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Implementation of Liveworksheets-Based *E-LKPD* Using Discovery Learning to Enhance Students' Creative Thinking and Collaboration Skills in Salt Hydrolysis

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Abstract

Low levels of students' creative thinking and collaboration need to be addressed to support the generation of new ideas and effective problem-solving in chemistry, particularly in challenging topics such as salt hydrolysis. This study examined differences in (1) creative thinking skills and (2) collaboration skills between students who learned using Discovery Learning–based electronic student worksheets (e-LKPD) delivered via Liveworksheets and those who used Discovery Learning–based printed student worksheets, as well as (3) students' perceptions of the learning experience. A quasi-experimental design with a nonequivalent control group was employed. Data were collected using both test and non-test instruments. Independent t-test results comparing pretest and posttest scores revealed a significant improvement in creative thinking skills among students using Liveworksheets-based e-LKPD (Sig. 2-tailed ≈ 0.00 < 0.05). Similarly, a significant difference in collaboration skills was observed between the two groups (Sig. 2-tailed ≈ 0.00 < 0.05). Student feedback indicated positive responses toward the implementation of Liveworksheets-based e-LKPD and Discovery Learning–based worksheets. These findings suggest that the integration of Discovery Learning with Liveworksheets-based e-LKPD can effectively enhance students' creative thinking and collaboration in learning complex chemistry topics, providing a promising approach for improving engagement and higher-order thinking skills.

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INTRODUCTION

Twenty first century learning is closely related to the four C skills, which include critical thinking, communication, collaboration, and creativity (Sidi, 2020). The 2013 Curriculum is a curriculum that requires students to play an active role in the learning process because it is designed with a student centered learning approach (Sani, 2014). Chemistry is one of the disciplines that has an important role in education. Chemistry is a science that studies chemical products, including all substances that exist in the natural environment, both natural and man made materials (Suljana et al., 2014).

Chemistry learning includes topics that are difficult for students to understand, one of which is salt hydrolysis. Students experience difficulties in understanding the literature on salt hydrolysis because there are many conceptual errors in the available literature (Felbriani et al., 2018). The topic of salt hydrolysis contains concepts that are quite difficult because it involves chemical reactions and calculations. This condition can create obstacles for students in mastering the material, especially if they only listen to the teacher's explanation without interactive two way communication between students and the teacher. The difficulties become more apparent when students are faced with chemistry problems that require them to answer questions related to conceptual understanding and algorithms.

The results of observations in chemistry learning in class XI at SMAN 8 Banjarmasin show several problems experienced by students, namely: (a) when the teacher asks questions, no students respond, which indicates that some students are still passive; (b) when working on worksheets, students only copy sentences from the textbook and are fixated on a single answer; (c) there is a lack of responsibility when working together with other students; and (d) the learning process tends to cause boredom because instructional media used in the classroom are not yet engaging. These conditions are considered to contribute to the low level of students' creative thinking and collaboration skills.

Creative thinking skills are an individual's ability to generate new ideas and implement them to solve problems (Julniarso, 2020). Creative thinking and collaboration skills are twenty first century competencies that students need to possess (Felbliza & Faulziah, 2021). Students' creative thinking and collaboration skills in chemistry learning have not yet received sufficient attention. Lack of appreciation and attention to these skills in the learning process may cause students to become unwilling or afraid to try something new.

One effort to overcome students' difficulties in understanding the topic of salt hydrolysis is the application of an enjoyable learning model that is student centered and involves meaningful learning activities, namely the Discovery Learning model. The Discovery Learning model has the potential to stimulate students' activity, arouse their curiosity, and move learning beyond rote memorization by encouraging students to discover concepts by themselves (Amyani et al., 2018). Discovery Learning guides students to find what they want to know by searching for information independently. Students then constructively organize and form what they know and understand into a final representation of knowledge (Cintia et al., 2018).

Electronic student worksheets (e LKPD) represent one variation of instructional media that can be used. An e LKPD can present material in a concise format, such as learning videos, audio, links, and various types of practice questions. The study by Costadelna and Sulniasih (2022) showed that the use of e LKPD based on Discovery Learning has very good characteristics and is feasible to be used in the learning process, and its use has positive impacts. The use of e LKPD is therefore expected to improve students' creative thinking and collaboration skills.

