

Development of E-learning based Collaboration (KABEL)

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ABSTRACT

E-learning-based collaboration (KABEL) can be used as an alternative to improve learning outcomes and student cooperation. This study aims to develop high school physics learning tools using models *e-learning based collaboration* in the form of lesson planning, student worksheet, teaching materials and learning outcomes on heat material. The method used is development research 4-D development models. The results of the study show: 1) The validation of learning devices achieves very valid criteria; 2) The practicality of learning devices is determined through the implementation of learning at 87% with very good criteria and student response questionnaires at 83.77% with good criteria; 3) The effectiveness of learning devices is determined through student activities at 83.64% with good criteria and student learning outcomes in temperature and heat at 45 with criteria *N-gain* medium. Thus, it was concluded that the design of learning devices using collaborative learning models based on e-learning heat material is valid, practical, and effective criteria.



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INTRODUCTION

One of the biggest challenges faced in education is teaching students how to use modern information and communication technologies effectively and think critically, solve problems creatively, and communicate clearly (Gazali & Pransisca, 2020). Skills in both communicating effectively and working together effectively are required. According to the United Nations (UN), these skills indicate the knowledge-based society (Knowledge-based Scoeity) that characterizes the globalized modern period (Vali, 2013). Society 5.0 is a society that can solve various challenges and social problems by utilizing various innovations that were born in the era of the industrial revolution 4.0 such as the Internet on Things (internet for everything), Artificial Intelligence (artificial intelligence), Big Data (large amounts of data), and robots to improve the quality of human life. This era is an opportunity as well as a new challenge for students to improve their soft skills as preparation for the future (Indarta et al., 2022).

Physics is a science that examines the interaction between energy and matter, which forms the basis of natural science. In learning physics, students are expected not only to master physics concepts theoretically but also to be able to use the scientific method to prove the physics concepts derived from the theory (Herayanti et al., 2017). Physics is considered a difficult subject because there are many formulas that must be memorized, and students find it difficult to answer questions related to internal events everyday life. This is because learning in schools is focused on solving physics formulas only (Haryono, 2020). The subject of heat is one of the materials that some students consider difficult, because to understand it requires some knowledge of the concepts of heat, specific heat, heat capacity, latent heat, Black's principle, changes in state and heat transfer (Fithriani et al., 2016).

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Recent technological developments have made it easier for people to quickly access a wide range of information (Siregar & Nasution, 2020). The internet makes it easier to satisfy people's insatiable curiosity. Using the internet as a teaching tool is one of its many educational benefits. The internet is a supplement to traditional classroom instruction, an alternative to traditional classroom instruction, and a replacement for traditional classroom instruction. The internet can be used as an instrument for research and study. The use of the internet as a learning medium can be considered as something that is commonly used among students. With the internet as a source of learning makes it easier for us to access various sources of information available, because the internet can help us improve our lives through education. The internet can also access various references, both in the form of research results, and articles on the results of studies in various fields (Sasmita, 2020).

Media in education is a valuable tool for facilitating the teaching and learning process (Gunawan et al., 2017). Learning media refers to the various tools educators employ to deliver educational content to students systematically. These tools are designed to promote effective and efficient learning in an environment conducive to learning. The advancement of computer technology offers potential for scientific learning innovations, particularly in physics. Computer technology is an invention that enhances the presentation of various forms of interaction, thereby optimizing the learning process. Physics concepts are implemented in computer programs using user-friendly software. The integration of computer technology in education has been found to benefit students' cognitive abilities and ability to achieve learning objectives (Herayanti & Habibi, 2017).

The media is not the only factor determining success in achieving learning outcomes. Teachers and lecturers should pay attention to appropriate learning models, accurate methods, and teaching approaches that have a significant impact (Affandy, 2020). Effective communication and knowledge transfer are crucial for educators. Educators should facilitate learning experiences that develop students' logical, systematic, critical, and creative thinking skills and ability to collaborate in comprehending physics concepts. Applying suitable learning tools can facilitate this outcome. Physics education still predominantly relies on direct instruction, where educators actively deliver content to students and teach it to the entire class. Consequently, the learning process often becomes repetitive, leading to students experiencing feelings of boredom and distress. When teaching physics to students, educators should utilize diverse approaches, strategies, methods, and learning media suitable for the specific context to achieve the intended learning objectives effectively.

