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4C Skills (Critical Thinking, Creative, Collaboration, and Communication) in Physics Learning: Have They Been Formated in Students?

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Abstract: One of the skills that are needed by students in current developments is 21st century skills, also known as 4C skills. This study aims to measure and describe the level of 4C skills possessed by students majoring in science at MA Plus Nurul Islam Sekarbela. The type of research used is descriptive-qualitative. The research subjects were all students majoring in science in grades 10–12, totaling 84 students. The research data was gathered using two methods: test questions for critical thinking and creative thinking, and observation sheets for collaboration and communication skills. All data obtained were analyzed descriptively and categorized based on the criteria of each 4C skill. Based on the research, it was found that communication skills were the skills with the highest score for students majoring in science at MA Plus Nurul Islam Sekarbela, with a score of 82.00, while creative thinking was the skill with the lowest score, with a score of 69.00.

Keywords: 4C skills; Creative thinking; Critical thinking; Collaboration; Communication; Physics learning

Introduction

The learning process determines how the various skills that exist in a person are formed, whether formally or informally. These skills start from the simplest, namely knowing, to the most complex skills, namely creating. With the development of the times that are increasingly changing, of course the skills needed by humans must also experience adjustments so that they are still able to keep up with these changing conditions. Currently humans are in industrial society 4.0 to 5.0 where there are four basic skills that humans must possess (Hendarsyah, 2019). These basic skills are known as 21st Century skills.

The educational process in almost all countries has the same goal, namely to be able to create a learning process that promotes the formation of these four skills. These skills are synonymous with other terms, namely 4C skills (Critical Thinking, Creativity, Collaboration, and Communication) (Rizaldi et al., 2020). Referring to these conditions, one of the learning processes that is considered capable of creating and forming 4C skills in students is learning science, especially physics (Nurjannah, 2021).

The physics learning process which is synonymous with discovery and proof can facilitate students in creating these skills (Dewi et al., 2019; Isnaniah et al., 2023). This is of course because learning physics tends to be done using various learning models that are multidirectional and student-oriented such as project based learning (Nurhayati et al., 2021), inquiry learning (Fatimah et al., 2020), problem based learning (Bethell et al., 2011), and discovery learning (Haryadi et al., 2019).

The nature of learning physics, which consists of three components (physics as a process, product, and attitude), is what makes learning capable of creating four 21st century skills (Murdani, 2020; Saputi et al., 2014). Apart from referring to this nature, learning physics is identical to a scientific approach that uses the mindset of the scientific method, which consists of formulating

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problems, conducting hypotheses, collecting data, processing data, and drawing conclusions (Juwita, 2020; Sari et al., 2018). Indirectly learning physics basically teaches students to get used to cultivating 4C skills in solving various contextual problems.

However, the problem in the process of implementing learning is that not all students have the same ability to receive and participate in every lesson in class. The same thing is also felt by researchers when applying various cooperative learning models in the physics learning process. Several models that have been used by researchers to support the learning process include project-based learning, problem-based learning, blended learning, and other cooperative models. Based on these conditions, the researcher was interested in measuring the extent of the 4C skills possessed by students, especially when carrying out the physics learning process by applying a project-based learning model.

Method

This research is qualitative and descriptive. This research was conducted at Madrasah Aliyah Plus Nurul Islam Sekarbela. The 84 students who participated in the study were all science majors in grades 10 to 12. During the research process, all classes were taught using a project-based learning model to bring up 4C skills in the physics learning process. The data collection process is divided into two stages in which to obtain data on critical and creative thinking skills using test questions with a total of five essay questions each that are arranged based on the indicators of each skill. Critical thinking indicators refer to Facione (2011), namely interpretation, analysis, evaluation, inference, and explanation, while indicators of creative thinking refer to Siswono (2010), namely fluency, flexibility, originality, and elaboration.

Data on other skills related to collaboration and communication were obtained using observation sheets that were carried out when the learning process took place in class. Collaboration skills are seen using indicators developed by Wahyuni (2016), including being willing to accept responsibility, helping each other, respecting the opinions of others, and respecting the work of others. Meanwhile, communication skills use indicators developed by Rahmawati et al. (2021), namely collecting information from other people's opinions and presenting information in the form of images or graphics. All data obtained were analyzed descriptively and compared with various supporting data from previous studies, which were sourced from scientific writings such as journals, seminars, proceedings, and books.

