eISSN: 2548-4613

Design of Physical Practicum Tools on Rotational Dynamics Matter with Scientific Concept

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***Abstract*—This study aims to produce sufficient practicum tools on the matter of dynamics of rotation with scientific concepts, to know the activities of students in learning when using the tool of the design result, to know the improvement of students' cognitive learning outcomes if in learning using the tool of the design result. This type of research belongs to Research and Development (R & D). The population of this research is the entire class XI semester 1 academic year 2017/2018 in SMA Negeri 2 Binjai. The sample specified in this study is one of the class XI of all classes in the research site that is class XI MIA 3. The procedure in the research is the stage of needs analysis, design phase, development and implementation stage. The research instrument uses a review questionnaire or response from a media expert, an assessment questionnaire or a response from a physics teacher, an assessment questionnaire or a student's response to the design of the practicum tool and the Observation. The conclusions obtained from the research are developed practicum tools get positive response from students, the activities undertaken by students during learning is quite active and experienced increase in each meeting, student learning outcomes increased significantly.**

Keywords—design of practicum tools; dynamics of rotation; scientific concepts

I. INTRODUCTION

The traditional paradigm assumes the teacher is the only source of learning, the student as the recipient of knowledge and learning is master of knowledge, shifted by modern learning where the role of the teacher is as a facilitator, students as problem solvers and learning is solving problems [1]. Physics learning is the process of creating conditions and opportunities so that students can construct their knowledge, process skills and scientific attitudes and include aspects of knowledge, process aspects and attitude aspects intact that can be implemented in the life process as superior characters [2].

Some physics teachers still use conventional methods or lectures without providing scientific experience. The lecture method is applied by the teacher so that the matter of physics taught is completed on time, regardless of the purpose of the learning poses. Some physics teachers assume if in any study of physics used the scientific method then the matter being taught will not be completed on time [2]. Physics is in fact studied through a mathematical approach, so it is often feared and disliked by students. Learning physics is not just about mathematics but students are expected to be able to understand the concepts contained, understand the problems and be able to solve them mathematically, this is what causes student discomfort to these subjects is getting bigger. The difficulties faced by most students are in interpreting the various concepts and principles of physics, because they are required to be able to interpret the physical knowledge precisely, not vaguely or ambiguously [3]. To be able to improve students understanding of strategies needed in implementing learning. Scientific (scientific) based learning is more effective than traditional learning. The results prove that in traditional learning, retention of information from teachers by 10 percent after 15 minutes and acquisition of contextual understanding by 25 percent. In scientifically based learning approaches, teacher retention of information is more than 90 percent after two days and the acquisition of contextual understanding is 50-70 percent [4].

Physics learning will be more meaningful if the students are actively involved in observing, understanding and utilizing the natural phenomena that exist in the surrounding environment [5]. Through practicum activities give students the opportunity to be able to see and prove the theories they learn, through direct observation and experimentation, in the end, the students' creativity and skills are improved. Students will be more motivated in assessing a theory, and indirectly the students' curiosity also develops and is larger. Seventy percent of students said they enjoyed doing physics labs [2].

The government has implemented a K-13 curriculum based on a scientific approach, with the aim that every teaching and learning process goes according to the scientific rules demonstrated by experimental activities. In fact, until now, many schools are not ready to implement this curriculum because of the lack of laboratory equipment. The results of research conducted by [6] in ten SMP Negeri in the city of

Cimahi West Java that 43% of respondents answered practicum 2-3 times, 29% of respondents 4-5 times and 26% more than five times and the results of the survey conducted by [7] concluded at several schools in Jakarta it is known that around 44.4% of schools do practicum activities less than three times per semester even about 50.2% of schools do not do practicum at all throughout the semester. According [8] the lack of availability of practicum tools in the school laboratory to be one of the factors causing the practice is rare or even not implemented.