E-learning is an internet-based platform that connects educators and students in a virtual learning environment (Hadisi & Muna, 2015). E-learning has proven to be an effective solution for overcoming the limitations of time and space between educators and students (Sudaryanto, 2017). The object is not limited to a single dimension of time and space, allowing it to exist at any time. The application of media-based learning E-learning facilitates efficient and convenient communication between educators and students, overcoming limitations of distance, location, and time through internet-based platforms. The media also contributes to developing students' creativity in learning science. E-learning does not mean replacing the learning model conventional in the classroom, but strengthens the learning model through content enrichment and technology development education (Elyas, 2018).

The use of media and learning models is significant in explaining science. E-learning-based collaboration (KABEL) is a solution that can be used as an alternative to improving student learning outcomes and collaboration. E-learning-based collaboration (KABEL) is a potential solution to the problem mentioned above, as it involves students collectively in a group. Study groups engage in collaborative learning based on their competencies (Chairunnisa et al., 2022). E-learning-based collaboration (KABEL) is suitable for high school education as it promotes students' cooperative work. (Kusumastuti et al., 2012) states that this model facilitates collaboration, mutual support, shared learning, idea contribution, and collective responsibility for achieving learning outcomes and progress. E-learning-based collaborative learning (KABEL) is one of the solutions that can be used as an alternative to improve student learning outcomes and collaboration. collaborative learning

RESEARCH METHOD

This study was developmental research that focused on developing E-learning based collaborative models to develop a valid, practical, and effective learning device. This study used a 4-D development model method. S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel developed the model's design (Haryono et al., 2021). The 4-D model consists of four different phases: defining, planning, development, and spread. The study did not include the deployment stage, focusing only on the limited trial stage.

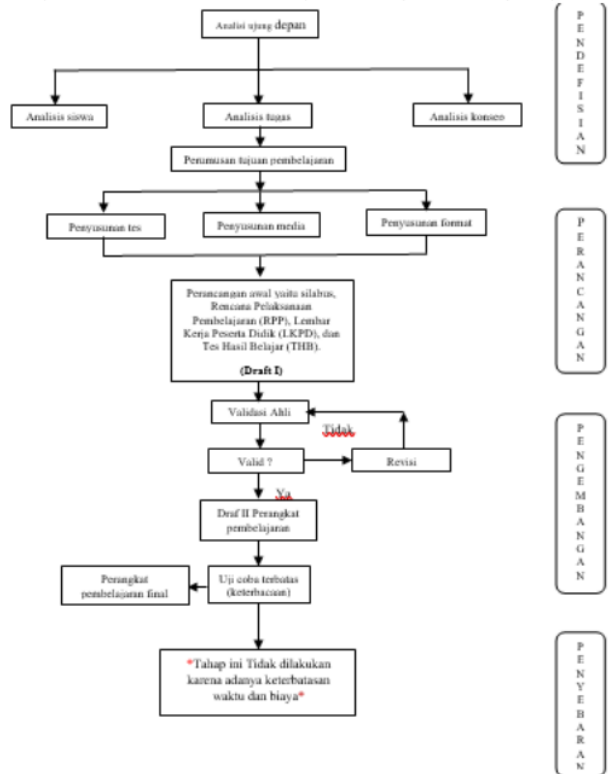


Figure 1. 4D Design model

The subjects of this research were 150 students in class XI. The setting of this study was at SMA Negeri 3 Lamongan, MAN 2 Lamongan, MAN 1 Lamongan in June for the 2022/2023 academic year. This research was conducted in three meetings. Data analysis on the development of the learning device was validity, practicality, and effectiveness analysis. This analysis is used to determine the quality of the learning tools developed.

RESULTS AND DISCUSSION

Result

Validation results

Table 1. Instrument Validation Results

Instrument Type	∑JTV	∑JST	PPV	% Category
lesson plan	159	180	88,33	Very Valid
Teaching Materials	162	180	90	
student worksheet	105	120	87,5	
THB	97	108	89,81	

Based on the validator's contribution to the learning tools, revisions were made to refine the learning devices made before. After refining teaching materials, the score of lesson plan was 88.33%, teaching materials at 90%, student worksheet at 87.50% and THB at 89.81% with very valid categories.

Practical Results

1. Implementation of Learning.

This research was conducted in 3 meetings through the learning management system (LMS) application via the link <http://kabel.unisda.ac.id/> for 150 students consisting of students from SMA Negeri 3 Lamongan, MAN 2 Lamongan, MAN 1 Lamongan. This research was conducted on heat material in class XI students .The following is the average score of the results of the learning implementation data.

