# The Analysis of Implementing STEM-based LKPD to Enhance Students' Collaboration Skills in School

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***Abstract -*** *This research focused on applying STEM-based LKPD to improve students' collaboration skills in schools. The aim is to determine whether STEM-based LKPD can improve students' collaboration skills at school. The method used is literature research by taking a literature review following the subject matter and analyzing it in depth to draw conclusions and findings. Based on a review of several literature sources and relevant research findings, the following conclusions are drawn: (1) the implementation of STEM-based instructional materials (LKPD) is effective in improving students' collaboration skills in science learning; (2) STEM learning can be integrated with various instructional models such as Project Based Learning, Problem-Based Learning, and cooperative learning models; (3) STEM-based instructional materials can be implemented in schools, ranging from elementary to high school levels.*

*Keywords: LKPD; STEM; Collaboration Capabilities*

## INTRODUCTION

To face the challenges of the 21st century, skills and abilities must be instilled in the future generation to compete with other nations. One of the skills that needs to be developed is collaboration skills. Collaborative skills must be developed more widely and deeply to promote collaborative learning (Cholis, 2020). Collaboration skills can also be referred to as teamwork skills, where teamwork skills are key to achieving effective learning processes, and teamwork skills are highly needed in education. Collaborative skills are one of the keys to effective learning, and these skills are essential in the workplace (Saenab et al., 2019). According to research by (Dewi et al., 2020), collaboration skills are the ability to exchange thoughts or ideas and feelings among students at the same level.

The research (Dewi et al., 2020) proves that collaborative learning has been proven effective when applied to students. Therefore, it is expected that collaborative learning can be implemented for students at various levels of education, ranging from elementary school to university so that students' collaborative skills can improve and support education even better. Based on literature studies, it is shown that student collaboration has the potential to be empowered through group and constructive learning such as PBL (Ilma, 2022). Project-Based Learning is a systematic learning model that involves students actively engaging in skills and knowledge through structured processes and products resulting from designed real-world experiences. Implementing the PBL model in practice applies a student-centred system, which means students play an active role in every learning process. Implementing project-based learning includes determining fundamental questions, developing project plans, creating schedules, monitoring, testing outcomes, and evaluating experiences (Fadilah et al., 2022).

Given the breadth of the identified issues, narrowing the problem is necessary to maintain the research focus. This study focuses on implementing STEM-based Worksheets (LKPD) to Enhance Student

Collaboration Skills in Schools. The aim is to determine whether STEM-based LKPD can improve students' collaboration skills in schools.

**RESEARCH METHODS**

This article discusses the analysis of implementing STEM-based Worksheets (LKPD) to enhance student collaboration in schools. The method used is literature research, which involves examining relevant literature to draw conclusions and findings. The literature is sourced from books, national and international journal articles, and other relevant sources. Specifically, this study focuses on scientific articles published in accredited national journals between 2018 and 2022. A total of twelve national articles discussing STEM-based LKPD and students' collaborative abilities are utilized in this research.

**RESULTS AND DISCUSSION**
**Results**

The analysis of the methods used in the twelve articles reveals that the research instruments consist of written tests, questionnaires, and observations. The written tests include fill-in-the-blank tests to assess the readability of instructional materials, essay tests to evaluate written communication skills, which have undergone validity and reliability tests, and difficulty and discrimination analyses. The improvement in written communication skills is assessed through pretest-posttest scores using the gain test. The questionnaires used include feasibility tests and student response questionnaires. Observations are conducted to assess oral communication and collaboration skills. The assessment of oral communication and collaboration skills involves percentage scores, and the improvement in skills is measured by

comparing the scores at each meeting (Nurhayati, 2019).

