Preliminary analysis of physical module practicum modelling project based learning to improve scientific skills of high school students

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Abstract. The practicum module is a learning resource with complete and stand alone units arranged to help students achieve their learning go independently. 21st Century L changes changes the teacher centered learning approach to student centered learning approach. One of the learning models that are appropriate for this change is Project Based Learning. Through this learning model, students can develop their skills in critical thinking, creative, collaborate, and communicate design experiments to produce products in physics practice. Through physics practice should be able to develop scientific skills of students. The reality that is encountered, there is still a lack of physics practicum modules, so students are not able to independently carry out Physics Physics. This study aims to survey the analysis of the need for teaching materials in schools needed in physics practice. This type of research is quantitative descriptive. The data taken in this study were obtained from interviews with teachers and students with direct observation. The research instrument consists of a questionnaire and observation sheet. The results of this study prove that it is necessary to develop teaching materials in the form of practical textbooks based on project based learning models to improve students' scientific skills.

1. Introduction

Smart, capable, creative, faithful, and noble human resources are human resources that are expected to exist in developing countries. The changing times that have influenced the development of science and technology have forced Indonesia to be able to prepare highly competitive human resources. Physics is one of the subjects that become a means for students to be able to master the knowledge, concepts and principles of physics, and can foster scientific skills, process skills and also creative thinking to solve problems in everyday life. According to Widodo, there are at least four skills that must be possessed by students in the 21st century, namely: creativity and innovation; critical thinking and problem solving; communication, and collaboration. In addition, based on Permendikbud No. 21 of 2016 concerning Content Standards, one of the competencies that must be developed in physics subjects is: developing an attitude of curiosity, honesty, responsibility, logical, critical, analytical, and creative through physics learning. Therefore in physics learning the ability to
analyze is required by optimizing scientific thinking of students so that they are able to achieve the goals of physics learning.

The problem that often occurs in the physics learning process is the lack of use of learning models that stimulate students to think scientifically. The use of a model of learning that has yet to develop scientific skills of learners make learning become monotonous even pitch sometimes boring. This limits the ability of learners in me nTry and download emukan new things. The assumption that physics is just formulas causes the enthusiasm of students in developing scientific skills to discover new things that have not been developed optimally. The physics learning process that can develop students' scientific skills is through practicum activities. Practical activities provide many benefits, because the true nature of physics is scientific products and processes. Practical activities should be done varied so that curriculum demands in accordance with 21st century skills are achieved. The obstacle faced by physics teachers is the lack of teaching materials or practicum guides, so practicum activities are not carried out properly. It is also difficult for students to find teaching materials that explain physics experiments to produce a product based on the concepts they learn. Teaching materials used in learning are not in accordance with the learning needs of students. The teaching material provided does not make students think scientifically, critically and creatively in accordance with the learning objectives. Learning that is still teacher-centered also causes students to lack understanding of physical concepts so that the application of physics concepts in a product is still low.

Student centered learning as an approach that should be used by teachers to guide in designing learning activities. Teachers should design learning activities that can activate learners and develop the potential possessed by each student. Project based learning (PjBL) is one of the learning models with special characteristics of the activities of designing and carrying out a project in it to produce a product. This learning model provides direct learning experiences to students through project making activities that lead to the creation of a product. According Hutasuhut (2010) states that in the PjBL students are required to use all their potential in solving problems in completing tasks. The existence of designing and making a project will support the development of the potential of each student.

The main elements in the PjBL model according to Lamer, namely (1). Knowledge, understanding, skills, (2). Challenging problems or questions, (3). Continuous demand, (4). Authentic, (5). Sounds and choices of students, (6). Reflection, (7). Criticism and revision, and (8). Product publications. The elements in PjBL stimulate students to carry out scientific activities, students solve real world problems by designing their own questions, planning learning, organizing research, and implementing various learning strategies. The project -based learning model has five steps, namely: (1) Establishing project themes, (2) Learning contexts, (3) Planning activities, (4) Processing activities, and (5) Implementing activities to implement projects (Santyasa, 2006). To create a product, students need the ability to think creatively in finding ideas for their products.

