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Development of Android-Based Mobile Learning Media Using Smart App Creator to Improve Students' Multi-Representation Ability in Thermodynamic Materials

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Abstract
This research is a development research that aims to determine the feasibility, attractiveness, and convenience of android-based mobile learning application products on Thermodynamics material. As well as to find out the increase in the sustainability of multi-percentage of grade XI students in Thermodynamics material with the mobile learnig application in learning. This study uses a research and development (R&D) method with the Borg and Gall model. The methods carried out are tests and questionnaires. Based on the results of data analysis for the expert test, a percentage of 95% was obtained with the criteria of "very feasible". For the validation test, media experts obtained a percentage of 95% with the criteria of "very feasible". As well as the practicality test conducted by physics subject teachers obtained a percentage of 93% with the criterion of "very feasible" and the student response to mobile learning media obtained a percentage of 79% with the criterion of "interesting and easy".

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1. INTRODUCTION

Learning physics is abstract and requires the ability to manage and understand different representations simultaneously. An in-depth understanding of concepts is very important in physics learning so that students can overcome challenges in solving physics problems. Without a strong understanding of the concepts, learners may face difficulties in solving physics problems [1].

Learning physics often involves experiments involving natural phenomena, experiments and observations. But in reality, learning physics sometimes feels boring because of the many formulas that must be learned, so students tend to only memorize formulas without really understanding the concepts. In fact, to understand physics well, students not only need to operate mathematical representations, but also have the ability to visual and verbal representations [2]. Verbal representation learns about the concepts and relationships of words, so that the structure of knowledge becomes clear. Meanwhile, visual representation includes photos, drawings, maps, diagrams, graphs, and tables. In physics, there are several learning materials that are often difficult for students to understand. This is because the material is abstract, complicated, and foreign. The use of the right representation of the concepts taught will make students not only memorize but also understand the concepts [3]

The use of learning media can help students in describing something abstract. For example, by displaying images, graphics, videos, and so on. Difficult material can be explained simply so that students can easily understand it. The use of learning media in the learning process can foster new interests and motivation and stimulate learning activities. The use of this learning media is very important to increase the effectiveness of learning. In addition to using interesting learning media, the use of varied representations

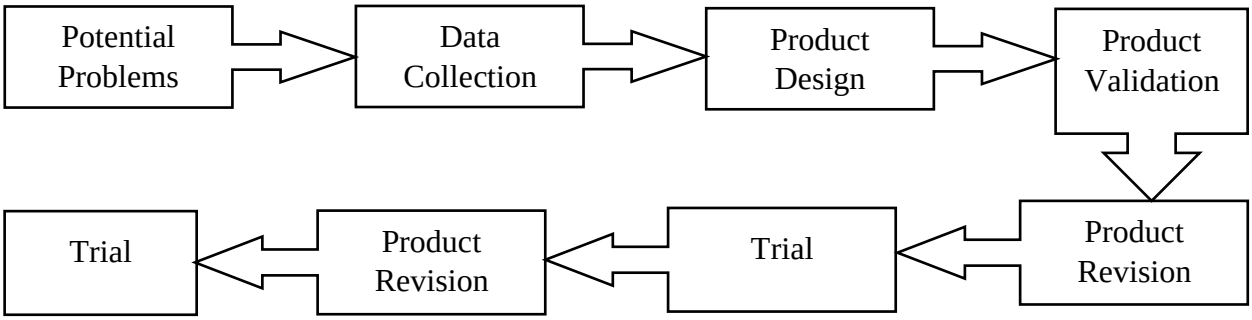
can also increase students' understanding of concepts. The use of multi-representation in physics learning is a fundamental part. Physics relies on mathematical modeling to describe natural phenomena and explain the relationships between variables. Therefore, physics learning should include the process of changing physical modeling to mathematical modeling [4].

Based on research conducted by ASTRI, improving the quality of learning can be done by using a variety of learning media. The development of varied learning media can improve students' multi-representation abilities [5]. From these problems, it is necessary to develop the right learning media to make it easier for students to understand physics learning. The learning media is by using the *Mobile Learning* on Android in order to improve students' multi-representation skills.

This research aims to develop android-based learning media to see the feasibility and convenience of media in learning, as well as to see the increase in multirepresentation after the use of various learning media.

2. RESEARCH METHODS

Researchers will use a type of research known as research and development (*Research and Development*) or often abbreviated as R&D [6]**.** The research method applied is a model *Borg and Gall* for research and development (R&D). There are 10 steps used in the research *Research and Development* (R&D) but the researchers limited it to only the eighth stage [7].



