

# Development of physics learning devices based on guided inquiry assisted by edmodo to improve students' material comprehension and science process skills

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**Abstract.** The learning devices in use should consider the technology that is currently developing. This study aims to produce learning devices on Static Fluid based on guided inquiry assisted by Edmodo which is feasible to improve students' material comprehension and science process skills of senior high school students. This research was a development research used 4D model. The product of this development research is a learning devices based on guided inquiry using Edmodo on the subject matter of Static Fluid. Power point learning media is used to provide an introduction to students. The guided inquiry Student Worksheet with answers to each question on it is provided in the Edmodo application. The whole learning process is based on guided inquiry which is the learning syntax written on the Learning Implementation Plan. Product field testing were preliminary field testing and main field testing on 11<sup>th</sup> grade students of SMAN 1 Seyegan. The feasibility of the developed learning devices is seen from the analysis of the validators' assessment scores and students' responses. The results of the research showed that the developed learning devices was feasible to improve students' material comprehension and science process skills of senior high school students in excellent category.

**Keywords:** *learning devices, guided inquiry, edmodo, static fluid*

## 1. Introduction

Physics is part of Natural Sciences which studies about natural phenomena as a whole. Physics is a subject that emphasizes on the ability to understand concepts of natural phenomena that occur while also emphasizing the mathematical competence of the students. In essence, physics consist of physics as a process, physics as a product, and physics as an attitude.

Physics learning that applies Curriculum 2013 emphasizes the use of scientific approach. This scientific approach is characterized by five points of learning experience, namely: 1) observing; 2) asking questions; 3) gathering information; 4) associating; and 5) communicating the results.

The selection of learning devices used in the learning process becomes very crucial for teachers. It is not easy for the teacher to choose learning devices that will be used in the learning process. This resulted in the majority of teachers being unable to meet the needs of students during the learning process.

Inappropriate learning devices will make learning ineffective and cause low student learning outcomes, both the learning outcomes on the aspects of attitude, knowledge, and skills. Therefore, learning devices that are in accordance with Curriculum 2013 and the characteristics of physics learning materials are needed.



Referring to Government Regulation, Number 19 Year 2005 Article 25 paragraph 4 states that graduate competencies include attitudes, knowledge, and skills. In the aspect of knowledge assessment, there is a standard of minimum completeness of mastery learning which is the lowest criterion to declare whether the students pass the subject or not. There is no clear criteria reference in the assessment of the aspects of skills and attitudes, it can even be said that the assessment of the aspects of skills and attitudes is still rarely done.

The success of a learning is influenced by many factors. One of them is the use of the learning model as an intermediary, container, or connector of learning messages that aim to provide students with an understanding of a concept. One learning model that is in accordance with the scientific approach and characteristics of physics learning materials is Guided Inquiry learning model. Guided Inquiry is a learning model that can train students' skills in carrying out the investigation process to collect data in the form of facts and process those facts so that students are able to build conclusions independently to answer questions or problems raised by the teacher (teacher-proposed research question). One of many representations of guided inquiry-based learning is in the form of experiments (practicum). A learning in which there are stages of experiments can be done considering the availability of practical devices in the physics laboratory.

In this study three observations were made during the physics class. Based on the results of the observations that have been made, physics learning at SMAN 1 Seyegan already uses learning devices based on revised of Curriculum 2013. In its practice, learning is still going one way from teacher to student hence that students are more likely to be passive. Exposure to physics learning material is done by showing materials and exercises using a projector or by explaining the materials on the board. This causes a lack of improvement in science process skills of the students. In addition, students do not understand the concepts of physics being taught, this can be seen from the percentage of students who score above the standard of minimum completeness of mastery learning, which is only 30%. Therefore, learning devices that are appropriate to the characteristics of physics learning materials are needed to improve the mastery of the materials and the process skills of the students, for example learning devices based on guided inquiry.

