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Development of Physics Mobile Learning Integrated with Games on Temperature and Heat Materials

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Abstract: This study aims to develop learning media in the form of learning videos of Phymol (Physics Mobile Learning) Integrated Games on the material of Temperature and Heat. The research method used is the R&D (Research and Development) research method with the ADDIE development model, including the stages of Analysis (analysis), Design (design), Development (development), Implementation (implementation) and Evaluation (evaluation). In this study, the product was validated using an expert validation instrument which was distributed to two lecturers and three teachers and a limited trial was conducted using student response questionnaires. The results of product validation show an average percentage of 92% with a very feasible category. The limited trial conducted by the researcher involved 30 students of SMA Negeri 5 Cilegon. Student responses showed an average percentage of 86% with a very good category. Based on the results of expert validation and student response questionnaires, physics learning media in the form of Phymol learning videos (Physics Mobile Learning) integrated Games on Temperature and Heat material is very feasible and can be used as a physics learning medium.

Keywords: physics learning, games, temperature and heat .

Abstrak: *Penelitian ini bertujuan untuk mengembangkan media pembelajaran berupa video pembelajaran Phymol (Physics Mobile Learning) Terintegrasi Games pada materi Suhu dan Kalor. Metode penelitian yang digunakan adalah metode penelitian R&D (Research and Development) dengan model pengembangan ADDIE, meliputi tahapan Analysis (analisis), Design (desain), Development (pengembangan), Implementation (implementasi) dan Evaluation (evaluasi). Dalam peneltian ini produk divalidasi menggunakan instrument validasi ahli yang disebarkan kepada dua orang dosen dan tiga orang guru dan dilakukan uji coba terbatas menggunakan angket respon siswa. Hasil validasi produk menunjukkan persentase rata-rata sebesar 92% dengan kategori sangat layak. Uji coba terbatas yang dilakukan peneliti melibatkan 30 siswa SMA Negeri 5 Cilegon. Respon siswa menunjukkan presentase rata-rata sebesar 86% dengan kategori sangat baik. Berdasarkan hasil validasi para ahli dan angket respon siswa, media pembelajaran fisika berupa video pembelajaran Phymol (Physics Mobile Learning) terintegrasi Games pada materi Suhu dan Kalor sangat layak dan dapat digunakan sebagai media pembelajaran fisika.*

Kata kunci: *pembelajaran fisika, permainan, temperature dan kalor.*

▪ INTRODUCTION

The rapid development of technology in the 21st century is fairly fast, even to all corners of the world. Advances in technology and information in the 21st century, provide changes to human lifestyles, both in terms of work, socialization, playing and learning. The entry of technological advances in various aspects of life, including in the field of education, both educators and students are required to have the ability to learn and teach in accordance with developments in the 21st century. Teachers as educators must be able to prepare their students to live in the digital age, one of which is using learning media in learning activities by utilizing technology systems to facilitate student experiences.

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One of the technological developments that are familiar among the public is the use of Android-based *smartphones* . The use of this *smartphone* is considered to be able to interfere with one's activities, if the smartphone is only used to play *games* or *social media* (Astuti et al., 2018) , especially students. It's different during this pandemic period, all members of the community, including employees, students and college students, require using *a smartphone* to carry out their activities. For students and students, learning that should be done face-to-face has to be done online (in a network). Likewise for private employees, educators and others who require them to work from home. In this case, the use *of smartphones* is currently used not only as a communication tool, but is widely used as a learning medium (Ismanto et al., 2017) .

The use *of smartphones* in education makes this device used as an alternative to learning activities in terms of media development (Kitchenham, 2011) . The use of *smartphones* in education is known as *Mobile Learning (m-Learning)* . According to (González et al., 2015) the use of *Mobile Learning technology* can make a good contribution to students in accessing materials, resources and even learning media. In addition, the existence of *smartphones* used in education can make technology like this have a central role so that it can be used to provide information to students through this Android -based *smartphone device* (Pachler, 2007) . This is also in accordance with (Bao & Koenig, 2019) which states that the existence of learning media that utilizes *smartphone technology* can provide opportunities for students to be able to develop learning through searching from the internet, which can train students' skills, besides that it can also build competence of students dynamically because of the mobility principle possessed by *smartphones.*

The selection of video as a medium for disseminating innovation that is able to combine and combine visuals with audio and can be packaged in various forms, one example is combining face-to-face communication with group communication, using text, audio and music (Yudianto, 2017). The existence of innovative and creative educators can develop and use learning media that is in line with the development of science and technology, including the use of video. Video can be a medium to explain difficult and abstract physics material to be displayed in class or used as independent study material for students. Therefore, it is necessary to have the ability of educators in developing physics learning videos that are used to help explain these difficult and abstract physics concepts. In addition, video can make the abstract concept concrete because it can display accelerated or slowed motion, displays something in detail so that it is easily observed by students (Hafizah, 2020) .