Limitations of practicum tools are also experienced by researchers in SMA Negeri 2 Binjai. Based on interviews with 3 physics teachers and 9 students in SMA Negeri 2 Binjai, it was found that they rarely carried out practicum by reason of limited practice tools, inadequate and even nonexistent tools. One of the matters that do not have laboratory tools in the laboratory is the dynamics of rotation. The absence of the rotational dynamics practicum tool in SMA Negeri 2 Binjai resulted in less optimum physics learning, this resulted in the result of the students' learning dynamics of low rotation. Interview results indicate that teachers and students hope that in the school is available practice tools to support learning with scientific approach. Overcoming the limitations of the practicum tool, all teachers think that it is necessary to design simple practical tools that are easy to manufacture, easy to use, cheap, but can be used in matter delivery.

II. RESEARCH METHOD

This research was conducted in SMA Negeri 2 Binjai located at Jalan Padang No 8 Binjai. The population in this study is all students of class XI semester 1 academic year 2017/2018 in SMA Negeri 2 Binjai. The sample specified in this study is one of the class XI of all classes located at the research site. Researchers have determined the class that is sampled is class XI MIA 3. Type of research is included in the type of research is Research and Development (R & D). The research procedure is shown in the figure

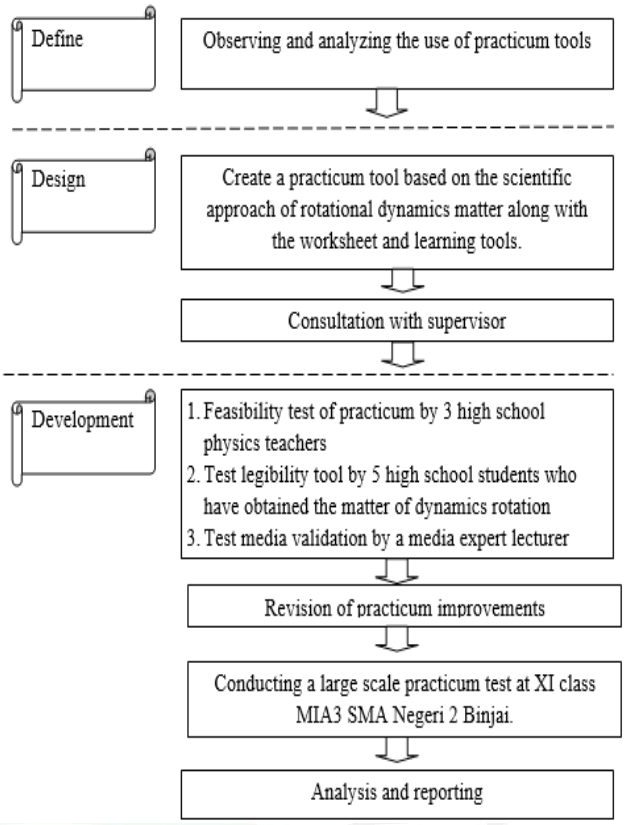

Fig 1. Research procedure

The instrument in the research is questionnaire and observation. Hypothesis in this research is test of student response and test result of learning after using practice tool of rotation dynamics with scientific approach. The test of the research hypothesis will be tested by gain normalization test. Data obtained from activity and test result of learning given. To show improvement of student achievement after using practicum of rotational dynamics with scientific approach with normalized gain test (N-Gain). As [9] points out that with a normalized average gain value it can roughly measure the effectiveness of a learning in conceptual understanding.

III. RESULT AND DISCUSSION

Based on the description of the research results, the design of the rotational dynamics practicum tool consisting of practicum of inertia moment, practicum of inertia moment and practicum of gravity center with scientific approach has been developed and then validated. Expert validation results obtained the average feasibility score for the moment of force practicum tool is 3.24 with a valid revision status with an average percentage of 82.1% feasibility with expert criteria strongly agree with this tool. Validation of moment of force practice tool with a feasibility score of 3.22 with valid revision status with 80.7 feasibility percentage with expert criteria strongly agree with this practicum tool. Validation of practicum of center of gravity with score 3,42 with validity status of revision with 85,7% feasibility percentage with expert criterion strongly agree with this practicum tool.

Besides the validation test by the practicum expert has also been tested eligibility by three physics teachers. Based on the percentage value of product feasibility by teachers, the first teacher gave 94.2% assessment, second teacher 85.7% and third teacher 90.7. So that the average of three thirds of teachers is 90.2% means that practicum tools meet eligibility to be used in learning and all teachers strongly agree that the practical tools of the design can be used in physics learning.

