Development of Android Comics media on Thermodynamic Experiment to Map the Science Process Skill for Senior High School

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Development of Android Comics media on Thermodynamic Experiment to Map the Science Process Skill for Senior High School

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Abstract. Technological development influences smartphone addiction. Low academic achievement has a negative influence on school life. Comics include media that are often used in everyday life and as entertainment facilities. Comics are not only functioned as entertainment tools, but are also used in education. Physics laboratories are still minimally utilized by physics teachers in schools, so students' science process skills are still lacking. The purpose of this study was to measure science process skills using Android-based physics comics on thermodynamic practicums. Development models used, namely R & D of Borg and Gall. Learning is done in the form of practicum on thermodynamic material. Android media use is used to measure science process skills. Physics learning innovation is applied in the XI science class of one of the senior high schools in Sleman, Yogyakarta, Indonesia. Data obtained from observation sheets of science process skills from modelling and implementation classes are very good; good; and enough. The results revealed that the application of Android comic media on thermodynamic experiment could map the science process skills of senior high school.

Keywords: Physics comics; Android; Thermodynamics experiment; Science process skills.

1. Introduction

Technological developments affect the addiction to smartphones. The low academic achievement has a negative influence on learning in school [1]. Smartphones are now a mandatory item for everyone [2]. Students view smartphones as entertainment devices with very frequent usage time [3]. Trends in the development of technology and information can be utilized in the world of education to be used as a mean of learning outside and in the classroom [4]. Teachers are expected to utilize smartphones in the learning process at school Smartphones can be used inside and outside the classroom in the learning process.

The development of life shows animation, comics, and games have a major influence on the entertainment market [5]. Comics carry an important legacy in creating their own narrative code in the 9th century [6]. Comics include media that are often used in everyday life and as entertainment facilities. Comics are not only functioned as entertainment tools, but are also used in the field of education [7]. Language in comics can transform rigid science into simple science that can be accessed and understood by students [8]. The advantages of comics are currently unknown, including the effects on skills and communication skills [9]. Comics are introduced to elementary, middle school, and student to assess the ability of comics to increase their interest and understanding [10].

The teacher education system needs to have activities to promote the development of teachers' pre-service affective and cognitive abilities such as the use of laboratory perceptions of self-efficacy and scientific process skills [11]. The teacher is expected to be an expert in science process skills and transfer these skills to students through practical knowledge. Science process skills seem almost unbound with science teaching and learning activities [12]. Physics laboratories are still minimally utilized by physics teachers in schools, so students' science process skills are still lacking. Students' attitudes toward science, gender influences, and student residence at the level of knowledge about science process skills are not very influential [13]. The 2013 curriculum prioritizes active students, so it is necessary to use laboratory equipment regularly. However, some schools sometimes still rarely carry out practical activities in the learning process. Practicum activities are expected to invite students to be active in scientific activities and invite students to conduct science process skills activities. The practicum of the thermodynamic chapter is still very rarely carried out in the classroom. Researchers are interested in taking the thermodynamic chapter for the physics comic making process.

Physics learning innovation is needed as a solution to the problems that arise in the classroom for each school. The solution is expected to map students' science process skills. Comic and smartphone media will be used in the learning process of thermodynamic practicum in class. Researchers intend to develop learning media in the form of android-assisted physics comics on thermodynamic practicum in senior high school.

The rest of this paper is organized as follow: Section 2 presents literature review. Section 3 describes the proposed research method. Section 4 presents the obtained results and following by discussion. Finally Section 5 concludes this work.

2. Related Works

Comics are a good educational tool to improve knowledge. The comic book features humour, narrative and visual representation and is a potential medium for science communication [14, 15]. Comics are a good educational tool to increase knowledge [14]. Comics consisting of simple and concise illustrations are superior learning tools compared to other learning tools. Comic clarity helps convey the message that give impact, especially with a strong story [10]. Comics have been used in various fields of educational research. These results show that comics are also effective in education. In addition, students who read comics show an increased level of interest in the material [10]. Comics can be used to replace LKS (student worksheets). Comics are attractive media because they are easy to understand by students, so they are effective in preventing student boredom [7].

