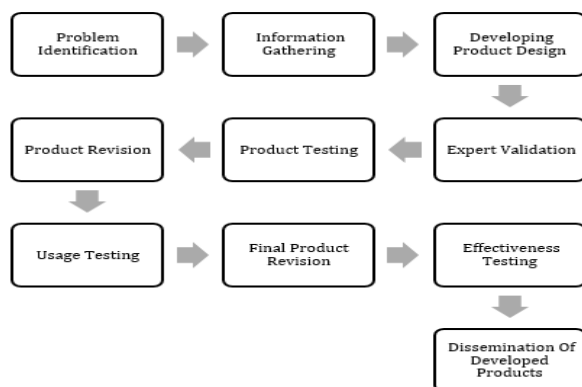

Figure 1. Research Flow

Data analysis

The validation used is a likert scale with five alternative answers namely 5 means very good, 4 means good, 3 means

enough, 2 means not good, 1 means very bad. Product validation sheet data is analyzed by looking for average scores and determining criteria. After validating the product, a limited test of the product is carried out on the learning activities and observations are made on the product achievement of the problem-solving indicators and the dissemination of student responses to the interactive media developed to train the ability to solve problems. The results of the observation and elevation of students responses are calculated using the following methods:

$$\% \ score = \frac{score \ obtained}{total \ score} \ x \ 100\%$$

The criteria for the percentage scores and observation sheets obtained are presented in Table 6. As well as for testing the impact of the use of interactive media using the Independent Samples T Test with the help of spss software.

Table 6.
Learning Media Instruments Assessment Criteria

Percentage	Criteria
≥ 80%	Media Very Worth Using
60% < X ≤ 80%	Media Worth Using
40% < X ≤ 60%	Media Enough to use
20% < X ≤ 40%	Media Not Suitable for use
X ≤ 20%	Media Not suitable for use

Results and Discussion

Results of Problem Identification

Analysis shows that in physical education lessons, most students have not understood the "Basketball Game" material. This is due to two main factors: still conventional teaching methods and the lack of use of interactive learning media. Of the 30 students observed, only four reached the minimum standard of material understanding. Physical education teachers need to increase the use of interactive learning technologies and update their teaching methods to be more effective in facilitating the material understanding of the basketball game.

Integrating everyday life issues into student learning can encourage active participation and encourage students to find creative solutions when they work together to results such as predictions, judgments, decisions, or other outcomes (Yee, 2019). The role of technology as the most common tool, such as audio and video platforms, can act as tutors and media that encourage co-creative thinking skills as well as facilitate collaborative creativity in education (Chen, 2021). Interactive learning media is crucial in education as it enables the design of a rich and collaborative learning environment through digital technology, which enriches learning contexts and fosters collaborative creativity. (Selfa-Sastre et al., 2022).

Results of Information Gathering

In the early stages, the information gathering was focused on basketball learning materials taught to eleventh grade upper secondary school students. The information gathered covered two main aspects, namely the short history and basic techniques of basketball games, as outlined

by (Putra et al., 2020) and (Harahap et al., 2022).

Basic data-related techniques in basketball learning become the focus of information gathering, including passes (chest pass, bounce pass, and overhead pass), dribbling (static and dynamic dribbling), shooting, and lay-up shoot. This information provides a comprehensive overview of the learning material at the eleventh level. These data form an important foundation in the creation of materials for interactive learning media, with detailed short histories and basic techniques, aimed at creating structured and engaging materials as well as supporting interactive and innovative learning approaches. (Jayanti et al., 2021). The importance of data according to students' needs is to identify critical areas that need attention and help develop more targeted and effective interventions (Barr & McNamara, 2022). Moreover, accurate, clear, and compliant data ensures valid and reliable findings that can be used to improve learning and teaching processes. (Pasang & Najib, 2022).
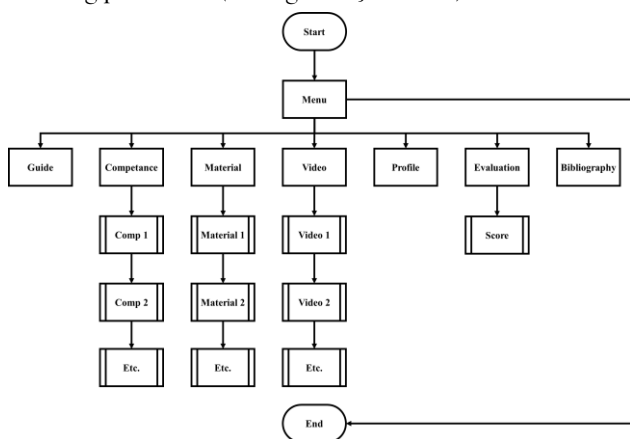
that contain an interactive media display plan (figure 3), creating designs that are used according to the storyboard that is structured (Figure 4), creating issues used for student evaluation instruments. Creation flowcharts and storyboard is an important thing in starting in the making of learning media (Octaviani et al., 2017); (Ji et al., 2018); (Arifin & Wardani, 2020); and (Warju et al., 2020).
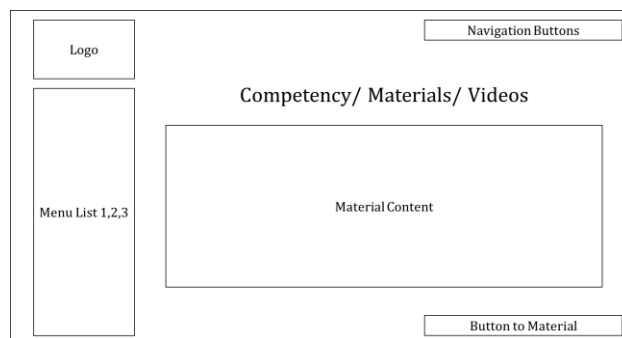

