CHAPTER I
INTRODUCTION

1.1. Problem Background

Education in the 21st century is accompanied by rapid technological developments that provide new challenges and complex problems that students must be faced with. The 21st century requires human resources to have three important skills, namely the ability to think critically, creatively, and solve problems. These three skills are known as high order thinking skills (HOTS). In order to be able to answer the challenges of the era, it is important to prepare students who are trained in critical thinking, creativity, and problem solving (Sani, 2019).

Based on the results of the Programme for International Student Assessment (PISA) in 2022, Indonesia is ranked 69th out of 81 countries that participated in this test (OECD, 2023). The questions used in PISA are the type of questions that assess students' ability to solve contextual life problems and students' ability to think at a higher level. However, the low rank of Indonesia in this study indicates that students' ability to think at a higher level is still low. One of the factors is because Indonesian students are less trained to solve high-level thinking (HOTS) questions due to the lack of HOTS-based questions used in the school (Junaidi et al., 2020). This is in line with the research result by Astuti et al. (2021) which stated that students' HOTS is still low and the improvement is needed. Students' HOTS achievement is strongly influenced by the learning experienced by the students.

One of the efforts made by the government to improve and train students' HOTS is by the implementation of 2013 curriculum which focuses on the curriculum improvement in two major parts, namely content standards and assessment standards (Kemendikbud, 2017). Improvement the content standards are designed to ensure that students are able to think critically in receiving various types of information, think creatively in solving a problem using their knowledge, and be able to make decisions in complex situations (Saputra, 2016). Meanwhile, the improvement in the assessment standards is carried out by adapting international

standard assessment models, which place greater emphasis on HOTS-based evaluation system (Kemendikbud, 2017).

The 2013 Curriculum highlights that student are required to have the ability to estimate, plan, and predict. This is in line with the realm of HOTS, which involves analysis (the ability to think in specializing certain aspects); evaluation (the ability to think in making decisions based on contextual life problems); and creating (the ability to think in constructing broad insights owned by the students) (Umami et al., 2021). Thus, in the 2013 Curriculum, students are directed to learn more actively and have higher-level thinking skills.

The HOTS can be viewed from two perspectives, according to Bloom taxonomy and Brookhart's. The ability to knowing (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6) is the dimension of thinking process in Bloom's taxonomy. In Bloom's taxonomy, the achievement of high-level thinking skills is included in the C4, C5, and C6 categories. Through these levels of ability, it is possible to determine the capacity of someone higher-order thinking (Anderson and Krathwohl, 2001). Meanwhile, according to Brookhart (2010), indicators of HOTS problems include critical thinking, problem solving or solution finding, and creative thinking.

In order to train and measure students' HOTS, teachers can administer HOTS-based assesment as an alternative strategy (Kusuma, 2017). However, the fact is that the use of HOTS-based questions is still rarely used in the school assessment system. This is due to the difficulty of preparing HOTS questions that require teachers' special skills in presenting various information with stimulus in the form of text, images, graphs, tables and others that contain information related to real life (Merta et al., 2019). In addition, to make the question items more effective, the stages of creating HOTS questions must be followed carefully. These stages run systematically, starting from selecting basic competencies that can be made into HOTS items, arranging a question grid, determining interesting and contextual stimulus, developing question items based on the question grid, and designing scoring guidelines or answer key (Fanani, 2018).

The main problem found in reality is the lack of teachers' understanding in preparing and developing HOTS questions (Salirawati, 2017). Therefore, the availability of HOTS questions in schools is still lacking. As shown in the previous research conducted by Wardani and Ibrahim (2020) at SMAN 1 Menganti that showed 66.7% of biology teachers in grade XI had not developed HOTS assessment instruments, while the other 33.3% of biology teachers had developed HOTS assessment instruments but it was not valid and unreliable.

From the interview with biology teachers in SMAN 2 Medan, it is known that teachers have tried to develop students' higher order thinking skills, but there are still some difficulties in developing HOTS questions. Moreover, the questions made by the teacher had not passed the validation stage before being used. By analyzing the biology summative test instrument for class XI at SMAN 2 Medan in the preliminary study, it can be known that 67% of the items used tend to only measured the ability to think at the memorization stage or low-order thinking skills (LOTS); where the proportion of C1 (13.3%), C2 (26.6%), C3 (26.6%), C4 (26.6%), C5 (0%), and C6 (6.7%) (as shown in the appendix 1). Most of the questions do not contain interesting stimulus, do not contextual, and some questions are not accompanied by images or graphics, text, and relatable visualizations. The use of HOTS assessment questions is still relatively rare because teachers believe that HOTS assessment questions are a difficult question and require special skills in their preparation. As a result, students' higher-order thinking skills are not measured and trained.

Due to the problems encountered in the field, namely the lack of HOTS-based test instrument, while there are curriculum demands in the form of HOTS-based learning assessments, therefore the development of HOTS-based questions is important to do. According to the Kemendikbud (2017), HOTS questions are measurement instruments used to measure high-level thinking skills, namely the ability to think that are not just remembering, reciting, or referring without processing. More than that, in the context of evaluation, HOTS questions give more emphasis on the ability to transfer one concept to another, obtain and apply

information, find links between various information, use information to solve problems, and analyze information critically.