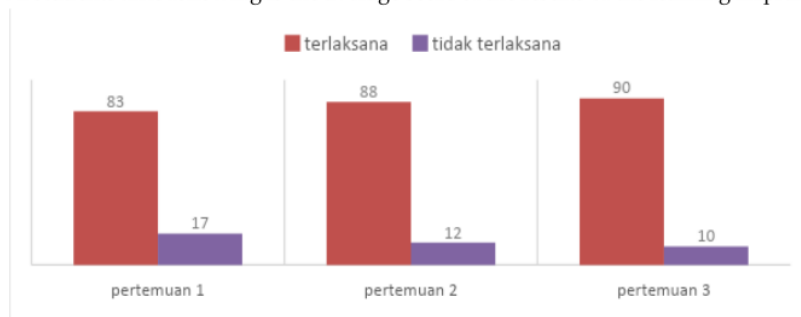


Figure 2. the learning implementation

Figure 2 shows that the implementation percentage for the first session is 83%, remaining 17% not implemented. The second session shows an implementation 88%, remaining 12% not implemented. During the third session, there was a 90% implementation rate, remaining 10% not implemented. The average score was 87%, met the criteria for excellent performance. The survey results show the approach is practical and meets the required criteria.

3 Student Response Questionnaire

Following are the results of the student response questionnaire percentage.

Table 2. Percentage of Student Questionnaire

Criteria	Average percentage (%)
Very good	65.38%
Good	34.62%
Enough	0.00%
Less	0.00%
Very less	0.00%

Based on table 2 above, out of 150 students from SMA Negeri 3 Lamongan, MAN 2 Lamongan, MAN 1 Lamongan. The 98 students or 65.38% responded in the very good category, and 52 students or 34.62% responded in the good category. From the average results it reached 83.77% with good criteria, the percentage results showed that the results of the student questionnaire met the practical criteria. This is in line with the research conducted by (Putra, 2021) which stated that the results of the student questionnaire met the practicality criteria

Results of the Effectiveness of Learning Devices

1. Student Activities

Observational research on student activity during the learning process was conducted 3 times with 150 students in class XI consisting of students from SMA Negeri 3 Lamongan, MAN 2 Lamongan, MAN 1 Lamongan and was observed by 2 observers. The following are the results of the percentage of student activity data.

Table 3. Percentage of Student Activity

Criteria	Average percentage (%)
Very good	79.49%
Good	3.85%
Enough	3.85%
Less	3.85%
Very less	8.97%

Based on Table 3 above, 79.49% of students with very good criteria totaled 119 students on average. Students with good criteria at 3.85% or 6 students. With sufficient criteria of 3.85% or an average of 6 students, with less criteria 3.85% or an average of 6 students, with very lacking criteria of 8.97%, namely an average of 13 students. Of the average results achieved, 83.64% achieved good criteria, this percentage indicates that student activities meet the effectiveness criteria.

Table 3 shows that most students, specifically 79.49%, obtained a very good score. On average, this corresponds to 119 students. The percentage of students with good scores was 3.85%, corresponding to an average of 6 students. The percentage of students with enough score was 3.85%, with an average of 6 students. Similarly, the proportion of students with less score was also 3.85%, with an average of 6 students. Furthermore, 8.97% of students obtained a significantly very low rating, with an average of 13 students falling into this category. On average, 83.64% of students attained a satisfactory rating, indicating that their level of engagement met the effectiveness criteria.

2. Learning Outcomes Test

The learning outcomes test is in the form of PG questions (multiple choice) with 29 questions. The learning outcomes test was conducted on 150 class XI students from SMA Negeri 3 Lamongan, MAN 2 Lamongan, MAN 1 Lamongan. Improvements in student learning outcomes were observed at each cognitive level, as shown in Figure 3