Figure 3. Interactive Media Storyboarding

Figure 2 Interactive Media Flowchart Generation

Figure 4. Interactive Media Design Making

Results of Developing Product Design

Activities at this stage are designing interactive learning media basketball learning material for high school students. Interactive media development based on needs analysis. Currently, the next phase of interactive learning media design is: creation of flowcharts to determine the flowchart in learning media creation (Figure 2), creating storyboards

The evaluation steps are integrated into the curriculum development process, with the creation of evaluation issues as a tool for feedback on the student's understanding of the learning material (Achmad et al., 2022). The evaluation process included a thorough trial with 35 respondents and 40 question items, assessing validity and reliability. The test was conducted at State High school 5 Purwokerto involving 35 students. The validity test can be seen in table 7.

Table 7.
Question Details Validity Analysis

No.	Question	Validity
1	Who invented the basketball game?	0.318
2	The mother of the international basketball organization is abbreviated by name	0.351
3	Basketball games in Indonesia are under the shadow of the organization	0.437
4	The goal of the basketball game is	0.354
5	Each player at the time of making the maximum registration consists of a player.	0.439
6	Below that is the basic technique of a basketball game is	0.532
7	Below that is the basic technique of passing in a basketball game is	0.383
8	The goal of receiving the ball when making a chest pass in a basketball game is	-0.354
9	The goal of receiving the ball when doing the overhead pass in a basketball game is	0.697
10	The goal of receiving the ball when making a bounce pass in a basketball game is	0.329
11	Follow Trought's movement while doing passing in a basketball game is	0.344
12	The attitude of the foot at the time of doing the passing in a basketball game is	0.37
13	The direction of view when doing passing in a basketball game is	0.53
14	The position of the hand at the time of holding the ball in the chest pass is	0.438
15	The core movement when doing chest pass in a basketball game is	-0.318
16	The position of the hand while holding the ball in the basketball bounce pass game is	0.342
17	The core movement when doing a bounce pass in a basketball game is	0.554
18	Position holding the ball on the overhead pass basketball game is	0.319

Table 7.
Question Details Validity Analysis

No.	Question	Validity
19	The most common mistake when passing a basketball game is	0.55
20	The attitude of the body when doing a dribbling movement in a basketball game is	0.327
21	The position of the leg when doing a dribbling movement in a basketball game is	-0.311
22	Dribbling in a basketball is done in a way	0.315
23	The position of the palm when doing dribbling in a basketball game is	0.731
24	The principle in doing shooting on a basketball game is	0.432
25	The balance attitude in doing shooting in a basketball game is	0.326
26	The direction of view when performing a shooting in a basketball is	0.338
27	The position of the hand at the time of shooting in a basketball game is	0.31
28	The most common mistake when shooting a basketball game is	0.571
29	The Follow Through position when performing a shooting in a basketball game is	0.712
30	The position of the hand when going to catch the ball in the lay-up shoot uses.	0.544
31	The left hand's attitude when holding the ball in the right lay-up technique is	0.361
32	The right hand's attitude when holding the ball in the lay-up shoot technique is	-0.403
33	The distance of the first step when performing the lay-up shoot movement is	0.355
34	The second foot distance when performing a lay-up shoot is	0.744
35	The attitude of the hand after performing the lay-up shoot is	0.344
36	The position of the foot in the landing on the basic technique of lay-up shoot is	0.329
37	The direction of view in the landing movement is the basic lay-up shoot technique.	0.306
38	Releasing the ball from the hand when making a lay-up is done in a way	0.563
39	The pattern of steps when performing the lay-up shoot movement is	0.426
40	The most common mistake in performing basic lay-up shoot techniques is	-0.563

The validity test of an instrument from a test element is said to be valid when the value r counts > r table (Tarigan et al., 2022). Reliability in research is used to state that a research test instrument can be trusted according to established criteria (Suwarto, 2022), (Riyani et al., 2017) and (Ndiung & Jediut, 2020). The reliability test was carried out with 35 elements, because it had discarded issues that had to be removed at different power test stages. Out of the 35 items that have been selected, the reliable figure is 0.878 and falls into the "Very High" category. (table 8)

Table 8.
Reliability Test

Cronbach's Alpha	N	Description
.878	35	Very High

Results of Expert Validation

The design validation was carried out by three experts: media experts, material experts, and linguists. Media experts gave a rating of 80.8% on the "Very Good" criterion, but there were revisions related to the size of the button icon that was too large. Material experts gave the rating of 97.8% with the same criteria, but material about a one-hand throw was replaced with a throw over the head. Linguists gave a score of 93.0% on the criteria of "Various Good", with some revisions to justify the unmatched writing. Overall, the validation results indicate the category "Very Good".