Table 1. Criteria for Critical Thinking Skills (Rizaldi et al., 2019)

Value Scale	Category
$81.25 < x \leq 100.00$	Very High
$71.50 < x \leq 81.25$	High
$62.50 < x \leq 71.50$	Medium
$43.75 < x \leq 62.50$	Low
$0.00 < x \leq 43.75$	Very Low

Table 2. Criteria for Creative Thinking Skills (Febrianingsih, 2022)

Value Scale	Category
81.00 – 100.00	Very Creative
66.00 – 80.00	Creative
56.00 – 65.00	Fairly Creative
41.00 – 55.00	Less Creative
0.00 – 40.00	Not Creative

Table 3. Criteria for Collaboration and Communication Skills (Purwanto, 2010)

Value Scale	Category
86.00 – 100.00	Very Good
76.00 – 85.00	Good
60.00 – 75.00	Pretty Good
55.00 – 59.00	Poorly Good
0.00 – 54.00	Not Good

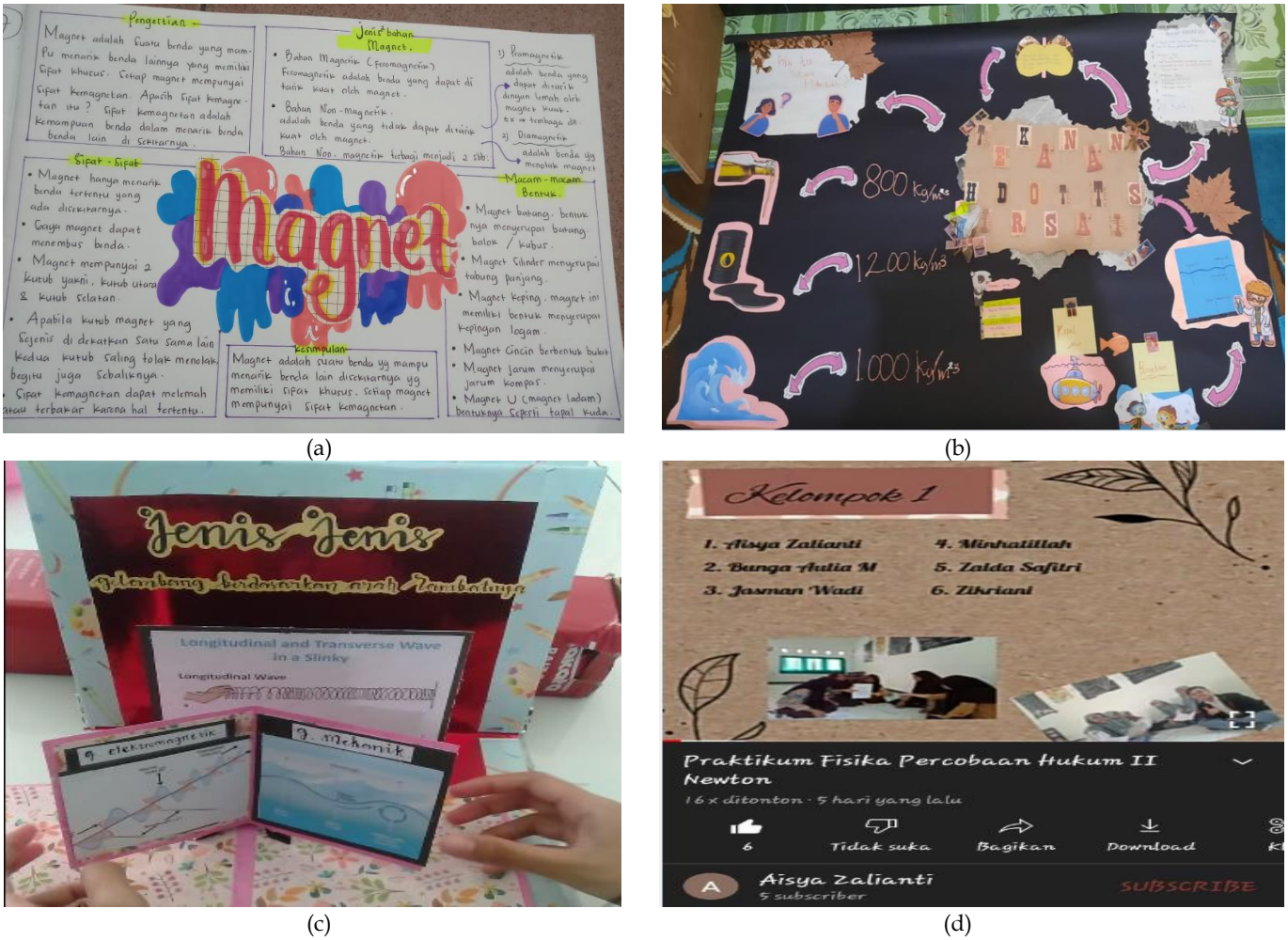
Result and Discussion

Implementation of Project-Based Learning

The project-based learning model is a good model used by teachers to support the physics learning process. This learning model gives students the opportunity to learn not only in the school environment but also in the home environment with group members. Researchers use this model because there have been many previous studies that prove that applying a project-based learning model can improve several skills in students. These skills include critical thinking (Husna et al., 2024), creative thinking (Octaviyani et al., 2020), problem solving (Muslim, 2017), and scientific literacy (Rizkamariana et al., 2019). Of course, by being able to grow or train some of these skills, it will indirectly have an impact on student physics learning outcomes.

The physics learning process at MA Plus Nurul Islam Sekarbela was carried out at three levels, starting in grades 10, 11, and 12. The research was conducted in all science major classes to measure the overall picture related to the 4C abilities that exist in students, with a total of 84 students. The stages passed by students in the physics learning process with project-based learning models include: 1). Start with the essential question, 2). Design a plan for the project, 3). Create a schedule, 4). Monitor the student and the progress of the project, 5). Assess the outcome, and 6). Evaluate the experience (Faozi et al., 2020; Ismathulhuda et al., 2022; Setiawan et al., 2020).

Implementation of learning with this model can bring up 4C skills because the stages carried out by students as a whole involve them, so that the center of learning is in the students. This involvement even arises when the teacher designs and determines the topics of projects carried out by students (Nurfitriyanti, 2016; Utami et al., 2015). Therefore, this model is able to represent that learning physics is designed, implemented, and useful for students (Fatimah et al., 2021; Rizaldi et al., 2020). The following are some of the products produced by students after using the project-based learning model.



