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[Research Article]

WHAT ARE STUDENTS' LEVELS OF COMMUNICATION AND COLLABORATION SKILLS THROUGH PROBLEM-SOLVING LEARNING?

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ABSTRACT

This study aims to analyze the collaboration and communication skills of Madrasah Aliyah students in physics. This research was conducted in one of the private Madrasah Aliyah in Garut Regency with the method used as a descriptive quantitative method. The sample in this study was 15 students of class XI IPA who were selected by random sampling technique. The instruments used in this study were observation sheets, a questionnaire of peer assessment and self-assessment questions adapted to indicators of collaboration and communication skills from the P21 Buck Institute of Education in problem-solving learning activities. The findings show significant data differences between the results of peer and student self-assessments, which are then analyzed in more depth with teacher observation data as a comparison. Based on the results of the analysis of, the main factors that influence students' collaboration and communication skills are the level of self-confidence and students' reading habits.

Keywords: *21st Century Skills, Assessment, Problem-Solving Learning*

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1. INTRODUCTION

Education is a parameter used to measure the quality of a country's human resources. A good education can be defined by a curriculum structure that applies to all learning processes (Silber-Varod et al., 2019; Dakhi et al., 2020). An excellent curriculum accomplishes ideas, critical-creative thinking, and communication, collaboration skills in students as the main themes of human resource development (Anisa, 2022; Winch, 2023).

Education is basically an attempt to teach people to be fully human (Anugerahwati, 2019; Ahmad et al ., 2019). Conceptually, national education is a key factor in determining a country's progress. Today's globalized political, social, and economic systems combined with the rules of competitive markets have led to tremendous growth in science, industrial management, and information and communication technology (ICT), with a significant impact on educational institutions. Over the past two decades, educators around the world have faced the challenge of preparing students for survival in the 21st century (Anugerahwati, 2019; Agmita et al., 2021; Knobel et al., 2022; Jumriani & Prasetyo, 2022).

During this period, the goals set for each educational system are of considerable importance. This includes the subjects of study, the skills and competencies to be developed, and the infrastructure needed to support learning activities in schools. The aim of the current education system is to improve the quality of society against a scientific, personal, economic and sociocultural perspective (Knobel & Reisberg 2022; McMahon, 2020). This constitute a need for educators to provide students with a holistic education that emphasizes life skills such as communication, collaboration, creativity and critical thinking (Anugerahwati, 2019; Ahmad et al, 2019; Rafik et al. al, 2022; Powell, 2021; Knobel et al., 2022).

Among the many skills that students must acquire in order to survive in society, collaboration and communication skills are the ones that get less attention. This is very disappointing given how many businesses and government agencies expect their employees to collaborate and communicate. Collaborative skills are the skills of working with others, such as showing ability to work effectively, respecting differences of opinion, and compromising with the team to achieve common goals (Di Marco et al, 2021). On the other hand, communication skills are the skills of communicating ideas and ideas both verbally and in writing.

In addition, communication skills include the ability to listen effectively and explain meaning, the ability to use communication for a variety of purposes (informing, directing, motivating, persuading, etc .), and the ability to effectively use a variety of media and technologies. It is also defined as the ability to speak, and the ability to speak multiple languages (Kusumawati et al, 2015; Anugerahwati, 2019; Powell, 2021).

Based on this problem, in an effort to train collaboration and communication skills students, supporting learning activities are carried out, one of which is problem-solving learning. Problem solving is one of the activities that can train collaboration and communication skills. Problem solving requires an active role and students' thinking skills. Problem-solving learning requires students to be able to analyze material, from searching data to drawing conclusions (Gaigher, 2007; Gustafsson et al., 2015; Williams, 2018; Agmita et al., 2021).