Research conducted by Giordano et al. (2024) highlighted the importance of validator assessment in the evaluation process. Validators have a crucial role to play in providing feedback to correct potential errors, ensure the validity of product contents and designs, and assess the feasibility of product implementation. (Sartinah et al., 2021). The results of the evaluation of experts who reach the category are excellent indicators that the media is worthy to be used in the intended context (Abdulrahaman et al., 2020).

Results of Product Testing

Following the advice of experts, the product was tested on 35 students of class XI at State High school 4 Purwokerto using the instruments presented in table 5. Based on the advice of experts conducted a trial with 35 students of class XI at State High School 4 Purwokerto, the application obtained an average score of 86.20% with the category "Very qualified". Students gave positive feedback about application creativity and its benefits in learning, but also highlighted audio quality issues as a major obstacle.

The function of suggestions from students is to identify their competency development needs according to individual abilities (Jackman et al., 2023). These suggestions help overcome barriers to learning that are necessary for deeper understanding (Deraney, 2021). By integrating direct input from students, learning applications can be customized to meet their learning needs, so that every student has an equal opportunity to succeed in their education.

Results of Product Revision

In the first stage of product testing, the main focus was to identify glitches related to audio errors in the interactive learning media. One of the problems that arose was the inconsistency of the sound when switching between menus, which could disrupt the user experience and reduce the effectiveness of the learning media. Researchers took the alternative step of reviewing all aspects of the sound and making the necessary improvements to ensure optimal sound quality. Initial evaluation showed that audio improvements were critical to achieving the product development objectives and improving the overall quality of the interactive learning media.

The importance of implementing learning application improvements lies in the ability to provide traceable information for application development (D de la Cruz et al., 2021). This is important because such improvements can

improve the quality of teaching learning processes (Haryani et al., 2021), as well as ensuring that they do not interfere with student learning styles (Yadav & Bhatia, 2022). The revision was carried out with the aim of improving the media that has been created (Wijayanti & Relmasira, 2019).

Results of Usage Testing

After product improvement based on the pilot test, the interactive learning media was tested on 62 students at State College 3 Purwokerto and 5 physical education teachers. As a result, 95.72% of the students and 96.40% of the teachers gave a rating of "Very worthy", reflecting the success of the improvements and the positive acceptance from students and teacher. Positive support from teachers also increased the validity and reliability of this learning media, demonstrating the important role of teacher involvement in supporting teaching in secondary schools. The high evaluation results confirm that this learning media is ready to be used in the learning environment.

Based on research by Budiarto et al. (2024) the app developed received a positive response from teachers and students because it received a very good category. This shows that the learning application has successfully met the expectations of its users. Furthermore, Qiu et al. (2022) stressed that the application is not only good in receiving responses, but also effective in improving the quality of education through the integration of information technology and modern education.

Results of Final Product Revision

The application ran smoothly and met its functional expectations during the trial, with no significant problems found. The positive perception of students and teachers of this application suggests that the application successfully meets their learning needs and preferences, supported by good user reviews. This positive impact provides a strong foundation for further development, focusing on enhancing user-loved features or adding new elements to enhance user experience. This interactive learning medium has provided a smooth experience and received positive feedback during the trial, paving the way for testing its effectiveness in improving student learning outcomes.

The final revision stage is crucial to improve the accuracy, validity, and reliability of the resulting model or findings (Utaminingsih et al., 2024). After passing the application stage and reaching the final revision stage, evaluation can be carried out to ensure its quality and effectiveness (Ahmad et al., 2024).

Results of Effectiveness Testing

This study aims to examine the effectiveness of using interactive learning media on the XI grade students of SMA Negeri 1 Purwokerto (group B) compared to SMA Negeri 2 Purwokerto as the control group (group A). Each class consisted of 36 students. The research used quasi experiment with nonequivalent control group design. The effectiveness test was conducted in three meetings: the pretest

was conducted in the first meeting, the treatment meeting was conducted in the second meeting, while the posttest was conducted in the third meeting. The results of descriptive analysis showed an increase in the average score in both groups, from 74.73 to 78.42 for group A, and from 73.85 to 83.09 for group B, indicating an increase in cognitive aspects in students. This indicates that there is an increase in the average cognitive aspect in students. The data can be seen in Table 9.

Table 9.
Descriptive Analysis

No.	Data	N	Mean	Std. Dev
1	Pre A	36	74.730	10.106
2	Pre B	36	73.857	9.087
3	Post A	36	78.428	6.808
4	Post B	36	83.095	6.842

After descriptive analysis, the next step is normality and homogeneity tests before conducting paired and independent t tests. The normality test is carried out to check the distribution of data whether normal or not, using the Kolmogorov-Smirnov and Shapiro-Wilk tests with the condition that the data is considered normal if the significance value (sig) > 0.05. The normality test results show that the data of pretest A, pretest B, posttest A, and posttest B are all normally distributed (sig > 0.05), as listed in Table 10.