(a) (b) (c) (d)

Figure 1. Various products in physics learning such as a). Mind mapping, b). Posters, c). Pop up book, and d). Tutorial video

4C Skills in Learning Physics

Critical Thinking Skills

Critical thinking is a high-level thinking skill possessed by a person and is used to be able to analyze various problems faced. Critical thinking has a difficulty level that is in categories C4–C6 according to Bloom's taxonomy, which is known as high-order thinking (Acesta, 2020; Jiwandono, 2020). This condition illustrates that having critical thinking skills is not easy but can be obtained instantly. By learning and getting used to thinking critically, one of the benefits is that it is not easy to accept various pieces of information that are obtained without an assessment process related to their truth. This is one of the skills that are really needed in these times, especially with regard to digital information technology, which is increasingly accessible to all parties, including children (Rizaldi et al., 2021).

The information circulating, especially at the youth level, namely in the middle school age range, is very difficult to limit because of the current culture that requires every child to use a communication device such as a smartphone. To familiarize students with the positive use of utilizing existing technology, researchers use smartphones as supporting learning resources during the physics learning process. One form of the teacher's efforts to minimize the negative impact on students is by cultivating various good behaviors, especially in utilizing technology. Based on the critical thinking skills test that has been carried out, the following is the percentage of each indicator owned by students.

Based on Table 4, it can be seen that the highest critical thinking skill category is owned by students, namely the explanation indicator with an average value

of 79.00, while the evaluation indicator is in the lowest group with an average value of 62.00. The use of the average value as a reference in categorizing critical thinking skills is appropriate because, of course, each student has strengths in each category. Therefore, to be able to represent the critical thinking skills possessed by students during the physics learning process.

