CHAPTER I
INTRODUCTION

1.1. Background

The test is an inseparable component of the evaluation process. Pertiwi, Muliyati, & Serevina (2016) state that the success of the learning evaluation activities really depends on the test instrument used. So, if the test instrument used is not qualified, it will have an impact on the evaluation results that are less than optimal, namely that the student's ability can't be measured accurately. According to Gronlund, test is an instrument of systematic procedure for measuring a sample of behavior by posing a set of question in a uniform manner (Sudaryono, 2012). Tests can also be interpreted as a technique or method used in carrying out measurement activities, in which there are various questions, statements, or a series of tasks that must be done or answered by students to measure aspects of students' behaviour (Arifin, 2016). So, the test serves as a measuring tool that determines the ability of students based on the results of the learning process.

The objective test is often referred to a dichotomously scored item because the answer is between true or false and the score is between 1 and 0. The objective test is one form of test that requires students to choose the correct answer among the possible answers provided, give short answers, and complete imperfect questions. This form of test allows students to answer a large number of questions in a test period so that the test material provided can cover most of the subject matter given. In this case the objective test consists of a true-false test, multiple choice test, matchmaking test, and complete or short answer test (Arifin, 2016).

One of the objectives for evaluating learning outcomes is the cognitive domain. Where the cognitive domain is a domain that emphasizes research on intellectual abilities and skills. According to Anderson & Krathwohl (2001) the cognitive domain is organized into several levels of ability, ranging from simple things to complex things, easy things to difficult things, and concrete to abstract things. There are two dimensions of the cognitive domain, namely the knowledge dimension and the cognitive process dimension. Knowledge dimensions are divided into four, namely factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge, while the dimensions of the cognitive process are divided into six categories, namely remember (C1), understand (C2), apply (C3), analyze (C4), evaluate (CS), and create (C6), including higher order thinking . The dimensions of knowledge and cognition are formulated in a learning objective matrix, meaning that each dimension of knowledge, whether factual knowledge, conceptual knowledge, procedural knowledge and metacognitive knowledge has its own dimensions of the cognitive process (Tanjung & Bakar, 2019).

According to Anderson & Krathwohl (2001) conceptual knowledge includes knowledge about categories, classifications and the relationship between two or more categories or classifications. This knowledge can be in the form of schemas, mental models or implicit and explicit theories in various models of cognitive psychology. These schemes, models and theories represent human knowledge about how a study of matter is organized and structured, and how parts or bits of information are systematically related to each other, and how these parts can function together. This type of knowledge consists of three sub-types, namely knowledge of classification and categories, knowledge of principles and generalizations and knowledge of theories, models and structures.

In the learning process, it is important to connect facts and a broader system of ideas that are reflected in the knowledge of an expert in a particular discipline. Bereiter and Scardamalia in Anderson & Krathwohl (2001) states that master factual knowledge but do not understand it in depth or do not integrate and organize it systematically and strictly causing inert knowledge problems, where information can be disclosed but cannot be used. So that by having conceptual knowledge, a person not only knows the discipline of knowledge, but his knowledge is organized systematically and reflects a deep understanding of the material of his study.

Conceptual knowledge becomes a component that is also important in understanding other higher dimensions of knowledge. Someone will not be able to understand how to solve problems if the concept is not strong enough. Such as the case in procedural knowledge which includes knowledge of how to do something and knowledge of the criteria used to determine when to use various procedures. So, according to the opinion of Bransford, Brown and Cocking in Anderson & Krathwohl (2001), an expert must know his scientific discipline in depth, and also be able to "practice" using his knowledge so that he knows when and where to use it. Thus, in order to be skilled in performing various procedures, it requires good knowledge in the form of knowledge in connecting between facts and a broader system of ideas and it's reflected in knowledge so as to create a correct understanding. Likewise with metacognitive knowledge, which implies well constructed metacognitive knowledge directs students to be able to plan, generate, and be able to create based on essential understandings that are mastered. So that to be able to understand higher knowledge in the form of procedural and metacognitive knowledge, a good understanding of conceptual knowledge is needed.