Table 10.
Normality Test

No.	Data	Statistic	df	Sig.
1	Pre A	.965	36	.311
2	Pre B	.974	36	.545
3	Post A	.970	36	.437
4	Post B	.969	36	.407

After ensuring that the data is normally distributed, a homogeneity test is carried out to check the equality of variances. The homogeneity requirement is met if the significance value (sig) > 0.05, indicating that the data analyzed is homogeneous. The homogeneity test results for pretest AB and posttest AB showed significance values of 0.128 and 0.954 respectively, indicating that both data were homogeneous (sig > 0.05). These results are listed in Table 11.

Table 11.
Homogeneity test

No.	Data	Levene Statistic	df1	df2	Sig.
1	Pre A B	.406	1	70	.526
2	Post A B	.003	1	70	.954

Table 12.
Paired Samples T Test

No.	Data	t	df	Sig. (2-tailed)
1	Pre A – Post A	-2.383	35	.023
2	Pre B– Post B	-5.039	35	.000

After all conditions are passed (normality test and homogeneity test) then perform the test paired samples t test with the aim of seeing the average difference of each group. The condition when there is such a difference group is a value sig. < 0,05. The results of the paired test showed that both methods have a significant difference of influence. There are significant differences between group A (without the use of interactive learning media) and group B (using interactive learning media), but as seen from the test, group B's significance values are smaller than that of group A, indicating that interactive Learning Media provides a more

significant improvement. The data can be seen in Table 12.

Independent samples t test is used to test two averages of the results of the posttest group AB. The data condition when there is a significant influence is when the sig value < 0,005. Independent Samples Test results show that there is an influence between the learning results of method A and method B that is significant. Referring to table 13 shows that there are negative values that show that the results of method B are greater than method A.

Table 13.
Independent Samples Test

Data	F	t	df	Sig. (2-tailed)
Post A B	0.003	-2.901	70	.005

Various studies have shown that multimedia methods have an important role to play in placing student evaluation tasks accurately and having a positive effect on learning outcomes Fu (2022). These findings are in line with a Nova et al. (2019) study that indicates that multimedia-based education contributes significantly to increasing the level of knowledge of students. Moreover, a study by Molina et al. (2018) also supports that this approach strengthens the correlation between multimedia use and better academic results.

Results of Dissemination

The dissemination of development products is done by disseminating interactive learning media over the Internet, mainly by placing the application on the Google Drive platform. The link "https://bit.ly/Basketball-Interactive-Media" is provided to make it easier for students to download and use the application. This approach is expected to improve application affordability, allowing users access to all the features and learning materials that have been developed. To ensure smooth access, researchers provide usage guidance through links, so it is expected that interactive learning media can be widely disseminated and make a positive contribution to supporting learning.

The function of product dissemination of learning application results is to ensure that the product can be used by a wider audience after going through the development and revision stages (Zulaeha et al., 2023). After the product has been successfully developed and revised, the next step is to disseminate it to potential users. This dissemination is the last step in the development process which aims to introduce and implement learning products to users (Susanti et al., 2021). Thus, the enhanced learning product can provide wider benefits.

Conclusion

Based on the synthesis of findings from the study of interactive learning media for basketball education, the following conclusions were drawn: 1) The study identified significant problems in the understanding of basketball concepts by students due to conventional teaching methods and lack of interactive learning media. 2) Through the development of interactive learning materials, including the creation of flowcharts, storyboards, and application design. The

stages of validation by experts and usage trials with teachers and students demonstrated the effectiveness and acceptance of the developed media, although initially there were audio quality issues that were later successfully resolved. 3) The effectiveness trial showed an increase in cognitive outcomes among the group of students who used the interactive learning media compared to the control group. Statistical analysis showed significant differences in favor of the interactive media group, demonstrating its efficacy in improving learning outcomes.

There are several important implications for future research. First, future research could focus on the development and application of interactive media in other subjects, not only in physical education, but also in various other disciplines. Secondly, further research could explore the long-term impact of using interactive media on students' understanding and academic achievement. In addition, research could also assess the effectiveness of interactive media in various learning contexts, such as online or hybrid learning. Finally, future research could utilize the latest technologies, such as augmented reality (AR) and virtual reality (VR), to create a more immersive and engaging learning experience. Thus, efforts to develop interactive learning media can be continuously improved to meet the increasingly dynamic and diverse needs of education.