In this study, we will discuss the use of physics learning videos to support classroom learning and independent learning and review their effectiveness. In addition, this study also discusses the development of physics learning videos based on the results of previous research in Indonesia and looks at development opportunities in the future.

Based on the description above, the application of learning videos that utilize *smartphone technology* is one way to motivate students to take part in learning according to the material provided by the teacher (Zulherman, Abidin Pasaribu, Ketang Wiyono, Saparini, 2019) . The addition of *games* in learning videos is also an alternative for teachers to overcome student boredom. Therefore, it is necessary to develop learning media in the form of integrated learning video games on temperature and heat material

that are packaged using an application that can be accessed using a smartphone for each student.

▪ METHOD

Participants

In this study, the subjects of the research trial were students of class XI MIPA. The existence of this stage is carried out to determine the response of students to the developed Phymol application. In addition, the object of this research is an integrated Phymol Learning Video *game* to help physics learning activities on temperature and heat material. The location of this research is SMA Negeri 5 Cilegon, which is located on Jl. Sunan Bonang Link. Hamlet Kel. Banjarnegara Ciwan and Cilegon City, Banten.

Research Design and procedures

The research method used is the *Research and Development* (R&D) research method. is a research method that produces a product, it can be in the form of modules, models or others, besides that there is also the effectiveness of the products that have been made (Dr. Budiyono Saputro, 2011) . The product here is defined as a product in the form of hardware or software, such as interactive learning models, guidance models and others (Maksum, 2012) .

This development research is an educational development research, the purpose of which is to develop a video learning Phymol (*Physisc Mobile Learning*) Integrated Games on Physics material in high school, especially on temperature and heat material. This research includes several processes, including the development process, product validation, and product readability testing.

The product produced in this research is an application called PHYMOL *(Physics Mobile Learning)*. This research procedure uses the ADDIE development model, the ADDIE development model is a development model consisting of 5 stages, namely (1) *Analysis*, at this stage a needs analysis is carried out in the form of a literacy study on *Smart Apps Creator media* as a support for making applications, then analysis of learning materials, and environmental analysis according to the product to be developed. (2) *Design*, at this stage is the design stage of the product to be developed. (3) *Development*, at this stage is the process of realizing the design that has been designed into a real product. (4) *Implementation*, at this stage the application of the product that has been developed, in this study the implementation stage was only limited to testing in small groups. (5) *Evaluation*, at this stage the process is shown to see how the products that have been developed have been successfully made and are suitable for use or not.

Instruments

Data collection techniques used by researchers are (1) Interview, In this study, researchers conducted interviews with Mr. Agus Setiawan, as a physics teacher at SMA Negeri 5 Cilegon, with the aim of knowing the problems that occur in physics learning activities. After the interview process is carried out (2) Observations, Observations were made during the learning activities. The aim is to find out the models and methods used by teachers in learning activities, especially in learning physics. In this study, observations were carried out at SMA Negeri 5 Cilegon. Furthermore, the distribution of (3) Questionnaires or questionnaires, The questionnaire used in this study was an expert

validation instrument sheet and a questionnaire to determine student responses to the developed learning media.

The data collection instruments in this development research are (1) Interview Guidelines, where the interview is structured, and the research and development interview process is conducted openly. So in this case, the interview guide only contains the essence of the interview regarding the problems that occur in classroom learning activities. Then, (2) Observation Guidelines, This observation was conducted to find out about the completeness of facilities and infrastructure, models and methods, the use of media and students' attitudes towards learning carried out in the classroom. The existence of an observation sheet is used by researchers as a reference in developing media that can be used in the learning process (Kristanto, 2018) . Furthermore, (3) the instrument validation sheet, which consists of an expert validation instrument sheet and a student response instrument sheet. On the Expert Validation Instrument Sheet, the use of this validation questionnaire is filled out by media experts, material experts which in this questionnaire are closed in nature. The use of this questionnaire aims to get advice and value from experts regarding the product being developed. The student response questionnaire was used when testing the product being developed. The aim is to find out responses about media products developed, and filled out by students (Wibowo, 2012) .