Learning is a process of changing conceptual understanding of science. The process of changing the understanding of the concept in question is an integral part of the transferring process, the level of understanding, the predicting ability, problem solving and the process of translating knowledge [16]. Learning is a system that has the aim to increase students' learning desires [17]. The teaching knowledge of the educators must be supplemented by technology, not just content or pedagogical knowledge. The Technology, Pedagogy, and Content Knowledge (TPACK) framework has three main sources of educator ICT integration knowledge, including (1) technology knowledge (TK) - knowledge of technological tools; (2) pedagogy knowledge (PK) knowledge of teaching methods; and (3) content knowledge (CK) - knowledge of subject matter [18].

The order of the smartphone addiction index is as follows: excessive use of smartphones, technological dimensions, social-psychological dimensions, smartphone preoccupation, and health dimensions [3]. The teaching and learning process does not only apply to students in utilizing electronic information. Teachers can also use electronics for teaching purposes in the classroom [16]. Mobile learning can improve the learning quality of students by providing access to learning in the form of content or content information without regard to social status, residence, and culture [17]. Android itself is part of a smartphone.

Basic science process skills include observing, classifying, measuring and using numbers, making conclusions, predicting, communicating and using time and space relationships. Integrated science process skills consist of interpreting data, operational definitions, control variables, making hypotheses

and experimenting [12]. Science process skills are processes in a practicum activity that are expected to exist when carrying out classroom learning. Observation and predicting skills were easier than other skills in science process skills. While fewer of the target students chose the correct option for items related to variable and experimental control skills [13].

3. Material & Methodology

Development models used, namely R & D of Borg and Gall, consists of: (1) preliminary study, literature review, and conducting field surveys, (2) planning phase, namely designing content or content, mapping material (Core Competencies, Basic Competencies, and target material), formulating objectives, (3) designing the initial draft of the product, starting from the development of android-based physics comic draft on thermodynamic material, designing Student Worksheets (LKS), Learning Implementation Plans (RPP), and evaluation sheets, (4) comic product validation by expert lecturers, physics teachers and Peer Reviewers, (5) product revisions, (6) final products that have been validated, (7) product trials.

The validity of Learning Implementation Plans (RPP), Student Worksheets (LKS), physics comic media was analyzed using Content Validity Ratio (CVR) and Content Validity Index (CVI). The score is given in the validation questionnaire item with CVR. Koh and Chai [18] states that the CVR value is determined by equation (1), i.e.:

$$CVR = \frac{(N_e - \frac{N}{2})}{\frac{N}{2}} \quad (1)$$

with, N_e is the number of validators who agree and N is the total number of validators. After identifying each questionnaire item with CVR, CVI is used to calculate the validity index with equation (2), that is:

$$CVI = \frac{jumlah\ seluruh\ CVR}{jumlah\ butir\ aitem} \quad (2)$$

The length of the interval percentage is determined in each category consisting of 5 categories. The grouping of values in each category is presented in Table 1.

