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Needs Analysis of STEM-PjBL based IPAS E-LKPD Development to Support Student Collaboration Skills

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Abstract: Implementing STEM-PjBL in elementary schools requires supporting facilities so that the learning process can run effectively. Therefore, this research aims to analyze the need for STEM-PjBL based E-LKPD to support students' collaboration skills. The research method used in the research uses a qualitative descriptive method. The subjects in this research consisted of 1 teacher and 75 class IV students at one of the SDITs located in West Bogor, with data collection techniques using questionnaires with a 1-4 Likert scale, interviews, and documentation studies. The data obtained is then analyzed and synthesized to conclude. The research results show that the LKPD used in schools does not fulfill the components of making LKPD well, there needs to be innovation in the appearance of the LKPD used, and students rarely carry out project-based learning in groups. Therefore, STEM-PjBL based Science E-LKPD is very necessary, one of which is to support students' collaboration skills.

Keywords: Student Worksheets, Science Learning, STEM-PjBL Learning, Collaboration Capabilities.

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A. INTRODUCTION

In today's era of globalization and advances in information technology, 21st-century learning has become very important in response to the demands of an increasingly complex and globally connected world. In this context, 21st- or 4th-century learning skills involving creative thinking, critical thinking and problem-solving, communication, and collaboration skills play a very important role (Tohani & Aulia, 2022). The success of achieving 21st-century proficiency is strongly linked to the role and ability of educators in designing lesson plans that are integrated with activities focused on the 4Cs (Kim et al, 2019). The importance of 21st-century skills is increasingly evident when it comes to learning natural sciences (science). The integration of 4C skills in science learning aims to provide a deeper and more applicable understanding to learners and develop collaboration skills to solve diverse problems they face in everyday life.

Collaboration Skill It is a social and interpersonal skill that enables individuals to cooperate with others effectively. Lase (2019) states that collaborative skills are needed now and in the future. This ability involves the ability to communicate and cooperate, which is needed in the social life of students. Efforts to support the ability to cooperate between students can be made through the implementation of group practicums. In harmony with

Nahar et al (2022), the practicum encourages students to be able to work together in observation activities and group discussions during the practicum. In the context of learning in schools, planning must be done creatively and innovatively so that learning activities can be designed to develop the ability to collaborate from an early age. Ajria et al (2018) identified several problems related to the ability to collaborate with elementary school students; one of the problems expressed was the low quality of coordination among group members when participating in problem-solving tasks.

Student collaboration ability is still low, special attention and efforts are needed to support collaboration ability in students. This is related to one of the current independent curriculum policies, namely encouraging character strengthening carried out through the implementation of project-based learning, especially in strengthening the profile of Pancasila students (Nurhayati et al, 2022). Students are encouraged to develop positive character, and the entire learning process is directed to shape student character. Providing space for students to not only develop knowledge but also social skills encourages students to work together. The Merdeka curriculum has been updated by combining the learning of Natural Sciences (IPA) and Social Sciences (IPS) into a single unit known as IPAS (Natural and Social Sciences), the implementation of which is given to each class teacher whether combined or separated in each semester (Suwaji et al, 2023). Science learning can be innovated with STEM-PjBL learning.

STEM (Science, Technology, Engineering, and Mathematics) is an educational approach that integrates learning across four disciplines Science, Technology, Engineering, and Mathematics (Tseng et al, 2013). In Indonesia, the implementation of STEM at the elementary school level is still low, with a percentage of 18.18% (Khotimah et al, 2021). While PjBL (Project-Based Learning) involves learning that involves learners in real projects where participants are expected to have tasks or challenges to complete (Simbolon & Koeswanti, 2020). STEM education with the Project-Based Learning (PjBL) method invites students to be active in the learning process and allows students to communicate and share discoveries with friends. Through STEM-based learning, the character of students can be formed with the ability to recognize concepts or knowledge (science) and apply that knowledge with skills in the field of technology. Students are invited to create or design a way (engineering) by analyzing and referring to mathematical data calculations (mathematics) to solve problems (Triana et al, 2020). In STEM-PjBL-based learning, learners not only understand academic concepts but also develop critical skills such as creative thinking, collaboration, communication, and problem-solving (Triprani et al, 2022; Tyas et al, 2021).