Along with the development of information technology that is so rapid, the learning process should be helped if possible, with the use of a learning technology. One learning technology that can be used is Edmodo. This application is modified to be able to help learning process when conducting experiments (practicum). Edmodo was chosen because it is one of learning technologies that is fun, easy to use, and can involve students to actively participate in the learning process. The use of smartphone by all students is another factor that supports the use of Edmodo in the learning process.

## 2. Related works

There are three methods of inquiry, namely guided inquiry, free inquiry, and modified free inquiry [1]. Guided inquiry is a learning in that the overall activity is carried out by students in the learning process such as planning investigations, observing, analysing, interpreting data, proposing answers, formulating conclusions and communicating, while educators act as motivators who direct and provide instructions both through complete procedures as well as directing questions during the inquiry process.

Improvement of students' learning outcomes has been widely applied using guided inquiry, this is shown from research results which shows that guided inquiry can improve student learning outcomes as indicated in posttest value that was higher than the pretest value [5]. From the point of view of cognitive theory domain, the implementation of Edmodo has increased their cognitive domain [6].

National Research Council (NCR) says that the inquiry includes several activities in the learning process. It is recommended that science process skills can improve students' abilities in understanding the concepts of science in learning Physics [3]. The activities undertaken by students include observing, asking questions, looking for sources of information, using devices to obtain information, analysing and interpreting data, explaining, predicting and communicating the results [7]. These activities are science process skills. Science process skills of students can be improved by implementing ICT-based practicum using tracker application [17] and using the thermal expansion practicum sets [18]. One learning model

that can help students to find concepts and use science process skills is guided inquiry learning model [8]. Teachers could implementing inquiry learning in improving students' process skills.

Students' science process skills in the learning process need to be developed considering the increasingly rapid development of this era so students are trained and can participate in global competition [9], [10]. A research result indicated that online-based electronic modules using Edmodo could create active learning for students [7], [11].

The instructor has an expanded user interface that provides access to these administrator rating functions such as uploading slideshows, creating quizzes, and enabling or disabling interactive features [12]. A student can access the materials or information every time and everywhere as long as there is an internet. This is a good idea if we develop this concept into an Indonesian education system because children in Indonesia can access the materials before they come into the classroom [6].

There are some sources that the teacher will put in Edmodo, there are videos, articles, questions, and quiz. The teacher will ask students to access Edmodo before coming to the classroom. A student can easily access the source of the lesson and can repeat it every time a student need. There are several advantages if the teacher uses Edmodo than the other media, Edmodo is easy to use for teacher and student, the teacher can put a note, quiz, poll, alert and student can access it every time [6]. Because Edmodo fulfilled the aspects of effectiveness, practicality, and validity, so it had good quality criteria [4].

### 3. Research method

This research is a development study using 4D model (Four D Models) developed by Thiagarajan and Semmel. The 4D model includes four stages, namely: Define, Design, Develop, and Disseminate [13]. The validity of the instrument was analysed using Content Validity Ratio (CVR) and Content Validity Index (CVI). CVR and CVI were used to analyse the results of the validation of data collection instruments, namely the questionnaire of students' responses to the learning media based on guided inquiry using Edmodo, questions about pretest-posttest, and observation sheets of science process skills. The calculation of CVR and CVI [14] uses the following equation:

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

$$CVI = \frac{total\ CVR}{total\ questionnaire\ items} \quad (2)$$

Notes:

$N_e$  = the number of validators who agree

$N$  = the total number of validators

The result range of CVR and CVI values is  $-1 < x < 1$ . These figures are categorized as follows:  $-1 < x < 0$  is not good,  $0$  is good,  $0 < x < 1$  is very good.

#### 3.1 Reliability Analysis

The reliability of learning instruments and data collection instruments was analysed using Percentage of Agreement (PA) which was formulated as follows:

$$PA = \left[1 - \frac{A-B}{A+B}\right] \times 100\% \quad (3)$$

Notes:

A = higher validator score

B = lower validator score

The instrument is said to be reliable if it has a reliability coefficient of  $\geq 75\%$ .

