



Development of an E-Module Based on Discovery Learning on Coordination System Material to Improve 4C Skills of High School Students

Pragiwati Setiana, Endah Peniati¹✉

¹ Department of Biology, FMIPA, Universitas Negeri Semarang, Indonesia

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Abstract

The results of interviews with biology teachers in class XI MIPA at SMA Negeri 1 Slawi show that the 4C skills of students in class XI MIPA are low due to the absence of a variety of teaching materials and that the role of the teacher as a teacher has not been implemented properly. Therefore, a discovery-learning-based e-module was developed on coordination material to improve students' 4C skills. The purpose of this study was to analyse the feasibility, readability, and practicality of using e-modules and the improvement of students' 4C skills on coordination system material. This type of research is research and development, and the research design used is the development research design, according to Thiagarajan et al. (1974). The instruments used in this study were the product validation questionnaire, teacher response questionnaire, readability questionnaire, student response questionnaire, pre-test and post-test questions, observation sheet, and peer assessment. The results of the study showed that the e-module was feasible to use, obtaining an average score of 92.97%. Students' readability of the e-module obtained a score of 96.48% with very good criteria. Students' responses to the practicality of using e-modules amounted to 89.82%, with very practical criteria. The discovery learning-based e-module developed on coordination system material has an effect on students in the form of increasing their 4C skills. The conclusion of this research is that e-modules based on discovery learning on coordination system material are feasible and practical to use in learning coordination systems, have very good readability, and are effective in improving the 4C skills of SMA Negeri 1 Slawi students.

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✉ Correspondence address:

Building D6 lt.1 Jl. Raya Sekaran Gunungpati Semarang

E-mail: endahpeniati@mail.unnes.ac.id

INTRODUCTION

The changing times have many impacts on aspects of life, one of which is education. Education is becoming increasingly important in the 21st century to ensure students have the skills to learn and innovate, the skills to use technology and information media, and the life skills needed to work and survive (Pratiwi *et al.*, 2019; Trilling & Fadel, 2009). According to Bruner (1961), there are two goals in education: school topics and understanding. According to this perspective, the purpose of education is not only to provide students with the tools to complete tasks but also to guide and help students understand and apply the knowledge they have learned in their daily lives. Student-centred learning sees students as designers and changes the teacher's role from providing information to helping students learn (Partanen, 2020). The concept of student-centred learning emphasises that students should actively participate in the learning process and have the responsibility to learn what they learn (Chen & Tsai, 2021). In Indonesia, student-centred learning has been implemented through the use of the 2013 curriculum.

Biology learning at SMA Negeri 1 Slawi has implemented the revised 2013 curriculum, whose learning is student-centred. In this school, the teacher only acts as a facilitator in learning biology in the classroom, namely by providing evaluations, providing corrections for misconceptions of the coordination system concept, and underlining essential coordination system material for students during discussion sessions after students present the results of their knowledge. Meanwhile, based on the observation results, the main task of the teacher as a teacher has not been carried out properly. According to Mulyasa (2007), there are 12 things that teachers must do as teachers, namely illustrate, define, analyse, synthesise, ask, respond, listen, foster trust, provide varied perspectives, provide media to review standard material, adjust learning methods, and provide a feeling tone. Among these 12 things, biology teachers at SMA Negeri 1 Slawi are lacking in asking questions, providing media to review standard material, and choosing learning methods that suit student needs. This resulted in students' critical thinking skills in finding an understanding of the concept of coordination system bioprocessing, students' creativity in making a work that will be presented, as well as skills in communicating and cooperating with students during discussions, not being found in SMA Negeri 1 Slawi students.

The 4C skills possessed by students are the goal of the implementation of the 2013 curriculum. Students who have 4C skills are expected to have the ability to communicate, share, and use information to solve complex problems; the ability to adapt and innovate to respond to new demands and changing circumstances; and the ability to expand the power of technology to generate new knowledge (Septikasari & Frasandy, 2018). The low 4C skills of SMA Negeri 1 Slawi students in learning biology material on the coordination system cause the goal of implementing the 2013 Curriculum to not be achieved, which is to produce human resources who are able to compete and adapt quickly in the era of society 5.0.