In the implementation of science learning, students still face challenges in understanding abstract concepts, therefore innovation is needed from teachers in presenting learning materials that are to the needs and development of students and education. According to research from Marshel & Ratnawulan (2020) Student worksheets (LKPD) are one of the tools that can support the implementation of science learning. LKPD is a very useful tool to direct the learning process by providing an organized structure so that students can more effectively and efficiently understand learning material and involve themselves in planned learning activities (Al Faruq et al, 2023). The use of Student worksheets (LKPD) is expected to provide significant support in the learning process and can increase student interest in learning

(Sianturi et al, 2021). However, the reality on the ground shows that most LKPD used in schools does not integrate experiments, demonstrations, or discussions. Research Istiqomah (2021) states many teachers tend to use conventional LKPD that is available instantly without the effort to plan, adjust, or create their own. The impact of this practice reflects the unattractiveness of LKPD, the lack of contextuality, and the impression of being boring, monotonous, and not by the needs of learners.

This is in line with the results of an interview with one of the grade IV teachers at SDIT Bogor City where the use of LKPD, especially those based on STEM-PJBL, has mostly never been developed and implemented by teachers. The use of LKPD still relies on manuals provided by educational centers and sources available on the internet so forms of activities and experiments in science learning are less innovative. This result was also reinforced by interviews with three students who showed that the worksheets used only contained short, colorless, and pictorial questions and rarely experimented and made a project, while students liked worksheets that were colorful and contained various media. As a result of these conditions, LKPD tends to be less attractive so students are less enthusiastic about learning (Finali et al, 2020). The presentation of LKPD needs to experience innovation, including the use of technology to improve the quality of learning, namely by developing E-LKPD. Mulyasari (2022) state that the use of E-LKPD can increase students' interest in learning. Based on environmental observations of one of the SDITs in West Bogor, 30 computer lab units are commonly used by students, and the SDIT is currently Developing digital learning. With supporting infrastructure conditions and a focus on developing digital learning, the e-LKPD development initiative in the school is considered very suitable. This can leverage existing technological resources and support the transformation towards more up-to-date learning.

Previous research, conducted by Endah & Hidayat (2022) explained that elementary schools require the creation of E-LKPD HOTS-based character education so that character education is not only taught in habituation but can also be integrated into learning. Research by Rakhman et al (2023) also revealed that the development of ESD-based E-LKPD on global warming material is needed for elementary school students as a support for teaching and learning activities. Sari (2023) state that teachers and students need E-LKPD based on Integrated STEM Integrated Problem Based Learning to stimulate critical thinking skills in solving problems, and Prabandari et al (2022) conclude that it is necessary to develop student worksheets that focus on science experiments as an essential companion book in the science learning process that is identical to practicum activities so that students can be trained in problem-solving and the ability to find concepts from the knowledge that has been learned. Based on the results of previous research, there are differences in the research to be conducted. The difference lies in the approach and form of learning. The research that will be carried out is an analysis of the development needs of E-LKPD IPAS based on STEM-PjBL to support the collaboration ability of elementary school students. The results of this research are expected to be the basis for the development of STEM-PJBL-based E-LKPD IPAS to improve student collaboration skills.

B. METHOD

In this study, researchers used descriptive and qualitative research methods. Qualitative descriptive research is a research approach used to describe and interpret certain phenomena, situations, or conditions by describing existing relationships and presenting developing opinions (Muzari et al, 2022; Rusandi & Muhammad Rusli, 2021). This research was conducted at one of the SDIT West Bogor. The purpose of this study is to determine the needs of students and teachers for the development of STEM-PjBl-based IPAS E-LKPD to support student collaboration skills. Data sources in this study are sourced from primary and secondary data. Primary data were obtained through informants in the study, namely one of the class IV homeroom teachers. Secondary data were obtained from documentation studies on mapping learning outcomes, implemented LKPD, and data supporting research.

The technique in obtaining data was carried out by conducting interviews with teachers and three students to find out the learning process of science and LKPD that was used specifically, then using questionnaires addressed to 75 students of grades IV A, B, and C given through Google Forms to see problems that occurred in the field with 15 questions using a Likert scale of 1-4 and documentation studies needed to sharpen research analysis related to the information in Get the results of interviews and questionnaires. The stages used in data analysis are data reduction, data display, conclusion, and verifying (Miles & Huberman, 1994). Starting with the data analysis of interview results, elaboration is carried out. After that, the interview and questionnaire data will be matched with existing documentation. The data obtained is used as a basis for an analysis of the development needs of STEM-PjBL-based E-LKPD to support student collaboration skills.