A. Practicum Tools dynamics of Rotation with the Scientific Approach can Increase Student Response

Based on the individual test conducted on five students, the average student response percentage was 77.5% with agreed criteria. According to students the appearance of the practicum tool is less interesting this is marked from the percentage of students' responses to the tool only tore 65% value. But the student's response to the tool strongly agreed on the easy-to-understand concept using the 85% practicum tool and the more enjoyable learning aspect using the 90% practicum tool. It states that although the appearance is less interesting but students can learn and understand the concept well and learn to use the practicum tool is very fun.

A large group trial conducted on 30 students obtained the result that the practicum tool with scientific approach developed got percentage of students' average response rate of 77.3%, students agree with the design of this practicum tool. In the pilot phase of the large group, each indicator received a favorable response. Similarly, the percentage of student responses in small groups the largest percentage of student responses is in the easy to understand concepts of 82.5% and learning is more enjoyable.

B. Practicum Tools dynamics of Rotation with the Scientific Approach can Increase Student Activity

Based on observation result of student activity during learning using practicum tool with scientific approach of meeting I, II and III has increased, the average activity of categorized quite active students at meetings I and II, become very active at meeting III.

Student learning activities at the first meeting in the category quite active with a percentage of 73.46%. This indicates that the function of practicum tool at this stage has not been maximal in directing student learning activities. Students are less active in processing the data so that many students are silent and not trying to process data. This is due to students' uniqueness in processing the data.

At the second meeting there was an increase in the percentage of student activity from 73.46 to 78.1% at the second meeting with an increase of 3.3%. There is a significant increase in the mental aspects. Students are getting more serious in processing data. This indicates that the practicum tool with a scientific approach is quite successful in increasing student activity.

At the third meeting there was an increase in student activity from 78.1% to 81.2 5, an increase of 3.16%. This indicates that students are getting very active at this meeting. Students are better equipped in practicum because most students are prepared by reading the material to be practiced. But there are still some students have not prepared themselves especially in processing the data so that this aspect still needs to be given motivation.

Thus obtained the conclusion that there is an increase in student activity on learning by using a practicum tool designed. Halini in line with research conducted by [10], there is an increase in student activity on learning by using practicum tools on practical activities. By using practicum tools designed students become more actively participate in learning activities and help them understand the subject matter. Students also feel learning using practice tools is very fun.

C. Tools of Practicum Dynamics Rotation with the Scientific Approach can Increase Student Learning Outcomes

Based on the results of student learning tests at meetings I, II and III obtained that student learning outcomes have increased. At the first meeting, no students achieved the value of learning completeness (75) with an average score of 60.27. At the first meeting many obstacles both from the use of time and readiness of students. At this meeting the learning is carried out in the classroom and the group division is implemented at this time. This causes the time spent in learning to decrease so as to impress the rush. In addition, almost all students have not read and are looking for information about style moments. Students are impressed not ready to follow the learning, so that learning are not ready well absorbed by the students. Learning using a practicum tool with scientific approach at this stage has not been successful as [11] states that one of the factors that influence learning outcomes is the readiness of students.

Based on the observations as described above, planned corrective action towards the implementation of learning meeting II. Improvements made are to assign students the task of seeking information about the practicum to be performed, ensuring that students have sufficient capital of understanding to observe events and read practicum-related materials.

At the second meeting there was an increase compared to meeting I. At the second meeting there was an increase from the average value of 60.27 at the first meeting to 79.16 at the second meeting with an increase of 18.89. There are 27 or 90% of students get mastery learning, this is because students are getting ready in following the learning.

Meeting III, based on data analysis, there is an increase of student learning outcomes from 79,16 at meeting II to 80,00 at meeting III. Increased learning outcomes of 0.84, there are 29 students have completed learning. This increase in yield is relatively small compared to the increase in learning outcomes from II to II. This is because students consider the second lesson to be successful and do not need to learn more. However, if compared with the value of pretest the increase of student value is big enough that from the average of pretest 35,93 to 80,00 at posttest, there is increase 44,07.