This study develops the e LKPD using Liveworksheets. Liveworksheets is an online platform available at Liveworksheets.com. Through this platform, students can complete interactive e LKPDs online and submit their answers directly to the teacher. This mechanism can save the teacher's time, motivate students to learn, and reduce paper use so that learning activities become more environmentally friendly.

These conditions form the basis for conducting a study entitled "The Implementation of e LKPD Using Liveworksheets Based on Discovery Learning toward Students' Creative Thinking and Collaboration Skills on Salt Hydrolysis Topic". The study aims to identify differences in creative thinking and collaboration skills between students who learn using e LKPD with Liveworksheets based on Discovery Learning and students who learn using printed LKPD based on Discovery Learning on the topic of salt hydrolysis at SMAN 8 Banjarmasin. The study also aims to investigate students' responses toward the use of e LKPD with Liveworksheets based on Discovery Learning at SMAN 8 Banjarmasin.

METHODS

The study employed a quasi-experimental design with a nonequivalent control group. It was conducted over two meetings during the 2022/2023 academic year at one senior high school in Banjarmasin. The experimental group used electronic worksheets (e-LKPD) developed with Liveworksheets, which were easily accessible online, while the control group used only printed worksheets (LKPD). The population of this study consisted of all students in grade XI MIPA at the school, comprising four classes. Two classes were selected as the sample using purposive sampling, with 34 students in the experimental group and 35 students in the control group. The research included independent and dependent variables. Data were collected through test instruments (pretest and posttest) and non-test instruments, including questionnaires and observations.

RESULT AND DISCUSSION

Data obtained in this study consisted of three types, namely test scores of creative thinking skills, questionnaire scores of students' collaboration, and questionnaire scores of students' responses to the e LKPD Liveworksheets based on Discovery Learning in the salt hydrolysis topic for the experimental class and the LKPD based on Discovery Learning for the control class. Tests functioned as measurement tools containing statements or questions that students needed to answer (Astiwi et al., 2020). Data from the creative thinking skill test and the collaboration questionnaire were collected through pretest and posttest, then analyzed using descriptive and inferential statistics, while data from the response questionnaire were analyzed descriptively. Scores of creative

thinking skills in the pretest and posttest were analyzed descriptively using SPSS version 20. The summary of descriptive results appears in Table 1.

Table 1. Pretest and posttest results for students' creative thinking skills

	N	Minimum	Maximum	Mean
Pretest experimental	34	.00	68.75	35.2941
Posttest experimental	34	43.75	93.75	77.9412
Pretest control	35	.00	68.75	35.7400
Posttest control	35	37.50	93.75	74.8429
Valid N (listwise)	34			

Descriptive results in Table 1 show that the experimental class with 34 respondents obtained a minimum pretest score of 0.00 and a maximum score of 68.75, with an average of 35.29, which falls into the moderately creative category. The control class with 35 respondents obtained the same minimum and maximum pretest scores, with an average of 35.74, which also falls into the moderately creative category. Posttest scores of the experimental class ranged from 43.75 to 93.75, with an average of 77.94, which is categorized as very creative. Posttest scores of the control class ranged from 37.50 to 93.75, with an average of 74.84, which is categorized as creative. These findings align with Hurrahma and Sylvia (2022), who reported that learning using e LKPD based on Liveworksheets has been empirically proven effective for students. Hypothesis testing was then conducted to examine the effect of e LKPD with Liveworksheets based on Discovery Learning on students' creative thinking skills using pretest and posttest data.

Hypothesis testing on pretest data indicated no significant difference in creative thinking skills between the experimental and control classes, which means both classes were comparable and feasible as research samples. Hypothesis testing on posttest data indicated a significant difference in the average creative thinking skills between the experimental and control classes. This pattern supports the findings of Costadelna and Sulniasih (2022), who concluded that e LKPD with Liveworksheets based on Discovery Learning influences students' learning outcomes. Average pretest and posttest scores for the experimental and control classes are illustrated in Figure 1.