C. RESULTS AND DISCUSSION

The results of the research will be directed at several aspects, namely the analysis of the learning process and the analysis of the use of LKPD. Overall, this study resulted in the following discussion:

1. Learning Process Analysis

The learning process in several schools has now implemented an independent curriculum. The Merdeka Curriculum currently has a Pancasila student profile program as a form of character education (Rizaldi & Fatimah, 2022). The Pancasila student profile consists of six dimensions, namely: 1) faith, fear of God Almighty, and noble character; 2) independence; 3) cooperation; 4) global diversity; 5) critical reasoning; and 6) creativity (Romhaningsih et al, 2023). Collaboration is included in the element of cooperation, and at the end of phase B in the sub-element of cooperation, learners must be able to display actions that are in accordance with the expectations and goals of the group. Based on the results of the interview, the curriculum implemented at the SDIT school uses an independent curriculum. Teaching materials used in learning are sourced from student handbooks, teachers, and other sources that come from the internet and independent learning platforms in the form of text and non-text using erklika, and some make their own teaching materials. Making LKPD is developed by the teacher himself according to the needs of learning objectives, and worksheets are used per week or once a week according to learning outcomes. In learning, students rarely use E-LKPD, but the school facilitates it by providing a computer lab containing 30 units and wifi at

school. In science learning, students are more likely to use models of problem-based learning. And for now, teachers use the model of discovery. Guided and occasional use of models for project-based learning. Science learning in class IV in one semester consists of four materials. Here are the learning outcomes that need to be developed.

Table 1. Learning Outcomes of Science material

Learning Materials	Learning Access
Plants of life resources	Understand the parts of plants, how to care for and preserve plants around them.
The existence of things and their changes	Learners identify the process of transformation and its change in everyday life by creating an experimental project on how the transformation of objects occurs
Style and motion	Demonstrate different types of forces and their effects on the direction, motion and shape of objects
Energy around	Learners identify sources and forms of energy and explain the process of changing forms of energy in life everyday.

The teacher also noted the implementation of IPA learning with a model of project-based learning. It makes students more motivated to learn. The PjBL model encourages students to become more directly involved in research, experimentation, and problem-solving (Romhaningsih et al, 2023). Through teamwork in PjBL projects, students also learn to collaborate, communicate, and respect each other's contributions (Ismail et al, 2020). One of the obstacles to implementing project-based learning is that several groups have completed the project, some groups have not completed group tasks, and some groups make the project less optimal. Solutions to these obstacles require direction related to the implementation of tasks and an emphasis on meeting deadlines more intensively from teachers. Students have never carried out science learning activities using the STEM-PjBL approach. STEM learning is only introduced at the beginning of the semester, although theoretically, teachers have understood the concept of STEM in learning, in practice, its implementation is still in the exploration stage. In the STEM-PjBL approach, students are not only invited to understand scientific concepts in depth but also to work together on projects that demand active involvement and contribution from each group member (Siew & Ambo, 2020). Natural Science (Science) learning with a STEM-PjBL (Science, Technology, Engineering, and Mathematics-based approach) and project-based learning in elementary schools encourages the integration of science concepts with practical applications in everyday life. Learners not only understand scientific theories but also experience their application through interesting projects.

STEM-PjBL learning also opens up opportunities for the development of 21st-century skills, such as critical thinking, creativity, collaboration, and communication skills. Students engage in real problem-solving processes that require cross-disciplinary thinking. By engaging STEM elements, students can see the interconnectedness between science and the real world, increasing learners' understanding of the relevance of science subjects in a broader context. Thus, science learning using STEM-PjBL at the elementary school level needs to be applied. Collaboration skills are the cornerstone of creating learning environments similar to real-

world situations, where solving complex problems often requires cooperation between individuals with different skill sets. The level of collaboration ability of students in the classroom is in a developing stage because there are still students who choose to choose their group mates and do not do assignments. This was reinforced by the results of the student needs questionnaire, which showed students had difficulty working with groups. 61.3% strongly agreed, 10.7% agreed, 16% disagreed, and 12% disagreed. It can be interpreted that as many as 61.3% of students find it difficult to do the same work while doing tasks together with their friends. The results are described as follows:

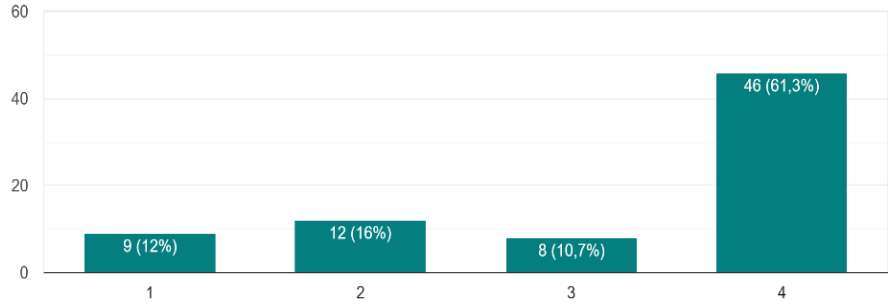


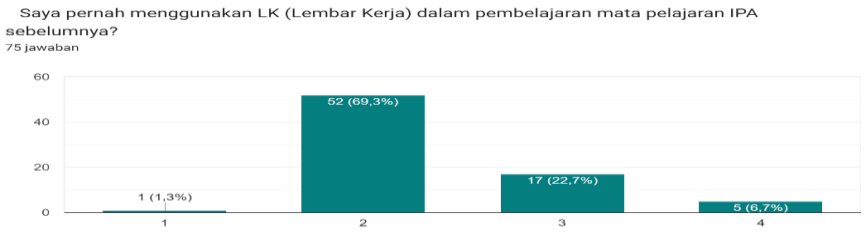
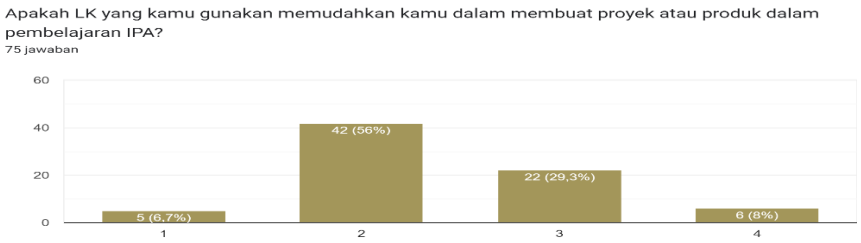
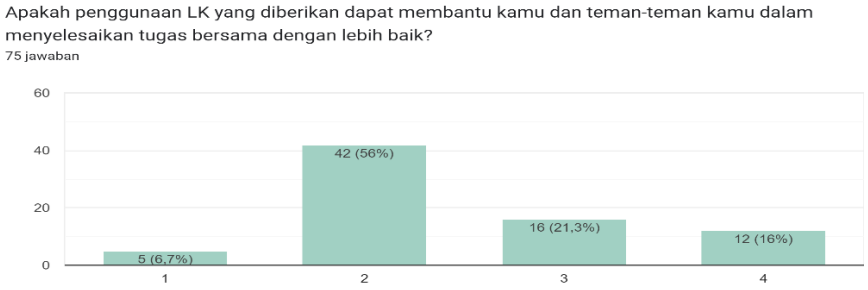
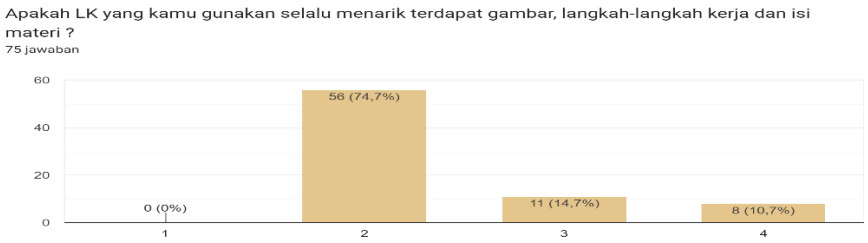
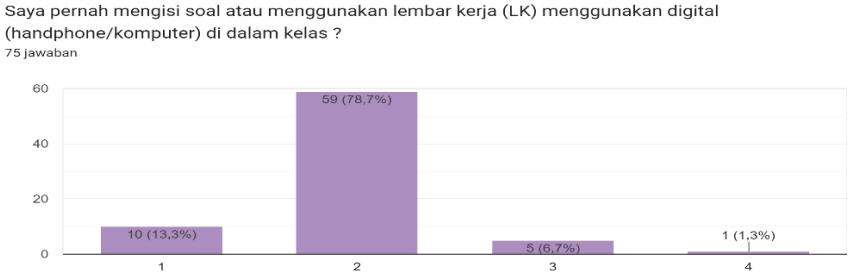
Figure 1. Percentage of difficulty students have in working together