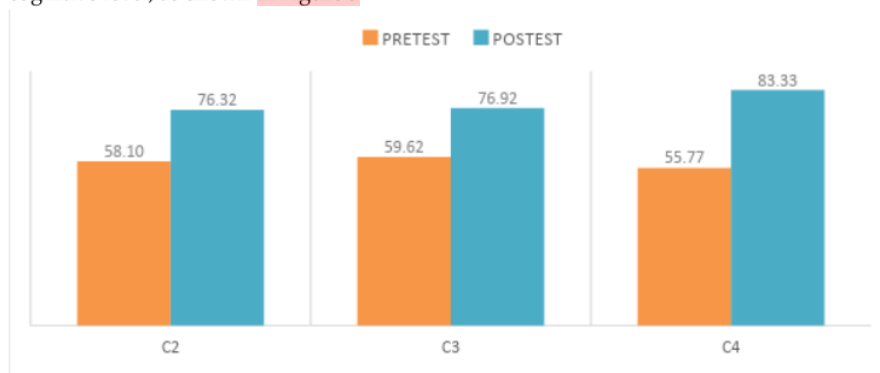


Figure 3. N-gain Pretest and posttest

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Figure 3 shows each indicator's cognitive range percentage using the N-Gain formula for pre-test and post-test. The pre-test score for the C2 indicator (understanding) was 58.10% with 19 questions. The C3 indicator (application) with 4 questions was 59.62%. Indicator C4 (analysis) with 6 questions was 55.77%. The cognitive level of learning outcomes after the test with indicator C2 (understanding) with a total of 19 questions was 76.32%. Indicator C3 (applying) with a total of 4 questions was 76.92%. And the C4 indicator (analyzing) with a total of 6 questions was 83.33%. The learning process before the student's treatment produces value (*pre-test*) student learning outcomes was 60.08%, while after the value treatment (*post-test*) student learning outcomes was 76.92%. Based on the two results before and after the test, it can be seen that the difference between the two results is 16.84%, with an increase in the N-Gain value of 0.22 (0.70 > N-Gain 0.30), including in the medium category. According to (hadromi dan Susanto, 2020), the results of their research showed an increase in the moderate category.

Discussion

This study aimed to develop e-learning-based collaboration (KABEL), for teaching heat material. These devices were implemented through a learning management system (LMS) application accessible via the link <http://kabel.unisda.ac.id/>. The study was conducted at SMA Negeri 3 Lamongan, MAN 2 Lamongan, and MAN 1 Lamongan. The development of learning tools for collaborative models of heat materials involves a four-stage process known as 4D development. According to Thiagarajan and Semmel, in research (Martini et al., 2017) includes: definition (define), design (design), development (develop), and deployment (disseminate). The first stage is the definition stage, followed by the design of draft 1 learning tools. The third stage refers to development, while the fourth pertains to deployment. However, the deployment phase was not executed. During the development stage of the previously designed learning device (Draft 1), enhancements were implemented based on feedback from three validators. These improvements were made to ensure the validity of the device and its suitability for learning purposes. The revised version of the device, referred to as the final tool (Draft II), was the outcome of this iterative process. The researchers will conduct online trials of the learning tools they have developed with a limited sample of 150 class XI students from SMA Negeri 3 Lamongan, MAN 2 Lamongan, and MAN 1 Lamongan.

Learning Device Validity

The validity of the learning devices was determined through expert validation conducted by three validators using validation instrument sheets. The validation process includes evaluating the content's development, readability, language, and overall content quality (Suhandi et al., 2023). The validation results from three validators indicate that the learning device uses e-learning-based collaboration (KABEL), which is deemed feasible for use with minor revisions. The results are presented as an average percentage value. The validated learning tools included the RPP (Implementation of lesson Plan), LKPD (Student work Sheet), Teaching Materials, and THB (Learning Outcomes) (Lainata et al., 2021). The modified learning materials were categorized as very valid, with 88.33% at lesson plan, teaching materials at 90%, student worksheet at 87.50%, and learning outcome at 89.81%. The validation results show that the learning tools developed are valid through construct validation tests with minor revisions and are categorized as very valid based on validity criteria according to (Asy'Ari et al., 2021), these devices are considered very valid based on validity criteria. The developed devices are both feasible and suitable for educational purposes. According to (Chalisah et al., 2022), their research findings indicate that the developed learning tools are both feasible and meet valid criteria.

The Practicality of Learning Devices

The practicality of learning devices is assessed by implementing learning and analyzing student questionnaire responses. When both teachers and students positively engage with well-designed learning devices, they are considered valid. According to (De Fauw et al., 2018) learning devices are considered as practical when experts or practitioners confirm their applicability and usability in real-world settings.