Data Analysis

Data analysis techniques are very important in the scientific method, because with data analysis, we can find out whether the data can be given meaning or meaning that is useful in solving problems from a research (Sugiyono, 2015) . The data analysis technique used in this research is quantitative data analysis technique. Where, the assessment data obtained from the results of the validator and questionnaires or student response questionnaires which were analyzed descriptively qualitatively. The assessment of the validator 's results will be used as a reference for revising a product to be feasible. The product design that has been developed will be assessed by the validator using a validation instrument. In addition to the validation instrument, the reference used as an assessment of the learning media that has been developed by the researcher is the student response questionnaire instrument, which then the results of the assessment of all aspects will be measured using *a Likert scale. The Likert* scale is a measurement scale in the form of a number of positive or negative statements about an attitude object (Wagiran, 2013) .

In this study, the answers to the validation instrument items were grouped into five choices. Each indicator will be measured and given a score on a scale of 1-5 in accordance with the guidelines for assessing the feasibility of a learning media that has been prepared by the researcher. In addition, each indicator of the student response questionnaire will be given a score of 1-5 scale, namely 5 (strongly agree), 4 (agree), 3 (disagree), 2 (disagree), and 1 (strongly disagree). The following are some of the analytical techniques used in phymol media development research, namely data analysis of Expert validation instruments, on research data on the feasibility of a developed product being analyzed descriptively (Bungin, 2010) . Analysis of the data on this validation instrument was used to determine and describe the feasibility of a product development video learning Phymol integrated *Games* on temperature and heat material at SMA Negeri 5 Cilegon. In Student Response Analysis, the data obtained from student response questionnaires were analyzed using qualitative descriptive data, using a Likert scale whose purpose was to

determine student responses regarding the phymol media developed (Kartini & Putra, 2020) .

▪ RESULT AND DISSCUSSION

The results of this development research are (1) a learning media in the form of an *Android application* called PHYMOL *(Physics Mobile Learning) which contains video games* integrated learning on the subject of Temperature and Heat, (2) an assessment of the feasibility of Phymol learning media by media experts and experts. material, (3) student questionnaire data on phymol learning media. The first step used in conducting this research is to determine potential problems and collect data. After these steps are carried out, researchers can begin to design and develop phymol learning media. Here's the link to download the phymol app: https://drive.google.com/file/d/151jWtUVHSipW3lvZDahHk80vvHQJHOaG/view?usp=sharing

This media has been developed and researched using the ADDIE development model which consists of five stages, namely *Analysis* (analysis), *Design* (design), *Development* (development), *Implementation* (implementation) and *evaluation* (evaluation). However, in this study, the *implementation stage* was not carried out, because at the trial stage it was limited to small group trials, namely the XI IPA class students of SMA Negeri 5 Cilegon. After carrying out these stages, learning media in the form of applications are produced in the form of phymol learning videos *(physics mobile learning)* integrated games on temperature and heat material. The following are the results of the development of a phymol learning video *(Physics Mobile Learning)* integrated with Games on the Material of Temperature and Heat.

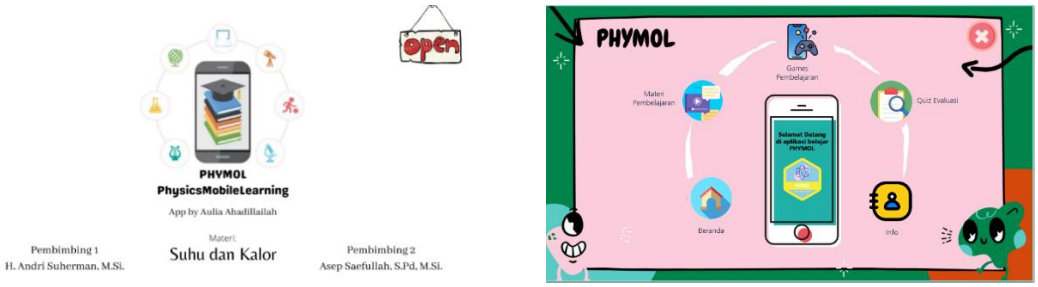

Figure 1. Start page view and Menu page view

In the initial view of the phymol application, it consists of a start page and a menu page. The start page is the page that first appears when the user opens the phymol application. The main menu page consists of buttons consisting of the Home menu button, material button, games button, quiz button and info button. Each button will display the appropriate page when pressed, as well as an exit button to exit the media.