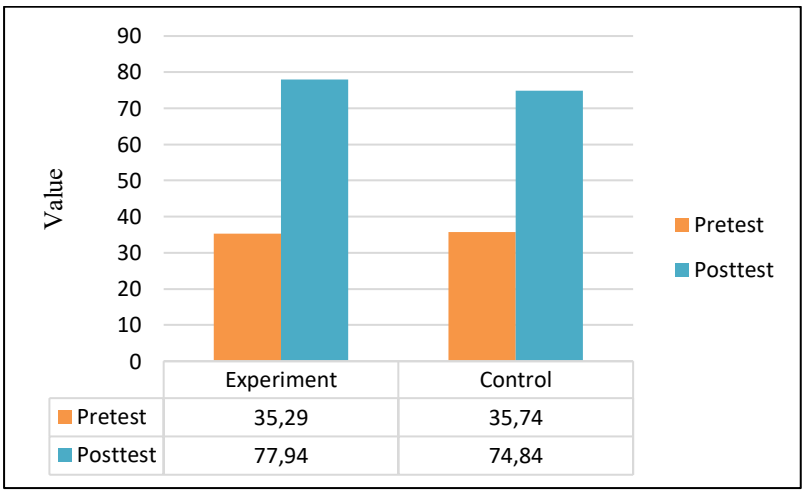

Figure 1. Average pretest and posttest scores of creative thinking skills

Figure 1 shows that the average posttest score of creative thinking skills in the experimental class (77.94) is higher than that of the control class (74.84). The difference relates to the learning media used. Students in the experimental class used e LKPD, which encouraged more active participation in the learning process and greater enthusiasm in solving problems. Annida et al. (2022) also reported a significant effect of e LKPD based on Liveworksheets on students' activeness in learning.

Use of e LKPD with Liveworksheets in the experimental class helped students become more active and more motivated. Analysis of N gain still revealed one student in the experimental class with a low N gain value, which occurred because this student rarely paid attention to the teacher's explanation or group presentations. N gain values in the control class indicated four students in the low category. These students tended to rely only on

reading text to obtain information without optimally involving listening and visual activities, which limited the effectiveness of their learning.

Learning activities using e LKPD with Liveworksheets based on Discovery Learning proved more effective in improving students' creative thinking skills. Atmojo et al. (2022) reported similar results, namely that e LKPD with Liveworksheets provided positive impacts for students. Students enjoyed a new learning atmosphere, the classroom became more interactive, learning activities appeared more engaging, and students became more enthusiastic and more motivated to participate. Improvements were evident in all indicators of creative thinking, namely fluency, flexibility, elaboration, and originality. Effendi and Farlina (2017) likewise found that around 80 percent of students had achieved maximum scores on creative thinking indicators, which were interpreted as good. Questionnaire scores of students' collaboration were analyzed descriptively using SPSS version 20. The summary of descriptive statistics is shown in Table 2.

Table 2. Descriptive statistics of students' collaboration scores

	N	Minimum	Maximum	Mean	Std. Deviation
Collaboration (experimental)	34	50.00	82.14	63.1835	7.49910
Collaboration (control)	35	48.21	78.57	61.4791	5.83130
Valid N (listwise)	34				

Table 2 shows that the experimental class with 34 respondents obtained collaboration scores between 50.00 and 82.14, with an average of 63.18, which falls into the strong category. The control class with 35 respondents obtained scores between 48.21 and 78.57, with an average of 61.48, which also falls into the strong category. Levels of collaboration in the salt hydrolysis topic can be further examined through the comparison of average scores for each indicator in the experimental and control classes, as illustrated in Figure 2.