4C skills are not owned by individuals naturally but exist because they are trained (Darmaji *et al.*, 2022; Octaviana *et al.*, 2022; Sintiawati *et al.*, 2021; Yuliani *et al.*, 2017). To make students actively participate so that 4C skills are honed in learning, e-modules based on discovery learning are carried out to improve the 4C skills of high school students on coordination system material. The use of e-modules in learning can take place effectively because it can help students who have learning difficulties and give them the opportunity to know what they must understand or master to achieve the learning objectives that have been set (Wulansari *et al.*, 2018).

RESEARCH METHODS

This research was conducted at SMA Negeri 1 Slawi, Tegal Regency, from March 21 to April 28, even semester of the 2022–2023 school year. The research method used is development research (Research and Development) and uses the 4D development research design (Thiagarajan *et al.*, 1974) with the stages of definition, Design, Development, and dissemination. Sampling was carried out using the purposive sampling technique. The sample for the small-scale test conducted at the development stage was composed of class XII MIPA 6 students. The small-scale test was conducted to determine the readability of the discovery-learning-based e-module on coordination system material that had been developed. The samples used for the effectiveness test of e-modules based on discovery learning of coordination system material were students of XI MIPA 2 and XI MIPA 6.

The data to be collected are the feasibility and readability of e-modules based on discovery learning of coordination system material as a product of development, the practicality of using e-modules based on discovery learning of coordination system material that has been developed, and the effectiveness of e-modules based on discovery learning of coordination system material in improving students' 4C skills after

using the product. The research instruments used for data collection are product validation questionnaires filled in by lecturers, teacher response questionnaires, e-module readability questionnaires filled in by students of class XII MIPA 6, and student response questionnaires to e-modules filled in by students of classes XI MIPA 2 and XI MIPA 6. In addition, pre-test questions and post-test questions are used to measure students' critical thinking skills; student creative thinking skills observation sheets are used to measure creative thinking skills; peer assessment questionnaires and student collaboration skills observation sheets are used to measure collaboration skills; and student communication skills observation sheets are used to measure communication skills. The results of the feasibility assessment, readability, and practicality of the product were analysed using descriptive percentages; the improvement of students' critical thinking skills was analysed using n-gain; and the improvement of students' creative thinking, collaboration, and communication skills were analysed using descriptive percentages.

RESULTS AND DISCUSSION

The results of this study include (1) the feasibility of e-modules based on discovery learning of coordination system material; (2) the readability of e-modules based on discovery learning of coordination system material; (3) the practicality of using e-modules based on discovery learning of coordination system material; and (4) the effectiveness of e-modules based on discovery learning of coordination system material to improve students' 4C skills. The results of the development of e-modules based on discovery learning of coordination system materials can be seen at <http://bit.ly/E-ModulSistemKoordinasiDL>.

Feasibility of a Discovery Learning-Based E-Module on Coordination System Material

The feasibility assessment of e-modules based on discovery learning on coordination system material uses a Likert scale with intervals of 1-4. The product validation sheet and teacher response questionnaire given to lecturers and teachers contain 42 statement items spread across four aspects of feasibility assessment, namely content feasibility, presentation feasibility, linguistic feasibility, and graphical feasibility. The average feasibility of the e-module that has been developed is presented in Table 1.

Table 1. Average Feasibility of Discovery Learning-Based E-Module on Coordination System Materials to Improve 4C Skills of High School Students that have been developed

Assessment Aspects	Lecturer Validation	Teacher Feedback	Average
Content feasibility	100%	87,50%	93,75%
Presentation feasibility	97,22%	84,72%	90,97%
Language feasibility	100%	85,42%	92,71%
Graphic eligibility	98,61%	90,28%	94,45%
Average Teacher Response (%)			92,97%
Criteria			Very Feasible

The average feasibility of e-modules based on discovery learning of coordination system material to improve 4C skills of high school students was obtained from product validation and responses from teachers, which showed that e-modules were very feasible to use with an acquisition rate of 92.97% (adjusted to the eligibility category by Arikunto (2013)). This proves that e-modules are feasible to use in learning biology coordination system material to improve students' 4C skills. The results of the assessment of each aspect are detailed as follows.

The aspect of content feasibility obtained an average feasibility value of 93.75% from lecturers and teachers with very feasible criteria. This shows that e-modules are electronic teaching materials that present learning materials logically, sequentially, and regularly and are able to guide students through content and assessment (Sari & Trisnawati, 2019). E-modules that include good material, techniques, limits, and evaluation methods can be used as a source of student learning for honing skills (Laili *et al.*, 2019).