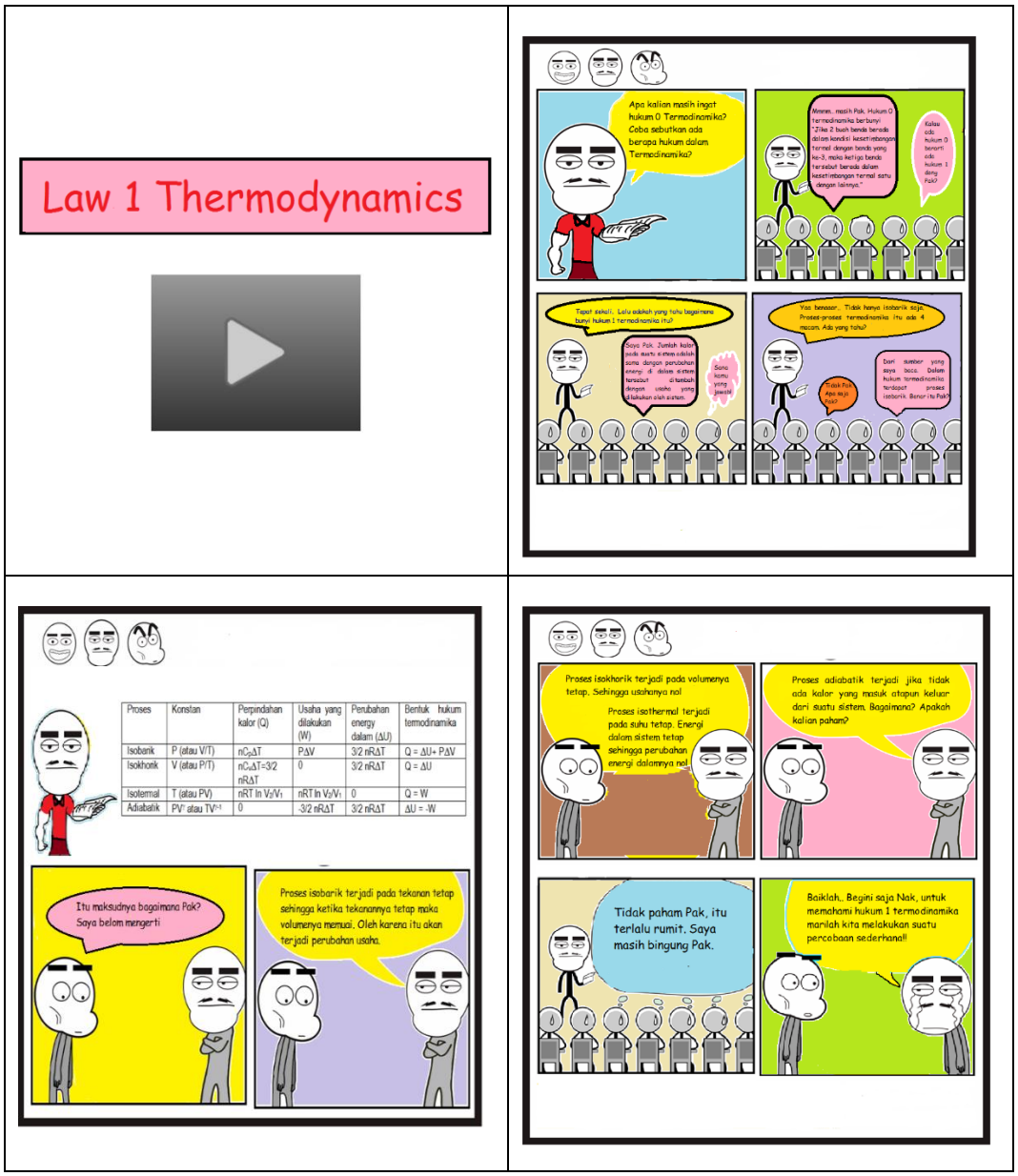
Table 1. Assessment Criteria

No	Interval %	Category
1	$80.01 \geq x \leq 100$	Very good
2	$60.01 \geq x \leq 80.00$	Good
3	$40.01 \geq x \leq 60.00$	Enough
4	$20.01 \geq x \leq 40.00$	Less good
5	$0.00 \geq x \leq 20.00$	Not good

The learning process is carried out in the form of practicum and group discussion on thermodynamic material. This learning process is expected to help students in understanding the material and science process skills. The use of Android in the form of smartphones is had by students to map science process skills. Physics learning innovation is applied in the XI science class of one of the senior high schools, Sleman, Yogyakarta. The innovation was carried out with 2 treatments, namely modelling and implementation classes. The modelling class is carried out by researchers and implementation classes by physics subject teachers.