This research is classified as Educational Design Research (EDR), development research in education. Data collection techniques in this study include observation, interviews, and questionnaires. The research instruments used include validation sheets for E-LKPD, observation sheets for learning implementation, and observation sheets for students' collaboration abilities. The validation of E-LKPD is conducted by two science education lecturers from the University of Jember, the practicality of E-LKPD is assessed by an observing science teacher, and the effectiveness of E-LKPD is calculated using the n-gain formula based on collaboration skill scores. The assessment results are then categorized based on validity, practicality, and effectiveness (Octaviana et al., 2022).

The data collection method involves observation and documentation techniques. Data analysis is performed using observation sheet analysis with the assistance of SPSS and Microsoft Office Excel. Multiple observers observe and assess collaboration skills during the learning activities. The STEM-based instructional materials include lesson plans, teaching materials, worksheets, and learning units. The validity of these materials is assessed through expert judgment by supervising lecturers and suitability tests by an expert lecturer and a high school physics teacher. The physics topics this research covers are temperature, heat, and their transfers (Cholis, 2020).

**The Implementation of STEM-based Worksheets (LKPD) in Schools**

Implementing STEM-based Worksheets (LKPD) can enhance students' critical thinking skills in the topic of the excretory system in 8th grade at SMP Negeri

1 Peusangan. Additionally, there is a difference in students' higher-order thinking skills between the experimental and control groups in the topic of the excretory system in 8th grade at SMP Negeri 1 Peusangan (Fithrti., S, 2021). According to Puspamareta (2020), based on the analysis and discussion presented, it can be concluded that students' practical skills, using student worksheets in Class X MIA 9 at SMAN 9 Makassar in the 2018/2019 academic year, fall under the high category, reaching 60.9%, after using guided student worksheets. This research proves that collaborative learning is effective for students. Therefore, collaborative learning is expected to be implemented at various levels of education, from elementary schools to universities, to enhance students' collaborative skills and improve the overall quality of education (Dewi et al., 2020).

According to the study by Octaviana et al. (2022), the obtained N-gain results indicate that the E-LKPD is categorized as moderately effective, as there was an improvement in the n-gain scores over two cycles, shifting from low to moderate. The results imply that the E-LKPD effectively enhances collaboration skills among students in Class 7C at SMP Negeri 1 Wuluhan. These findings can be a reference for conducting similar research using different variables, materials, and/or research subjects. Furthermore, using E-LKPD in the learning process can be considered an alternative teaching material, as it can be accessed anytime and anywhere through electronic media such as smartphones, laptops, and other electronic devices.

On the other hand, according to the research by Dewi et al. (2020), the study reveals that students majoring in STEM education possess high collaboration skills due to being accustomed to collaborative learning processes. The overall achievement quality of collaboration skill indicators for the 2017 cohort was 80% with a high-quality category. Similarly, the overall achievement quality for the 2018 cohort was 79% with a high-quality category. Finally, the overall achievement quality for the 2019 cohort was 82%, with a very high-quality category, as shown in Table 1.

**Table 1.** Overall Quality of Achievement for Skill Indicators in Each Cohort of STEM Education

| Cohort | % Quality | Category |
|--------|-----------|-----------|
| 2017 | 80% | High |
| 2018 | 79% | High |
| 2019 | 82% | Very High |

Source: (Dewi et al., 2020)

**Discussion**
**STEM-based Student Worksheets (LKPD)**

Education in the current era of globalization demands schools to nurture students capable of critical thinking (STEM), where children can engage in activities independently. Along with the rapid development of technology, it has changed how we communicate, interact, and more. In Indonesia, STEM refers to four fields of knowledge: science, technology, engineering, and mathematics (Setiawan et al., 2020).

Applying students' knowledge to problem-solving through science, technology, engineering, and mathematics produces students who can solve classroom and everyday problems. STEM can be implemented in instructional materials, including Student Worksheets (LKPD) and student task pages (Kebudayaan, 2013).