The presentation feasibility aspect obtained a score of 90.97%. This shows that the e-module has a decent presentation. In the e-module, there are also practise questions in each learning unit that students can do independently at the end of learning in class. Practise questions contained in e-modules are able to foster students' enthusiasm and curiosity to always try and improve their abilities (Raquizitya & Agung, 2022). In addition, the discovery learning-based e-module that has been declared feasible presents clear instructions and is contained in the introduction, which contains basic competencies, indicators of competency achievement, concept maps, instructions for use, and e-module identity. Clear instructions in an e-module make it easier for students to use the e-module and know the learning objectives that must be achieved (Wulansari *et al.*, 2018).

The aspect of linguistic feasibility that obtained very feasible criteria with a percentage of 92.71% proves that the language used has been adjusted to the level of students' thinking ability. The language in the e-module is appropriate, which helps teachers use the e-module and helps students understand the material easily (Sarah & Ngaisah, 2016).

The aspect of the feasibility of the e-module developed obtained a score of 94.44% with very feasible criteria. This shows that the e-module has an attractive appearance. Attractive and interactive modules make students motivated to learn (Hastiningrum & Haryanto, 2020).

Readability of a Discovery Learning-Based E-Module on Coordination System Material

The e-module readability assessment uses a Likert scale of 1-4 intervals. The questionnaire sheet given to students in the form of a Google Form contains 15 statement items covering five aspects of assessment: independent instruction, independence of material content, stand-alone, adaptive, and user-friendly. Before filling out the readability questionnaire, students read the e-module and try to work on the questions in the e-module until completion. Furthermore, students can fill out the readability questionnaire to find out their opinions about the e-module. The results of the readability questionnaire for e-modules based on discovery learning are presented in Table 2.

Table 2. Readability of a Discovery Learning-Based E-Module on Coordination System Material to Improve 4C Skills by Class XII MIPA 6 Students at SMA Negeri 1 Slawi

Aspects	Acquisition Score	Maximum Score	Readability of E-Modules
Self Instruction	983	1008	97,5%
Self Contained	282	288	97,9%
Stand Alone	138	144	95,8%
Adaptive	140	144	97,2%
User Friendly	541	576	93,9%
Average Readability of E-Module Students XII MIPA 6			96,48%
Criteria			Very good

The readability of e-modules based on discovery learning by students obtained an average percentage of 96.48%. This shows that the e-module is very good in readability and can facilitate students in learning so that it helps students achieve learning objectives (Pramana *et al.*, 2020). The results of the e-module readability assessment for each aspect are detailed as follows.

The independent instruction aspect of the readability test obtained a percentage of 97.5% with very good criteria. Independent instruction allows students who study e-modules to have the ability to learn on their own without depending on others (Depdiknas, 2008; Sarah & Ngaisah, 2016). In the aspect of material independence, the percentage obtained was 97.9%, with very good criteria. This proves that the e-module developed can make students learn the coordination system material thoroughly because of the separation of material that facilitates the learning process. The aspect of material independence in one module includes all learning materials related to one unit of competency or sub-competency studied so as to give students the opportunity to learn the material thoroughly (Sarah & Ngaisah, 2016; Wulansari *et al.*, 2018).

The stand-alone aspect obtained a percentage of 95.8% with very good criteria. The self-standing aspect means that the e-module does not depend on other teaching materials or require supporting tools (Wulansari *et al.*, 2018). The discovery learning-based e-module on coordination system material was declared good in terms of readability because, according to student assessments, students do not need other media to study coordination system material. E-modules containing adaptive aspects are characterised by the content of e-modules that adjust the development of science and technology with flexible use (Depdiknas, 2008; Sarah & Ngaisah, 2016; Wulansari *et al.*, 2018). The results of the readability test of the discovery learning-based e-module on coordination system material developed obtained a percentage of 97.2% with very good criteria in the adaptive aspect. This shows that the e-module developed is flexible and contains the latest science and technology.

The user-friendly aspect obtained a percentage of 93.9% with very good criteria. This shows that the developed e-module has friendly instructions, helps users with the use of simple language, and is easy to understand (Wulansari *et al.*, 2018).