#### 3.2 Analysis of validity and reliability of question items on pretest-posttest

Item analysis was performed using ITEMAN program. Criteria on whether the item is good or not can be seen from biserial points correlation. The following table presents the validity test criteria based on

the biserial points correlation value.

**Table 1.** Criteria of test validity of questions.

Interval <i>Biserial Point</i>	Validity Criteria
> 0.40	Very Good
0.30 – 0.39	Good
0.20 – 0.29	Revision Needed
< 0.19	Poor

Reliability analysis of the question items is seen by looking at the alpha coefficient value, measured on a scale from 0 to 1. Criteria for the level of reliability of question items [15] are presented in the following table:

**Table 2.** Criteria of level of reliability.

Reliability coefficient	Reliability category
0.00-0.20	Not reliable
0.20-0.40	Somewhat reliable
0.40-0.60	Fairly reliable
0.60-0.80	Reliable
0.80-1.00	Very reliable

### 3.3 Appropriateness analysis using ideal standard (*Sbi*)

The appropriateness analysis of guided inquiry-based learning using Edmodo utilizes Ideal Standard (*Sbi*) that comply with the following equation:

$$\bar{x} = \frac{\sum x}{n} \quad (4)$$

Notes:

$\bar{x}$  = average score  
 $\sum x$  = number of scores  
 $n$  = amount

Assessment of the validity of learning devices that was developed uses a scale of four. The range of instrument assessment scores [16] is presented in the following table:

**Table 3.** Instrument rating results range.

Score Range	Category
$\bar{X} \geq 3.0$	Very good
$3.0 > \bar{X} \geq 2.5$	Good
$2.5 > \bar{X} \geq 2.0$	Bad
$\bar{X} < 2.0$	Very bad

## 4. Results and Discussion

### 4.1. Define stage

This step consists of five stages: initial analysis, student analysis, task analysis, concept analysis, and the decision on learning objectives. The result of this define stage shows that physics is one of the boring and difficult subjects to understand. In addition, the delivery of the materials is monotonous, using conventional methods such as lectures, and the lack of involvement of students in the learning process makes the students' improvement on the aspects of the process skills to be low. At this stage the core

competency, basic competency, and indicators of achievement of competencies are produced for subject matter of Static Fluid. The learning objectives are based on the indicators of achievement of competency.

#### 4.2. Design stage

This design phase aims to design and prepare the learning devices based on guided inquiry using Edmodo. The result of this stage is an early design set of the guided inquiry learning media using Edmodo on the subject matter of Static Fluid as an initial product. The data collection instruments in this study included pretest-posttest question sheets, instrument validation sheets, student questionnaire response sheets to the learning media based on guided inquiry using Edmodo, observation sheets of process skills, and observation sheets of Learning Implementation Plan implementation. While the learning instruments include the Learning Implementation Plan, learning media based on guided inquiry using Edmodo, and the Student Worksheet.

#### 4.3. Develop stage

The development stage is composed of several activities consisting of validation from expert lecturers & physics teachers of grade 11<sup>th</sup> SMAN 1 Seyegan, empirical test for question sheets of pretest-posttest, limited trials, and field trials. These validations aims to improve the initial design of the developed learning devices. Those validated learning instruments are the developed learning media, Student Worksheet, and Learning Implementation Plan. The validated data collection instruments include the pretest-posttest question sheets, student questionnaire responses to learning media based on guided inquiry using Edmodo, and observation sheets on science process skills. These three learning tools are used in the learning process. Power point learning media is used to provide an introduction to students. The guided inquiry Student Worksheet with answers to each question on it is provided in the Edmodo application. The whole learning process is based on guided inquiry which is the learning syntax written on the Learning Implementation Plan. The feasibility of the learning media that used in the classroom is obtained from student questionnaire responses to learning media based on guided inquiry in main field testing are presented in the following table 4:

**Tabel 4.** The feasibility of the learning media.

No	Indicators	SBi	Category
1.	Content and purpose	3.13	Very good
2.	Instructions	3.21	Very good
3.	Technical	3.24	Very good
	Average	3.21	Very good

#### 4.4. Disseminate stage

Disseminate stage is the final stage of this development research. At this stage the researcher conducted the distribution by giving the learning media based on guided inquiry using Edmodo in the form of a printout to physics teacher of grade 11<sup>th</sup> in SMAN 1 Seyegan. This research article was published in an international seminar.