The practical suitability of learning devices is obtained by analyzing the implementation of learning questionnaires and feedback from students learning. Based on research data, learning implementation was 83% at the first meeting, with 17% not implemented. At the second meeting, the implementation of learning was 88%, with 12% not implemented. Whereas at the third meeting, the implementation of learning was 90%, with 10% not implemented. The data found and analyzed above shows that it has greater implementation than those that were not implemented. Similar to the opinion by (Putri et al., 2020) stated that the learning devices developed are considered practical if experts or practitioners state that the learning devices developed can be applied and used in the field, the practicality of the learning tools developed is based on the implementation in classroom.

The study used a student response questionnaire comprising 16 statements. A closed-ended questionnaire with a Likert scale was utilized, encompassing both positive and negative statements. The effectiveness of student worksheet was categorized positively, while implementing the Collaborative E-Learning Model (KABEL) in activities 1-5 was also positively categorized. However, activities 4 and 6 were categorized negatively. Similarly, the effectiveness of instructional implementation for activities 1-3 was regarded as positive, whereas activity 2 was categorized as negative. The questionnaire responses indicate that the instructional materials were considered practical for use in the classroom. This finding is consistent with (Edelson et al., 2021), who proposed that using practical instructional materials can support teachers in facilitating the learning process. Supported by (Fadilah. MS et al., 2020) research conducted at SMPN 1 Bluto and the results obtained by the learning device were stated to be valid in terms of the results of the validity of the device with a score of 3.57; Effective teaching materials in terms of student responses are included in the very good category with a result of 83.2%.

The Effectiveness of Learning Devices

(Winget & Persky, 2022) The effectiveness of the learning process is assessed based on the extent to which students achieve the predetermined learning objectives. Learning devices show effectiveness when they accomplish predetermined learning objectives based on specific criteria. Learning devices are effective when they successfully impact all needed student learning outcomes, meeting or surpassing the predetermined minimum competency level. Learning devices can be utilized if their design has successfully attained effectiveness. One can acquire effective learning tools by observing student activities and evaluating the resulting learning outcomes. The effectiveness measurement is conducted by utilizing student activity indicators that have been adjusted to align with the level of the lesson plan, also known as Lesson Plan. According to (Chowdhury et al., 2022), the developed learning devices demonstrate effective criteria for attaining learning objectives. The observed increase in student learning outcomes from the pre-test to the post-test suggests that the utilization of the WhatsApp application has a positive effect. This finding aligns with the research conducted by (Alamer et al., 2023), which suggests that the use of WhatsApp significantly influences student learning outcomes, leading to positive effects. Students believe that the act of communicating, coordinating, and discussing becomes more convenient in the absence of face-to-face interactions. The average percentage of student participation across three meetings was 83.64%, considered as a "good" category. The data indicates that the students' activities align with the criteria for effectiveness in the learning process when using the collaborative learning model. According to (Ntobuo et al., 2018), the learning model collaboration can be understood as a cooperative process undertaken by individuals and groups, both within the original group and the expert group. This approach emphasizes the significance of fostering meaningful and intellectual learning by cultivating social aspects, aiming to attain shared objectives. The effectiveness of the model used in the study was confirmed.

Based on the test results of learning from students obtained from data analysis before learning obtained a percentage of 0.08%, whereas after being given treatment the value (*post-test*) student learning outcomes 76.92%. Based on both pre-test scores and *posttest*, *post-test* seen that the difference in value between the two is 16.84%, with an increase in value *Tune* of 0.45 ($0.70 > N\text{-gain} = 0.30$) included in the moderate category. Based on the distribution of score categories *gain* given by Hake (1999), the gain score obtained is in the high category. So that it can be ascertained that learning devices using e-learning-based

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collaboration (KABEL) model was highly developed. This is in line with (Gitadewi et al., 2022) research conducted at SMPN 21 Surabaya which states that the results of the students' concept comprehension tests showed an increase in the scores obtained between the pretest and posttest scores, namely the medium category and 90% of students passed. While the acquisition of mastery indicator scores for understanding concepts is included in the high category. Then the results of student learning motivation showed an increase in the acquisition of scores between the pretest and posttest in the medium category. The data obtained shows that the Integrated Flipped Classroom model with N-gain is effective as a learning tool to increase students' conceptual understanding and learning motivation during the Covid-19 pandemic.

Conclusion

The research discussed in the previous chapter led to the conclusion that the use of models for e-learning-based collaboration (KABEL) on the heat material (Design of lesson plan; Student worksheet, Teaching Materials; Learning Outcomes) is valid, practical, and effective, with N-gain of 0.45 ($0.70 > N\text{-gain} = 0.30$) categorized as a moderate category.

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