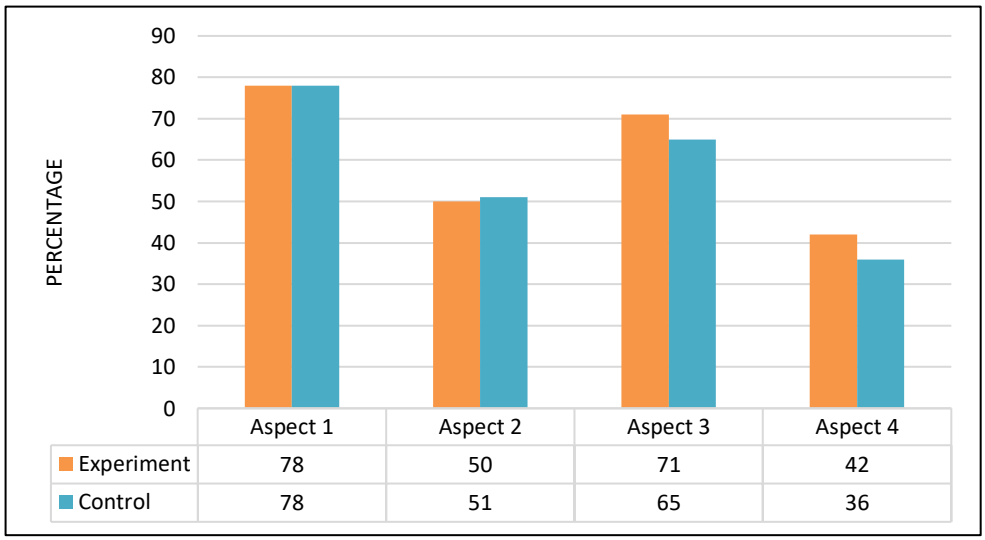

Figure 2. Comparison of collaboration indicators

Levels of achievement for each collaboration indicator in the experimental and control classes show variation, although one aspect has the same level of achievement in both classes. Collaboration in this study included four main aspects. The first aspect of collaboration concerns commitment to completing tasks within the specified time frame using students' knowledge and making decisions based on mutual agreement (Safaah et al., 2017). Questionnaire items for this indicator consisted of six positive statements. Figure 2 shows that the experimental and control classes obtained the same score for this aspect, namely 78 percent, which indicates a good level of collaboration. Students in both classes were accustomed to working through problems presented in stages in the LKPD and e LKPD, which required them to be active in asking questions, expressing opinions, and working together to solve problems with confidence. Optimization of LKPD in terms of visual design and learning quality requires transformation to an electronic format that can improve innovation and creativity, which is supported by the use of e LKPD (Putra & Agustiana, 2021).

The second aspect concerns respect for other group members' opinions. Questionnaire items for this indicator consisted of three positive statements. Figure 2 shows that the experimental class achieved 50 percent and the control class 51 percent. Collaboration on this aspect in the experimental class falls into the good category, and the difference between classes is relatively small. Both classes implemented the same steps of the Discovery Learning model to train collaboration, with differences arising mainly from the media used. The third aspect

concerns deliberation within the group. Questionnaire items for this aspect consisted of two positive statements. Figure 2 indicates that the experimental class achieved 71 percent and the control class 65 percent. These scores show that students in the experimental class demonstrated better deliberation skills, including the use of collective agreements and joint decision making, compared with the control class.

The fourth aspect concerns participation, including the provision of feedback to complete tasks and the willingness to assume responsibility in the group. Questionnaire items for this aspect consisted of three positive statements. Figure 2 shows that the experimental class achieved 42 percent and the control class 36 percent. These results are consistent with the characteristics of the Discovery Learning model, which shifts learning from a teacher centered situation to a student centered situation, while the teacher acts as mediator and facilitator (Ayuningtyas et al., 2018). Students are encouraged to express their opinions, engage in peer discussions, and raise questions to solve problems, which fosters greater confidence in collaboration.

Discussion of these findings indicates that overall use of e LKPD with Liveworksheets based on Discovery Learning in the salt hydrolysis topic can enhance students' collaboration in the learning process. Liveworksheets functions as an online platform for collecting assignments directly (Prabowo, 2021). Increased collaboration appears in the scores obtained at the end of learning and in the overall average collaboration levels, with the experimental class achieving an approximate average of 60 percent and the control class around 58 percent. Hartini et al. (2018) reported similar findings, namely that confronting students with problems to be solved scientifically facilitates understanding and application of concepts through laboratory activities and class discussions. Jayadiningrat et al. (2019) also reported that implementation of the Discovery Learning model improves students' learning activities through its procedural steps.

Scores of creative thinking skills from pretest and posttest as well as collaboration questionnaire scores were then converted into N gain values to determine the extent of improvement in the experimental and control classes after completion of the salt hydrolysis learning activities. N gain data for creative thinking skills are presented in Table 3.

Table 3. Interpretation of N gain for students' creative thinking skills

Class	Average *N-gain*	Category
Experiment	0,65	Medium
Control	0,59	Medium

Average N gain values in Table 3 show that the experimental class has a higher N gain than the control class. Students in the experimental class who used e LKPD with Liveworksheets based on Discovery Learning experienced greater improvement in creative thinking skills than students in the control class who used printed LKPD based on Discovery Learning in the salt hydrolysis topic. The average N gain of the experimental class, 0.65, falls into the medium category, and the average N gain of the control class, 0.59, also falls into the medium category. Collaboration scores obtained from the questionnaire after learning activities were converted into N gain values to determine the extent of improvement in collaboration in each class after the salt hydrolysis lessons. N gain data for collaboration are presented in Table 4.