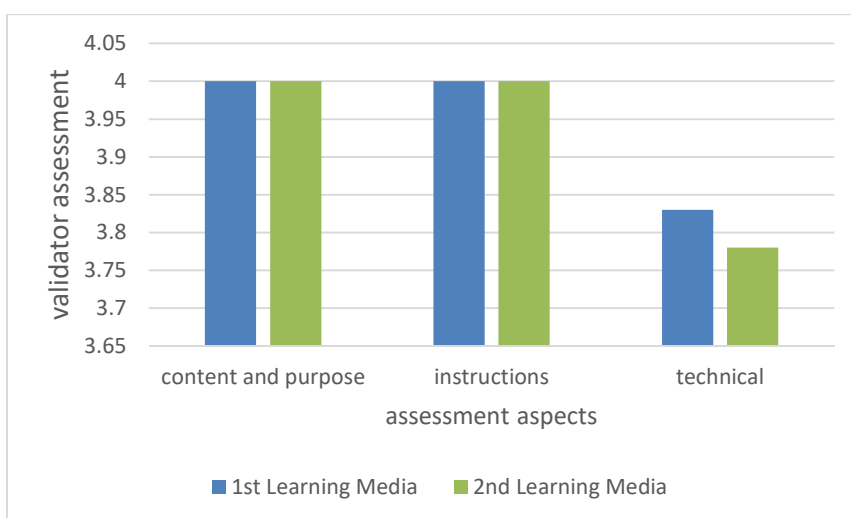
#### 4.5. Feasibility of the learning media

The *first* assessment is an evaluation by the validator. This assessment is carried out by filling out the validation sheet which is based on three aspects of the assessment namely the aspects of contents and objectives, instructional aspects, and technical aspects. A media validation analysis was done by using Ideal Standard (Sbi) by calculating the average score on each aspect. The first meeting part in the learning media obtained an average score of 3.94 in very good category. The second meeting part in the learning media obtained an average score of 3.92 in very good category. Therefore, it can be concluded that the developed learning media have been stated as valid by the validators.

The *second* assessment is based on the students' responses through their answers in the questionnaire of the students' responses to the developed learning media. The results of the questionnaire responses of

the students were obtained during a limited trial conducted on 7 students of grade 11<sup>th</sup> MIPA 3 SMAN 1 Seyegan, and a field trial on 28 students of 11<sup>th</sup> grade MIPA 2 SMAN 1 Seyegan.

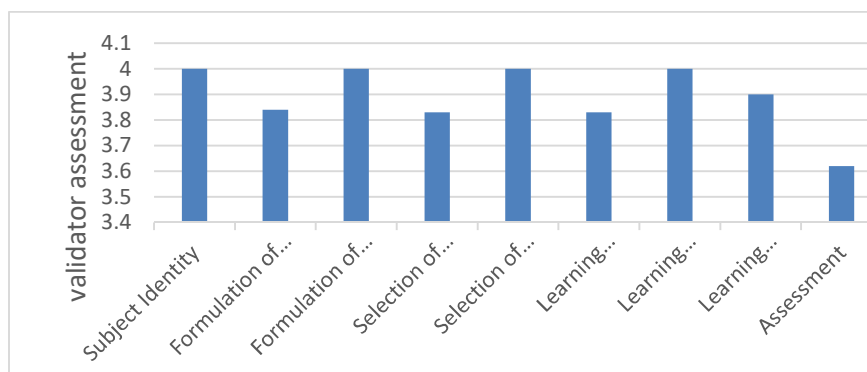
Based on the analysis of the results of the questionnaire responses of students in terms of the contents and objectives aspects, instructional aspects, and technical aspects, which have an Ideal Standard (Sbi) score of 3.15 in the limited trial test in very good category and 3.21 in the field trial test which is also in very good category according to the Ideal Standard (Sbi) rating category in Table 3. From these results, the learning media based on guided inquiry using Edmodo was stated as valid and received positive responses from users, the high school students. Graphical data of feasibility of learning media can be seen in figure 1.



