Analysis of 21st Century Skills in the Implementation of Project Based Learning in Biology Learning Merdeka Curriculum

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Abstract: 21st century skills are important skills that every student must have to be prepared to face global challenges. One of the innovative learning models that can improve 21st century skills is project-based learning. Project Based Learning is one of the main characteristics in the implementation of the Merdeka Curriculum. This study aims to analyze the 21st century skills of students in the implementation of project based learning in merdeka curriculum especially in the biology subject. This research uses a quantitative descriptive method with case study strategy. Data were obtained from the observation process. The observation instrument used represents four categories of 21st century skills namely critical thinking, creativity and inovation, communication, and collaboration. Based on the results, it can be known that communication skills have the most approaching standard and standard categories among other skills. Furthermore, for creativity and innovation, in this study the results show that there are still many students in the category below standard and approaching standard. Therefore, it can be concluded from the results of the study that most of student are still at an intermediate level for 21st century skills but the results might different depending on the grade level, characteristics students, subject area and teacher.

Keywords: Biology learning; Merdeka curriculum; Project based learning; 21st century skill

Introduction

Education must prepare students to face the challenges of the 21st century The quality of education is expected to prepare, assist, provide facilities and ensure that educational activities carried out can make a positive contribution to students to develop their knowledge, life skills, and social character needed and important for students to face the challenges of life in the 21st century. As well as in learning, students must have 21st century skills such as critical thinking, creative thinking, problem solving, collaboration, and communication. Therefore, education institutions can carry out effective and efficient planning, implementation, and assessment of learning in achieving the competence of 21st century skills in students.

Individuals must learn 21st century skills in order to adapt to the challenges, issues, lives, and vocations of the 21st century. Assessment and Teaching of 21st Century Skills categorizes 21st century skills, knowledge, attitudes, values and ethics into four categories (Saavedra et al., 2012). First, ways of thinking which are classified as creativity and innovation, critical thinking, problem solving, decision making, and learning about learning (metacognition). Second, ways of working which include communication, collaboration, and teamwork skills. Third, tools of working which consists of general knowledge and literacy in communication and information technology. Fourth, living in the world includes citizenship, life and career, personal and social responsibility, and cultural competency and awareness are all aspects of living in the world.

The OECD developed a framework of 21st century skills that are considered essential for students to develop in order to adapt to society and the development of knowledge according to the present era. (Ananiadou et al., 2009). This OECD framework consists

of cognitive skills, intrapersonal skills, interpersonal skills, and technical skills. Another similar model of 21st century skills is also used by Soland et al. (2013) with the three components of the OECD framework (Ananiadou et al., 2009), but eliminates technical skills. This model classified 21st century skills as follows: cognitive skills (academic mastery, critical thinking, and creativity); interpersonal skills (communication and collaboration, leadership, and global awareness); and intrapersonal skills (growth mindset, ways of learning, intrinsic motivation, and resilience). Meanwhile, the National Education Association (n.d.) describes 21st century skills into "The 4Cs." "The 4Cs" consist of critical thinking, creativity, communication, and collaboration. In line with this, Anagün (2018) also describes 21st century skills that are important to develop in the learning process including creative thinking, critical thinking and problem solving), communication, and collaboration. These 4C skills are important skills for students to be mastered. Referring to BNSP which explains that in the 21st century students must have (creative thinking), (critical thinking and problem solving), (communication), and (collaboration). Astutik et al. (2021) explain that developing skills in the 21st century helps students become aware of information, knowledge and technology, and grow into people who have skilled thinking abilities. Therefore, practicing 21st century skills is an important thing that needs to be considered and improved in education.

In order to improve 21st century skills, the learning that is used must be student-centered. The merdeka curriculum used in Indonesia focuses on essential materials and competency development through the application of student-centered learning. Using student-centered learning will encourage students to be more independent, creative, and increase learning motivation. This can be done with meaningful learning and using innovative learning models. One of the innovative learning models that can improve 21st century skills is project-based learning.