The five steps in PjBL greatly require students' scientific skills. Project-based learning has enormous potential to train students 'thinking processes that lead to students' scientific skills. Students become encouraged in learning, the teacher acts as a mediator and facilitator. So in this study a preliminary analysis of the high school physics learning process uses a practical module modeled as Project Based Learning to develop scientific skills.

2. Research Method
This study uses descriptive an sis method. This descriptive study aims to survey the analysis of the needs of teaching materials needed in physics practicum in schools. The data taken in this study were obtained from interviews and observations with physics teachers and students of Class XI MIPA 1 and XI MIPA 2 as well as direct observation. This research was conducted at SMAN 7 Sijunjung.

The research instrument used consisted of questionnaire sheets and observation sheets. Data collection techniques are done by direct interviews with teachers about the problems encountered in learning physics. The questionnaire sheet contains 5 aspects, namely the carrying capacity of physical practicum activities, implementation of physical practicum, physical practicum obstacles, analysis of
physical material, and analysis of teaching material requirements. Data regarding carrying capacity, implementation, and practical obstacles fisika use sk a la dichotomy, yes or no. The acquired data is categorized and analyzed descriptively to mem obtain data as needed. Analysis of physical material is done by analyzing Basic Competencies. Analysis of teaching material needs is used to find out effective teaching materials used in learning. Yag data obtained in a nalysis in percentages and graphs.,

3. Results and Discussion

Interviews and direct observation by educators and learners do the stairs 1 1 2 June 2019. Based on the results of interviews conducted turned out to have the same problem. The results of the analysis of interviews with teachers can be seen in table 1. below:

| No | Question                                                                 | The answer                                                                 |
|----|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 1  | What learning methods do you usually use to teach physics concepts?        | Lecture and discussion                                                     |
| 2  | How many times in one semester Father / Mother doing practical physics ?  | Very rarely, only once in a semester                                        |
| 3  | Based on your experience, how do you learn the physics of students ?      | Many students have not been completed and must often be remedial           |
| 4  | As long as you teach the physics concept, what teaching materials have you used? | Diktat, books from publishers                                             |
| 5  | In your opinion, do you need teaching materials for physics?              | Yes, it is really needed                                                   |
| 6  | According to you, what are the weaknesses of the teaching materials that you have used? | Not interesting and not yet in accordance with the demands of achieving basic competencies |
| 7  | What kind of teaching material do you need to teach physics concepts according to the 2013 curriculum developing 21st century skills? | Teaching materials that can stimulate students to be active, creative, and innovative in learning |
| 8  | In the physics learning process that Mr / Ibuk teach, students are able to do simple projects based on the concepts that Mr / Ibuk teach? | Not yet, only about 5%                                                   |
| 9  | A pakah teaching materials about physics lab is already available in schools ? | Not yet                                                                    |
| 10 | A pakah Mr / Ibuk already trained scientific skills to students learning physics? | So far not yet                                                            |
| 11 | What is the obstacle for you in teaching physics concepts through practicum? | The absence of guidelines or practicum modules                            |
| 12 | What do you expect after using the physics practicum module in accordance with the demands of basic competencies? | Participants have scientific skills and produce products from the physics concepts they learn |

Based on an analysis of the results of interviews with educators, it was concluded that the learning objectives of physics in accordance with the 2013 curriculum have not been reached to the maximum. Learning still uses lecture and discussion methods. Experimental methods through practical activities have not been implemented well. Learning is still centered on the teacher because students
have not been able to realize *learning and innovation skills* in learning. This is due to the unavailability of teaching materials as a practical guide. Teachers are still difficult to teach physics through scientific performance because learning resources are still inadequate.

Analysis of the questionnaire distributed to 66 students regarding the carrying capacity of the school towards physical practicum activities can be seen in table 2 below:

**Table 2.** Results of the analysis of the carrying capacity of schools for physics practicum activities

| No | Item                                                                 | Percentage of student responses (%) |
|----|----------------------------------------------------------------------|-------------------------------------|
|    |                                                                      | Yes       | Not      |
| 1  | The school has a physics laboratory                                  | 90.90     | 9.09     |
| 2  | The laboratory is equipped with a practicum manual                   | 4.54      | 95.45    |
| 3  | There is a physics practicum module in school library                | 4.54      | 95.45    |
| 4  | Practical equipment as needed                                        | 18.18     | 81.81    |
| 5  | The teacher has mastered good practical methods                      | 30.30     | 69.69    |

Based on the results of the analysis above, the school already has a physics laboratory, but it has not been maximized for practicum activities. About 95.45% of students stated that the practicum manuals were not yet available in the laboratory, and the practicum modules were also not available in the library. Practicum equipment is not yet available as needed, students who stated this around 81.81%. Students also stated 69.69% of teachers had not yet mastered good physics practicum methods. This has become an obstacle in learning physics through practical activities that have not been carried out to the maximum.