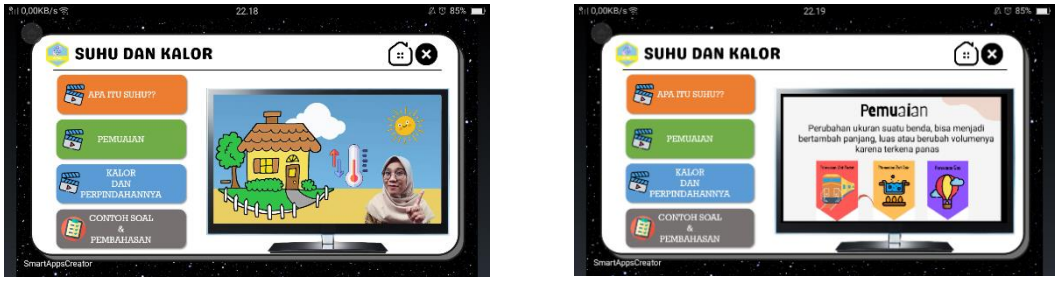

Figure 2. Learning video display

Figure 3. Games page view

Figure 4. Quiz page view

On this page, a learning video in the form of temperature and heat material will be presented which is divided into several sub-chapters. On the games page display, there is a page that contains several games that can be played, according to the material described in the learning video. In addition, there is a quiz page display, which can be used as evaluation material after studying temperature and heat material.

Figure 5. Score gain page view

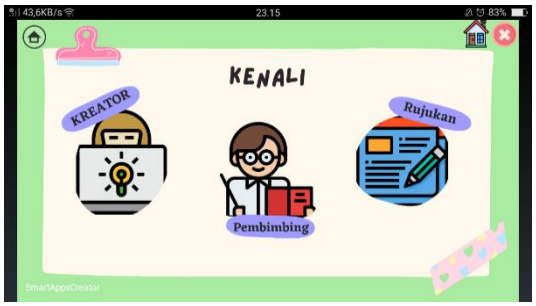

Figure 6. Info Page View

On this page, there are three menus including the creator menu, the supervisor menu, and the last one is the reference menu. On this page, users can find out who made the application, then the supervisor and some references used by the creator to create an application. In this study, validation assessments were obtained from experts related to the developed media, which are presented in the following table:

Table 4 . Expert Validation Results

Assessment Aspect	Expert Team					Average Score indicator	Max Score	Average Score Per Aspect
	1	2	3	4	5			
Content Feasibility Aspect								
Conformity of SK & KD Presentation	5	5	4.7	5	3	4.5	5	4.5
Accuracy	4	5	5	5	4	4.6		
Encourage Curiosity	5	5	4	5	3	4.4		
Aspects of Feasibility of Presentation								
Presentation Technique	5	5	5	5	3	4.6	5	4.6
Material Presentation Support	4.5	5	5	5	4	4.7		
Learning Presentation	4.5	5	5	5	3.5	4.6		
Coherence & Coherence of Thought	5	5	5	5	3	4.6		
Language Eligibility Aspect								
Communicative	4	4	5	5	4	4.4	5	4.6
Dialogic & Interactive	5	5	5	5	4	4.8		
straightforward	5	5	4	5	4	4.6		
Suitability with the development of students	4	5	5	5	4	4.6		
Aspects of Contextual Assessment								
Contextual Reality	4.5	5	5	5	3.5	4.6	5	4.7
Contextual Component	5	5	5	5	4	4.8		
Aspect of Feasibility of Graphics								
Media Size	5	5	5	5	3	4.6	5	4.6
Display Design (Cover)	4.5	5	5	5	3.5	4.6		
Media Content Design	4.8	5	5	5	3.8	4.7		
Media Programming	5	5	5	5	3	4.6		
Total						**78.3**	**25**	**23**
Overall Average							**92%**	
Category							**Very Worthy**	

In addition to being presented in tabular form, the following are the results of validation by experts related to media developed by researchers, which are presented in the image below:

