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Development of HAPAL Mobile Learning as a Science Learning Media for Junior High School Students

Purwanti*, Nizar Alam Hamdani, Asep Rohayat, Deni Darmawan, Dian Rahadian, Dody Hermana
Educational Technology, Postgraduate School, Institut Pendidikan Indonesia.
*Corresponding Author. Email: purwanti2727@gmail.com

Abstract: This research aims to develop HAPAL mobile learning products as a science learning media that is suitable for use by junior high school students. The research method used is research and development (R&D) with the ADDIE model. The research subjects used were media expert and material expert as well as class VIII students at SMPN 4 Pakenjeng Garut. The instrument used was a questionnaire for expert validation and student responses as users. The results of the media expert validation obtained an average value of 88.9 with a very valid category and the material expert obtained an average value of 86.39 with a very valid category. The average value of student responses to HAPAL mobile learning was 90.12 with a very valid category. So it can be concluded that HAPAL mobile learning is suitable for use in science learning at junior high school level.

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Introduction

Junior High School (SMP) science instruction seeks to cultivate students' scientific attitudes, scientific thinking abilities, and scientific problem-solving abilities. Mastery of science helps to understand nature so that it can help to take appropriate actions (Widodo, 2021). Science is a subject that integrates basic concepts from various branches of science, such as Physics, Chemistry, and Biology, in order to equip students with an understanding of natural phenomena scientifically. Based on the results of interviews with junior high school students regarding the learning difficulties faced in science subjects, it was found that students had difficulty with the branch of Physics because it contains various mathematical equations that require in-depth understanding. One of the Physics materials at the high school level that is considered difficult is Archimedes' law. The reason why Archimedes' law is considered difficult by students is because the material is one of the abstract materials even though its phenomena are often found in everyday life (Yuliana et al,. 2021). Students have difficulty in applying the concept of Archimedes' law into mathematical calculations to solve the given problems (Widodo et al., 2018). In addition, students often experience misconceptions in the material of Archimedes' law which causes them difficulty in applying examples of Archimedes' law events in everyday life and poor understanding of the concept (Sarniti and Oktavianty, 2018). Rohmayanti (2020) explains that students' difficulties in understanding the material of Archimedes' law are in understanding the position, mass, density, and volume of objects immersed in fluids.

Data on learning outcomes of class VIII students at SMPN 4 Pakenjeng, Garut Regency - West Java, in the science subject of the Pressure of Substances material which contains the material of Archimedes' law, it was found that only 30% of students were able to

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achieve the minimum completion criteria. Furthermore, the results of interviews with class VIII science teachers at SMPN 4 Pakenjeng showed that one of the causes of low student learning outcomes in the Archimedes' law material was because the understanding of the concept in the material was still lacking. The Archimedes' law material contains mathematical equations that require in-depth understanding.

Based on the data obtained, a solution is needed to overcome students' learning difficulties in Archimedes' law material. According to Abdulhak and Darmawan (2017), educational technology is a complex and integrated process that involves people, procedures, ideas, equipment and organizations to analyze problems, find solutions to problems related to aspects of human learning. Digital learning media is a solution to learning problems that occur by utilizing current technological developments because it is more effective and efficient in its use. Learning using digital media provides a new revolution in the learning methods used from previously learning in the classroom to being able to be done outside the classroom (Sitepu, 2022). Based on the results of the questionnaire response of students at SMPN 4 Pakenjeng, Garut Regency - West Java, regarding digital learning media, it shows that digital learning media is very important. Student responses show that 100% of students agree with the use of digital learning media that can be accessed via smartphones, 80% of students are interested in digital learning media that contain various material content so that they are in accordance with their learning needs. This is supported by the smartphone facilities owned by all students. Smartphones can be used to access digital learning media designed and developed by teachers.

The development of digital learning media for the material on substance pressure which contains Archimedes' law has begun to be discovered, one of which is in a researrch conducted by Rohana et al., (2021) the product produced in the research is interactive multimedia that can help improve students' understanding of concepts. The features presented in the media include learning instructions, basic competencies, materials, questions, summaries, and profiles. The media produced can be accessed via a computer or laptop. The disadvantage of the media developed in the research is that the material displayed is only in text form, there is no explanatory video about the material being studied. Explanation of the material in the form of a video is certainly needed because students' learning styles vary. In addition, the media developed in the research was not equipped with a demonstration of practical work, even though the material on substance pressure which contains Archimedes' law requires practical work as proof of Archimedes' law itself. Another research related to the development of digital media on the material on Archimedes' law was conducted by Lestari et al., (2024) the product produced in the research was interactive learning media containing in-depth conceptual explanations accompanied by examples of questions on Archimedes' law. However, in this research, the media developed can only be accessed via a computer/laptop. In addition, Purwanti's (2025) research produced a product in the form of a digital learning module in the form of flip html. Students can easily open the digital module via their smartphone without having to install the application because it is shared via the flip html link. The drawback of this research is that the module presented is only in text form and is not equipped with a video explaining the material and a video experiment. The addition of content in the form of videos or simulations is very necessary to help students understand abstract concepts into concrete ones.