HOTS assessment instrument is a set of assessments dominated by questions with cognitive levels C4 (analysis), C5 (evaluation), and C6 (create). Questions to measure HOTS are developed by paying attention to the characteristics of HOTS question, namely the questions are in the form of contextual problems for students, the form of the questions is various, and the questions contains stimulus. For assessments conducted by schools, such as summative evaluations, the suggested forms of HOTS questions can be in the form of multiple-choice and essay questions. The selection of such question form is based on the number of examinees, who are generally quite large, while the scoring results must be carried out and announced as soon as possible (Widana, 2017).

Many research related to the development of HOTS assessment instrument has been carried out, such as the research conducted by Rini and Budijastuti (2022) which succeeded in developing HOTS item tests on the human movement system topic that were declared valid, reliable, and able to measure problem-solving. Research by Fidya (2022) on the development of HOTS question instrument on tissue and organ material in plants showed that it is a valid and reliable instrument. The result of theory validity is very valid 90,67% in material aspect, 90% in construction aspect, and 100% in language aspect. The result of emphiric validity belongs to valid 80%, the reliability is 0,818, the difficulty index is 30% difficult question and 70% medium question, the discriminating index is 30% low, 30% enough, and 40% good. As well as research by Ulfa and Kuswanti (2021) that showed the developed HOTS assessment instrument of the respiratory system that was valid and reliable with proportion of difficulty index was 60% moderate and 40% difficult.

Based on some problem background stated above, it is necessary to conduct the research entitled **"Development of HOTS-Based Biology Summative Test Instruments at Odd Semester of Class XI MIA in SMAN 2 Medan"**.

1.2.Problem Identification

Based on the problem background, several problems can be identified as follows:

1. The lack of HOTS question items in biology summative test instruments used in schools.
2. Students are less trained to work on HOTS type questions.
3. Biology summative test instruments developed by teachers are often not validated in the compilation process.

1.3. Scope of Study

Based on the problems identification, the scope of this research is the development of a HOTS-based biology summative test instrument for class XI at odd semester. The development carried out refers to the ADDIE development model which consists of five stages, namely analysis, design, development, implementation, and evaluation. The developed product is in the form of multiple-choice and essay question which focuses on class XI biology subject material in odd semester, including cell, plant tissue, animal tissue, human movement system, and human circulatory system topic. The test instrument validated by material expert and evaluation expert to find out the feasibility level of the test instrument. After declared valid, the HOTS-based test instrument will be tested three times on the research subject to find out the validity, reliability, difficulty index, discriminating index, and distractor function.

1.4. Scope of Problem

To focus the direction of research, limitation on problems in this study are carried out, which are as follows:

1. The test instrument that was developed is a HOTS-based biology summative test instrument for class XI.
2. The HOTS-based test instrument was developed using ADDIE development model by Dick and Carry (1996).

3. The developed product is in the form of multiple-choices and essay question based on Bloom's taxonomy at the cognitive level C4-C6 and focuses on the topic of cell, plant tissue, animal tissue, human movement system, and human circulatory system.
4. The test instrument was validated by material expert in the aspects of material, construction, and language.
5. The test instrument was validated by evaluation expert in the aspects of material, construction, language, and HOTS.
6. The test instrument was tested three times on the research subject to find out the validity, reliability, difficulty index, discriminating index, and distractor function of the the HOTS-based test instrument that will be developed.

1.5. Research Questions

Based on the problems identification and problems limitation, problems can be formulated in this study, as follows:

1. What is the feasibility level of the test instrument based on material expert?
2. What is the feasibility level of the test instrument based on evaluation expert?
3. How is the validity of HOTS-based biology summative test instrument that was developed?
4. How is the reliability of HOTS-based biology summative test instrument that was developed?
5. How is the difficulty index of HOTS-based biology summative test instrument that was developed?
6. How is the discriminating index of HOTS-based biology summative test instrument that was developed?
7. How is the distractor function of HOTS-based biology summative test instrument that was developed?

1.6. Research Objectives

Based on the problems formulation, the objectives of this study are as follows:

1. To find out the feasibility level of the test instrument based on material expert.

2. To find out the feasibility level of the test instrument based on evaluation expert.
3. To find out the validity of HOTS-based biology summative test instrument that was developed.
4. To find out the reliability of HOTS-based biology summative test instrument that was developed.
5. To find out the difficulty index of HOTS-based biology summative test instrument that was developed.
6. To find out the discriminating index of HOTS-based biology summative test instrument that was developed.
7. To find out the distractor function of HOTS-based biology summative test instrument that was developed.

1.7. Research Benefits

The expected benefits of this study are as follows:

1. For students, the HOTS-based biology summative test instrument that was developed can be used as a tool to train and measure students' HOTS.
2. For teachers, the HOTS-based biology summative test instrument that was developed in this study can be used to measure students' higher-order thinking skills and also as a reference to develop higher-order thinking skills-based tests.
3. For schools, the HOTS-based biology summative test instrument that was developed in this study can be used as reference material for the development of HOTS evaluation instruments in the future.
4. For researchers, this research can be used as a reference to develop similar research in future studies.