Development of physic learning system by using discovery learning model integrated into 21st century learning

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Abstract. The integration of 21st century learning into learning system have to be conducted quickly. The 21st century learning integrates the literacy ability, knowledge ability (HOTS), skill (4C) and attitude (PPK) and also the master in technology skill. Yet, in the fact the ability students skill have not developed maximally. Therefore, teachers have to be able to develop the learning system which using model discovery learning which is integrated into 21st century learning, the assessment in this study included knowledge assessment, skills assessment and 21st century skills assessment (4C). This study aims to produce a 21st century integrated learning integrated learning learning model that is valid, practical and effective. The learning development model refers to the Plomp model including the Preliminary Research Phase, Development or Prototyping Phase and Assessment Phase. The results of the study show, (1) learning devices developed are valid; RPP with an average, 83 (valid); LKS with an average of 0.81 (valid); LKPD with an average of 0.83 (valid); and Assessment with an average of 0.82 (valid); (2) Learning devices are declared practical, namely: 1) student activities are in good criteria, average score is 74.1%; The level of practicality of the learning device averaged 89.12 (practical) while the effectiveness of the learning devices developed could be seen from the learning outcomes of students, that is, more than 80% of students had exceeded the KKM.

1. Introduction

Various efforts to improve the quality of education have been carried out by the Indonesian government, including improving the curriculum. The current curriculum is the 2013 Revised Curriculum which is a refinement of the 2013 curriculum. While the development of the 2013 curriculum itself is a further step pioneered in 2004 and 2006 curriculum. In the 2013 curriculum the revision was demanded in an integrated attitude, knowledge and skills. 2013 Revised Curriculum Development is also based on an analysis of future needs to meet Indonesia's golden generation in 2045. Based on these developments, a determination of Graduates’ Competency Standards (SKL) was established based on XXI Century Competence.

Completion of the 2013 curriculum gives teachers the freedom to be more creative and innovative, inviting students to develop character or skills to follow the learning process, and create quality learning. Other related parties such as education researchers have made progress in education in Indonesia. For example, a study conducted by Damayanti et.al [1] about the application of discovery learning models assisted by macromedia flash animation media concluded that the quality of learning device products is
classified as valid, practical, and effective and the learning achievement of students has increased development. Saputro et. al [2], in their study showed that the development of physics learning devices is a discovery learning model to improve learning outcomes and creative thinking skills.

However, all expectations from the 2013 curriculum have not seen significant results. Based on observations made by researchers on physics learning activities in MAN 1 Padang Pariaman, on September 30, 2017, using questionnaires in the form of a Front End Analysis questionnaire showed that in general students still had difficulty understanding physics material, educators still often used the lecture method seldom invited to conduct experiments in the laboratory, and from interviews with educators, it was found that educators still had difficulty preparing teaching materials that were appropriate to the needs of students.

Based on the conditions of physics learning that have been described, the development of physics learning devices is carried out using a discovery learning model integrated with 21st century learning. Research problems are formulated as follows: How is the validity, practicality and effectiveness of physics learning devices using the Discovery Learning model in the eyes of Newton's Law of Integrated Motion 21st Century Learning?

2. Material and Method
The type of research conducted is research and development to produce a new product or improvement of existing products. Research and development is a research method used to produce certain products and test the effectiveness of these products. The development research that will be used in this study is the Plom model. This model consists of 3 development stages, namely Preliminary Research (initial investigation phase) prototyping phase (prototype design phase), and assessment phase (assessment phase) [3].

Learning tools in this study include (1) RPP, (2) Handouts, (3) LKPD and (4) Assessment. The development of integrated learning learning tools in 21st century learning refers to the general education development model of Plomp which consists of the preliminary investigation phase, the prototyping phase (prototype design phase), and the assessment phase (assessment phase).