However, in the availability, tests of conceptual knowledge are still rare. Existing physics books have not prepared a standard conceptual knowledge test. Where, based on evaluation theory, the test must be standardized in order to be used properly. In this case a good test is a test that meets the requirements in the form of validity, reliability, practicality, objectivity, economics and usefulness (Arikunto, 2013). This is also supported by the results of interviews with the Physics teacher at SMAN 7 Medan, which stated that the tests available in schools had not used standard conceptual knowledge tests. In terms of assessment, the teacher has never specifically provided a standard conceptual knowledge test to find out students' conceptual knowledge, especially in physics subjects. Whereas conceptual knowledge is very important in an effort to classify knowledge, linking it so that it is interrelated so that a principle, physical laws, theories, models and structures can be understood correctly (Anderson & Krathwohl, 2001). This is also what underlies the ability of students to solve problems, supported by the statement of Streveler, et al. (2008) which states that conceptual knowledge is an important element to solve problems (Rahmawati, et al., 2018). According to Rittle-Johnson, Seigler, and Alibali in Kola (2017) state that conceptual knowledge is essential for generation and selection of appropriate procedure in solving a problem, where conceptual knowledge could guide learners' choice among alternative procedures and permits students to transfer an explanation of a phenomenon to different situations and according to Lichtenberger, et al. (2017), the major way to evaluate conceptual knowledge of students in physics education research is by means of a multiple-choice test. Gronlund state multiple-choice tests are the tests with objective grade which does not tend to differentiate from person to person and are able to be graded in a short time (Prawita, Sirait, & Sahyar, 2018). The aim of instilling conceptual understanding in Physics is very difficult to establish. However, as claimed by Suarez, et al in (Prawita, Sirait, & Sahyar, 2018), high quality conceptual multiple-choice tests may be able to diagnose students' misconceptions and might later on lead to better understanding of the Physics concepts.

According to Sutopo (2014), in order to meaningfully comprehend the new knowledge, the students have to independently employ their mental faculty to process all information they receive so that it can be synergistically linked to their prior knowledge (Furwati, Sutopo, & Zubaidah, 2017). One way to know the students' knowledge of certain natural phenomena is to ask them to describe such phenomena by using various representations. According to Furwati, et al. (2017) the students are said to have mastered particular scientific concepts if they are able to represent the concept with different representational formats, known as multi representations. Ainsworth (1999) says that the term multiple representation (MRs) refers to the many different forms in which a certain physics concept is expressed, demonstrated, depicted, and communicated, such as words, graph, algebraic expression, pictures, free-body diagrams , data table, etc (Klein, Muller, & Kuhn, 2017). Multi representation is considered as the key to learning science because it can represent the concept of science into various forms. Heuvelen (1991) states that physics education research points out that competent handling of representation is a key to successful physics learning and the use of multiple-representation helps students explain the physical phenomenon and solve scientific problems (Klein, Muller, & Kuhn, 2017).

One of the physics materials that apply a lot of conceptual knowledge is the Rotation Dynamics and Equilibrium of Rigid Body. Where students often have difficulty analyzing the relationship between one concept and another which are interrelated. According to Apriani, et al. (2016) the concepts of rotational dynamics and rigid body equilibrium require an analysis and high accuracy of a simple event. In solving the problem, the concepts of rotational dynamics and rigid body equilibrium must link the concepts of force and Newton's laws, the concept of kinematics of motion and the concept of circular motion. In determining the formula, it is not necessarily easy to memorize, but requires an understanding of how the force acts in a system that causes the object to be stationary or moving, as well as what factors affect the object rotating or not. Research conducted by Rosengrant, et al (2009) states that to solve dynamic problems that require students' ability to analyze the forces acting on an object and describe it in the form of free body diagrams, one of the right ways is using multiple representations (Sekarpratiwi, Putra, & Yulianto, 2018). The preparation and development of tests are intended to obtain valid tests, so that the measurement results can reflect the results or learning achievements achieved by each individual test participant after participating in teaching and learning activities (Sudaryono, 2012). The learning evaluation instrument developed was focused on a conceptual understanding test based on conceptual knowledge carried out by Anderson from Bloom's taxonomy theory combined with conceptual knowledge in physics in the form of 5 representation (formal, graphical, numerical, pictorial and verbal). This test aims to show the level of ability and success of students in mastering and understanding the content of the subject matter. The instrument to be developed in this study is a multiple choice test to measure students' conceptual knowledge skills.