Practicality of E-Modules Based on Discovery Learning Coordination System Material

The e-module response questionnaire assessment uses a Likert scale interval of 1-4. The questionnaire sheet given to students in the form of a Google Form contains 15 statement items covering five aspects of assessment: independent instruction, independence of material content, stand-alone, adaptive, and user-friendly. Before filling out the questionnaire, students learned the coordination system material using e-modules as teaching materials. At the end of the lesson, students filled out a response questionnaire to find out their opinions about the e-modules that had been used. The results of students' responses to the e-module based on discovery learning are presented in Table 3.

Table 3. Responses of XI MIPA 2 and XI MIPA 6 Students at SMA Negeri 1 Slawi Towards the Practicality of Using Discovery Learning-Based E-modules on Coordination System Material to Improve 4C Skills of High School Students

Aspects	Acquisition Score	Maximum Score	Student's Response
Self Instruction	1433	1596	89,8%
Self Contained	414	456	90,8%
Stand Alone	199	288	87,3%
Adaptive	208	288	91,2%
User Friendly	821	912	90%
Mean Student Responses to the Practicality of Using E-Modules (%)			89,82%
Criteria			Very Practical

The practicality of e-modules shows that e-modules can help the teacher's role in learning, reduce the teacher's burden to explain material repeatedly, increase student curiosity, and make learning fun (Ranny & Zainul, 2019). Practical e-modules can also be used by students to learn independently (Syafri *et al.*, 2023; Tamrin, 2021). The results of the practicality of using e-modules based on discovery learning on coordination system material obtained a percentage of 89.82%. This shows that the e-module developed is practical for use in learning. Each aspect of the assessment of the practicality of the use of e-modules obtained a percentage with the following details.

The self-instruction aspect obtained a percentage of 89.8%. This proves that the discovery learning-based e-module on coordination system material developed is practical to use because it contains clear learning objectives in each learning unit; in-depth material with examples, supporting illustrations, and summaries; contains a context that is in accordance with the student's learning environment; uses language that is easy to understand; contains practice questions that hone students' abilities; and there is a material mastery level measurement instrument listed at the end of each exercise question.

The material independence aspect obtained a percentage of 90.8%. This proves that the e-module developed is practical to use because the separation of material facilitates the learning process of students so that they learn the coordination system material thoroughly. Student learning completeness in learning the coordination system using e-modules is seen from the results of working on exercise questions at the end of each learning unit in the e-module.

The stand-alone aspect obtained a percentage of 87.3% with very practical criteria. The stand-alone aspect means that the e-module does not depend on other teaching materials or require supporting tools (Wulansari *et al.*, 2018). The discovery learning-based e-module on coordination system material was declared very practical in the stand-alone aspect based on student assessment, where students did not need other media during the learning process using the e-module.

The adaptive aspect obtained a percentage of 91.2% with very practical criteria, indicating that the e-module is flexible to use and contains the latest science and technology. In addition, the e-module also presents examples and illustrations taken from life in the community that make it easier for students to understand the material and concepts of the coordination system.

The user-friendly aspect obtained a percentage of 93.9%. This shows that the e-module used by students in the learning process of coordination system material is very practical to use, contains clear instructions for use, and can be accessed whenever students need it. Students can access e-modules using devices, laptops, or computers. Easy access to e-modules makes learning go well.

Improvement of Students' Critical Thinking Skills

Critical thinking allows students to think systematically by evaluating evidence, thinking with logic, and understanding the language underlying other people's statements (Jamaluddin *et al.*, 2020). The improvement of students' critical thinking skills is measured by the N-Gain test obtained from their pre-test

and post-test scores. The achievement value of critical thinking skills obtained by students in each aspect of the pre-test and post-test questions is presented in Figure 1.