The technique used is qualitative descriptive analysis in which data analysis is in the form of a qualitative description of data meaning. Data obtained from observations when learning thermodynamic practicum

in the laboratory. The media used is android-assisted comic media created using the *sigil* application. The comic can be read in Android by using the *Himawari Reader* application. Comic research designs like Figure 1.



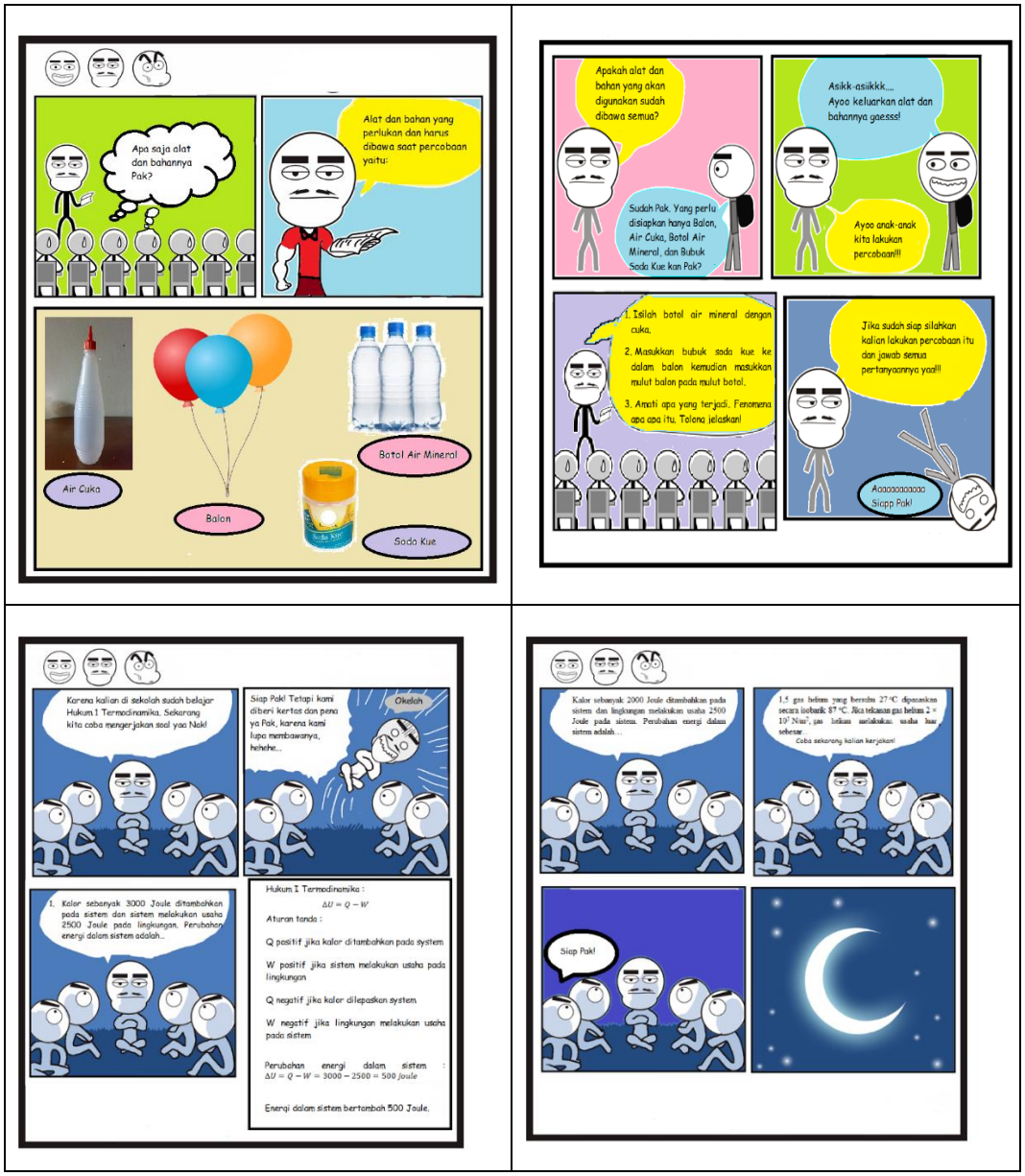


Figure 1. Physics Comic Law 1 Thermodynamics

4. Results and Discussion

This section presents the obtained results and following by discussion.