The results of the initial investigation showed that the competency of students' attitudes gained an average of 80.04%, in the learning process students always prayed before and after learning, natural phenomena associated with learning make the faith of students increase so that they love nature, students can accept ideas and input from friends during learning. Knowledge competencies of students get an average of 73.06%, students have low knowledge, this relates to the principles, the use of the equation of Physics, the use of learning tools so that it affects the understanding of the material of students, it requires learning tools that support the process learning of students. The competency of students 'skills also gets a low average of 64.81%, which includes competency in observing, asking, trying, reasoning and communicating, the low competency of students' skills is caused by not often the students doing skills activities especially lab work due to educators do not carry out learning methods that involve students doing laboratory activities, besides that students rarely ask educators, so that they are unable to solve learning problems.

Preliminary Research results are used as the basis for the development or manufacture of prototypes. After the indicators are formulated, and concept maps are established, the next step is to design learning devices in the form of RPP, Handouts, LKPD and Assessment. The device is designed for four times face-to-face with a time allocation of 4 x 45 minutes. Development based on the design of the contents of the device, and ends with the accuracy of the use of Indonesian in accordance with the Indonesian Language Spelling (EBI). The RPP was prepared according to the format in the attachment of Permen Dikbud No. 22 of 2016 concerning learning in primary and secondary education. To facilitate students in learning, teaching materials are also designed. One form of teaching material is in the form of handouts. handouts are summaries of learning material. To complete the handout, a student worksheet (LKPD) is designed. The learning steps in RPP, handouts, and LKPD are adapted to the learning steps using an integrated 21st century learning learning model that can explore all the abilities of students.
The assessment in this study was divided into three namely knowledge assessment, 21st century skills assessment (4C) and skills assessment. The assessment was designed based on Permendikbud No. 23 of 2016 concerning the standard of educational assessment by educators in primary and secondary education. Knowledge assessment is designed in the form of an essay test that contains learning indicators. The 4C assessment and skills are designed in the form of an observation sheet that contains skill indicators and is assessed by the observer at each meeting.

After the learning device is designed, the prototype II stage is carried out, namely in the form of self evaluation and expert validation. Self-evaluation is to revise itself the learning device developed. Self-evaluation is carried out by 2 people, first the author himself and 1 friend who develops learning devices. Furthermore, learning materials are validated by experts through filling in instruments that have been made at the design stage. Before the validation of the learning device, the validator first validates the assessment of the instruments of validity and practicality.

In this study, the validation carried out emphasizes the validation of content, constructs, and language. Construct validity to test the validity of construction, while the validity of the language shows the language components used in accordance with the rules of good and correct Indonesian language, clarity of information and effective use of language. so that the learning device used is in accordance with the criteria that should be and the arrangement of the devices made is appropriate and meets the requirements for the preparation of learning devices.

After the learning device is produced using a valid Discovery Learning model of 21st century learning, one-to-one evaluation, small group evaluation and field testing (field test) are conducted. Field trials Evaluation was conducted in class X MAN 1 Padang Pariaman which aims to see practicality. To see the effectiveness of the assessment phase of the learning device using the integrated learning model of Learning Learning in the 21st century in terms of three aspects, namely, learning outcomes, skills of students and 21st Century or 4C Skill Training.

3. Results and Discussion
For the results of the validation of the validators on the development of learning devices namely RPP, LKPD, and teaching materials are presented in Table 1

| No | Rekapitulasi | Rata-rata | Kriteria |
|----|--------------|-----------|----------|
| 1  | RPP          | 0.83      | Valid    |
| 2  | Handout      | 0.83      | Valid    |
| 3  | LKPD         | 0.83      | Valid    |
| 4  | Assessment   | 0.82      | Valid    |
|    | Average      | 0.82      | Valid    |

The average value of the five validators is valid. Thus the learning device is said to be valid. After being declared valid, the learning device is tested on prototype III. In prototype III one-to-one evaluation and small group evaluation on prototype IV were conducted. This aims to determine practicality.

Based on the results of interviews with students, in general the students already understood the material and examples of questions contained in the handouts, the composition of attractive colors to be read and looked at. Practical activities on LKPD make motivated students to continue learning physics and make it easier for them to understand learning. Based on the results of the person-to-person evaluation, revisions to the learning device were conducted, especially handouts and LKPD. The prototype 3 revision is called prototype 4.