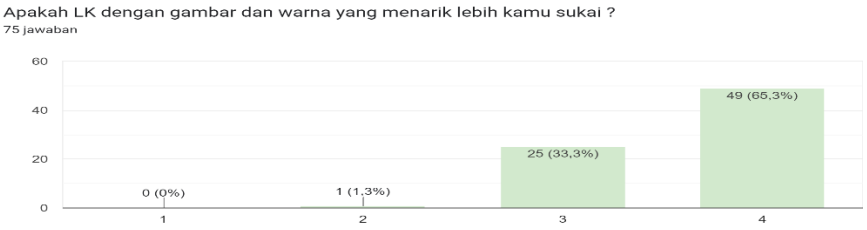
Students also experience difficulties in learning science, with a percentage of 42.7% of students liking to do experiments. 42.7%, in science learning, as many as 81.3% of students rarely make products or projects. Students also do not like group learning as much as 64%. Reinforced by interviews, three students stated that science learning fills more questions through books, rarely experiments or makes a product, and is less like group learning because some students do not participate in work and it is difficult to distribute tasks.

2. LKPD Usage Analysis

LKPD (Student Worksheet) has a crucial role in supporting science learning, especially when applying project-based learning models, STEM projects, problem-based learning, and others. Febriyanti et al. (2021) explained that through LKPD, students can be more actively involved in learning activities, run experiments, collaborate, and record observations or student analysis results. The use of LKPD in science learning helps structure directed learning, provides step-by-step guidance, and provides space for students to reflect on what they learn. Worksheets can also serve as an evaluation tool for teachers to monitor student progress and identify areas for improvement (Veldhuis, 2020). Overall, the use of LKPD in science learning provides a clear framework and supports interaction between teachers and students, thereby increasing learning effectiveness and ensuring that students achieve a deep understanding of concepts. It is important to create LKPD that supports learning with a display that increases student motivation and student engagement positively. One of the results of the needs questionnaire shows that students rarely use LKPD, and the LKPD used is less attractive. The following are the results of the questionnaire on the need to use LKPD.

Table 2. Results of the Needs Analysis Questionnaire on aspects of LKPD use

Questionnaire Results	Information
	Students rarely use LK with a percentage of 69.3% in science learning
	56% of students feel that the LK used is less helpful in making products
	56% of students find it difficult and the LK given is less helpful in working in groups
	As many as 74.7% of students stated that the LK used was less attractive
	78.7% of students rarely fill out questions using computer devices

	50.7% of students really like doing assignments with digital devices
	65.3% of students prefer LK with attractive images and colors

The results of the questionnaire were reinforced by interviews with teachers and students. 70.7% of students stated that the LK used was less attractive, based on interviews with students who rarely used LK, not every day students used LK, and the LK used did not contain images, only text and no color, and 69.3% of students rarely used LK and rarely made a product. This was also revealed by teachers, who have never developed STEM-PjBL-based LKPD, only LKPD containing student experiments. In developing LKPD, teachers first determine the criteria for achieving learning objectives, starting with prerequisite competencies, competencies that must be achieved, and advanced competencies. After determining the criteria or indicators, it will be easier for teachers to create an LKPD that can measure learning competencies for students. In tune with that, Desrinelti & Miaz (2022) state the initial step in developing LKPD, namely determining achievements, indicators, and learning objectives. The teacher stated that LK can support collaboration skills because it contains group identity. There is a project that helps students form the ability to cooperate, communicate, and conduct discussions, and then collaboration will be built.

Worksheets that teachers expect, LKPD that contains language that is easy to understand, has no typos, is able to measure students' abilities, has practical instructions, contains identities, and has rubrics that make it easier for teachers to assess and is easy for students to fill in. Based on student questionnaires and interviews, 65.3% of students like colorful worksheets and pictorials, and there are several media, not only text, in them. This SDIT school is developing digital classes, so the opportunity for E-LKPD is very large, facilitated by the foundation in the form of digital devices to develop student collaboration. Students will also be more motivated if the worksheets used have a display that attracts their attention. Rahayu et al (2021) also stated that E-LKPD with an attractive design can make students more focused and increase interest in learning. The difficulty in developing E-LKPD, especially project-based and STEM-PjBL, for teachers is determining innovative projects based on problems, then carefully preparing and managing students with different abilities.