Funding

Acknowledgments

References

Abdullah, A., Achmad, A., & Sahibu, S. (2021). Media Pembelajaran Interaktif Mata Kuliah Pemograman Web Berbasis Android. *Inspiration: Jurnal Teknologi Informasi Dan Komunikasi*, *11*(1), 45. https://doi.org/10.35585/inspir.v11i1.2626

Abdulrahaman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, *6*(11), e05312. https://doi.org/10.1016/j.heliyon.2020.e05312

Abidah, A., Aklima, A., & Razak, A. (2022). Tantangan

Guru Sekolah Dasar dalam Menghadapi Era Society 5.0. *Jurnal Ilmiah Profesi Pendidikan*, 7(2c), 769–776. https://doi.org/10.29303/jipp.v7i2c.498

Achmad, G. H., Ratnasari, D., Amin, A., Yuliani, E., & Liandara, N. (2022). Penilaian Autentik pada Kurikulum Merdeka Belajar dalam Pembelajaran Pendidikan Agama Islam di Sekolah Dasar. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, 4(4), 5685–5699. https://doi.org/10.31004/edukatif.v4i4.3280

Afriana, S., & Prastowo, A. (2022). Penggunaan Media Pembelajaran E-Comic dalam Menumbuhkan Motivasi dan Antusiasme Belajar Peserta Didik Sekolah Dasar. *Didaktis: Jurnal Pendidikan Dan Ilmu Pengetahuan*, 22(1), 41. https://doi.org/10.30651/didaktis.v22i1.11089

Ahmad, A. M., Rahman, A. A., Saleh, M. H., & Daud, Z. (2024). Diversifying Quranic revision methods using gamification-based teaching material for tahfiz education. *International Journal of Evaluation and Research in Education* , 13(2), 987–996. https://doi.org/10.11591/ijere.v13i2.26218

Apifa, W. A. P., Ilham, I., & Iqroni, D. (2020). Profil Keterampilan Shooting Free Throw Atlet Bola Basket. *Jurnal Olahraga Dan Kesehatan Indonesia*, 1(1), 30–36. https://doi.org/10.55081/joki.v1i1.296

Arifin, M. B., & Wardani, Y. A. (2020). Pengembangan Media Audio Visual Menggunakan Contextual Teaching and Learning (CTL) dalam Pembelajaran Menulis Paragraf Narasi pada Siswa Kelas VII SMP. *Diglosia: Jurnal Kajian Bahasa, Sastra, Dan Pengajarannya*, 3(4), 373–384.
https://doi.org/10.30872/diglosia.v3i4.146

Assis Lauria, A., Bastos Lôbo, I. L., Mendes Pires Melo, L. A., Magalhães Pereira, B., & Fonseca Bicalho, C. C. (2023). Avaliação da ansiedade-estado em jovens basquetebolistas em competições escolares. *Retos*, 50, 971–975. https://doi.org/10.47197/retos.v50.99312

Barr, M. L., & McNamara, J. (2022). Community-Based Participatory Research: Partnering with College Students to Develop a Tailored, Wellness-Focused Intervention for University Campuses. *International Journal of Environmental Research and Public Health*, 19(23). https://doi.org/10.3390/ijerph192316331

Bond, M., & Bedenlier, S. (2019). Facilitating Student Engagement Through Educational Technology: Towards a Conceptual Framework. *Journal of Interactive Media in Education*, 2019(1). https://doi.org/10.5334/jime.528

Budiarto, M. K., Gunarhadi, G., & Rahman, A. (2024). Technology in education through mobile learning application (MLA) and its impact on learning outcomes: Literature review. *Journal of Education and Learning*, 18(2), 413–420. https://doi.org/10.11591/edulearn.v18i2.20976

Chang, T.-S., Teng, Y.-K., Chien, S.-Y., & Tzeng, Y.-L. (2021). Use of an interactive multimedia e-book to improve nursing students'' sexual harassment prevention knowledge, prevention strategies, coping behavior, and learning motivation: A randomized controlled study. *Nurse Education Today*, 105, 104883. https://doi.org/10.1016/j.nedt.2021.104883

Chen, Y. (2021). Analysis of Community Interaction Modules of European and American Universities. *Journalism and Media*, 2(2), 129–154. https://doi.org/10.3390/journalmedia2020009

D de la Cruz, M. S., Smith, R. S., Silverio, A. E., Casola, A. R., & Kelly, E. L. (2021). What we learned in the development of a third-year medical student curricular project. *Perspectives on Medical Education*, 10(3), 167–170. https://doi.org/10.1007/s40037-021-00648-x

Deraney, P. M. (2021). Voices of future educators: Graduate students' conceptions about teaching and learning in higher education. *Journal of Educational and Social Research*, 11(5), 160–172. https://doi.org/10.36941/jesr-2021-0114

Ewing, S., & Seale, C. (2023). Multimedia: Past, Present, and Future. In *Reference Module in Social Sciences*. Elsevier. https://doi.org/10.1016/B978-0-323-95689-5.00022-5

Frick, P., & Schüler, A. (2023). Extending the theoretical foundations of multimedia learning: Activation, integration, and validation occur when processing illustrated texts. *Learning and Instruction*, 87, 101800. https://doi.org/10.1016/j.learninstruc.2023.101800

Fu, J. (2022). Innovation of engineering teaching methods based on multimedia assisted technology. *Computers and Electrical Engineering*, 100, 107867. https://doi.org/10.1016/j.compeleceng.2022.107867

Giordano, G. M., Sanmarchi, F., Mucci, A., Rucci, P., Brando, F., Caporusso, E., Giuliani, L., Melillo, A., Pezzella, P., Bucci, P., Rocca, P., Rossi, A., Bertolino, A., Rossi, R., Pergola, G., Galderisi, S., & Maj, M. (2024). External validation of the five domains of negative symptoms: Focus on cognition, functional capacity, and real-world functioning. *European Psychiatry*, 67(1). https://doi.org/10.1192/j.eurpsy.2023.2478