After conducting a person-to-person evaluation, a small group evaluation (small group evaluation) was carried out by practicing learning tools that had been designed for students consisting of 8 people and divided into 2 groups, each group consisting of 4 people with high ability 1 person 2 people and 1 person is low. The recapitulation of the results of the small group practicality test is found in table 2.
From table 2, the results of the small group evaluation show that the practicality of the learning tools for handout 90.0 with very practical criteria and LKPD 92.9 with very practical criteria are obtained. Through this evaluation, the authors also get input from educators and students, so that the learning device must be refined before a large group is conducted. After revising the results obtained in the small group evaluation, a prototype 4 was produced, namely the learning device using a valid and practical Discovery Learning model, this prototype 4 will be tested in class X MIA 1 MAN 1 Padang Pariaman with the number of participants 32 students educated. Trial learning devices using integrated learning model of 21st century learning carried out as many as 4 meetings. The learning data of the learning device uses the integrated learning learning model of 21st century learning obtained from the practical questionnaire and observation of the implementation of learning. The results of the trial obtained are described as follows.

3.1. Results of Questionnaire Practicality
In summary the results of the practical sheet on the educator's response can be seen in Table 3.

### Table 3. Practicality Test Results of RPP, Handout, LKPD AND Assessment according to Educator Response

| No | Statement  | Percentage | Category  |
|----|------------|------------|-----------|
| I  | RPP        | 89.2       | Practical |
| II | HANDOUT    | 92.3       | Practical |
| III| LKPD       | 87.5       | Practical |
| IV | ASSESSMENT | 87.5       | Practical |
|    | Total Average | 89.12 | Practical |

In Table 3, in general, the results of the practicality test using the educator response questionnaire show that the practical value is 89.12%. Based on the criteria that have been made, the practicality of learning devices using integrated learning learning models of the 21st century is declared practical.

The results of the practical test of handouts and LKPD use the integrated learning model of 21st century learning according to students' responses can be seen in Table 4.

### Table 4. Practicality Test Results of Handouts and LKPDs According to Students' Response

| No | Statement | Practical Percentage | Category  |
|----|-----------|----------------------|-----------|
| I  | HANDOUT   | 82.4                 | Very practical |
| II | LKPD      | 83.1                 | Very practical |
|    | Total Average | 82.7   | Very practical |

It can be seen in Table 4 that the average practicality level of handouts and LKPDs using 21st century integrated learning learning models according to students' responses is 82.7%. So, it can be concluded that handouts and LKPD use the 21st century integrated learning learning model that is very practical according to the responses of students.

3.2. Results of Observation of Learning Implementation
Observation of the implementation of learning aims to see whether learning is in accordance with the RPP that has been designed. Practical data is taken from the results of observations on the implementation of the lesson plan and questionnaire responses of educators and students during the learning process using integrated learning model of 21st century learning.
### Table 5. RPP Practicality Test Results According to the Implementation Questionnaire

| No | Meeting to | Practical Percentage | Category   |
|----|------------|----------------------|------------|
| 1  | I          | 82.1                 | Practical  |
| 2  | II         | 91.6                 | Practical  |
| 3  | III        | 94.0                 | Practical  |
| 4  | IV         | 94.0                 | Practical  |
|    | Total Average | 90.42               | Practical  |

### 3.3. Effectiveness of Learning Devices

The effectiveness of physics learning devices is seen from the activities of students at the time of learning and learning outcomes of students after learning by using a device of learning physics discovery learning model integrated 21st century learning.

#### 3.3.1. Student learning outcomes

Data on learner competency learning outcomes obtained from the written test results at each meeting. The results of the first to fourth meetings are the results of the answers to the practice scores on the worksheet. The results of the knowledge competency analysis can be seen in Table 6.