Picture 1 Model Borg and gall

At the potential problem stage, it starts from identifying the potential or problem. Potential problems are carried out by means of observation and interviews. The second stage of data collection aims to identify the needs in the learning process that will be carried out. The steps taken at this stage include literature studies and field studies. The third stage of product design, at this stage is designed for the media to be developed. *Mobile Learning* Designed to be as attractive as possible, product design includes customized appearance, language, size, and materials. The fourth stage of product validation aims to determine the level of feasibility of the product after it has been developed before use. Product validation was carried out by 2 media experts, 2 material experts, and 2 physics teachers. To calculate the eligibility percentage, from media experts, material experts and teachers can use the formula [8].

$$P = \frac{f}{N} \times 100\%$$

Information:

$P =$ Final Score
$f =$ Value Acquisition
$N =$ Maximum value

The calculation of the criteria for the percentage of product eligibility based on the responses of media experts and material experts can be seen in the table below:

Table 1 Product Eligibility Criteria [9]

Category	Mobile Learning *Eligibility Score*	Criterion
4	81,25 % - 100%	Highly Worthy
3	62, 50 % - 81,25 %	Proper
2	43,5 % - 62,50 %	Quite Decent
1	25 % - 43,5 %	Less Worthy

The fifth stage of product revision, after being validated by material experts, media experts and teachers, can be found out what the weaknesses are. This weakness will then be continued for improvement by revising the design. The sixth stage of the trial is to conduct an assessment to see information on whether the product is suitable for use or not. Calculation of the percentage of convenience and attractiveness, from the responses of teachers and students can use the formula [8].

$$P = \frac{f}{N} \times 100\%$$

Information:
$P =$ Final Score
$f =$ Value Acquisition
$N =$ Maximum value

The calculation of the criteria for the percentage of attractiveness and convenience of the product based on the responses of teachers and students can be seen in the table below:

Table 2 Product Attractiveness and Convenience Criteria [10]

Category	The value of mobile *learning appeal*	Criterion
4	80-100%	Very Interesting and Easier
3	60-79%	Interesting and Easier
2	50-59%	Less Interesting and Easier
1	0-49%	Not Interesting and Easy

The seventh stage of product revision is carried out to improve the product through feedback and input from students. The eighth stage of the trial was carried out in broader learning [7]. At this stage to see the improvement of students' multi-representation skills through pretest and posttest. Pretest and postets data were quantitatively analyzed to see the improvement that occurred before and after learning [11], then it is calculated using the formula:

$$N - Gain = \frac{Nilai\ Posttest - Nilai\ hasil\ pretest}{Nilai\ ideal - Nilai\ Pretest}$$

The value obtained is then described according to the criteria

Table 3 N-Gain Value Criteria

N-Gain Value	Interpretation
0,30≤ g	Low

0.30<g<0.70	Keep
g ≤ 0.70	Tall

3. RESEARCH RESULTS AND DISCUSSION (12 Pt)

3.1.Research Results

1. Potential Problems

At the beginning of the study, the researcher first conducted a needs analysis to find out what needs are needed to continue the creation of *mobile learning* media that has been planned from the beginning. The purpose of conducting a needs analysis to obtain data and supporting information in the creation *of mobile learning media* so that the media produced is in accordance with the necessary needs. The researcher conducted the analysis when conducting observations and interviews with teachers and students

2. Data Collection

Data collection is carried out after problems are found, this is used as material for planning learning media that is expected to overcome these problems. The data obtained was in the form of data on teachers' needs for existing teaching materials, the low ability of students to multi-represent in the school, and physics material for class XI, especially thermodynamics material. Furthermore, they look for references that are in accordance with the development *of android-based mobile learning* media in the form of journals, dissertations, theses, and also books that contain supporting materials in media creation.

3. Product Design

After data collection, the next stage is product design. At this stage, the media *Mobile Learning* Android-based is developed as attractively as possible by using *Smart App Creator*. In determining media design *Mobile Learning* Android-based on thermodynamic materials can be carried out in several stages, namely:

1) Planning of new product concepts
2) Design of new product devices

4. Product Validation

The finished product is then validated by the material validator and the media validator. Validators provide suggestions on the quality of the material and media that has been developed. After being declared valid by the validator, the *mobile learning media was* tested for feasibility by Physics teachers at SMAN 1 Padang Tualang before being tested on a small scale to grade XII students to see the improvement after the application of the product that had been developed. The validation stage will be explained as follows.

1) Subject matter expert validation

The validation of material experts was carried out by Mrs. Nuraini Fatmi S.Pd.I., M. Pd as a lecturer in physics education at Malikussaleh University. The validation results of the material expert validators regarding *the mobile learning* media that has been developed are as follows:

Table 4 Results of Validation of Material Experts

It	Validators	Total Score	Average	Percentage	Criterion
1	V1	77	3.67	95 %	Highly Worthy
2	V2	75	3.57	95%	Highly Worthy

Based on Table 4, the validation results of the first validator on the android-based *mobile learning media* that has been developed received an average score of 3.67 with a percentage of 95% with the criteria of "very feasible". The results of the second

validator obtained an average score of 3.57 with a percentage of 3.57 with the criteria of "very decent".