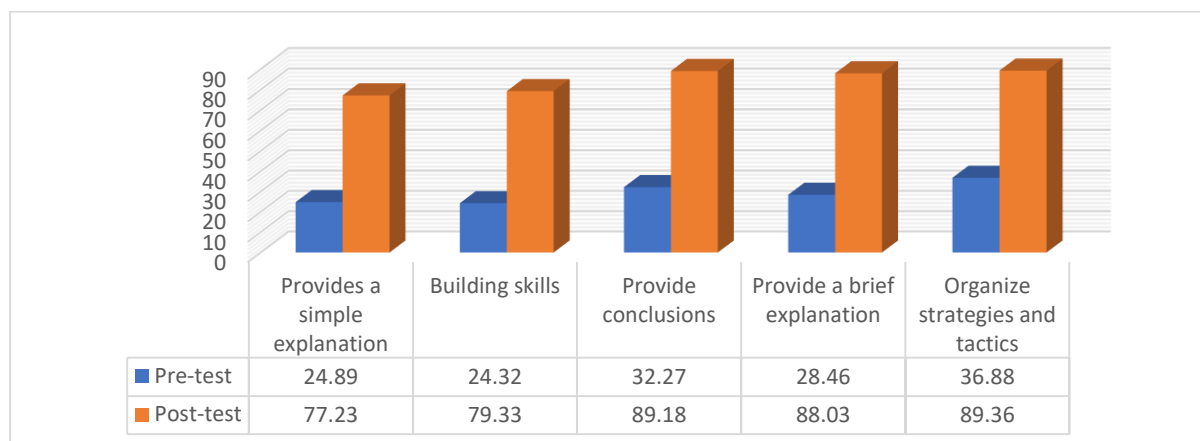


Figure 1. Average Achievement Score of Pre-Test and Post-Test of Critical Thinking Skills of Class XI MIPA Students at SMA Negeri 1 Slawi on each aspect of Learning Coordination System Material After Using Discovery Learning-Based E-Module

Figure 2 shows that students' pre-test scores on each aspect of critical thinking are lower than their post-test scores. The acquisition of the average student pre-test value is not more than 36.88, while the acquisition of the average student post-test value ranges from 77.23 to 89.36. The lowest pre-test score was in the aspect of building skills, which amounted to 24.32, and the highest pre-test score was in the aspect of organising tactical strategies, which obtained a score of 36.88. Then, for the acquisition of the lowest post-test score on the aspect of providing a simple explanation of 77.23 and the highest post-test value on the aspect of organising tactical strategies with a score of 89.36, The average pre-test and post-test scores of students' critical thinking skills were used to analyse the n-gain score. The n-gain score was calculated to determine the magnitude of the increase in students' critical thinking skills after using the discovery learning-based e-module on coordination system material. The results of the analysis of students' n-gain scores for each aspect of critical thinking skills are presented in Table 4.

Table 4. Results of N-Gain Score Analysis of Each Aspect of Critical Thinking Skills of XI MIPA Class Students at SMA Negeri 1 Slawi After Using Discovery Learning-Based E-Modules on Coordination System Material

Aspects of Students' Critical Thinking Skills	N-Gain Score	Criteria
Provides a simple explanation	0,70	Medium
Building skills	0,73	High
Provide conclusions	0,84	High
Provide a brief explanation	0,83	High
Organize strategies and tactics	0,83	High
Average	0,79	High

Based on table 4, the highest n-gain score is in the aspect of providing conclusions with an acquisition of 0.84, including high criteria. The high level of students' critical thinking skills in this aspect shows that students are able to master the concept of the coordination system correctly and master relevant information related to the coordination system problem. Relevant information about the problem at hand is needed to make reasonable and rational conclusions (Sundari & Sarkity, 2021). The lowest n-gain score was in the aspect of providing simple explanations worth 0.70 with moderate criteria. This shows that students are getting used to identifying the purpose of the question and providing reasons or explanations for answers (Sarwanto *et al.*, 2021).

The average n-gain score of students' critical thinking skills is 0.79 with high criteria. The analysis results prove that students' critical thinking skills after using e-modules based on discovery learning on coordination system material are able to improve the critical thinking skills of students in class XI MIPA at SMA Negeri 1 Slawi. Thus, critical thinking skills are acquired through practice rather than being born (Darmaji *et al.*, 2022). Students can practice critical thinking skills through a student-centered learning process that allows students to learn actively and discover new ideas (Munawwarah *et al.*, 2020; Rini &

Aldila, 2023). The improvement of students' critical thinking skills in all aspects that have been described is influenced by the training of students' critical thinking skills. The training was carried out by learning using e-modules based on discovery learning which contained discovery learning syntax on student worksheets in each learning unit.

Improvement of Students' Creative Thinking Skills

Creative thinking skills can be developed through learning. During the learning process, students' creative thinking skills will be stimulated through experimenting with images, information, instruments, materials, and problems (Mahanal & Zubaidah, 2017). These activities create students who are active in expressing opinions and arguing and are able to convey problems or solutions (Yuliani *et al.*, 2017).