Referring to the three journals, the researcher intends to develop learning media for Archimedes' law material in the form of mobile learning, which is a digital learning media that is accessed via smartphone or mobile-based. Mobile learning is seen as having a

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transformative impact on the education system and providing learning opportunities for students because it can provide direct access to users (Winters, N, 2007). Mobile learning or mobile-based learning has become one of the innovations that is widely applied in the world of education. Mobile learning is a form of learning that utilizes mobile devices (smartphones, tablets, or other portable devices) to access, deliver, and interact with learning materials.

This research aims to develop learning media in the form of mobile learning on Archimedes' law material that is suitable for use by students. The novelty of the learning media developed on Archimedes' law material in this research is that it contains learning achievements, learning instructions, experimental videos, materials that present two choices, namely video and text, and practice questions provided in the form of quizzes. All of these features can be accessed in one mobile application via smartphone. The mobile learning developed is called HAPAL, which is an abbreviation of Archimedes' Law Understanding and Application. This is because the mobile learning developed contains materials that can help students understand Archimedes' law and also contains applications of Archimedes' law in everyday life, so that the material presented is contextual.

Research Method

The research method used is the research and development (R&D). The research and development model used in this research is the ADDIE model. Making products using the ADDIE process is one of the most effective tools today (Branch, 2009). ADDIE is an acronym for research steps, namely Analyze, Design, Develop, Implement, and Evaluate. The research subjects used in this research were material expert and media expert to assess the feasibility of the HAPAL mobile learning developed and junior high school students in grade VIII at SMPN 4 Pakenjeng - Garut totaling 32 students.

The research instrument used is a questionnaire to collect data from respondents with the aim of digging up some information. The questionnaire compiled includes:

a) Expert validation questionnaire. This questionnaire is used to assess the validity or feasibility of the developed HAPAL mobile learning product. The validators involved are media expert and material expert.
b) Student response questionnaire. This questionnaire is used to determine the responses of students as users to the use of the developed HAPAL mobile learning.

Analysis of media expert and material expert validation data using a Likert scale with a score of one to five. Here is the formula for calculating the results obtained:

$$V - ah = \frac{TSe}{TSh} \times 100\%$$

Information:
V-ah = Expert validation (Percentage Value)
Tse = Total empirical score achieved
TSh = Total expected score
(Akbar, 2017)

The expert validation assessment criteria for the development of HAPAL mobile learning are as follows:

Table 1. Expert Validation Criteria

Validation Criteria	Validation Level
85,01% - 100,00%	Very valid, or can be used without revision
70,01% - 85,00%	Fairly valid, or usable but needs minor revisions
50,01% - 70,00%	Less valid, recommended not to use because it needs

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	major revision
01,00% - 50,00%	Invalid, or may not be used

(Akbar, 2017)

Analysis of student response questionnaire data using a Likert scale of one to five. Here is the formula for calculating the results:

$$V - au = \frac{TSe}{TSh} \times 100\%$$

Information:
V-au = Audience/student validation (percentage value)
TSe = Total empirical score achieved
TSh = Total expected score

The criteria for student responses to the use of HAPAL mobile learning are as follows:

Table 2. Student Response Criteria

Validation Criteria	Validation Level
81,00% - 100,00%	Very valid, or can be used without revision
61,00% - 80,00%	Fairly valid, or usable but needs minor revisions
41,01% - 60,00%	Less valid, recommended not to use because it needs major revision
21,00% - 40,00%	Invalid, or may not be used
00,00% - 20,00%	Absolutely invalid, should not be used

(Akbar, 2017)

Results and Discussion

This research produced a mobile learning product HAPAL (Archimedes' Law Understanding and Application) on the subject of Science, the topic of Archimedes' Law for junior high school students. The implementation of each stage of ADDIE development in this research is described as follows:

1) Analysis Stage

The analysis stages in this research consist of curriculum analysis, field analysis, and literature analysis which are explained as follows.

a) Curriculum Analysis

Curriculum analysis is conducted to determine the relationship between the development of learning media and the learning objectives expected in the curriculum. In this case, the development of HAPAL mobile learning is focused on the material of the pressure of substances, sub-material of Archimedes' Law, which is found in the learning of Natural Sciences (IPA) for junior high school grade VIII.