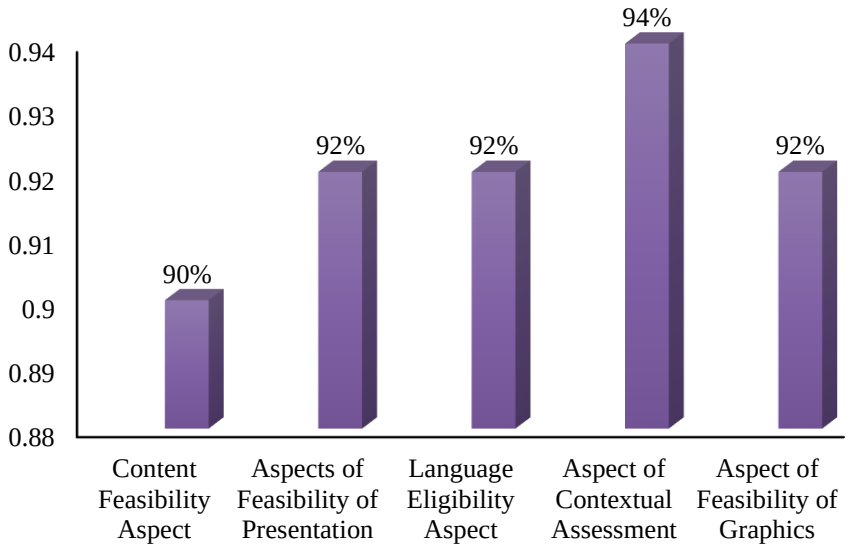

Figure 7. Graph of Expert Validation Results

The results of student responses related to physics learning media in the form of integrated Phymol learning videos on temperature and heat materials are presented in table 5 below:

Table 5. Results of Student Response Questionnaires

Assessment Aspect	No. Question	Number of Student Responses					Percentage	Interpretation
		SS	S	KS	TS	STS		
Skills	1	15	15	0	0	0	86%	Very good
	2	8	20	1	1	0		
	3	10	18	2	0	0		
	4	7	21	2	0	0		
	5	12	18	0	0	0		
Contents	6	7	21	2	0	0	84%	Very good
	7	9	19	2	0	0		
	8	6	23	1	0	0		
	9	7	21	2	0	0		
	10	10	20	0	0	0		
language	11	14	15	1	0	0	89%	Very good
	12	14	16	0	0	0		
	13	14	15	1	0	0		
Overall Average							**86%**	**Very good**

In addition to being presented in tabular form, the assessment of student response questionnaire results is presented in the form of the image below:

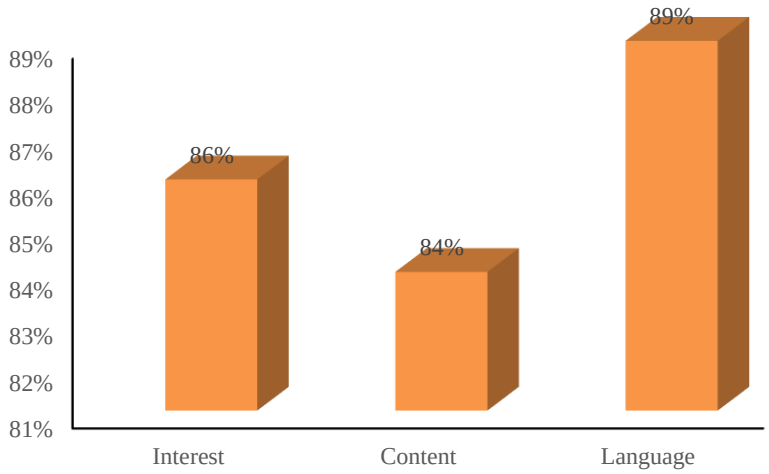

Figure 8. Graph of Student Response Results

Designing an integrated learning media phymol games on temperature and heat material is one of the interactive learning media that can be used by students in learning activities that are intended so that students understand more about learning materials, especially on temperature and heat material. In addition, students are not easily bored in participating in learning activities because in this phymol learning media, several games are connected that can be played by students. In addition, in the phymol learning media there is a quiz which is used to find out how far the students' understanding has been after doing their special learning on temperature and heat material.