Project-based learning is a practical, inquiry-oriented teaching method which students are involved in creating, building, and testing what they have created or designed by collaborating with other students. (Devkota et al., 2017). Sedangkan Thomas (2000) explains that project-based learning is student-centered and refers to problem solving through making projects. Project based learning according to Bell (2010) is a learning model that teaches concepts in the curriculum through a project. Projects in project based learning are driven by scientific questions that lead to research and allow students to apply the knowledge they have gained. Based on this explanation, it can be concluded that project-based learning is a learning model that makes students gain understanding and skills through

direct experience in completing real projects. One of the characteristics of project-based learning is learning that has relevance to students' real-world context. Project-based learning encourages students to be active in learning, develop critical thinking skills, collaborate with their peers.

Project-based learning is a development in teaching that is used as a learning approach introduced by John Dewey (Mihardi et al., 2013). Dewey emphasized the idea of "learning by doing". However, in recent years, project-based learning has been used as a learning model to explore and develop students' creativity. There are many components of project-based learning that are derived from the principles of constructivist teaching approaches (Frank et al., 2003). As explained by Aldabbus (2018) project-based learning is a teaching method that centralizes learning on students and is based on the theory of constructivism developed by Gergen (1995); Piaget et al. (1978).

Project-based learning is a learning model that uses a student learning approach to authentic problems (constructivism) (Mihardi et al., 2013). Based on the explanation above, project-based learning is a learning strategy developed based on the constructivist learning theory that requires students to construct their own knowledge. Constructivism is a learning theory that relies on the idea that students construct their own knowledge from the context of their own experience. (Wilson, 1996). Therefore, project-based learning is seen as one of the approaches to create a learning environment that can encourage students to construct their own knowledge and skills.

Project-based learning emphasizes students' independent learning. Therefore, project-based learning is closely related to constructivism learning because it also emphasizes independent learning (Surahman et al., 2019). Learning with a constructivist approach provides opportunities for students to gain affective, cognitive and psychomotor competencies comprehensively through projects that are structured and derived from real problems. Project-based learning itself has its roots in constructivist learning and discovery-based learning that prioritizes the process of inquiry, so that students are able to find solutions to problems based on their own perspectives (Jalinus et al., 2017). In project-based learning the learning experience is organized around a project that takes place over a long period of time. Project-based learning takes place through investigative activities carried out by students. The projects are complex activities based on difficult topics or challenges that require students to develop, solving problem, and make decisions as they work on projects.

Project-based learning has six key characteristics: driving questions, a focus on learning objectives, participation in educational activities, student

collaboration, the use of technology, and the development of real products (Krajcik et al., 2014). This creation process requires students to work together to find solutions to authentic problems through a process of integration, application and construction of knowledge. Teachers act as facilitators, providing feedback and support the students to aid their learning process (Guo et al., 2020). Meanwhile, Thomas (2000) identified five important characteristics of project-based learning, namely student-centered, driving questions, constructive inquiry activities, student autonomy, and realism, with the importance of student collaboration, reflection, reframing, and presentation (Kokotsaki et al., 2016). In the process of project-based learning itself, students need to solve problems by defining problems, discussing ideas, designing questions, collecting and analyzing data, and sharing results with their peers (Chen et al., 2019).