### Table 6. Results of Knowledge Competency Assessment

| Meeting to | Average Value | Complete learners(people) | Students Completed (people) | Not Percentage (%) |
|------------|---------------|----------------------------|----------------------------|-------------------|
| I          | 73.28         | 16                         | 16                         | 50.00             |
| II         | 78.59         | 30                         | 2                          | 93.75             |
| III        | 82.50         | 32                         | 0                          | 100               |
| IV         | 85.94         | 32                         | 0                          | 100               |
| Average    | 80.08         | 32                         | 0                          | 85.93             |

From table 6 it can also be seen that the learning outcomes in the cognitive domain have increased at each meeting. This value is higher than the classic KKM set by the school, which is 75. If guided by the KKM, the students' classical cognitive values can be said to be complete. If you look at the completeness of students individually, then more than 85% of the total number of students in the class has reached KKM or completed as shown in Figure 1.
3.3.2. 21st Century Skill Assessment Results (4C). 4C assessments of students are conducted at each meeting. The results of this observation can be seen briefly can be seen in Table 7.

| Observation Aspect | Value (%) | Average | Category |
|--------------------|-----------|---------|----------|
| Think Critical     | 60 68 80 93 | 75.5    | Good     |
| Collaborative      | 62 76 80 95 | 78.3    | Good     |
| Creative           | 61 78 92 95 | 81.5    | Good     |
| Communicative      | 61 76 80 94 | 77.7    | Good     |
| Average            | 61 74.5 83 94.3 | 78.25   | Good     |

Table 7 shows that overall 21st century skills students are in a good category with a class average of 78.25%. From each meeting the attitude of students has increased.

3.3.3. Skill Assessment Results. Learning outcomes of students in competency skills are taken from the activities of students when doing practicum at each meeting. The results of observing the skills of students can be seen in Table 8.

| Student Skills                              | Value (%) | Average (%) | Category |
|---------------------------------------------|-----------|-------------|----------|
| Prepare tools                               | 62 73 80 91 | 76.5        | Good     |
| Formulating Hypotheses                      | 60 78 82 95 | 78.8        | Good     |
| Participation in each practical             | 57 76 91 94.5 | 79.6      | Good     |
| Accuracy using the tool                     | 57 74 81.3 95 | 76.8       | Good     |
| Read and record practicum results           | 61 69 86 91 | 76.7        | Good     |
| Answering questions related to experiments   | 61.7 74.2 85.2 94 | 78.7      | Good     |
| The timeliness of preparing the report is   | 61.7 75.8 89.1 94.5 | 80.3     | Good     |
| Presenting group reports                     | 58.6 73.4 80.5 95 | 76.9      | Good     |
| Make Conclusions                            | 61.7 69.5 79.7 92.2 | 75.8      | Good     |
| On average                                  | 60.1 73.6 83.9 93.6 | 77.8      | Good     |

Based on Table 8, the average skill of students as a whole is 77.8% and is in the good category. If guided by the effective category table, then this average value is in the 75-90 interval with the effective category with classical completeness in students reaching 85% at the end of the meeting.
4. Conclusion

The results showed that the physics learning device using integrated learning learning model 21st century learning developed was valid both in terms of content and constructs and had met practical criteria both from the aspect of implementation, ease and time required. This can be seen from empirical data, namely practical questionnaire data according to students and educators and observational data on the implementation of learning. As well as effectiveness which is considered effective, seen from empirical data. In this case, it can increase the activity of students during learning and learning outcomes of students who more than 85% reach KKM.

References

[1] Damayanti S Q, I K Mahardika and Indrawati. 2016. *Penerapan Model Discovery Learning Berbantuan Media Animasi Macromedia Flash Disertai LKS yang Terintegrasi dengan Multirepresentasi dalam Pembelajaran Fisika di SMA.*

[2] Saputro, R P, Wasis and T Koestuari. 2015. *Pengembangan perangkat pembelajaran Fisika Model Discovery Learning Untuk Meningkatkan Hasil Belajar dan Keterampilan Berfikir Kreatif.* Surabaya: Program Pasca Sarjana Universitas Surabaya

[3] Plomp, T. 2013. *Educational and Training System Design.* Enschede. University of Twente: Netherlands