Problem solving learning meets the 21st century skill requirements, including communication and collaboration (Tambunan, 2019; Rios et al., 2020). According to Faiz & Purwati (2021), the emergence of independent learning in Indonesian education is part of overall educational development. A general education that, when implemented, provides students with opportunities for cooperation between scientific disciplines. Thus, the existence of autonomous learning is a form of coping with the challenges of the 21st century through cooperation between scientific disciplines. A problem-solving model of learning is a learning model that focuses on finding solutions and concludes that students can improve their thinking skills by developing new problem-solving methods, strategies, or techniques (McMahon, 2020; Syafrl, 2021) .

There are several stages in problem solving learning activities, including: 1) understanding the problem, 2) making plans, 3) implementing plans, and 4) re-examining the solutions that have been obtained (Gaigher, 2007; Gustafsson et al, 2015; Williams, 2018; Polya, 2020). Stages of problem solving learning can facilitate students to collaborate in solving problems and also convey ideas resulting from group deliberations. Based on this background, this study aims to analyze students` collaboration and communication skills in problem-solving learning activities.

2. METHOD

The method used in this study is a descriptive quantitative method which aims to create an objective description or description of a situation using numbers, starting from data collection, interpretation of the data as well as the appearance and results (Fraenkel & Wallen, 2009).

2.1 Population and Sample

The population in this study was 147 students at MA Al Jauhari with 15 students randomly selected as sample. The instruments used in this study were peer collaboration and communication skills questionnaires, self-assessments, and teacher observation sheets. There are six indicators used in this study consisting of three indicators of collaboration skills and three indicators of communication skills adapted from Partnership21.

2.2 Data Collecting

The data for this study are the scores of the peer assessment questionnaire and the self-assessment of each indicator. The results of the self-assessment questionnaire answers will be compared with the results of teacher observations and the results of peer assessments. The three data from questionnaires and observations were compared and analyzed for the correlation between the three. The data obtained from the research results were processed and analyzed quantitatively, then described descriptively.

The research was carried out for approximately one semester. In practice, students were given problems to solve according to the concepts to be studied. Before being given problems, students were asked to read books and sources relevant to the material in the learning process. The topics chosen in this study are center of gravity, elasticity, thermodynamics, and fluid statics. The research flow is presented in Figure 1 below:

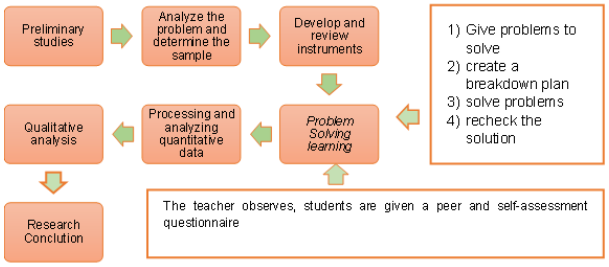

Figure 1. Research flow

In problem solving learning activities, teachers evaluate students' collaboration and communication skills according to the title of the observation sheet. The observable indicators of collaboration skills include: 1) responsibility for the group; 2) group help; and 3) respect other members. The indicators of communication skills observed based on P21 include 1) use of different media; 2) communicating thoughts and ideas; and 3) language skills. These six indicators are observed at each meeting. In addition to the observer's observations, data on collaboration and communication skills were also collected from the evaluations of friends and themselves. Survey data is processed on a percentage basis to get correlations both data (observation, peer, and self-assessment). Table 1 show the rubrics which is developed to analyze students' collaboration and communication skills according to Buck Institute of Education BIE.

Table 1. Collaboration and Communication Rubric

Individual Performance	Levels			Aspect
	Below Standard	Approaching Standard	At Standard	
Takes Responsibility for Oneself	• is not prepared, informed, and ready to work with the team • does not use technology tools as agreed upon by the team to communicate and manage project tasks • does not do project tasks • does not complete tasks on time • does not use feedback from others to improve work	• is usually prepared, informed, and ready to work with the team • uses technology tools as agreed upon by the team to communicate and manage project tasks, but not consistently • does some project tasks but needs to be reminded • completes most tasks on time • sometimes uses feedback from others to improve work	• is prepared and ready to work; is well informed on the project topic and cites evidence to probe and reflect on ideas with the team • consistently uses technology tools as agreed upon by the team to communicate and manage project tasks • does tasks without having to be reminded • completes tasks on time • uses feedback from others to improve work	Collaboration
Helps the Team	• does not help the team solve problems; may cause problems • does not ask probing questions, express ideas, or elaborate in response to questions in discussions	• cooperates with the team but may not actively help it solve problems • sometimes expresses ideas clearly, asks probing questions, and elaborates in response to	• helps the team solve problems and manage conflicts • makes discussions effective by clearly expressing ideas, asking probing questions, making sure everyone is	Collaboration