2) Media expert validation

The validation of media experts was carried out by Mrs. Deassy Siska, S. Si., M. Si as a lecturer in the Physics Education study program, Malikussaleh University, and Mrs. Rini Meiyanti, S.T., M. Kom as a lecturer in the Informatics Engineering study program, Malikussaleh University. The validation results of the media expert validators regarding *the mobile learning* media that has been developed are as follows:

Table 5 Results of Media Expert Validation

It	Validators	Total Score	Average	Percentage	Criterion
1	V1	72	3.60	95 %	Highly Worthy
2	V2	67	3.35	95 %	Highly Worthy
Average		3.48		95 %	Highly Worthy

Based on table 5, the results of validation conducted by media experts on the android-based *mobile learning* media developed, namely validator 1, obtained a score of 72 which has an average value of 3.60 with a percentage of 95% and is included in the "Very Feasible" criterion. Meanwhile, validator 2 obtained a score of 67 which has an average score of 3.35 with a percentage of 95% and is included in the "Very Feasible" criteria. The average obtained from both validators is 3.48 with a percentage of 95% with the criteria of "Very Feasible".

3) Validation by the teacher

Mobile learning *media* was tested by physics teachers at SMAN 1 Padang Tulang, namely Mrs. Sri Agustina, S. Pd and Mrs. Mardhiah S. Pd. I to assess the appearance of *mobile learning media* from various aspects. The results of the teacher's assessment of *the mobile learning* media developed can be seen in Table 6.

Table 1 Teacher Assessment Results

It	Validators	Total Score	Average	Percentage	Criterion
1	G1	123	3.62	97 %	Highly Worthy
2	G2	121	3.56	97%	Very interesting

Based on Table 6, the results of the G1 assessment of android-based *mobile learning media* that have been developed obtained a score of 123 with an average score of 3.62 with a percentage of 97% with the criterion of "Very Feasible". The results of the G2 assessment obtained a score of 121 with an average score of 3.56 with a percentage of 97% included in the "very feasible" criteria

5. Product revision

After validating to the validator, the next stage is to revise the product in accordance with the advice and input from expert lecturers. At this stage, there are several revisions, namely, before the revision is made, namely the use of the logo there is only the university logo on each application display, the validator suggested that the logo of the physics education association be added to each application display. Then in the law 0 thermodynamics learning video, there is no text explaining ice blocks and fireballs. Use *backsound* It is also too loud that the explanation on the video is not heard clearly. This product revision is carried out so that the media *Mobile Learning* which is perfectly developed for use in learning activities.

6. Trial

The next step is to test a limited-scale product. At this stage, it was carried out on grade XII science students at SMAN 1 Padang Tualang who had studied Thermodynamics

material totaling 10 students to obtain student responses to the media *Mobile Learning* by giving a questionnaire to students.

Table 7 Results of Small-Scale Student Responses

It	Student	Total Score	Average	Percentage	Criterion
1	S1	45	3.46	87%	Very Interesting and Easier
2	S2	41	3.15	79%	Interesting and Easier
3	S3	35	2.69	67%	Interesting and Easier
4	S4	40	3.08	77%	Interesting and Easier
5	S5	47	3.62	90%	Very Interesting and Easier
6	S6	40	3.08	77%	Interesting and Easier
7	S7	36	2.77	69%	Interesting and Easier
8	S8	41	3.15	79%	Interesting and Easier
9	S9	47	3.62	71 %	Interesting and Easier
10	S10	43	3.31	83%	Very Interesting and Easier
Average			3.19	80%	Very Interesting and Easier

7. Product Revision

After conducting a small-scale trial, the product revision is carried out again based on a small-scale trial. This revision was carried out to improve *Mobile Learning* which is made so that the product can be tested on a large scale. Product evaluation can be done by providing questionnaires, observations and product assessment sheets. The results of this evaluation are then revised and refined in accordance with suggestions from various parties, including use.

8. Trial

Based on the results of the value *pretest* Of the 25 students in the experimental class, the lowest score was 20, and the highest score was 65 with an average *pretest* 43.2. While the results of the *posttest* Of the 25 students, the lowest score obtained was 65, and the highest score was 85 with an average score of *posttest* 77.6.

Results of value analysis *pretest* and *postest* from 25 students in the control class, the lowest N-Gain of students was 0.38 and the highest N-Gain was 0.77. so that the average score of the N-Gain test was obtained of 0.59 or in a percentage of 59% with the "moderate" criterion. Therefore, it can be concluded that the media *Mobile Learning* can improve students' multi-representation ability with moderate interpretation with good criteria

4. CONCLUSION

Based on the results of research conducted by researchers at SMAN 1 Padang Tualang with the research title "Development *of Android-Based* Mobile Learning Media Using *Smart App Creator* to Improve Students' Multi-Representation Ability in Thermodynamic Materials" it can be concluded that:

i. The results of the experts' validation of the *android-based mobile learning media* that has been developed are declared to be very valid according to the assessment of the material validator, media validator, and teacher response. Material experts obtained the overall criteria with the "Worthy" criterion, media experts obtained the overall score with the Worthy criterion, and the teacher's response obtained the overall score with the predicate of Worthy. Overall value of the attractiveness and convenience *of mobile learning* products with the criterion of "very easy and attractive".
ii. Based on the N-Gain test conducted in the experimental class, a result with a percentage of 59% was included in the "moderate" criteria. And the control class obtained results with a percentage of 49% included in the "moderate" criteria. This means that there is an

increase in students' multi-representation abilities after applying products developed by researchers.

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