**Figure 1.** Feasibility of the learning media.

#### 4.6. Feasibility of the learning implementation plan

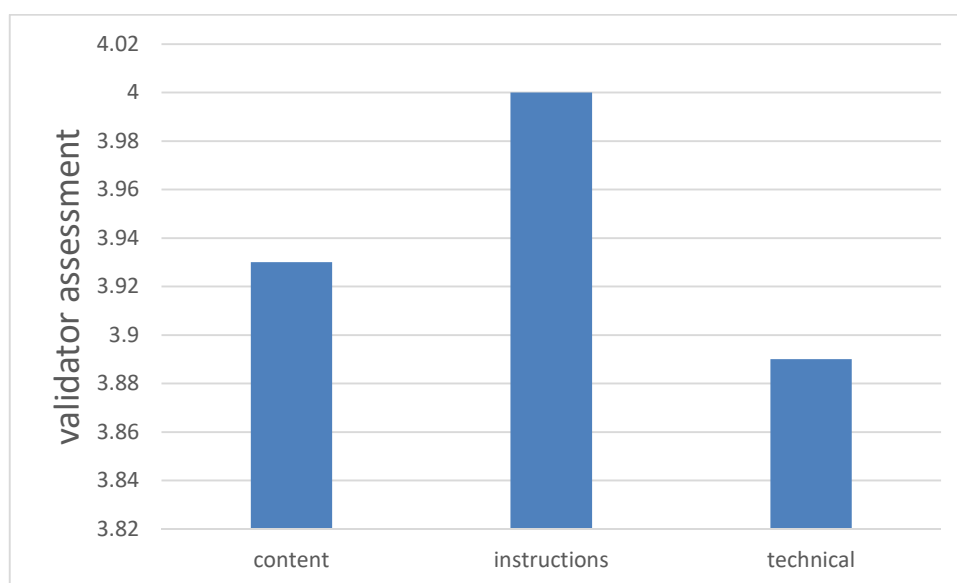
The Learning Implementation Plan assessment is done by filling out a validation sheet which was based on some aspects of assessment namely the aspects of learning subject-identity, formulation of indicators, formulation of learning objectives, selection of teaching materials, selection of learning resources, selection of learning media, learning methods, learning scenarios, and the assessment. The validation analysis of Learning Implementation Plan was done by using the Ideal Standard (Sbi) by calculating the average score on each aspect. For all these aspects, the developed Learning Implementation Plan obtained an average score of 3.89 in very good category. Graphical data of feasibility of Learning Implementation Plan can be seen in figure 2.



**Figure 2.** Feasibility of the learning implementation plan.

#### 4.7. Feasibility of the student worksheets

This assessment of the Student Worksheets is carried out by filling out validation sheet which is based on three aspects of assessment namely the contents and objectives aspects, constructional aspects, and technical aspects. The validation analysis of the Students Worksheets was done by using the Ideal Standard (Sbi) by calculating the average score on each aspect. For all these aspects, the developed Students Worksheets obtained an average score of 3.94 in very good category. Graphical data of feasibility of Learning Implementation Plan can be seen in figure 3.



**Figure 3.** Feasibility of the student worksheet.

#### 5. Conclusion

Based on the results of this research and the discussion, we can concluded that the developed learning media product based on guided inquiry using Edmodo on the subject matter of Static Fluid is feasible to be used to improve students' materials comprehension and science process skills of the students of 11<sup>th</sup> grade MIPA SMAN 1 Seyegan with an overall assessment in very good category.

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