Project-based learning is an appropriate learning model to be used in 21st century learning (Barus, 2019). Project-based learning can enhance 21st century skills in the globalization era (Wagner, 2008; Slough et al., 2013). Project-based learning can be seen as an approach in learning that develops 21st century skills in students, because the learning process involves students to conduct investigative activities and face challenges in the real world. In line with the results of the Buck Institute for Education (BIE) research that the project-based learning model can improve 21st century skills in students, namely Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovation. This is because the use of project-based learning in classroom learning will encourage students to be more active in learning (Cintang et al., 2018). According to several research, project-based learning is one of the learning approaches that can assist students enhance their 21st century skills (Bell, 2010; Boss et al., 2013). Project utilization in learning can develop students' creative thinking skills and self-regulated learning with outstanding results (Zakiah et al., 2020). This is because project-based learning focuses more on student activities, they are involved in planning, designing, and implementing projects in real-life situations by collaborating with their peers and teachers who support (scaffolding) their learning. (Devkota et al., 2017). According to Winangun (2021) Project-based learning by implementing a scientific approach can develop students' potential in terms of critical thinking, communication, collaboration, and creativity in accordance with the demands of 21st century learning. Similarly, the results presented by Edvision (2007) that there are more than 70 schools that implement project-based learning show improvements in 21st century skills and higher order thinking skills. project-based learning

helps students to be able to think critically, solving problems, and collaborate (Duke et al., 2021).

Based on the explanation above, the implementation of project-based learning in education in Indonesia can help students develop critical thinking skills, collaboration, problem solving, and application of knowledge in a real-world context. In addition, project-based learning can also increase students' motivation and engagement in the learning process as they are actively involved in the project. This is also very relevant to 21st century learning where students focuses not only on the knowledge domain but also emphasizes character aspects, literacy mastery, skills and technology. Merdeka curriculum currently implemented in Indonesia emphasizes the use of project-based learning to improve learners' skills. Learning in the merdeka curriculum is designed to be more flexible and contextually oriented, cultural context, school vision, and student needs-oriented. (Festiyed et al., 2022). Project-based learning is one of the main characteristics in the implementation of Merdeka Curriculum. According to Jufriadi et al. (2022) merdeka curriculum effectively enhances 21st century skills, such as critical thinking skills, communication skills, and creativity to produce graduates student that have global competitiveness. In line with this, Nursalam et al. (2023) explained that project-based learning is part of the merdeka curriculum program that should be implemented by "sekolah penggerak". Project-based learning is a learning model that is widely used in science learning, one of them is in biology learning.

Project-based learning is also implemented in biology learning with merdeka curriculum. There is a reduction of content material, students can choose based on their interests in the implementation of biology learning in high schools using merdeka curriculum (Setyani et al., 2023). Biology learning at school requires students to understand, apply, analyze conceptual and procedural knowledge, and apply it to solve problems. (Aqil, 2017; Aripin et al., 2018). The main problem in learning biology according to Yusup (2018) is the difficulty of students in understanding biology lessons, because they tend to memorize the content material, students should understand the concepts in it. Understanding concepts in biology learning is expected to help students solve problems in real life. Biology learning can facilitate teachers and students to learn biology concepts widely, so that it can make students get the opportunity to learn biology concepts and important issues in biology learning deeply appropriate with the stages of their learning development (Widiya, 2022). Therefore, project-based learning is very suitable to be applied in biology learning to improve 21st century skills which consist of critical thinking, creative thinking, collaboration, and communication. Meaningful learning

through projects in biology is one of the teacher's ways to improve students' 21st century skills.

Project based learning stands out as a highly recommended learning model for biology lessons in the merdeka curiculum. This endorsement is highlighted in the biology subject teacher's guidebook merdeka curriculum, where it is explained that project based learning serves as an effective alternative learning strategy. The guidebook emphasizes that project based learning can stimulate and fulfill the elements outlined in the learning outcomes, making it a valuable tool for enhancing biology lessons (Solihat et al., 2022). This research emphasizes specifically on analyzing 21st century skills, which have not been widely researched in the context of implementing project-based learning in biology lessons for the merdeka curriculum. Based on this, it is necessary to analyze the 21st century skills in the implementation of project-based learning in biology learning of the merdeka curriculum. This study aims to determine 21st century skills (4C) in students so that it can facilitate teachers in developing project-based learning in learning biology of an merdeka curriculum and practicing 21st century skills in students.