Individual Performance	Levels			Aspect
	Below Standard	**Approaching Standard**	**At Standard**	
	• does not give useful feedback to others • does not offer to help others if they need it	questions in discussions • gives feedback to others, but it may not always be useful • sometimes offers to help others if they need it	heard, responding thoughtfully to new information and perspectives gives useful feedback (specific, feasible, supportive) to others so they can improve their work • offers to help others do their work if needed	
Respects Others	• is impolite or unkind to teammates (may interrupt, ignore ideas, hurt feelings) • does not acknowledge or respect other perspectives	• is usually polite and kind to teammates • usually acknowledges and respects other perspectives and disagrees diplomatically	• is polite and kind to teammates • acknowledges and respects other perspectives; disagrees diplomatically	Collaboration
Explanation of Ideas & Information	• does not present information, arguments, ideas, or findings clearly, concisely, and logically; argument lacks supporting evidence; audience cannot follow the line of reasoning • selects information, develops ideas and uses a style inappropriate to the purpose, task, and audience (may be too much or too little information or the wrong approach) • does not address alternative or opposing perspectives	• presents information, findings, arguments and supporting evidence in a way that is not always clear, concise, and logical; the line of reasoning is sometimes hard to follow • attempts to select information, develop ideas and use a style appropriate to the purpose, task, and audience but does not fully succeed • attempts to address alternative or opposing perspectives, but not clearly or completely	• presents information, findings, arguments and supporting evidence clearly, concisely, and logically; the audience can easily follow the line of reasoning • selects information, develops ideas and uses a style appropriate to the purpose, task, and audience • clearly and completely addresses alternative or opposing perspectives	Communication
Organization	• does not meet requirements for what should be included in the presentation • does not have an introduction and conclusion	• meets most requirements for what should be included in the presentation • has an introduction and conclusion, but they are not clear or interesting	• meets all requirements for what should be included in the presentation • has a clear and interesting introduction and conclusion	Communication

Individual Performance	Levels			Aspect
	Below Standard	Approaching Standard	At Standard	
	• uses time poorly; the whole presentation, or a part of it, is too short or too long	• generally, times presentation well, but may spend too much or too little time on a topic, a/v aid, or idea	• organizes time well; no part of the presentation is too short or too long	
Technology Skill	No tech Skill	Proficient in using one of the technologies to assist groups in completing projects	Proficient in selecting and using various technologies to assist groups in completing projects	Communication

3. RESULT AND DISCUSSION

3.1 Result

Collaboration and communication ability in this study were obtained from observations using observation sheets and questionnaires. Collaborative skills in this study are limited to indicators of group responsibility, team support and respect for others. Based on the processing results, we found that the percentage of students' collaboration skills increased with each meeting. Based on the results of the research, the presentation of students' collaboration and communication skills differs depending on the instruments used either peer, self, or observation, for more details presented in tables 2 and 3.