Grando, D. (2022). Multimedia in microbiology education: a critical sustainable resource. In *Importance of Microbiology Teaching and Microbial Resource Management for Sustainable Futures* (pp. 81–105). Elsevier. https://doi.org/10.1016/B978-0-12-818272-7.00011-0

Halimatusyadiah, H., Suryana, Y., & Ganda, N. (2020). CD Interaktif Berbasis Flash sebagai Media Pembelajaran Kondisi Geografis Indonesia Kelas V. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 7(4), 199–208. https://doi.org/10.17509/pedadidaktika.v7i4.26631

Harahap, Imran, & Hariadi. (2022). Pengembangan media pembelajaran permainan bola basket berbasis adobe flash. *Jurnal Pedagogik Olahraga*, 8(1), 5. https://doi.org/10.24114/jpor.v8i1.36344

Harahap, L. K., & Siregar, A. D. (2020). Pengembangan

media pembelajaran interaktif berbasis adobe flash cs6 untuk meningkatkan motivasi dan hasil belajar pada materi kesetimbangan kimia. *JPPS (Jurnal Penelitian Pendidikan Sains)*, *10*(1), 1910. https://doi.org/10.26740/jpps.v10n1.p1910-1924

Haryani, H., Astriyani, E., & Devana, V. T. (2021). Exploration of Islamic Religious Learning Innovation Technology with the iLearning Approach. *APTISI Transactions on Technopreneurship*, *3*(2), 75–86. https://doi.org/10.34306/att.v3i2.211

Hernández-Mosqueira, C., Cresp Barría, M., Peña-Troncoso, S., & Pavez-Adasme, G. (2023). Perfil dermatoglifico de seleccionados chilenos de básquetbol categoría sub 14 (Dermatoglyphic profile of chilean basketball teams category sub 14). *Retos*, *48*, 630–636. https://doi.org/10.47197/retos.v48.96101

Jackman, P. C., Sanderson, R., & Jacobs, L. (2023). Developing inductions to support mental health and wellbeing in doctoral researchers: findings from a qualitative co-design study with doctoral researchers and university stakeholders. *European Journal of Higher Education*, *13*(1), 62–79. https://doi.org/10.1080/21568235.2021.1992293

Jang, S., & Suh, E. E. (2022). Development and application of a mobile-based multimedia nursing competency evaluation system for nursing students: A mixed-method randomized controlled study. *Nurse Education in Practice*, *64*, 103458. https://doi.org/10.1016/j.nepr.2022.103458

Jayanti, D., Septiani, J. I., Sayekti, I. C., Prasojo, I., & Yuliana, I. (2021). Pengenalan game edukasi sebagai digital learning culture pada pembelajaran sekolah dasar [Introduction of educational games as digital learning culture in elementary school learning]. *Buletin KKN Pendidikan*, *3*(2), 184–193. https://doi.org/10.23917/bkkndik.v3i2.15735

Ji, Z., Zhang, Y., Pang, Y., & Li, X. (2018). Hypergraph dominant set based multi-video summarization. *Signal Processing*, *148*, 114–123. https://doi.org/10.1016/j.sigpro.2018.01.028

Kaya, E., Karatana, Ö., & Yıldırım, T. Ö. (2023). The relationship between the online learning process, 21st century skills and work readiness in senior nursing students. *Nurse Education in Practice*, *73*, 103801. https://doi.org/10.1016/j.nepr.2023.103801

Li, H., Zhang, T., Woolley, J. D., An, J., & Wang, F. (2023). Exploring factors influencing young children's learning from storybooks: Interactive and multimedia features. *Journal of Experimental Child Psychology*, *233*, 105680. https://doi.org/10.1016/j.jecp.2023.105680

Mayer, R. E. (2021). Cognitive Theory of Multimedia Learning. In *The Cambridge Handbook of Multimedia Learning* (pp. 57–72). Cambridge University Press. https://doi.org/10.1017/9781108894333.008

Molina, A. I., Navarro, Ó., Ortega, M., & Lacruz, M. (2018). Evaluating multimedia learning materials in primary education using eye tracking. *Computer Standards & Interfaces*, *59*, 45–60. https://doi.org/10.1016/j.csi.2018.02.004

Ndiung, S., & Jediut, M. (2020). Pengembangan instrumen tes hasil belajar matematika peserta didik sekolah dasar berorientasi pada berpikir tingkat tinggi. *Premiere Educandum : Jurnal Pendidikan Dasar Dan Pembelajaran*, *10*(1), 94. https://doi.org/10.25273/pe.v10i1.6274

Nova, F., Allenidekania, A., & Agustini, N. (2019). The effect of multimedia-based nutrition education on parents' knowledge and body weight change in leukemia children. *Enfermería Clínica*, *29*, 229–233. https://doi.org/10.1016/j.enfcli.2019.04.027

Occa, A., & Morgan, S. E. (2022). The role of cognitive absorption in the persuasiveness of multimedia messages. *Computers & Education*, *176*, 104363. https://doi.org/10.1016/j.compedu.2021.104363