Method

This research uses a quantitative method with a case study strategy. This method is used to analyze the ability of 21st century skills in 11th grade high school students majoring in science during the implementation of project-based learning in biology learning with merdeka curriculum. The population in this study were 11th grade students from high schools in Bandung who conducted project-based learning. The sample of this study amounted to 72 students from two classes, of which in each class there were 7 groups. Then observations were made on students in groups during biology learning using project-based learning by three observers. The observation instrument used during learning refers to the rubric adapted from the Buck Institute of Education (BIE, 2013) to assess the 21st century skills (4C) of learners by giving a checklist (√) in the appropriate category (below standard, approaching standard, and at standard) on the observation sheet.

The observation instrument used represents four categories of 21st century skills consisting of critical thinking skills, creative thinking skills, communication skills, and collaboration skills. Observations were conducted for four meetings with a total of 10 JP (lesson hours). The data analysis used in this study was descriptive statistical analysis. The score calculation was calculated by recapitulating the occurrence of each indicator in each aspect of 21st century skills, then summing the occurrence of 21st century skills (4C) in each descriptor of each indicator of the 21st century skills

aspect, then converting the raw score into a percentage value for each category of each indicator of the 21st century skills aspect (4C).

Result and Discussion

This research aims to analyze the 21st century skills of students in the implementation of project-based learning in biology learning with merdeka curriculum. The 21st century skills seen in this study consist of 4C skills, namely critical thinking, communication, collaboration, creative thinking and innovation. Initially, there were 72 students observed during the implementation of project-based learning in biology learning, but there were 5 students who were absent for several meetings so they were excluded from the data. In the end, this study observed 67 students in grade 11 IPA to see their 21st century skills (4C) through observation. Based on the results of the research that has been conducted, the percentage of 21st century skills of students in learning biology of the merdeka curriculum using project-based learning is presented in the following graph.
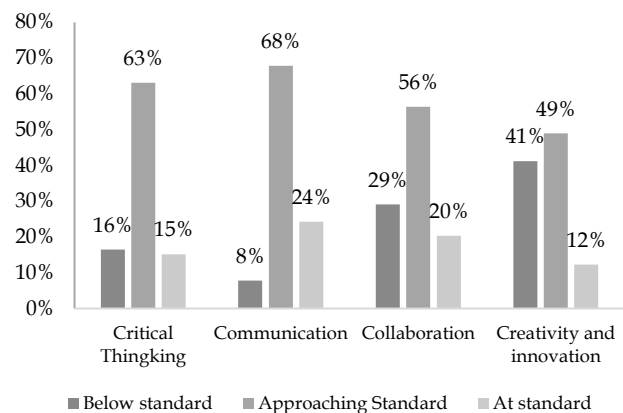

Figure 1. Graph of students' 21st century skills

The 21st century skills assessment is categorized into three groups, namely below standard, approaching standard, and standard. Based on the graph above, the average in all skills is in the approaching standard category. In critical thinking skills 63% of students are in the approaching standard category, 16% of students are below standard, and 15% of students are in the standard category. Critical thinking skills can be seen from six indicators. The following is data on the assessment of critical thinking skills based on the indicators.

Based on the data in the table 1, most students can analyze the driving questions in the approaching standard category, namely about 79% students. In analyzing the driving question, most students can elaborate the answer to the driving question by

recognizing some of the main parts of the driving question, although not considering the complexity of the driving question. There were 15% students in the below-standard category in analyzing driving questions. There were only 6% students in the standard category in analyzing the driving question by showing their understanding of the main parts of the driving question. On the indicator of asking follow-up questions, 66% of students were in the approaching standard category. This means that most students ask follow-up questions in completing the project but only limited to what they understand. While there are 25% of learners who do not ask follow-up questions that are in the below-standard

category. In the standard category, 9% of students expand the follow-up questions asked. Furthermore, in the information gathering indicator, 64% of students are in the approaching standard category. In this case, it means that students can collect information from 1 - 2 sources. In the standard category there are 24% of students who can collect a variety of information from more than 2 sources. While 12% of students only use one source to collect information. Furthermore, critical thinking indicator is using facts or evidence to evaluate arguments in developing and improving ideas or evaluate arguments in developing and improving ideas or products.