The basic competency for Archimedes' law material is "explaining the pressure of substances and its application in everyday life including blood pressure, osmosis, and capillarity of transport tissue in plants". The operational verb in the KD is "explaining" meaning that the level of cognitive understanding of the Archimedes' law material is at C2, namely understanding. Based on the KD in the Archimedes' law material, the learning objectives that are compiled must at least be in accordance with the expected cognitive level and efforts are needed to achieve these competencies. Efforts that can be made are by compiling learning objectives according to the indicators of conceptual understanding, which contain seven indicators, namely interpreting, giving examples, classifying, summarizing, concluding, comparing, and explaining.

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b) Field Analysis

A preliminary field study was conducted by looking at educational report card data at SMPN 4 Pakenjeng, data on students' science learning outcomes, interviews, and student learning needs questionnaires.

Based on the 2024 SMPN 4 Pakenjeng education report card data, it was found that the quality of learning at SMPN 4 Pakenjeng Garut was categorized as lacking with a decrease in achievement of 1.89 from 2023. In addition, SMPN 4 Pakenjeng ranked at the bottom in Garut Regency, namely in the range of 81% - 100% of all educational units in the city. One of the causes is the learning method which is still conventional or teacher centered. So innovation is needed in learning to overcome this. Learning innovations in class for each subject will of course be different because each subject has different characteristics and difficulties. The subject of Natural Sciences or commonly abbreviated as IPA in Junior High Schools (SMP) consists of three branches of knowledge, namely Physics, Chemistry, and Biology. Based on the results of interviews with junior high school students regarding the learning difficulties faced in the subject of IPA, it was found that students had difficulty in the branch of Physics because it contains various mathematical equations that require in-depth understanding.

Based on the data on the results of students' Physics Science learning at SMPN 4 Pakenjeng Garut, only 30% of students were able to achieve the minimum completion criteria. This is because students' conceptual understanding of Physics Science material is still lacking, so learning innovations are needed that are in accordance with the needs of students and the development of the times. Based on the results of the questionnaire on the needs of students at SMPN 4 Pakenjeng Garut regarding digital learning media, it shows that 100% of students agree with the use of digital learning media that can be accessed via smartphones, 80% of students are interested in digital learning media that contain various material content so that they are in accordance with their learning needs. This is supported by the smartphone facilities owned by all students. Smartphones can be used to access digital learning media designed and developed by teachers.

c) Literature Analysis

One of the physics materials at the high school level that is considered difficult is Archimedes' law. The reason why Archimedes' law is considered difficult by students is because the material is abstract, although its phenomena are often found in everyday life (Yuliana et al., 2021). Students have difficulty applying the concept of Archimedes' law to mathematical calculations to solve the problems given (Widodo et al., 2018). In addition, students often experience misconceptions about Archimedes' law which makes it difficult for them to apply examples of Archimedes' law events in everyday life and lack of understanding of the concept (Sarniti and Oktavianty, 2018). Rohmayanti (2020) explains that students' difficulties in understanding Archimedes' law are in understanding the position, mass, density, and volume of objects immersed in fluids. Based on the results of curriculum analysis, field analysis, and literature analysis, the development of HAPAL mobile learning is very much needed to help students understand the concept of Archimedes' law.

2) Design Stage

The design stage is the second stage in the development of HAPAL mobile learning, at this stage the design of the product and research instruments to be used is

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carried out. The design stage carried out by researchers includes compiling an outline of the contents of HAPAL mobile learning, making flowcharts, making storyboards, and determining and compiling research instruments. The following is the HAPAL mobile learning flowchat.