Table 4. Data on Students' Critical Thinking Skills

Indicator	Average Value	Category
Interpretation	78.00	High
Analysis	67.00	Medium
Evaluation	62.00	Low
Inference	74.00	Very High
Explanation	79.00	Very High
Average	72.00	High

The indicator explaining that it has the highest average value illustrates that MA Plus Nurul Islam Sekarbela students have advantages in the process of explaining or describing a phenomenon based on the data that has been obtained both during the information literacy process and when conducting discussions with their respective group mates. The ability to explain is an important indicator that students can use in communicating scientifically, especially with regard to physics concepts (Supeno et al., 2017; Widianingtiyas et al., 2015). Many students have high academic abilities, but it is very difficult to be able to convey their knowledge or understanding to others. This is of course due to the limited ability to explain context, which is quite low. Apart from referring to the ability to explain, based on the test results, it was found that the ability to evaluate students was still quite low compared to other indicators of critical thinking skills.

Evaluation is the ability to assess information that has been previously collected. This capability is one of the tools for determining whether or not various data that has been obtained through the previous process is used as a reference in explaining new information (Susilowati et al., 2021). In addition, with good evaluation skills in students, it is hoped that they will be able to take action and detect if something goes wrong during the process of solving physics problems. After the error is found, a corrective solution will be obtained so that the conclusions that will be drawn are closer to the truth.

Creative Thinking Skills

Creative thinking is a high-level thinking pattern that is in the same group as critical thinking skills. Creative thinking provides opportunities for students to be able to find various solutions to solving a problem. Creativity is a major factor that students must have in developing this skill. There are four indicators of creative thinking that are measured by researchers in the physics learning process, including

Table 5. Data on Students' Creative Thinking Skills

Indicator	Average Value	Category
Fluency	72.00	Creative
Flexibility	73.00	Creative
Originality	64.00	Fairly Creative
Elaboration	68.00	Creative
Average	69.00	Creative

The description of creative thinking skills developed or adapted by the author is as follows: (1) Indicators of fluency illustrate that students have a tendency to generate lots of relevant ideas, are able to increase their enthusiasm for learning for themselves or their friends around them, and have a good flow of thoughts. (2) The indicator of flexibility illustrates that students can generate the same ideas under a variety of different conditions after the development process is carried out, are able to change perspectives on a problem, and tend to have different thoughts from the answers that generally appear in a problem solving exercise. (3) The indicator of originality illustrates that students are able to produce ideas that are unusual, different from other friends, and are rarely raised by many other children. (4) The indicators of elaboration illustrate that students are able to develop, add to, and enrich an idea, explain a particular context in detail, and expand an idea.

Based on Table 5, it can be seen that students of MA Plus Nurul Islam Sekarbela have creative thinking skills with an average score of 69, so if it refers to the category used, students majoring in Science at MA Plus Nurul Sekarbela are included in the creative category. Of the four indicators of creative thinking, it can be seen that originality is still the lowest when compared to the other indicators. This can be seen during the learning process, where students are still unable to develop an opinion or answer that comes purely from their own style of language. Students are still oriented toward answers sourced from various literature, such as textbooks and the internet. However, if you look at the category, it still falls into a group with a creative category. Physics learning that addresses various contextual problems is certainly one of the parts that allows answers to be obtained from various contexts. The solution must be able to be studied and observed by students from the perceptions of other fields so that various kinds of arguments will appear to be able to produce answers with a high degree of truth.

The demands of learning physics, especially in mastering creative thinking skills, are basically one of the efforts to be able to create human resources who have an open mindset towards a problem. This is to make it possible not to depend on a particular pattern so

as to rule out the possibility of another input that might give better results. This is also related to later, when students carry out the process of collaboration in a learning environment in class. With creativity, various products will be produced; in this case, they can be in the form of ideas or student work that become inspiration for other learning disciplines.