The results of research conducted by Desi Prawita, Motlan Sirait, Sahyar (2018) show that the test consists of 36 questions in total. The average item difficulty of the questions is intermediate (0.54) and the discrimination is in a well state (0.38). It is established that the KR-20 coefficient of the test prepared is sufficient (0.82) for the reliability of a test. Yul Ifda Tanjung and Abu Bakar (2019) in their research show that the development of physics test instrument based on the conceptual knowledge dimension of Revised Bloom's Taxonomy on the topic of General Physics meets the eligibility criteria of a good test instrument. Nurlena and Sahyar (2021) in their research showed that the content validity of the objective test conceptual knowledge of physics onWork and Energy in SMA was very good with average value is 3,86. Judging from empirical validity in the wider field test was obtained 33 items were valid and 7 items were invalid. Test reliability value is 0,86. Klein, et al. (2017) in their research obtain 11 multiple choice and 7 multiple true false question involving multiple representational formats such as graphs, pictures and formal expressions. Measurement characteristics of KiRC were assessed in a validation, including usefulness for measuring learning gain. Validity is checked by interviews and by benchmarking KiRC against related measures. Values for item difficulty, discrimination, and consistency are in the desired ranges, In particular, a good reliability was obtained (KR20 – 0.86). The things that makes this research different from previous research is from the material/topic and type of knowledge being measured that use conceptual knowledge dimension by Anderson combined with conceptual knowledge in physics in the form by using multi representation.

Based on the background above, the researcher is interested in conducting research with the title "The Development of Objective Test for Conceptual Knowledge on Rotational Dynamics Topic in High School".

1.2. Problem Identification

Based on the background of the problem presented, several problems can be identified, namely:

1. Physics books do not yet exist to prepare a standard conceptual knowledge test that meets the criteria of a good test.
2. The unavailability of standard conceptual knowledge tests in schools.
3. In the evaluation process, the teacher only provides a test of ordinary learning outcomes and has not used a specific conceptual knowledge test.

1.3. Problem Scope

In order for this research to achieve the expected goals and objectives optimally, it is necessary to limit the problem as follows:

1. This research is focused on the aspects of validity, reliability, level of difficulty, descrimination index, and distractor efficiency of the objective

test of conceptual knowledge on Rotational Dynamics material by focusing on conceptual knowledge.

2. The research subjects for analyzing the student's conceptual understanding were students of class XI even semester at SMAN 7 Medan.

1.4. Problem Formulation

In accordance with the problem boundaries that have been stated, the following problems can be formulated:

1. How is the validity of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed?
2. How is the reliability of the objective test instrument conceptual knowledge on the Rotational Dynamics Topic in High School that has been developed?
3. How is the level of difficulty of the conceptual knowledge objective test instrument the Rotational Dynamics Topic in High School that has been developed?
4. How is the discrimination index of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed?
5. How is the distractor efficiency of the conceptual knowledge objective test instrument distractor on the Rotational Dynamics Topic in High School that has been developed?

1.5. Research Objectives

Based on the formulation of the problem, the objectives to be achieved from this study are as follows:

1. To determine the validity of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed.
2. To determine the reliability of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed.

3. To determine the level of difficulty of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed.
4. To determine the discrimination index of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed.
5. To determine the distractor efficiency of the conceptual knowledge objective test instrument on the Rotational Dynamics Topic in High School that has been developed.

1.6. Research Benefits

With this research, it is hoped that it can be useful, including:

1. For students, the conceptual knowledge objective test questions that have been developed can be a medium for training and measuring their conceptual knowledge.
2. For teachers, the conceptual knowledge objective test questions that have been developed can be a reference in conducting assessments to find out students' conceptual knowledge.
3. For institutions/schools, the objective test questions that have been developed can be a reference to increase students' conceptual knowledge so that it can help improve school quality.
4. For other researchers, this research can be a reference if they want to do similar research.

1.7. Operational Definition

In order to avoid mistakes and misunderstandings in the desired meaning in this study, the authors make an operational definition as follows:

1. Validity is the level of permanence of an evaluation tool in measuring what should be measured (Arikunto, 2017).
2. Reliability is the level of consistency of measurement results with the same test at different times (Arifin, 2016).

3. Level of difficulty is the opportunity to correctly answer a question at a certain ability level (Arikunto, 2017).
4. Discrimination index is the ability of the items to differentiate between students who master the material from students who do not master the material based on certain criteria (Arifin, 2016).
5. Distractor efficiency is the function of the deceiver in making test takers fooled by alternative answers (Arikunto, 2017).
6. Conceptual knowledge is knowledge about the interrelations between the basic elements in a a larger structure that enable them to function.