Tables 2 and 3 show the percentages for each indicator of student collaboration and communication skills at each meeting. Based on the data in the table, the percentage increase is at an excellent level for each indicator at each meeting for both collaboration and communication skills. This applies to peer and self-assessment data as well as observations, except for the self-assessment data for the first indicator of collaboration skills, namely contributing in groups by searching for various relevant sources before learning activities take place

Table 2. Percentage of Communication Skills for each Indicator

Levels	Type	Center of gravity			Elasticity			Thermodynamics			Fluid		
		Indicator			Indicator			Indicator			Indicator		
		1	2	3	1	2	3	1	2	3	1	2	3
Excellent		7%	13%	27%	7%	20%	40%	13%	47%	53%	20%	60%	53%
Good	Peer	53%	67%	53%	87%	80%	53%	87%	53%	47%	80%	40%	47%
Lack		40%	20%	20%	7%	0%	7%	0%	0%	0%	0%	0%	0%
Excellent		7%	13%	27%	7%	20%	40%	13%	47%	53%	20%	60%	53%
Good	Self	53%	67%	53%	87%	80%	53%	87%	53%	47%	80%	40%	47%
Lack		40%	20%	20%	7%	0%	7%	0%	0%	0%	0%	0%	0%
Excellent		7%	27%	33%	20%	33%	33%	20%	40%	40%	27%	67%	40%
Good	Observation	93%	47%	27%	80%	47%	60%	80%	60%	47%	73%	33%	53%
Lack		0%	27%	40%	0%	20%	7%	0%	0%	13%	0%	0%	7%

Table 3. Percentage of Collaboration Skills for each Indicator

Levels	Type	Center of gravity			Elasticity			Thermodynamics			Fluid		
		Indicator			Indicator			Indicator			Indicator		
		1	2	3	1	2	3	1	2	3	1	2	3
Excellent		0%	27%	33%	13%	27%	33%	13%	27%	33%	20%	40%	60%
Good	Peer	60%	53%	67%	73%	67%	67%	67%	67%	53%	80%	60%	40%
Lack		40%	20%	0%	13%	7%	0%	20%	7%	13%	0%	0%	0%
Excellent		7%	27%	27%	27%	33%	100%	7%	40%	40%	20%	33%	40%
Good	Self	87%	67%	67%	73%	67%	0%	93%	60%	53%	67%	67%	60%
Lack		7%	0%	0%	0%	0%	0%	0%	0%	7%	13%	0%	0%
Excellent		7%	27%	13%	7%	27%	27%	20%	40%	40%	20%	47%	53%
Good	Observation	20%	33%	87%	40%	67%	73%	40%	53%	53%	53%	47%	47%
Lack		73%	40%	0%	53%	7%	0%	40%	7%	0%	27%	7%	0%

3.2 Discussion

At the first meeting, the focus material was 7% of students in the Excellent category, and then it increased to 27% in the next meeting, namely elasticity material. However, at the third meeting, the percentage for the excellent category returned to 7%, to be precise, in thermodynamic materials; then, the percentage again increased to 20% at the fourth meeting on fluid matter.

Indeed, there is a considerable time interval between the third encounter for thermodynamic materials and the second encounter for elastic materials. This time frame is the reason why students return unprepared without preparing materials that allow them to be used during class problem-solving (Tokan & Imakulata, 2019; Jia et al., 2020), which is consistent with the results of teachers' interviewing students.

In addition, another conjecture is that students` learning styles tend to prefer to try and learn from projects (trial and error) rather than reading and seeking information and then trying (Astutik & Nuraini, 2021; Syafril et al., 2021). This learning style allows students to contribute to their groups but does not dig deeper information through reading (Sadiah, 2021; Yanti et al, 2021; Khori et al, 2021).

This learning style causes students to be at a good level on indicators of being responsible for groups in collaboration skills (Khori et al., 2021; Suseno, 2020). This is in accordance with the data in table 2 that 93% of students are in the good category for one skill indicator collaboration. From this data, it can be concluded that learning that requires group collaboration, such as problem-solving and laboratory activities, can train students' communication and collaboration skills (Di Marco et al, 2009; Malik & Ubaidillah, 2021; Zhang & Hwang, 2022).

Problem-solving learning activities provide opportunities for students to learn to solve problems in groups by carrying out a series of activities starting from planning, implementing, and also concluding (Kusumawati et al., 2015; Makiyah et al., 2021; Alt & Raichel, 2022; Zhang & Hwang, 2022). The stages of problem-solving learning allow students to communicate ideas for problem solving solutions and use various media (McMahon, 2020; Powell, 2021; Syafril et al, 2021).