Analysis of the implementation of physics practicum activities in schools can be seen in table 3. below:

**Table 3.** Results of analysis of practical activities

| No | Item                                                                 | Percentage of student responses (%) |
|----|----------------------------------------------------------------------|-------------------------------------|
|    |                                                                      | Yes       | Not      |
| 1  | Practicum is carried out for each KD skill                          | 4.54      | 95.45    |
| 2  | Practicum is carried out to conduct experiments                      | 28.78     | 71.21    |
| 3  | Practicum is carried out to make a device / product of physics       | 0         | 100      |
| 4  | Practicum is held 1-2 times per semester                            | 4.54      | 95.45    |
| 5  | Practicum is held 5-6 times per semester                            | 0         | 100      |
| 6  | Practical never implemented in one semester                         | 37.88     | 62.12    |

An overview of the implementation of physics practicum activities can be seen from the table above. It can be seen that practicum is not implemented in every Basic Competence in the aspect of skills. As many as 28.78% of students said that practicum implementation was not to conduct experiments, even 100% of students stated that no physical products were produced through
practicum. Practicum is carried out, only in very few frequencies, 1-2 times in one semester. It was seen that only 37.88% of students stated this, and there were even students who had never practiced in one semester. From this analysis, it was concluded that students have not been able to improve their scientific skills, because dominant learning is carried out in class by learning theories and practice questions only.

Barriers to the implementation of practicum activities in learning can be seen in table 4 below. The main obstacle felt by students is the absence of practicum manuals that are in line with the demands of the 2013 curriculum (98.48%). In addition, the absence of a tool-making guide book also became a dominant obstacle in the implementation of practicum activities. About 96.96% of students had difficulty in applying the concept of physics in practice. So that the enthusiasm and interest of students to learn physics is reduced. It is seen that only 30.30% of students are motivated to learn through the lecture and discussion methods. Students are interested in learning physics by directly engaging in conducting experiments or experiments (69.70%). As many as 62.12% of students are motivated to learn through practical activities.

| Table 4. Results of analysis of barriers to the implementation of practical activities |
|---------------------------------|----------------|----------------|
| No Item                         | Percentage of student responses (%) | Yes | Not |
|---------------------------------|---------------------------------|-----|-----|
| 1 The laboratorium room is inadequate | 60,60                       | 39,40 |
| 2 Laboratory equipment is not as needed | 63,63                       | 36,37 |
| 3 There is no practical manual    | 96,96                       | 3,04 |
| 4 There are no manuals for making physical devices / products | 98,48                       | 1,52 |
| 5 Students have difficulty in applying physics concepts | 96,96                       | 3,04 |
| 6 Students lack motivation in practicum activities | 60,60                       | 39,40 |
| 7 More interested in the lecture and discussion methods | 30,30                       | 69,70 |
| 8 More interested in the experimental method / experiment | 60,60                       | 39,40 |

Analysis of physical material is done by looking at each Basic Competency that demands the skills of students in practicum and making tools. The analysis results can be seen in the following table 5:

| Table 5. Results of analysis of physical material |
|---------------------------------|----------------|----------------|----------------|
| No Kompetensi Dasar | Kelas | Kompetensi Dasar | Kelas |----------------|----------------|
| 1. 4.1 Membuat prosedur kerja ilmiah dan keselamatan kerja misalnya pada pengukuran kalor | X | 4.1 Membuat karya yang menerapkan konsep titik berat dan keseimbangan benda tegar | XI |
| 2. 4.2 Menyajikan hasil pengukuran besaran fisis berikut ketelitiannya dengan | X | 4.2 Melakukan percobaan tentang sifat elastisitas suatu bahan berikut presentasi | XI |
| No | Kompetensi Dasar                                                                 | Kelas | Kompetensi Dasar                                                                 | Kelas |
|----|---------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------|-------|
| 3  | 4.3 Merancang percobaan untuk menentukan resultan vektor sebidang (misalnya   | X     | 4.3 Merencanakan dan melakukan percobaan yang memanfaatkan sifat-sifat fluida     | XI    |
|    | perpindahan) beserta presentasi hasil dan makna fisinya                          |       | statis, berikut presentasi hasil dan makna fisinya                              |       |
| 4  | 4.4 Menyajikan data dan grafik hasil percobaan gerak benda untuk menyelidiki   | X     | 4.4 Membuat dan menguji proyek sederhana yang menerapkan prinsip dinamika fluida,| XI    |
|    | karakteristik gerak lurus dengan kecepatan konstan (tetap) dan gerak lurus      |       | dan makna fisinya                                                                |       |
|    | dengan percepatan konstan (tetap) berikut makna fisinya                          |       |                                                                                |       |
| 5  | 4.5 Mempresentasikan data hasil percobaan gerak parabola dan makna fisinya      | X     | 4.5 Merencanakan dan melakukan percobaan tentang karakteristik termal suatu bahan,| XI    |
|    |                                                                                |       | terutama terkait dengan kapasitas dan konduktivitas kalor, beserta presentasi   |       |
|    |                                                                                |       | hasil dan makna fisinya                                                          |       |
| 6  | 4.7 Melakukan percobaan berikut presentasi hasilnya terkait gaya serta hubungan| X     | 4.7 Membuat karya/model penerapan Hukum I dan II Termodinamika dan makna fisinya | XI    |
|    | gaya serta hubungan gaya, massa dan percepatan dalam gerak lurus benda dengan   |       |                                                                                |       |
|    | menerapkan metode ilmiah                                                         |       |                                                                                |       |
| 7  | 4.8 Menyajikan karya mengenai gerak satelit buatan yang mengorbit bumi,          | X     | 4.9 Melakukan percobaan gelombang berjalan dan gelombang stasioner, beserta     | XI    |
|    | pemanfaatan dan dampak yang ditimbulkannya dari penelusuran berbagai sumber      |       | presentasi hasil dan makna fisinya                                               |       |
|    | informasi                                                                       |       |                                                                                |       |
| 8  | 4.10 Menyajikan hasil pengujian penerapan hukum kekekalan momentum, misalnya    | X     | 4.10 Melakukan percobaan tentang gelombang bunyi dan/atau cahaya, berikut        | XI    |
|    | bola jatuh bebas ke lantai dan roket sederhana                                   |       | presentasi hasil dan makna fisinya misalnya sonometer, dan kisi difraksi        |       |
Based on the table 5, it appears that there are 9 basic competencies in grades X and XI that can enhance students' scientific skills through practical activities. The basic competency demands of these skill aspects are students are able to design and conduct experiments and produce work in the form of tools or products. Analysis of teaching material needs can be seen in the following table 6:

Table 6. Results of analysis of teaching material requirements

| No | Item                                                                 | Percentage of student responses (%) |
|----|----------------------------------------------------------------------|------------------------------------|
|    |                                                                      | Yes       | Not       |
| 1  | Teaching materials are in accordance with the demands of the 2013 curriculum in achieving 21st century skills | 87,87     | 12,13     |
| 2  | A physics practicum module is required                               | 96,96     | 3,04      |
| 3  | Project Based Learning model is needed in developing teaching materials | 87,87     | 12,13     |
| 4  | Teaching materials are equipped with materials, questions, practical guidelines | 87,87 | 12,13 |
| 5  | Interesting and colorful teaching materials                          | 96,96     | 3,04      |
| 6  | Teaching materials are equipped with a tool for making the guide     | 87,87     | 12,13     |

Based on the analysis of the need for teaching materials above, students need a practical module with the Project Based Learning model. Teaching materials should be interesting and colorful and in accordance with 21st century curriculum and skills demands. This can be seen with a percentage of around 87-97% of students who answered yes.

4. Conclusion

Based on the results of the preliminary analysis by conducting interviews and observations at SMAN 7 Sijunjung, the authors conclude that a practicum module is required with a Project Based Learning model to improve students' scientific skills. This was done so that the demands of the 2013 curriculum that were in line with the goals of national education in the 21st century could be achieved properly.

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