When the STEM approach is combined with Student Worksheets (LKPD), it allows students to engage in activities that involve identifying relevant problems based on the given context. From these identifications, they will focus on

solving the problems by creating a product (Hasanah et al., 2021; Fithri et al., 2021). It also helps develop human resources that can think critically, logically, creatively, and systematically while enhancing communication and collaboration skills, enabling them to face global challenges and contribute to the country's future economy (Suardi, 2020).

Collaborative skills must be developed extensively and profoundly to foster collaborative learning. The key to collaboration is listening and considering each other's perspectives within a functioning team. Collaborative skills train individuals in teamwork and leadership, adapting to different roles and responsibilities, working effectively with others, building empathy, and respecting different viewpoints. The benefits of learning through collaborative skills include the growth of individual and collective knowledge, increased social interaction, and the development of empathy towards other students (Cholis et al., 2020).

**Student Collaboration in Learning**

The STEM approach is hoped to shape human resources capable of critical, logical, creative, and systematic thinking and enhance communication and collaboration skills. In turn, enables individuals to face global challenges and contribute to the future economic development of their country (Suardi, 2020). In order to face the challenges of the 21st century, it is crucial to instil the skills and abilities required by the next generation to compete with other nations. One of these essential skills is cooperation. Collaboration skills must be developed extensively and profoundly to foster collaborative learning (Cholis, M. R. N., 2020). Collaboration is a form of learning conducted in groups, where differences in opinions and information are discussed through activities such as giving suggestions, listening to and participating in discussions, and respecting different perspectives (Octavia et al., 2022).

The learning process is characterized by educational interactions, which are conscious interactions with specific goals. These interactions stem from the educators (teachers) and the pedagogical learning activities of the students, proceeding systematically through the stages of planning, implementation, and evaluation. Learning does not occur instantaneously but progresses through specific stages. During the process, teachers assist students in learning effectively, fostering the desired collaborative learning process.

Implementing physics learning using the STEM approach can facilitate students in developing collaboration skills more optimally (Sury et al., 2022). The test results indicate a significant difference in improving collaboration skills between the experimental and control groups. The application of STEM-based learning needs to maximize the integration of STEM aspects in facilitating collaboration skills in learning tools and activities. Additionally, the duration of learning can be extended and tailored to the learning activities to optimize the development of collaboration skills. Students' collaboration skills after implementing physics learning with the STEM approach showed improvement, as indicated by the Ngain test result with a score of 0.81, which falls under the high category (Cholis, M. R. N., 2020). The application of collaborative learning can be used by teachers as a teaching strategy to improve student learning outcomes, particularly in physics learning (Lenggogeni, 2019).

According to the study by Nurhayati (2019), collaboration skills are obtained through observations during the learning

process, particularly during group discussions. The aim is to assess students' ability to collaborate within assigned groups to achieve shared goals. The results of the observation on collaboration skills are presented in Table 2.

**Table 2.** The Result of Observation Collaborative Skill

| Indicators | Pretest | Posttest |
|---|---|---|
| Indicator 1 | 71,11% | 77,78% |
| Indicator 2 | 86,67% | 84,44% |
| Indicator 3 | 68,89%% | 73,33% |
| Average | 75,56% | 78,52% |

Source: (Nurhayati, 2019)

**CONCLUSION**

Based on the review of various literature and relevant research findings, the following conclusions can be drawn: (1) STEM-based learning is effective in improving students' collaboration skills in science education; (2) STEM learning can be integrated with various teaching models such as Project-Based Learning, Problem-Based Learning, and cooperative learning models; (3) STEM-based LKPD can be implemented in schools, ranging from elementary to high school levels.

Based on several studies, STEM-based LKPD is considered an alternative medium that can be used to enhance student collaboration in schools. Furthermore, STEM learning is highly suitable for 21st-century education. It is hoped that in the future, many teachers from various fields will implement, apply, and even develop STEM-based LKPD in their teaching processes. Additionally, support from various parties, including the government and relevant institutions, is necessary to provide training and seminars related to STEM-based LKPD, ensuring its effective implementation in the learning process.

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