In addition, language skills and an understanding of physics greeting symbols are also needed in problem-solving learning activities, so this method is recommended in learning activities (Di Marco et al., 2009; Zhang & Hwang, 2022; Alt & Raichel, 2022). Figures 2 and 3 show the average research

data for collaboration and communication skills.

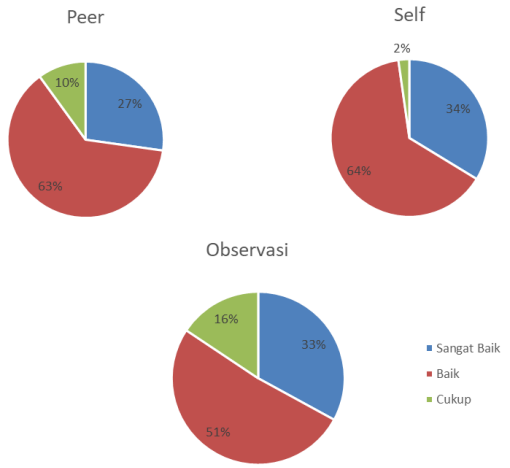

Figure 2. Average Percentage of Collaboration Skills

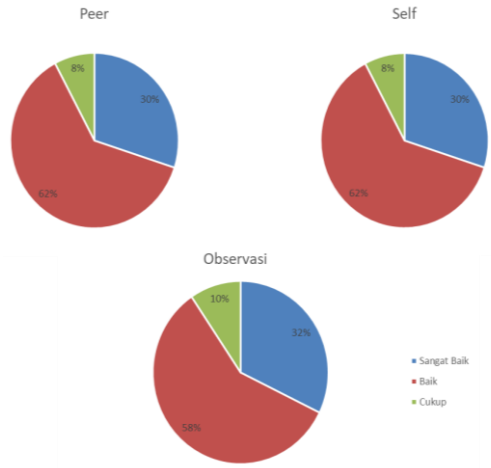

Figure 3. Average Percentage of Communication Skills

Based on Figure 2, most students have good category collaboration skills with a percentage above 50%, both from peer and self-assessment results, as well as from observation results. Likewise, the results of the percentage of communication skills presented in Figure 3 show that most students have communication skills in the good category, followed by the excellent category at more than 30%, and finally in the adequate category with a percentage of no more than 10%.

Overall, both the peer, self and observation results show consistent data. To be more accurate, the authors conducted a Spearman correlation test with the help of the Xlstat2019 application. The results show that there is a positive correlation between the three data, both peer-assessment and self-assessment, self-assessment with observation, and observation with peer-assessment. The use of these three types of assessment can assist teachers in assessing students more objectively, efficiently, and integrative (Fallows & Chandramohan, 2001; Spiller, 2012; Harris & Brown, 2013; Alt & Raichel, 2022).

The findings from this study include several factors that can influence students` collaboration and communication skills, including reading habits, student self-confidence, environmental factors, insight and knowledge and learning methods at school and home (Anugerahwati, 2019; Ahmad et al., 2019; Powell, 2021; Knobel & Reisberg, 2022; Malik, & Ubaidillah, 2021; Owens & Hite, 2022). Therefore, to improve students' collaboration and communication skills, learning activities in schools should adopt supportive methods, such as problem-based learning, project-based learning, STEM, contextual learning, and other student-centered learning.

4. CONCLUSION

Based on the results of the analysis, the communication and collaboration skills of MA Al-Jauhari students are mostly in the good category and problem-solving learning is suitable for practicing collaboration and communication skills. As for the use of peers, self-assessment and observation can provide a more accurate level of students` collaboration and communication skills. Other findings are factors that can affect collaboration and

communication skills, such as learning style, reading habits, and environment. In addition, a student-centered learning approach should be adopted in 21st-century skills training.

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