

# CHAPTER I

## INTRODUCTION

### 1.1 Problem Background

In the face of future working life, students must have various appropriate skills in the 21st century, known as the 4Cs skill, including critical thinking and problem-solving skills (González-Pérez & Ramírez-Montoya, 2022). To evaluate the quality of students, many countries, including Indonesia, take part in international standard assessments such as PISA (the Program for International Student Assessment) to measure mathematics, science, and reading literacy skills in students aged 15 years. Based on the PISA 2018 database, students in Indonesia scored lower than the average score in the reading, mathematics, and science categories. Compared to the OECD average, only a tiny percentage of students in Indonesia achieve the highest level of proficiency at Level 5 or 6 in at least one subject. Others achieve a minimum proficiency level of Level 2 or higher (OECD, 2019). It happens due to students' lack of critical thinking skills in solving PISA problems (Sa'adah et al., 2020).

Some findings showed that students' critical thinking skills still need to improve in the learning process. Students' critical thinking was still in the low category (Hidayati et al., 2021). It was due to (1) a lack of analyzing a problem, (2) difficulty doing high-level questions (C4-C6), and (3) difficulty connecting concepts and problems and expressing opinions. It also leads to an absence of activeness during learning (Saputri et al., 2019). The learning process only memorizes and hoards information that comes from the teacher rather than evaluating and synthesizing information (Wahyudi et al., 2020). Critical thinking and problem-solving are closely related.

Problem-solving is the process of students finding the best answer to overcome a problem by integrating their knowledge. However, students' ability to solve a

problem is still categorized as low (Cahaya et al., 2018; Bellvian et al., 2021; Permata et al., 2022). From the five stages of problem-solving, students only reach the first stage (identification) and the second stage (examination). Students have not been able to plan, implement, and evaluate answers or solutions to problems in biology learning (Cahaya et al., 2018; Permata et al., 2022). Lack of problem-solving skills is due to students being less actively involved just by listening to explanations from teachers (Permata et al., 2022) and subject matter that needs to be mastered so much more difficult (Bellvian et al., 2021; Agustyaningrum et al., 2021).

Lack of critical thinking and problem-solving skills showed that the students' cognitive ability to develop high-order thinking skills (HOTS) was low. The higher a student's cognitive ability, the higher the learning outcomes to show that the learning process is successful. Unfortunately, the average overall HOTS score of students is still in the low category, where the lowest score is the evaluating aspect (C5) in the plant physiology course (Supriyatin et al., 2020). It indicates low cognitive learning outcomes in students, which is caused by complex and abstract material content which students find difficult to understand (Rahmatika et al., 2020).

Learning resources have an essential role in optimizing the learning process. Learning resources facilitate students to do learning independently to prepare or complete themselves (Bukit et al., 2022). Unfortunately, there are some obstacles related to learning resources, such as limited learning sources and difficulties in understanding learning resources. The availability of learning resources is limited in schools. Students must share and return books to the library after learning activities (Chasanah et al., 2019). The available learning resources are not contextualized, causing the delivery of the subject matter to be suboptimal and affecting the decline in student motivation and learning outcomes (Hermanto et al., 2021). Thus, students can not completely understand the lesson without independent learning opportunities and a lack of contextual learning resources.

Other findings found that the learning resource used in the Genetics course was limited to only diktats and practicum guides, where the material in diktats is not in-

depth and also challenging to understand (Daulay et al., 2020). Related obstacles were also found in the Animal Development course, one of the biological studies related to the developmental process that occurs before animal birth to adulthood. Hence, the material's content is abstract and complex (Ulfa & Kartika, 2022). There are difficulties in understanding the learning resource, diktat, used in this course at Universitas Negeri Medan. It is due to the use of language that is difficult to understand, and the appearance needs to be more apparent in both writing and images (Tarigan et al., 2022). The preliminary study at Universitas Negeri Padang found that not all students have a diktat that can be used in this course, and as many as 58% of them need help understanding this course through diktat as a learning resource (Afnas & Sumarmin, 2020).

Learning resources are essential in optimizing learning by facilitating students to learn independently (Njoroge, 2019). Modules can be used because they are systematically designed based on specific learning models that have learning objectives, materials, and worksheets/evaluation sheets (Priantini & Widiastuti, 2021; Putra et al., 2018).