Table 1. Percentage of Students' Critical Thinking Skills Based on Indicators

Indicator	Category		
	Below standard	Approaching standard	At standard
Anayze driving question	15%	79%	6%
Asking follow-up questions	25%	66%	9%
Gathering information	12%	64%	24%
Evaluating the information	25%	45%	30%
Use facts or evidence to evaluate arguments	19%	69%	12%
Explaining the reasons for the choices that have been made	9%	72%	19%
Provide alternative answers	46%	48%	6%

In this indicator, 69% of students are included in the approaching standard category. In this category, it means that they recognize that valid arguments and strong facts are needed but most do not evaluate carefully when developing answers to driving questions. Meanwhile, 19% of students were categorized as below standard for this indicator. This shows that students accept arguments in answering driving questions but do not question the validity of arguments to improve ideas and solutions. Furthermore, there are 12% of students who are categorized as standard, which means that students assess the reasons or arguments are valid and relevant to the facts given so that they can improve ideas and solutions. Then, critical thinking indicator is explaining the reasons for the choices that have been made. There are 72% of students in the approaching standard category, this means that most students are able to explain the choices they made when answering questions or making products but are not supported by valid arguments or facts. While there were 19% of students who explained the reasons for answering driving questions or making products with valid reasons and supporting facts.

In the below-standard category there were 9% of students who did not provide valid reasons and supporting facts in defending answer choices. The last critical thinking indicator is providing alternative answers. In this indicator there were 46% of students in the below-standard category because they did not provide alternative answers in answering questions or making product designs. While there were 48% of students who realized possible alternative answers to driving questions or product design but did not consider them carefully. There were only 6% of students who realized that there were limited answers to the guiding question or product design so they considered other perspectives.

The next 21st century skill is communication skills. In communication skills 68% of students are in the approaching standard category, 8% of students are below standard, and 24% of students are in the standard category. This is because most students are in the approaching standard category. Below is a detailed percentage of students' indicators on communication skills.

Table 2. Percentage of Students' Communication Skills Based on Indicators

Indicator	Category		
	Below standard	Approaching standard	At standard
Explaining ideas, information and opinions	9%	49%	42%
Adjusting the language used when interacting with others	3%	78%	19%
Explain clearly and persuasively	9%	69%	22%
Presenting results	10%	76%	13%

In communication skills, the first indicator is explaining ideas, information, and opinions. In this indicator there were 49% of students in the approaching standard category where they were able to convey information but not accompanied by clear and logical supporting facts. In the standard category there were 42% of students who were able to explain information ideas and opinions with clear, concise, and logical supporting facts. However, there were 9% of students who did not convey information about the reasons for their ideas or discoveries. The next indicator of communication skills is the language used when interacting with others. In this indicator, most students were in the approaching standard category with a percentage of 78%, where they tried to adjust the conversation according to the context and task using formal language.

There are 19% of students who complete the conversation according to the context by using formal language. While there were 9% of students who did not adjust the conversation according to the context and project. The next indicator in communication skills is explaining clearly and persuasively. In this indicator there are 69% of students in the near standard category,

this means that students speak clearly with intonation loud enough but with a monotonous tone.

Furthermore, creativity and innovation where 49% of students are in the approaching standard category, 41% of students are below standard, and 12% of students are in the standard category. This is because most students are in the approaching standard category.