The improvement of students' creative thinking skills was measured using a poster assessment observation sheet containing each indicator of creative thinking skills according to Munandar (2009). Poster assessment was conducted twice, namely the assessment of posters made by students before using e-modules based on discovery learning and posters made by students after using e-modules based on discovery learning on coordination system material. Posters made by students before and after learning coordination system material using the developed e-modules are presented in Figure 2.

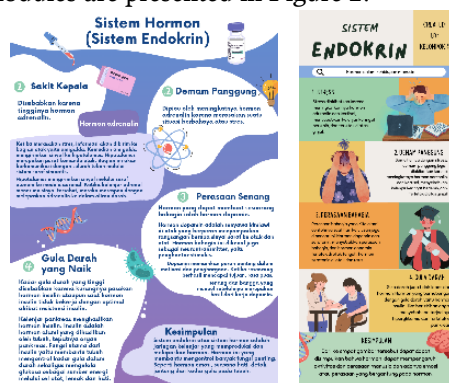


Figure 2. Posters made by XI MIPA Class Students at SMA Negeri 1 Slawi Before and After Learning Coordination System Material Using E-Modules Based on Discovery Learning

The results of the observational analysis of the creative thinking skills of students in class XI MIPA at the SMA Negeri 1 Slawi learning coordination system are presented in Figure 3.

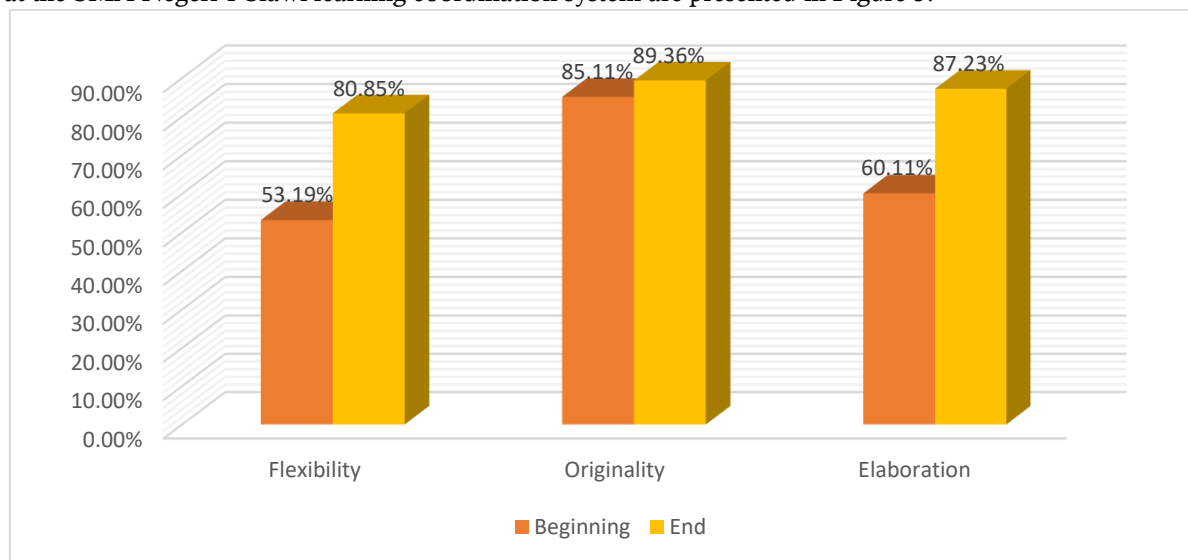


Figure 3. Percentage of Observation Analysis Results of Each Indicator of Creative Thinking Skills of XI MIPA Class Students at SMA Negeri 1 Slawi During Coordination System Learning Using an E-Module Based on Discovery Learning

Figure 3 shows that the creative thinking skills of students in class XI MIPA at SMA Negeri 1 Slawi during the learning of coordination system material using e-modules based on discovery learning have increased. In the observation of students' creative thinking skills, the indicator of original thinking carried out at the beginning and end, obtained the highest value which was 85.11% with very creative criteria and

89.36% with very creative criteria. This proves that creative thinking skills will increase when students understand the problem and look for solutions with varied strategies (Kardoyo *et al.*, 2020; Tumurun *et al.*, 2016). In addition, it proves that students can think of things that others have never thought of (Yuliani *et al.*, 2017). Students' original thinking indicators are trained through the learning process using e-modules in problem identification activities, data collection, data processing, and drawing conclusions.