From meeting I to meeting III a significant increase in value, this indicates that the use of practicum tools in learning can improve learning outcomes.

D. The Practicum Tools of Rotational Dynamics with the Scientific Approach can Prove the Matter of the Moment of Force, Moments of Inertia and Center of gravity.

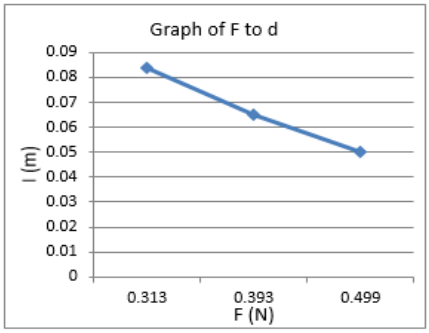

Fig 2. Relation F to d by teacher

The result of the student lab to lift the load 0.65 N on the left which is 0.04 m from the center of the rotation required the load and the varying distance on the right arm. The load is 0.313 N at a distance of 0.082 m; load 0.393 N at a distance of 0.065m; a load of 0.500 N at a distance of 0.051 m, as shown in Figure 3.

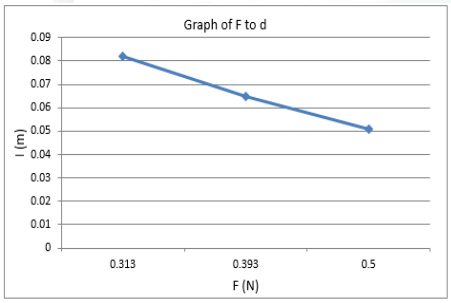

Fig 3. Relation F to d by student

The two graphs above show that if the load is large then the arm is small, otherwise the small-arm needs a large-style arm, meaning that the force is inversely proportional to the arm of the moment. The results of the teacher and student practice using the spring indicate that the required tensile force is small if the large tensile angle and the required tensile strength are large if the tensile angle is small. The results of the practice using a spring can be seen in Figure 4.

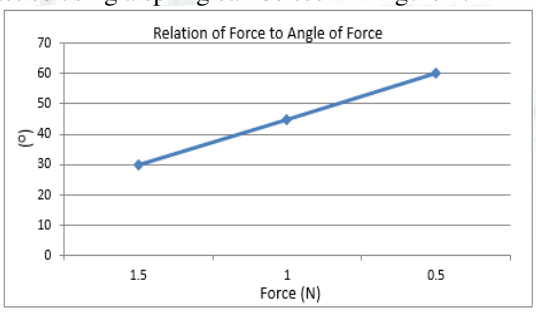

Fig 4. Relation of Force to Angle of Force

The results of the teacher and student practice show that the moment of force depends on the style, the force arm and the force angle to the force arm. This result proves that the result of practicum of force moment approached the theory.

The results of the practice of teacher and student inertia moments show that.

- At the same height the average time required for every object to roll is not the same. The smallest time experienced by marbles and steel balls, then the solid cylinder and the largest hollow cylinders.
- The inertia of each object is different depending on the type of thing. The largest inertia is a hollow cylinder, then a solid cylinder then a steel ball and marbles.
- The average inertial practicum inertial coefficient is close to theory, steel balls (spherical coefficient = 2/5), solid cylinders (coefficient cylinders = ½) and hollow cylinders (hollow cylinder coefficient 1).
- Inertia depends on the mass and the radius of the body. The greater the mass or the radius of the object the greater the inertia of the object.

The results of teacher and student practicum of gravity center show that:

- the weight of the object depends on the shape of the object's build.
- The grativity center of Square-shaped objects will have an ½ of length or width, triangle-shaped object has an emphasis 1/3 of its height. and a semi-circular braid has 4R / 3 of it. This result is close to the theory of ½ long, 1/3 high and 4R / 3π.

IV. CONCLUSION

The conclusions obtained from the research are developed practicum tools get positive response from students, the activities undertaken by students during learning is quite active and experienced increase in each meeting, student learning outcomes increased significantly.

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