One of the learning models that can be implemented into modules is project-based learning (PjBL) is suitable to be implemented into modules. The module is designed systematically by integrating the syntax of project-based learning and providing project activity as a task that students must do. Students can strengthen their knowledge by conducting investigations collaboratively through project activities (Pakpahan et al., 2021; Purba et al., 2019). Implementing this learning model into the module has several good impacts and is effective for the lecture process (Hsin & Wu, 2023) and at the same time can help improve critical thinking skills (Baidowi et al., 2023) and problem-solving (Ardithayasa et al., 2022) and increase student's cognitive learning outcomes (Chasanah et al., 2021; Saleh & Triyono, 2022)

Researchers made observations in January 2023 on biology students in 2021 who had attended the Animal Development course at Medan State University. The results show: 1) students' need for PJBL-based modules is 94,4%, which is due to the

limited learning resources provided by lecturers in this course, which at that time was online learning and lecturers only shared material manuscripts, and 2) students' understanding of material which are determination and differentiation (21.1%) and endoderm organogenesis: digestive tube and glands (31.6%) that is due to difficulties in understanding those learning materials.

Based on the problems above, it is necessary to develop project-based modules as a source of self-study in the Animal Development course to encourage thinking skills and learning outcomes. This research was conducted on a thesis titled "Development of Project-Based Module and Its Effect on Cognitive Learning Outcomes, Critical Thinking and Problem-Solving Skills on The Topic of Determination, Differentiation, and Organogenesis."

## **1.2 Problem Identification**

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

1. Students' critical thinking were still low
2. Students' ability to solve problem is still categorized as low
3. The availability of learning resource is limited, difficult to understand, and unclear
4. Low students' understanding of material which are determination, differentiation, and endoderm organogenesis: digestive tract and glands in animal development course.

## **1.3 Problem Scope**

So that the research does not deviate from the research purpose, it is necessary to scope the study problem as follows:

1. There are two lecture topics, namely: a) cell determination and differentiation, and b) endoderm organogenesis: digestive tract and glands.
2. Students who are the research subject are from Biology education class 2022 who were taking the Animal Development course.

3. The cognitive learning outcomes focused on high-order thinking skills (HOTS), namely C4-C6.
4. PJBL-based module is developed to see the feasibility and effectiveness of cognitive learning outcomes, critical thinking skills, and problem-solving skills in the Animal Development course.

#### **1.4 Problem Formulation**

Based on the identification and scope of the problem which is described above, problems can be formulated as follows:

1. How student needs analysis of project-based modules?
2. What is the feasibility of project-based modules on the topics of cell determination and differentiation, and endoderm organogenesis: digestive tract and glands based on material expert?
3. What is the feasibility of project-based modules based on learning design expert?
4. What is the feasibility of project-based modules based on layout design experts?
5. How do students respond to project-based modules?
6. What is the effectiveness of project-based modules on the cognitive learning outcomes, critical thinking skills, and problem-solving skills on the topic of cell determination and differentiation, and endoderm organogenesis: digestive tract and glands in the animal development course?

#### **1.5 Research Objectives**

Based on the problem formulation which is described above, the objectives to be achieved in this study were determining:

1. The student needs analysis of project-based modules.
2. The feasibility of developing project-based modules on the cognitive learning outcomes, critical thinking skills, and problem-solving skills on the topic of cell determination and differentiation, and endoderm organogenesis: digestive tract and glands in the animal development course based on material expert.

3. The feasibility of developing project-based modules based on learning design expert
4. The feasibility of developing project-based modules based on layout design experts.
5. Students' responses to project-based modules.
6. Knowing the effectiveness of PjBL-based modules of the learning outcomes, critical thinking skills, and problem-solving skills on the topic of determination, differentiation, and organogenesis.

### **1.6 Research Benefits**

The benefits of research conducted by the author are:

#### **1) For Researchers**

Researchers can find out the effectiveness of project-based modules to improve the cognitive learning outcomes, critical thinking skills, and problem-solving skills on the topic of determination, differentiation, and organogenesis.

#### **2) For Lectures**

Through this research, project-based modules can be used by Biology lecturers in learning the topics of determination, differentiation, and organogenesis in the Animal Development course.

#### **3) For Students**

Students gain cognitive learning outcomes, critical thinking skills, and problem-solving skills through the application of project-based modules on the topic of determination, differentiation, and organogenesis.

#### **4) For University**

This research provides innovation in Animal Development lecture activities on the determination, differentiation, and organogenesis to maximize lecture activities.