The lowest indicator of students' creative thinking skills in the initial and final observations was the flexible thinking indicator which scored 53.19% with moderately creative criteria and 80.85% with creative criteria. This is because students can interpret images in various ways (Yuliani *et al.*, 2017). Different ways produce different interpretations so it is possible that students can be mistaken in interpreting the images they see.

Improvement of Students' Collaboration Skills

Collaboration skills are important for students because they increase knowledge to achieve learning goals, and students can also exchange ideas to solve problems and gain more knowledge than completing tasks independently (Wulandari *et al.*, 2021). Collaboration skills must be practised frequently because it will help students become proficient in collaborative activities (Octaviana *et al.*, 2022).

The improvement of students' collaboration skills was measured using observation and peer assessment. The student collaboration observation sheet contains 11 statements that contain indicators of collaboration skills, according to Trilling & Fadel (2009). Meanwhile, the peer assessment questionnaire contains 10 questions that contain indicators of collaboration skills, according to Trilling & Fadel (2009). The results of the analysis of the improvement of collaboration skills of students in class XI MIPA at SMA Negeri 1 Slawi on learning coordination system material using e-modules based on discovery learning are presented in Figure 4.

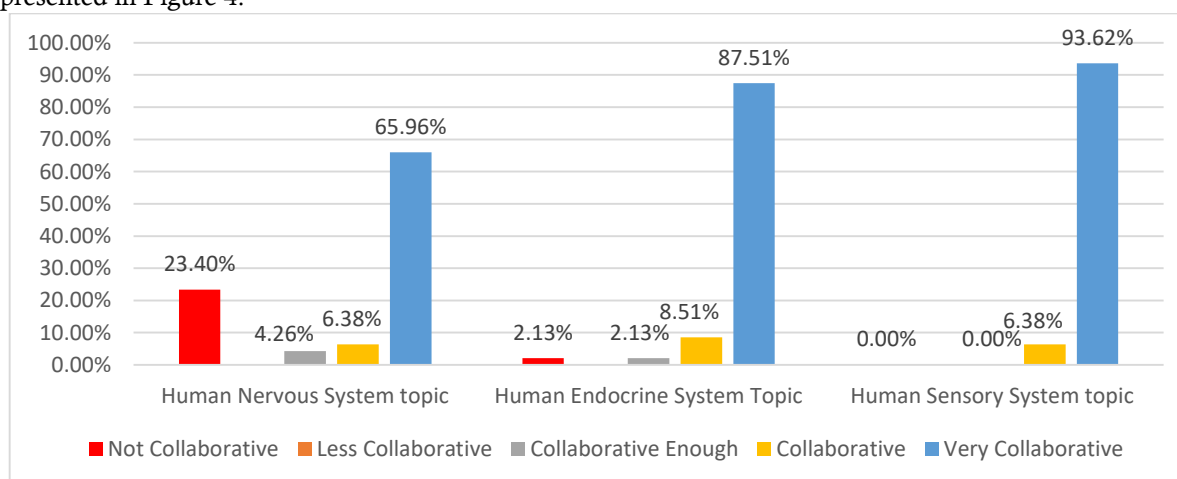


Figure 4. Percentage of Analysis Results of Improvement of Collaboration Skills of XI MIPA Class Students at SMA Negeri 1 Slawi During Coordination System Learning Using E-Modules Based on Discovery Learning

Figure 4 shows that students who learned coordination system material using e-modules based on discovery learning experienced an increase in collaboration skills. The increase occurred because students were active during the learning process. In learning the topic of the nervous system, there are still 23.40% of students who are not collaborative, which means that a number of these students are still working on tasks independently and have not been collaborative during the learning process. In the next lesson, namely learning the topic of the human endocrine system, the number of students who were not collaborative decreased to 2.13% of students, and in learning the human sensory system, there were no students with low collaboration skills. The decrease in the number of non-collaborative students occurred after students used the research product, where they became active in learning and completed tasks on student worksheets in groups.

During the learning process of the coordination system material using the e-module, students completed the task well, judging by the quality of the content and writing, and when presenting, each group member showed a collaborative attitude. This proves that the behaviour and attitudes of group members affect the quality of collaboration, and collaborative group members tend to write good work (Li & Mak,

2022). In addition, providing support and encouragement among group members creates a collaborative learning environment of good quality (Sun *et al.*, 2022).