The beginning of making this phymol media is to carry out an analysis related to media needs, analysis of learning materials that will be used as the subject of making this phymol learning media, as well as conducting an environmental analysis of what media have been used in learning activities, especially in physics learning. The material chosen is Temperature and Heat, which contains learning videos presented in the form of pictures, illustrations and animations that are related to everyday life and are equipped with examples of questions and their discussions. The process of making phymol media is adjusted to the initial design that has been made at the *Design stage* .

Based on the results at the *Design stage* that has been carried out, it was found that this phymol learning media product has the advantage that in this application an explanation accompanied by animation and pictures related to everyday life can support student explanations so that they understand more about learning concepts, especially on material. temperature and heat. Then this phymol application is accompanied by games and quizzes. This game can support students so they don't get bored easily in participating in learning activities. In addition, the quiz is here to test students' conceptual understanding skills after studying temperature and heat. After the media creation process in *Smart Apps Creator* is done, publish the file as an .apk extension. this is done so that the media can be run on mobile phones with *Android OS* to facilitate the learning process.

From the initial product that has been made, media validation tests have been carried out by experts with the aim of knowing the feasibility of learning media based on rational thinking. The assessment was carried out using a validation instrument. This assessment was conducted to determine the suitability, advantages and disadvantages of the developed media. If there are still deficiencies in the learning media, a revision and review of the learning media will be carried out based on the assessment as well as comments and suggestions from experts.

The results of the expert's assessment show that the learning media is suitable for use in learning as shown in table 4.9, by obtaining a media feasibility percentage of 92%, it is categorized as very feasible , meaning that phymol learning videos can be used as physics learning media (Caesaria et al., 2020) . Several experts gave suggestions and comments on the phymol learning media. One of them is Dr. Lukman Nulhakim, M.Pd who is a lecturer from the Science Education study program as validator 1, who provides suggestions regarding additions on the first page by including the name of the owner of the phymol media, then the material that is the subject of the discussion and includes the supervisor. In addition, it is necessary to add a prologue or prefix sentence on the *games* and *quiz pages* that are used to inform phymol media users regarding the games to be played and the quizzes that will be done. Then, Cecep Faturrohman, S.Pd as validator 5 who is a teacher from MA Al-Inayah Cilegon, gave suggestions regarding the buttons used must be in accordance with their uses.

The final result of the validator's assessment of the experts regarding learning media in the form of the development of integrated learning video games on temperature and heat material, has met the criteria for being eligible to be used as learning media, so that further limited trials can be carried out on students. This limited trial was carried out by distributing response questionnaires to students who were attended by 30 students of class XI IPA SMA Negeri 5 Cilegon. Based on the responses from students, the percentage of student responses to the phymol learning media was 86% with very good criteria, as in table 5. This category describes students motivated in learning physics by showing enthusiasm to follow and get satisfactory grades in learning, using innovative learning resources. in the learning process, mastering science and technology and creating a conducive environment for learning. As well as meeting student motivation, of course, teachers must use the right media or learning resources, so that student motivation can be fulfilled in accordance with expectations (Novisya & Desnita, 2020) . According to (Sari et al., 2017) also stated that learning motivation is very important in the learning process because requires interaction and active participation of students in successful learning. Integrated PHYMOL (Physics Mobile Learning) Learning Videos on the Materials of Temperature and Heat" is appropriate to be used as a support for learning in Physics subjects on the subject of Temperature and Heat.

▪ CONCLUSION

Based on the results of the research and development of Physics Mobile Learning (Physics Mobile Learning) integrated Games on temperature and heat material, it can be concluded that the Phymol learning media was developed with reference to the ADDIE development model which includes the Analysis, Design, Development stages), Implementation (implementation) and Evaluation (evaluation). The average feasibility value by experts revealed that phymol media is categorized as very feasible, with a

percentage of 92%. And the results of the limited test through the questionnaire instrument for student responses obtained an average score of 86% with a very good category which was carried out at SMA Negeri 5 Cilegon. The physics learning media in the form of Integrated Phymol (Physics Mobile Learning) Games learning videos on temperature and heat material is declared very feasible to be used as physics learning media in high school / MA, especially class XI on temperature and heat material.

The development of this phymol learning video is very influential in the field of education, which is the latest innovation developed by making easy learning applications without a programming language, this can also be used by educators and becomes a new innovation in providing material. In addition , there are shortcomings in this study, namely the media that is produced has a large enough size, making it difficult to download if the memory on the smartphone is not sufficient. However, from this , it is hoped that further research can change the size according to the needs of smartphones in general, and this application can contain some more material.

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