However, there are 22% of students in the standard category who are able to speak clearly not too fast or too slow and the intonation is loud enough and uses tone to emphasize information. Then there were 9% of students who spoke with mumbling and small intonation. The last indicator in communication skills is presenting results. In this indicator there were 76% of students in the approaching standard category because they had an introduction and conclusion but it was not clear and interesting and they only presented most of the content that should have been included in the presentation. In the standard category there were 13% of students where they delivered all presentation content and had clear and interesting introductions and conclusions. Then in the below-standard category there were 10% of students who did not fully convey the points that should be conveyed and did not have an introduction or conclusion.

Table 3. Percentage of Students' Collaboration Skills Based on Indicators

Indicator	Category		
	Below standard	Approaching standard	At standard
Responsible for themselves	13%	72%	15%
Organizing the work	84%	13%	3%
Assisting group members	12%	49%	39%
Receive and give feedback to develop solutions	7%	67%	25%
Working as a whole group	-	81%	19%

Next is collaboration skills. In collaboration skills 56% of students are in the approaching standard category, 29% of students are below standard, and 20% of students are in the standard category. This is because most students are in the approaching standard category.

The first indicator of collaboration skills is self-responsibility with 72% of students in the approaching standard category. This means that most students generally prepare the tools and materials needed in carrying out project-based learning such as books, gadgets, and internet connections. There are 15% students in the standard category where they prepare the tools and materials needed in carrying out project-based learning. Then, they have high independence in doing assignments and are on time in submitting assignments. While in the below-standard category there were 13% of students where they did not prepare the tools and materials needed in learning and did not complete the assignment on time. In the category of indicators of organizing work, most students by 84% are

in the below standard category, this is because when working on projects they do not make a list of tasks and do not share tasks with their groupmates. There are 13% of students in the approaching standard category, where they make a list of tasks and divide project tasks with their group members but are not detailed and not well followed. There were only 3% of students in the standard category who divided project tasks in detail and assigned roles as needed based on the abilities of their group members. On the indicator of helping the group, there were 49% of students in the approaching standard category where they were actively involved in group activities to complete the project but not until the activity was completed. Then there are 39% of students in the standard category where they are actively involved in the group to complete the project until the activity is completed. In the indicator of receiving and giving feedback in developing solutions, 67% of students are in the approaching standard category because they generally recognize and respect other

people's opinions and are polite and kind to group members. There were 25% of students in the standard category where they acknowledged and respected other people's opinions and were polite to their groupmates. However, there are 7% of students who do not recognize or respect other people's opinions and disrupt group discussion activities. The last indicator in collaboration skills is working as a whole group where almost all students are in the near-standard category with a percentage of 81%. This means that they worked on

project tasks separately and combined at the end. Then there are 19% of students who are in the standard category for this indicator. In this category students develop ideas and construct the product by involving all group members.

Furthermore, creativity and innovation where 49% of students are in the approaching standard category, 41% of students are below standard, and 12% of students are in the standard category. This is because most students are in the approaching standard category.

Table 4. Percentage of Students' Creativity and Innovation Abilities Based on Indicators

Indicator	Category		
	Below standard	Approaching standard	At standard
Defining creative challenges	34%	55%	10%
Compiling information with innovative methods	67%	33%	-
Developing techniques	42%	52%	6%
Enhance an idea or solution	6%	82%	12%
Creating presentation resources using a diverse range of engaging techniques	57%	22%	21%

On creativity and innovation skills, the first indicator looked at was setting creative challenges where 55% of students were approaching the standard. In this category, students understood the basic purpose of innovating but not completely. Then, there are 34% of students below standard, where they only follow directions without understanding the purpose of innovating in solving problems for project preparation. Furthermore, there are 10% of students in the standard category. The second indicator in creativity and innovation is gathering information with innovative methods. In this indicator, 67% of students were below standard, where they only used one type of information source such as websites/books/articles. Then, the rest were in the approaching standard category, which means they found one or two unusual sources of information sourced from scientific articles or journals.