Improvement of Students' Communication Skills

Communication is important for defining, expressing oneself, and being part of a social structure through interactions with others and the environment (Çağlayan *et al.*, 2021). With the existence of communication between students and other students in learning, learning activities become active, and the classroom atmosphere becomes effective (Dewi *et al.*, 2020).

The improvement of students' communication skills was measured using a communication observation assessment. The student communication skills observation sheet was prepared based on the communication skills indicators according to Daryanto & Karim (2017). The observation and assessment of communication skills was carried out by a third party as an observer of student communication activities during the learning of coordination system material. The results of the questionnaire assessment were then analysed to determine the magnitude of the improvement in students' communication skills. The results of the observation analysis of each indicator of communication skills of students in class XI MIPA at SMA Negeri 1 Slawi in learning the coordination system using e-modules are presented in Figure 5.

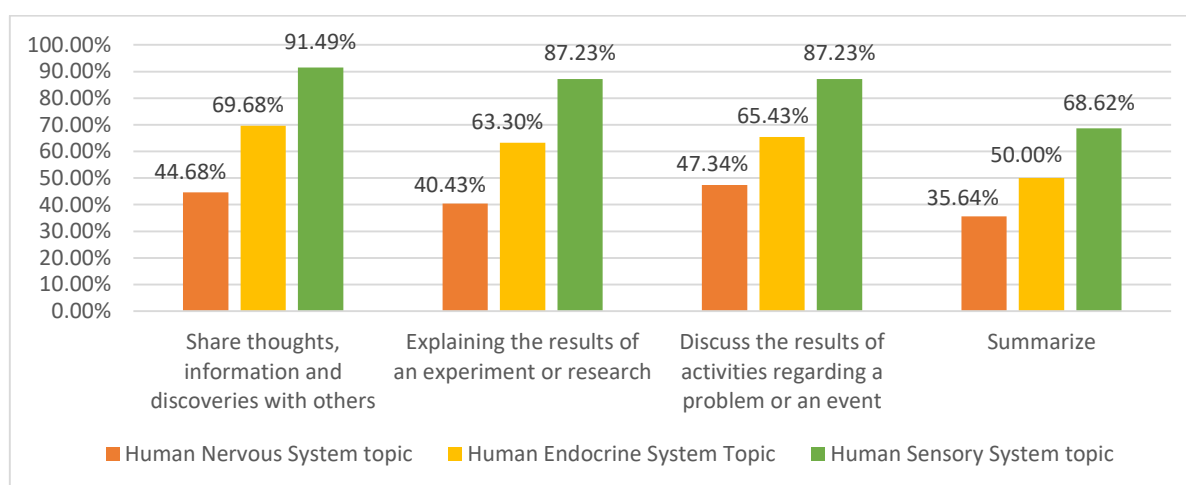


Figure 5. Percentage of Observation Analysis Results of Each Indicator of Communication Skills of XI MIPA Class Students at SMA Negeri 1 Slawi During Coordination System Learning Using E-Modules Based on Discovery Learning

Figure 5 shows that the communication skills of students in class XI MIPA at SMA Negeri 1 Slawi during the learning of coordination system material using e-modules based on discovery learning have increased in each indicator of communication skills. The indicator of sharing thoughts, information and discoveries with others is the indicator of communication skills that has the highest percentage of achievement by students at the end of learning coordination system material worth 91.49% very good criteria. It shows that students' communication skills on this indicator are very well developed and students convey information, ideas, and discoveries clearly and easily understood (Fitriah *et al.*, 2020; Khan *et al.*, 2017).

The conclusion indicator is the lowest indicator of communication skills achieved by students, which is worth 68.62% with good criteria. This is because students have little difficulty interfering and explaining in communication. Interference is the ability to find and obtain the necessary parts when making conclusions, while explanation is the ability to convey arguments accurately (Suriati *et al.*, 2021). The increase in the conclusion indicator shows that students are able to convey conclusions with good confidence and use good and straightforward language. Thus, it can be proven that communication skills in the learning process with good criteria are influenced by learning activities that are fun and full of motivation (Nurmala & Priantari, 2017).

CONCLUSION

Based on the results of the discovery learning-based e-module research on coordination system material that has been developed, it is feasible and practical to use in learning biology in class XI SMA Negeri 1 Slawi with very good readability. The e-module was successful in improving the 4C skills (Critical

thinking, Creative thinking, Collaboration, and Communication) of students in class XI SMA Negeri 1 Slawi.

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