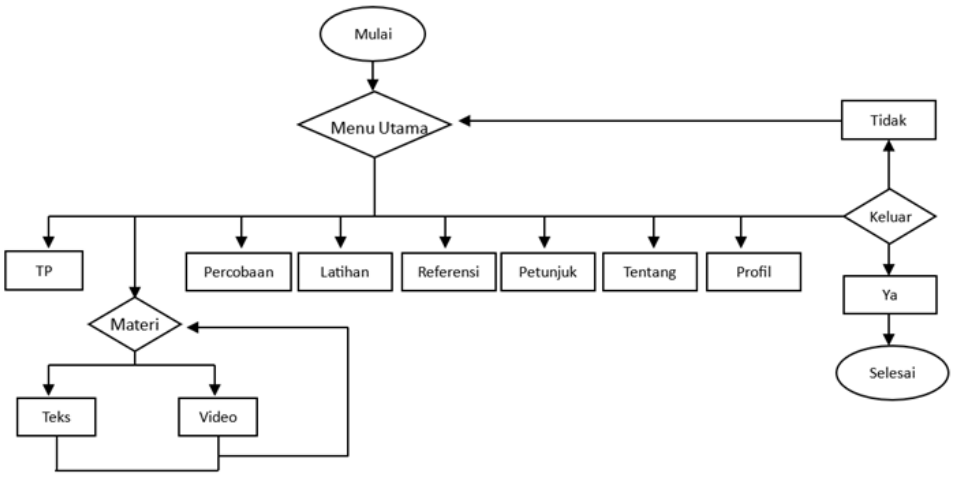

Figure 1. Flowchart of Mobile Learning HAPAL

The flowchart that has been made is then developed into a storyboard (Darmawan, 2016). A storyboard is a more detailed development of the flowchart. The storyboard that the researcher compiled consists of descriptions, images/visualizations and information that can facilitate the process of developing HAPAL mobile learning.

3) Development Stage

The development stage aims to create and modify learning media until it is ready to be tested in the learning environment (Cahyadi, 2019). At this stage, researchers create HAPAL mobile learning according to what has been planned at the design stage. The stage of creating HAPAL mobile learning begins by ensuring that the required software has been installed and works properly on the device used. At this stage, researchers use Canva Edu, Microsoft PowerPoint, Articulate Storyline, and Web2APK. After all the software and materials are ready, the next step is to produce HAPAL mobile learning.

Figure 2. Mobile Learning Hapal Display

After the HAPAL mobile learning application is completed, the next step is to create a user guide using Microsoft Word which is then saved in PDF format. Once completed, the researcher uploads the guide to Google Drive which will later be shared with HAPAL mobile learning users. The HAPAL mobile learning user guide consists of installation

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instructions, feature introduction, use of HAPAL mobile learning in learning, and problem solving.

Expert Validation Test

Validation tests were carried out by media expert and material expert. Media expert assess aspects of guidance and information, program performance, systematics, aesthetics and design principles. The results of media expert validation can be seen in the following table.

Table 4. Media Expert Assessment

No	Assessment Aspects	Value	Category
1.	Guides and information	90	Very Valid
2.	Program performance	86,7	Very Valid
3.	Systematics, aesthetics, and principles of design	90	Very Valid
Average		**88,9**	**Very Valid**

The material expert assessed the aspects of guidance and information, content/material, and evaluation. The results of the material expert assessment can be seen in the following table.

Table 5. Material Expert Assessment

No	Assessment Aspects	Value	Category
1.	Guides and information	86,67	Very Valid
2.	Content/Material	87,5	Very Valid
3.	Evaluation	85	Fairly Valid, Needs Minor Revision
Average		**86,39**	**Very Valid**

In addition to obtaining data in the form of feasibility values from the media being developed, at the validation stage, several responses and suggestions were obtained from the material and media experts which can be seen in the following table.

Table 6. Responses and Suggestions from Media Expert and Material Expert

Response/suggestion	
Media Expert	**Material Expert**
• Very potential if it can be explained by simulation • For questions, add an explanation of the question so that it is not just true or false that is known.	• Practice question number two, look for a picture that shows floating. • Questions related to experiments on putting objects in water are answered by questions.

The responses and suggestions from media expert and material expert were used as considerations for revising the media developed before being tested on students. The results of the revision can be seen in the following table.

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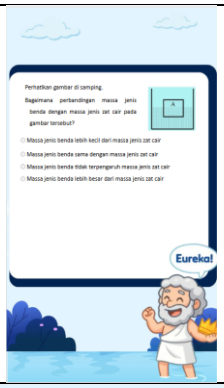
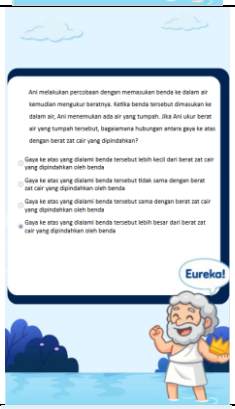
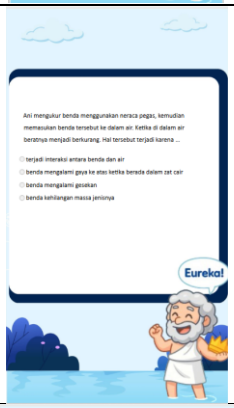
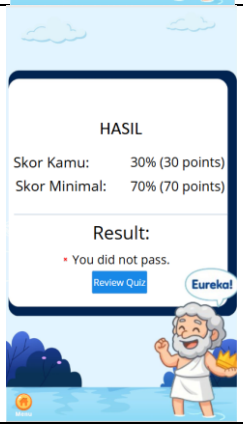
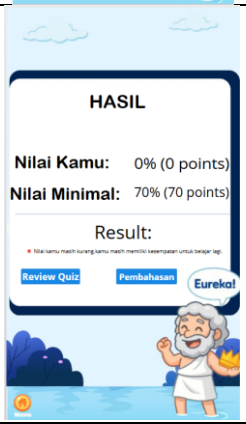
Table 7. Media Revisions Based on Validator Responses and Suggestions