Octaviani, A. N., Permana, E., & Yayat, Y. (2017). Pengembangan Multimedia Interaktif untuk Meningkatkan Hasil Belajar Siswa pada Kompetensi Dasar Stability Flight and Dynamics Siswa SMK. *Journal of Mechanical Engineering Education*, *4*(1), 12. https://doi.org/10.17509/jmee.v4i1.7435

Ongor, M., & Uslusoy, E. C. (2023). The effect of multimedia-based education in e-learning on nursing students' academic success and motivation: A randomised controlled study. *Nurse Education in Practice*, *71*, 103686. https://doi.org/10.1016/j.nepr.2023.103686

Park, C., Kim, D., Cho, S., & Han, H.-J. (2019). Adoption of multimedia technology for learning and gender difference. *Computers in Human Behavior*, *92*, 288–296. https://doi.org/10.1016/j.chb.2018.11.029

Pasang, B. S. A., & Najib, S. A. M. (2022). Implementation of education for sustainable development in geography subjects among trainee teachers. *International Journal of Evaluation and Research in Education*, *11*(3), 1099–1106. https://doi.org/10.11591/ijere.v11i3.22159

Polevoy, G., Fuentes-Barría, H., & Aguilera-Rguía, R. (2024). Efectos de 52 semanas de un programa de ejercicio físico sobre la velocidad y fuerza muscular de jugadores rusos de baloncesto de entre 12 a 13 años. Ensayo Controlado Aleatorizado (Effects of 52 weeks of a physical exercise program on the speed and muscl. *Retos*, *55*, 908–914. https://doi.org/10.47197/retos.v55.106261

Prasetyo, B. (2021). Meningkatkan Keaktifan Siswa pada Materi Permainan Bola Basket melalui Model Pembelajaran Savi (Somatik, Auditori, Visual dan Intelektual). *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *4*(8), 881–887. https://doi.org/10.54371/jiip.v4i8.362

Práxedes, A., González, R., Del Villar, F., & Gil-Arias, A. (2021). Combining Physical Education and unstructured practice during school recess to improve the students' decision-making and execution (Combinando las clases de Educación Física con práctica no estructurada durante los recreos para aumentar la

toma de decisi. *Retos*, *41*, 502–511. https://doi.org/10.47197/retos.v0i41.83455

Putra, R. A., Wahjoedi, H., & Spyanawati, N. L. P. (2020). Pengaruh Model Pembelajaran Kooperatif Tipe Teams Games Tournament Terhadap Hasil Belajar Teknik Dasar Shooting Bola Basket. *Jurnal Ilmu Keolahragaan Undiksha*, *8*(2), 108. https://doi.org/10.23887/jiku.v8i2.29816

Qiu, F., Zhang, G., Sheng, X., Jiang, L., Zhu, L., Xiang, Q., Jiang, B., & Chen, P. kuo. (2022). Predicting students' performance in e-learning using learning process and behaviour data. *Scientific Reports*, *12*(1), 1–15. https://doi.org/10.1038/s41598-021-03867-8

Ramadhan, M. N., Sukarmin, Y., Arovah, N. I., Anwar, N. I. A., & Aksir, M. I. (2023). The Effect Of Imagery Training On The Accuracy Of Free Throws In Basketball Players In Terms Of Concentration. *Retos*, *51*, 603–609. https://doi.org/10.47197/retos.v51.100554

Riyani, R., Maizora, S., & Hanifah, H. (2017). Uji validitas pengembangan tes untuk mengukur kemampuan pemahaman relasional pada materi persamaan kuadrat siswa kelas viii smp. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *1*(1), 60–65. https://doi.org/10.33369/jp2ms.1.1.60-65

Rodríguez-Cayetano, A., López Ramos, S., Escudero Ollero, D., & Pérez-Muñoz, S. (2023). Efecto de un programa de preparación física específica sobre la condición física en jugadores sub18 de baloncesto (Effect of a specific physical preparation program on physical fitness in U18 basketball players). *Retos*, *50*, 152–160. https://doi.org/10.47197/retos.v50.97320

Samosir, R. S., Ziveria, M., Candrasari, S., & Salman. (2021). Mendesain Bahan Ajar Berbasis Multimedia Bagi Dosen Dan Mahasiswa PGSD FKIP Universitas Djuanda Bogor. *ABDIMAS Jurnal Pengabdian Kepada Masyarakat*, *2*(2), 1–10. https://doi.org/10.53008/abdimas.v2i2.182

Sartinah, E. P., Andajani, S. J., Ashar, M. N., & Budiati, E. F. R. (2021). The accessible it for the courses on the special education undergraduate program. *World Journal on Educational Technology: Current Issues*, *13*(1), 96–105. https://doi.org/10.18844/wjet.v12i4.5186

Selfa-Sastre, M., Pifarré, M., Cujba, A., Cutillas, L., & Falguera, E. (2022). The Role of Digital Technologies to Promote Collaborative Creativity in Language Education. *Frontiers in Psychology*, *13*(February). https://doi.org/10.3389/fpsyg.2022.828981