E-LKPD is the same as LKPD; the difference lies in its form as an electronic file that can be accessed through devices such as smartphones, laptops, and computers, in contrast to ordinary LKPD, which is printed in the form of physical documents (Awe & Wau, 2022). The stated LKPD criteria are good, according to Kosasih (2021), and involve several essential aspects. First, a good LKPD must present questions and activities that require students to conduct experiments. In addition, the discussion of material in LKPD should not be too broad but include information relevant to the tasks to be done by students. Finally, a good LKPD should also be equipped with supporting components, such as a preface, introduction, table of contents, and other parts. Here are the test worksheets used in schools:

Figure 2. LKPD used in schools

The worksheets used by students still need to be improved. Students more often use exercises in textbooks and rarely make a project in science learning. Teachers also reveal that science learners are more likely to use the guided discovery learning model. The LKPD used by the school has not facilitated the implementation of STEM-PjBL activities; the LKPD available is more in the form of short answer questions and only uses practice questions in student books, so the appearance of the LKPD has not been innovative and experimental, and the activities are still the same as the previous curriculum. Based on the criteria and components of LKPD, according to the experts above, the following is a list of standards or checklists that are part of the systematics of making student worksheets (LKPD):

Table 3. Checklist in accordance with the systematics of making LKPD

No	Aspects	Exist	None
1.	There is a participant identity column	√	
2.	There is learning access		√
3.	There is a purpose of learning	√	
4.	There is a summary of the material		√

5.	Suitability of learning objectives with LKPD content	√	
6.	Use easy-to-understand language	√	
7.	There are indications for the use of LKPD		√
8.	The writing of tools and materials is clear	√	
9.	There are practicum work steps	√	
10.	Contains questions that can stimulate students to solve problems		√
11.	Observations	√	
12.	Question sheet		√
13.	Conclusion	√	
14.	There is an assessment sheet		√

The results of the analysis show that the LKPD used in schools has not developed STEM-PjBL-based worksheets or project-based ones. The LKPD used contains short-answer questions, uses questions from existing books or the internet, and sometimes uses experimental worksheets. Above have been presented examples of experimental worksheets used; worksheets have not fully met good LKPD standards. LKPD content consists of student identity columns, learning objectives, language used that can be understood by students, tools and materials, practicum work steps, and observation results. The systematics of LKPD in general, according to Akbar (2016) as a wrestler, are: 1) title; 2) study instructions; 3) competencies to be achieved; 4) indicators to be achieved; 5) supporting information; 6) duties; 7) work steps; and 8) assessment. Trianto (2009) also said the components of LKPD include experimental titles, brief theories about materials, tools, and materials, experimental procedures, observational data, as well as questions and conclusions for discussion material. In the LKPD used, there are no learning outcomes, supporting information or material summary, instructions for using LKPD, no questions that can stimulate students to solve problems, provide opportunities for students to experience, follow a process, make observations, collect information, plan, make, prove, or conclude, and there is no assessment.

Science learning involves projects and experimental activities, so an appropriate student worksheet (LKPD) is needed as a guide for students. Through LKPD, it is expected that students can develop understanding through the process of building knowledge in their minds. LKPD plays an important role in helping students more easily understand the subject matter, providing a meaningful learning experience (Nafilah et al, 2022). By using LKPD, learners are actively involved in the exploration of new concepts, which are then connected to the surrounding environment. In the preparation of LKPD, innovation is the key to improving the quality of learning; one way to achieve this is by utilizing E-LKPD (Nismidawati et al, 2022). Using E-LKPD can provide an interesting learning experience for students because there is the use of multimedia images, animations, text, audio, and navigation that enrich learning content and can create a learning environment that suits the characteristics and needs of students in this digital era. E-LKPD also acts as an effective tool to facilitate students in carrying out learning activities, adding to the learning experience of students by facilitating

interaction, discussion, and collaboration with friends using digital devices. Therefore, STEM-PjBL-based E-LKPD is needed to support student collaboration skills.

D. CONCLUSIONS AND SUGGESTIONS

From the needs analysis that has been done, the collaboration ability of students still needs to be improved; mostly, as many as 61.3% of students have difficulty working with groups. The use of LKPD in science learning is a critical aspect; most students do not like that the LKPD used only contains text and is not colored, and in science learning, students tend to use LKPD, which contains short answer questions and rarely makes projects in groups. Innovation is needed in the preparation of LKPD, namely in the form of E-LKPD IPAS based on STEM-PjBL as a guide in implementing science learning to be more meaningful by involving activities to create projects and experiments by integrating STEM elements in learning. Moreover, 65.3% of students showed that they were more motivated to learn by using colorful LKPD and accompanied by various media. Therefore, the development of STEM-PjBL-based E-LKPD IPAS to support student collaboration skills needs to be carried out to provide a contextual and meaningful learning experience.

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