4.1. Results

At the development stage, the feasibility of the learning media that will be used in the classroom is obtained from the assessment of the comic media developed by the validator found in Table 2.

Table 2. Expert Validation Results

Instrument	CVI	Katagori
Learning implementation plan (RPP)	1	Very good
student worksheet (LKS)	1	Very good
comic media	1	Very good
questionnaire on science process skills	1	Very good
observation sheet of science process skills	1	Very good

The data was obtained from practicum activities and discussions in the class observed by observers to map students' science process skills. Observation data during modelling classes can be seen in Table 3.

Table 3. Mapping of Science Process Skills Based on Observations during Modelling

	the number of students	Percent (%)
Very good	7	30.43
Good	13	56.52
enough	3	13.04
Total	23	100

Graphical data of Science Process Skills observations of high school students in one of the senior high school in Yogyakarta during the modelling class can be seen in Figure 2.

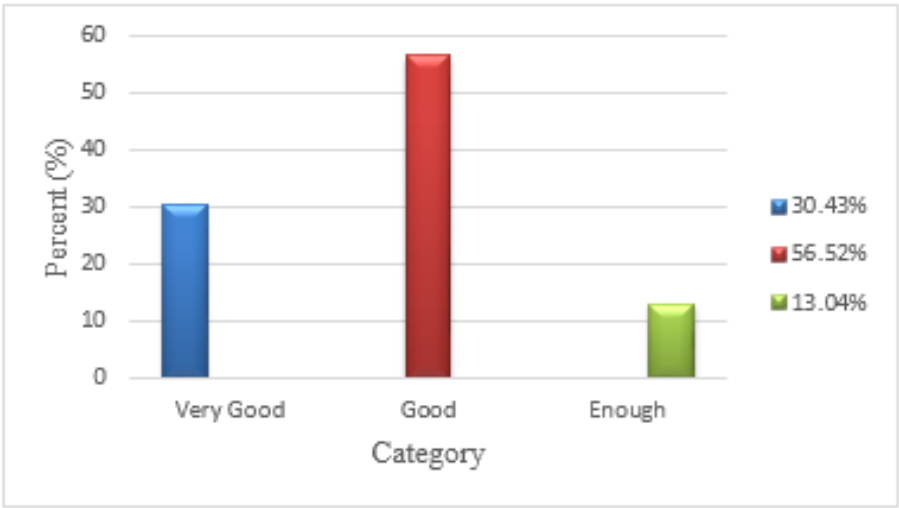


Figure 2. Charts of Student Science Process Skills Based on Observations during Modelling

Data from the Science Process Skills observation during the Implementation class in senior high school can be seen in Table 4.

Table 4. Mapping of Science Process Skills Based on Observations during Implementation

	Number of students	Percentage (%)
Very good	5	21.74%
Good	15	65.22%
Enough	3	13.04%
Total	23	100%

Graphical data of observations of Science Process Skills of high school students in one of the senior high schools in Yogyakarta when the implementation class can be seen in Figure 3.