Collaboration Skills

Working together is one of the characteristics of cooperative learning, where learning is designed to be carried out in the form of study groups. This type of learning is applied in almost all subject areas, including physics, where the researcher uses a project-based learning model. One of the advantages that researchers point to when implementing cooperative learning is the impact it produces. If learning is carried out independently, it is certain that the skills that develop are only limited to individual abilities, such as academics, but if learning is carried out in groups, then various skills can be developed by students, such as collaboration, knowledge, communication, etc. In this study, there are four indicators that are the focus of researchers in the physics learning process: accepting responsibility, helping each other, respecting the opinions of others, and respecting the work of others.

Of course, to measure these four indicators, instruments are needed, so in this case, the researcher uses observation sheets that are used when the physics learning process is carried out, especially at the discussion stage or when carrying out experimental activities. The following are the results of the categories of student collaboration skills during the physics learning process at MA Plus Nurul Islam Sekarbela.

Figure 2. Forms of student cooperation in completing physics projects

Based on the table above, it is found that the skills of cooperation between MA Plus Nurul Islam students are included in the good category, with the highest score found in the indicator of help each other with a value of 87.00. Collaboration is indeed a skill that emerges within students from an early age. This is certainly different from the other three skills of the 21st century. From an early age, students are used to playing together in their environment, so indirectly these skills grow and develop directly as they get older. This can also be seen in the physics learning process that uses a project-based model. The use of this model further encourages students not only to believe in themselves but also to trust their group mates, both in terms of finding and solving problems.

Table 6. Student Cooperation Skills Data

Indicator	Average Value	Category
Willing to accept responsibility	70.00	Pretty Good
Helping each other	87.00	Very Good
Respecting the opinions of others	82.00	Good
Respecting the work of others	77.00	Good
Average	79.00	Good

Communication Skills

Communication skills are a person's ability to convey meaning or information that is owned by other people with a specific purpose. To measure communication skills, researchers used indicators developed by Rahmawati et al. (2021), namely collecting information from other people's opinions and presenting information in the form of images or graphics. The following is data on the communication skills category of students majoring in science at MA Plus Nurul Islam Sekarbela.

Table 7. Student Communication Skills Data

Indicator	Average Value	Category
Collecting information from other people's opinions	81.00	Good
Presenting information in the form of images or graphics	84.00	Good
Average	82.00	Good

Based on the table above, it can be seen that the students of MA Plus Nurul Islam Sekarbela fall into the good category in terms of communicating both to collect and convey data. These two indicators are generally able to represent students' skills in obtaining and informing others of various data or findings learned in the physics learning process. One activity that describes students' communication skills when the physics learning process takes place is the activeness between group members in seeking information, either from their own group or from other groups.

Students do not hesitate to ask questions regarding the difficulties encountered during the ongoing discussion process. Every opinion expressed by other people will be used as a reference to examine the truth of the problem at hand. In addition, it also appears that students confidently report or present the results of

group discussions that have been carried out in front of other groups. Of course, good communication skills cannot be separated from the conditions of a class, which in general can be said to be conducive if there are no problems that occur between classmates or other problems that affect the learning situation in class. But do not rule out the possibility of active communication in what will appear to be noisy classroom conditions. It is in this situation that the teacher's role is to be able to manage the learning process so that students stay on the right track, namely by discussing and finding solutions to the problems they are facing.

Figure 3. Product presentation from project

Based on the description above, the following table provides an overview of the 4C skills possessed by students majoring in science at MA Plus Nurul Islam Sekarbela during the physics learning process.

Table 8. Comparison of Students' 4C Skills

Skills	Value	Category
Critical Thinking	72.00	High
Creative Thinking	69.00	Creative
Collaboration	79.00	Good
Communication	82.00	Good

Based on Table 8, it can be seen that among the 4C skills, which are a benchmark for the achievement of the learning process in the 21st century, MA Plus Nurul Islam Sekarbela students have a higher value of communication skills than other skills. Meanwhile, creative thinking is the skill with the lowest score.

Conclusion

The physics learning process that occurs at MA Plus Nurul Islam is basically designed and implemented to be able to introduce and improve 4C skills, especially in the process of solving existing problems. One of the efforts to improve these skills is by using a project-based learning model. Based on the research data, it was found that communication skills were the skills with the highest scores possessed by students majoring in Science at MA Plus Nurul Islam Sekarbela, while creative thinking was the skills with the lowest scores.

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The authors declare no conflict of interest.

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