The next indicator is developing techniques, 52% of students are in the approaching standard category. This means they developed some original ideas for making products but did not develop better use of techniques. In the below standard category, 42% of students stayed within the framework provided and did not use new techniques in developing ideas to complete the project. There were only 6% of students in the standard category who used new techniques to develop ideas for the project. The fourth indicator was improving ideas or solutions, where 82% were in the approaching standard category which means they considered and used suggestions and criticisms to revise ideas but did not find out more. In the below-standard category there were 6% of students who did not consider or use critique suggestions to revise ideas. In the standard category there were 12% of students who explored and used

suggestions and critiques to revise ideas to make them better. The last category in this indicator is making presentation materials with interesting techniques, where most students present ideas and products only by reading text notes with no interesting features, as many as 57% of students. Meanwhile, in the approaching standard category, 22% of students tried to include interesting elements in their presentation to make it look more alive, although not as a whole. Then, there were only 21% of students in the standard category where they tried to make interesting presentation media.

In the implementation of project-based learning in biology learning, of all the 21st century skills measured in this study, it can be seen that communication skills have the most categories of approaching standards and standards category among other skills. In line with this research Saimon et al. (2023) yang menemukan bahwa implementasi project based who found that the implementation of project-based learning successfully improved 4C skills among university students in Tanzania where the data showed that learners' communication skills improved as their projects progressed. The same thing was also presented by Saldo et al. (2020) project-based learning enables learners to significantly improve and develop verbal and nonverbal communication skills. This is because the learning atmosphere using the project-based learning model gives rise to interactions that occur between student-teacher and student-student (Wirantini et al., 2016). Furthermore, for creativity and innovation, in this study the results show that there are still many students in the category below standard and approaching standard. This means that most students' creativity and innovation skills are still at the lower and middle levels. Based on

the results of the assessment of aspects of creativity and innovation in this study, there are indications that there are still many students who lack creativity and innovation skills. Creativity is one of the 21st century skills that students need to face technological advances and prepare for their lives in the future (Hanif et al., 2019). Creative learning helps students to achieve efficacy in problem solving (Purwanti, 2015). The results obtained in this study are different from the results of the study Ismuwardani et al. (2019) which revealed that the implementation of project-based learning in learning can improve students' creativity. Lou et al. (2017) so stated that project-based learning has a positive influence on creativity development effectively. This is because project-based learning provides an opportunity to positively impact students' creativity as they will develop their own ideas to create products (Hanif et al., 2019).

Based on the research results that have been presented, it can be seen that students' 21st century skills in the implementation of project-based learning in biology learning are mostly in the average category close to the standard. Therefore, it can be concluded that students' 21st century skills are still at an intermediate level. Although according to some experts the project-based learning approach is effective for developing 21st century skills because it allows students to seek and analyze information, discuss and provide feedback with peers, and collaborate with their groups to complete a project (Boss et al., 2013). However, the practice of project-based learning varies depending on the grade level and subject area. In line with this, Hixson et al. (2012) stated that the relationship between the use of project-based learning and teaching 21st century skills varies according to the characteristics of the target class and the teacher. Characteristics of the target class include the subjects taught, teacher-reported learning outcomes, and achievement levels. In the implementation of project-based learning itself, the project should allow for student autonomy, should have proper planning, management, and rigorous assessment, thus connecting the content of the material learned deeply and enhancing 21st century skills (such as collaboration, communication, creative thinking and critical thinking) through the development of authentic products and presentations by students.

Conclusion

Based on the results of research on students in grade 11th in biology lessons merdeka curriculum using project-based learning, it is known that in all aspects of 21st century skills most students are in the approaching standard category. Therefore, it can be concluded that most of them are still at an intermediate level for 21st

century skills. In the results of this study, communication skills were most prominent among all 21st century skills. However, different results were seen in the aspects of creativity and innovation which showed that there were still many students who were in the below standard and near standard categories. So, although project-based learning is known to improve 21st century skills in students, the results may be variable depending on the grade level, the characteristics of the targeted learners, the subject area and the teacher.

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