Sukariasih, L., Erniwati, E., & Salim, A. (2019). Development of Interactive Multimedia on Science Learning Based Adobe Flash CS6. *International Journal for Educational and Vocational Studies*, *1*(4). https://doi.org/10.29103/ijevs.v1i4.1454

Susanti, T., Kurniadewi, F., & Nurjayadi, M. (2021). Development of protein metabolism electronic module by flip PDF professional application. *Journal of Physics: Conference Series*, *1869*(1). https://doi.org/10.1088/1742-6596/1869/1/012025

Suwarto. (2022). Karakteristik Tes Ilmu Pengetahuan Alam. *JURNAL PENDIDIKAN*, *31*(1), 109. https://doi.org/10.32585/jp.v31i1.2269

Tarigan, E. F., Nilmarito, S., Islamiyah, K., Darmana, A., & Suyanti, R. D. (2022). Analisis Instrumen Tes Menggunakan Rasch Model dan Software SPSS 22.0. *Jurnal Inovasi Pendidikan Kimia*, *16*(2), 92–96. https://doi.org/10.15294/jipk.v16i2.30530

Utaminingsih, S., Madubala, S., Fajrie, N., Mustofa, H. A., & Azman, M. N. A. (2024). Developing an autistic child assessment model through art therapy on concentration ability in inclusive early childhood education: A case study in Indonesia. *Multidisciplinary Science Journal*, *6*(9). https://doi.org/10.31893/multiscience.2024165

Varas, D., Santana, M., Nussbaum, M., Claro, S., & Imbarack, P. (2023). Teachers' strategies and challenges in teaching 21st century skills: Little common understanding. *Thinking Skills and Creativity*, *48*, 101289. https://doi.org/10.1016/j.tsc.2023.101289

Wang, Y., Gong, S., Cao, Y., Lang, Y., & Xu, X. (2023). The effects of affective pedagogical agent in multimedia learning environments: A meta-analysis. *Educational Research Review*, *38*, 100506. https://doi.org/10.1016/j.edurev.2022.100506

Warju, W., Ariyanto, S. R., Soeryanto, S., & Trisna, R. A. (2020). Analisis kualitas butir soal tipe hots pada kompetensi sistem rem di sekolah menengah kejuruan. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *17*(1), 95. https://doi.org/10.23887/jptk-undiksha.v17i1.22914

Wibanto, W. (2017). *Desain dan Pemrograman Multimedia Pembelajaran Aktif* (Issue January). https://books.google.co.id/books?hl=id&lr=&id=9pULDgAAQBAJ&oi=fnd&pg=PA1&dq=Wibanto,+W andah.+2017.+Desain+dan+Pemrograman+Multime dia+Pembelajaran+Aktif.+Jakarta:+Depublish.&ots= 5G-gfQzNRQ&sig=AEwM-VpvWrJbEZ2f4VD-rkrk2cQ&redir_esc=y#v=onepage&q&f=false

Wijayanti, W., & Relmasira, S. C. (2019). Pengembangan Media PowerPoint IPA Untuk Siswa Kelas IV SD Negeri Samirono. *Jurnal Penelitian Dan Pengembangan Pendidikan*, *3*(2), 77. https://doi.org/10.23887/jppp.v3i2.17381

Yadav, D. K., & Bhatia, D. (2022). Effect of Reflective Practices on Student Learning in Higher Education—A Real Life Approach. *International Journal of Educational Reform*. https://doi.org/10.1177/10567879221094298

Yee, S. F. (2019). *A Phenomenological Inquiry into Science Teachers' Case Method Learning*. Springer Singapore. https://doi.org/10.1007/978-981-13-2679-0

Zhao, J., & Zhang, J. (2020). Application of multimedia technology in water conservancy and hydropower engineering. *Journal of Visual Communication and Image Representation*, *71*, 102707.

https://doi.org/10.1016/j.jvcir.2019.102707

Zou, D., & Teng, M. F. (2023). Effects of tasks and multimedia annotations on vocabulary learning. *System*, *115*, 103050. https://doi.org/10.1016/j.system.2023.103050

Zulaeha, I., Subyantoro, Hasanudin, C., & Pristiwati, R. (2023). Developing Teaching Materials of Academic Writing Using Mobile Learning. *Ingenierie Des Systemes d'Information*, *28*(2), 409–418. https://doi.org/10.18280/isi.280216

Datos de los/as autores/as y traductor/a:

Akbar Kusuma Abadi	akbarkuzuma@students.unnes.ac.id	Autor/a
Indah Sari Dewi	indahsaridewi17@students.unnes.ac.id	Autor/a
Syahrizal Islam	Syahrizal_islam027@students.unnes.ac.id	Autor/a
Okky Putra Alwin Pratama	okkypratama1718@students.unnes.ac.id	Autor/a
Aljawahir Agus Kristiono	aljawahir@students.unnes.ac.id	Autor/a
Muhammad Budi Wijaya	muhammadbudiwijayas2@students.unnes.ac.id	Autor/a
Akbar Kusuma	akbarkuzuma@students.unnes.ac.id	Traductor/a