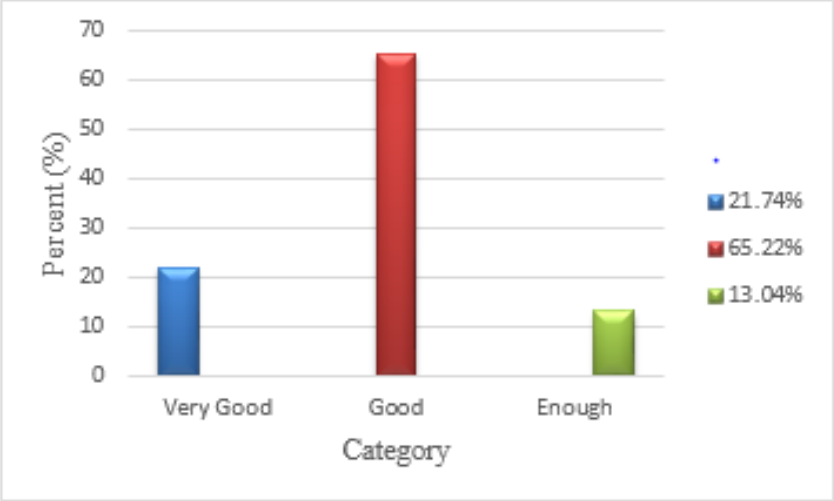


Figure 3. Charts of Mapping Science Process Skills of Students Based on Observations During Implementation

4.2. Discussion

Based on the analysis in Table 1, the Learning Implementation Plan (RPP) has a Content Validity Index (CVI) of 1 (very good). The RPP is said to be feasible to be used in learning in the material of Law 1 thermodynamics. The results of the Student Worksheet (LKS) have a CVI of 1 (very good) and the PA value obtained is 88.33%. It can be categorized as reliable because PA> 75%. Android-assisted physics comic media has a CVI of 1 (very good). Whereas the questionnaire and observation sheet on cooperative attitudes have a CVI of 1 (very good). The results of all devices in the development of comic learning media have a CVI value of 1 with a very good category, it is said to be feasible to use in physics learning in the classroom.

The results of data analysis of science process skills based on observations when modelling classes conducted by observers obtained a percentage of 30.43% is very good; 56.52% good; and 13.04% is enough. Whereas based on observations when the implementation class is obtained results a percentage of 21.74% is very good; 65.22% is good; and 13.04% is enough. KPS for students of class XI Science in one of the senior high schools in Yogyakarta are categorized as good, because when conducting experiments in the laboratory some students fulfil indicators on aspects of science process skills. However, not all aspects are fulfilled, because students in the learning process still rarely conduct experiments in the laboratory.

Comic media is an effective educational tool at various levels of education. Comics have been used in various fields of educational research and show that comics are effective in the field of education [10]. The comic storyline is more interesting than LKS, so it is effective in preventing student boredom [7]. Practicum activities in the classroom are fun when physics comics are applied in the classroom. Students are more interested in using comic media. Students can see the learning videos contained in the comics, so that the enthusiasm of the students gets bigger.

Presentations are made by students and the teacher acts as a facilitator. The teacher can test students' abilities to describe science process skills through question and answer sessions. Question and answer sessions between students and teachers, helping to improve student interpersonal skills and fine skills. They can be formed in addition to attracting students to use their science process skills [12]. Teachers are more intensively guiding to improve aspects of skills. Students are more accustomed to learning themselves discovering concepts, scientific principles, and developing creativity in solving scientific problems [19]. Students must be directly involved in the learning process [20-23]. Students become more active and enthusiastic in the learning process. Practicum activities in the classroom can bring the attitude of students' science process skills. The use of physics comic media can attract students to conduct thermodynamic practicum activities. Mapping of science process skills can be displayed in tables and figures in Table 2, Table 3, Figure 2, and Figure 3. Gender has no effect and there is no difference in knowing the science process skills of students.

The results of science process skills during implementation and modelling are not much different. Researchers only have one class so that during modelling and implementation using subjects that are the same as time and different teaching materials. The percentage of observation sheets of science process skills is categorized as good for all students. So it can be said that the application of this comic media is considered successful.

5. Conclusion

The conclusions from this study reveal that the development of Android-based physics comic media on thermodynamic practicum is appropriate to be used in physics learning in class and categorized as good for all students. Development of Android-based physics comic media on thermodynamic practicum can be used to map students' science process skills in senior high school.

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