Response/suggestion	Before Revision	After Revision
Adding simulation		
Replace the image with a more appropriate one in the practice questions		
Replacing multiple choice sentences that are not appropriate		
Adding discussion of practice questions		

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Conducting Small Scale Trials

The small-scale trial aims to determine the response of students as users to the media developed. In this one-on-one trial, students are given a student response questionnaire which will then be seen how much percentage of student acceptance of the media developed. This small-scale trial was conducted on five students with an average of 96.32 in the very valid category, meaning that HAPAL mobile learning can be used without revision.

Conducting Small Group Trials

Small group trials were conducted on 20 students with various android devices. HAPAL mobile learning can be installed and function on various devices used by students. Based on the data from the small group trials, the average student response was 90.3 with a very valid category, meaning that HAPAL mobile learning can be used without revision.

4) Implementation Stage

The implementation stage is the trial stage on target users with their learning environment, in this case HAPAL mobile learning is used by students in the learning process. The average student response at the implementation stage was 90.12 with a very valid category, meaning that the developed HAPAL mobile learning is suitable for use in learning.

5) Evaluation Stage

Evaluation is the last stage of the research conducted. At this stage, the researcher evaluates the students' responses to the HAPAL mobile learning used in learning. The students' responses to the media developed for each aspect of the assessment can be seen in the following table.

Table 8. Student Response Data

Assessment Aspects	Value	Category
Panduan dan Informasi	90	Very Valid
Desain dan Fasilitas Media	90,5	Very Valid
Meteri	88,1	Very Valid
Evaluasi	92	Very Valid
Efek Pedagogy	90	Very Valid
Rata- Rata	**90,12**	**Very Valid**

The results of the study showed that students' responses to each aspect of the HAPAL mobile learning assessment were in the very valid category, with an average score of 90.12. This value was obtained based on the results of an assessment questionnaire that covered various aspects, such as guidance and information, media design and facilities, materials, evaluation, and pedagogical effects. This high score reflects that students feel satisfied and helped by the presence of mobile-based learning media.

The very valid categorization refers to the learning media validity assessment guidelines, which state that a score above 85 is included in the very good category and is suitable for use (Akbar, 2017). Thus, HAPAL mobile learning meets the eligibility criteria in terms of users, especially students as the main target. This high validity is also an indicator that the design, content, and learning approaches used in the development of HAPAL mobile learning are in accordance with the needs and learning characteristics of students.

Mobile learning allows access to learning content without relying on space, mobile learning can be used for distance learning independently by students or conventional

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learning in the classroom (Talan, 2020). HAPAL mobile learning provides more flexible learning opportunities for students, so that students can learn anytime and anywhere independently. This is in accordance with the research of Syaputrizal and Jannah (2019) which states that mobile learning-based physics learning media using the Android platform can increase student learning independence. Learning independence affects students' understanding of concepts. The better the learning independence, the better the students' understanding of concepts (Yani, et al 2022).

Conclusion

With an average validation score of 88.9 from media experts, 86.39 from material experts, and 90.12 from student responses, it can be concluded that the HAPAL mobile learning is feasible to be used in science learning.

Recommendation

The development of HAPAL mobile learning that has been carried out provides several recommendations as follows:

1) For students, HAPAL mobile learning can be used as a learning resource both during classroom learning or independent learning at home. The use of HAPAL mobile learning can help improve students' conceptual understanding of Archimedes' Law material.
2) For further researchers, HAPAL mobile learning has great potential to develop high-level thinking skills by adding content that supports these abilities.
3) For educators, HAPAL mobile learning can be used as a science learning medium for Archimedes' Law material that provides interactive features so that it will foster students' interest in learning.

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