Table 4. Interpretation of N gain for collaboration skills

Class	Average *N-gain*	Category
Experiment	1,86	High
Control	1,66	High

Average N gain values in Table 4 show that the experimental class again obtained a higher N gain than the control class. Students in the experimental class who used e LKPD with Liveworksheets based on Discovery Learning showed greater improvement in collaboration skills than students in the control class who learned with printed LKPD based on Discovery Learning in the salt hydrolysis topic. The average N gain of the experimental class, 1.86, is categorized as high, and the average N gain of the control class, 1.66, is also categorized as high. Inferential analysis using t tests on pretest and posttest data for creative thinking and collaboration was preceded by assumption testing. Normality testing used the Kolmogorov Smirnov procedure, and homogeneity testing used SPSS version 20. Results of the normality tests showed that data for creative thinking skills and collaboration followed a normal distribution, with significance values (Sig.) greater than 0.05. Results of the homogeneity tests indicated that the data were homogeneous, with significance values (Sig.) greater than 0.05, in line with the criteria proposed by Suljarweni (2015).

T-test Result

The t test was carried out on pretest and posttest data of students' creative thinking skills in the experimental and control classes after the data met the assumptions of normality and homogeneity. Results of the t test for creative thinking skills are presented in Table 5.

Table 5. T-test results for pretest and posttest data of students' creative thinking skills

Test	N	Descriptive Statistic		Paired T-Test		
		Mean	(Std.Deviation)	*t*	*df*	Sig. (2-tailed)
Pretest experimental	34	35,29	18,52	-15,377	33	0,000*
Posttest experimental		77,94	11,12			
Pretest control	35	35,74	18,96	-12,865	34	0,000*
Posttest control		74,84	14,16			

*p < 0,05 indicates a statistically significant difference

Results in Table 5 show that the Sig. (2 tailed) value is 0.000 < 0.05. This value indicates a significant difference between pretest and posttest scores in the experimental class and also between pretest and posttest scores in the control class. The conclusion is that learning produced a significant effect on students' creative thinking skills in both classes. Descriptive analysis indicates that the average pretest score in the experimental class was 35.29 and increased to 77.94 in the posttest. This change reflects a substantial improvement in learning outcomes after the implementation of e LKPD with Liveworksheets based on Discovery Learning. The control class also experienced improvement, from an average of 35.74 in the pretest to 74.84 in the posttest, although the magnitude of the increase was lower than that observed in the experimental class. This pattern strengthens the earlier finding that e LKPD contributes more strongly to the enhancement of creative thinking skills than printed LKPD using the same learning model. A t-test was also applied to collaboration data obtained from the experimental and control classes after learning. The analysis used SPSS version 20. Results of the t test for collaboration are presented in Table 6.

Table 6. T-test results for collaboration scores in the experimental and control classes

Test	N	Descriptive Statistic		Paired T-Test		
		Mean	(Std.Deviation)	*t*	*df*	Sig. (2-tailed)
Collaboration experimental–control	69	62,31	6,71	74,35	68	0,000*

*p < 0,05 indicates a statistically significant difference

Results in Table 6 show a Sig. (2 tailed) value of 0.000 < 0.05. This value indicates a statistically significant difference between the collaboration scores of students in the experimental and control classes after the treatment. The conclusion is that the implementation of e LKPD with Liveworksheets based on Discovery Learning produced a significant positive effect on students' collaboration skills compared with the use of printed LKPD based on Discovery Learning. Student response questionnaires were administered at the end of the learning sequence to identify levels of interest and acceptance toward the salt hydrolysis lessons under the two different treatments. The experimental class received e LKPD with Liveworksheets based on Discovery Learning, whereas the control class received printed LKPD based on Discovery Learning. Measurement of student responses in the experimental class used a questionnaire consisting of nine positive statements and one negative statement. Measurement of responses in the control class used a questionnaire consisting of ten positive statements. Average response scores for the two classes are presented in Table 7.

Table 7. Interpretation of student responses in the experimental and control classes

Class	Average response score	Category
Experiment	41,23	Positive
Control	37,37	Positive

Average response scores in Table 7 show that the experimental class achieved a higher level of response than the control class. The average response score of 41.23 in the experimental class falls into the positive category, and the average score of 37.37 in the control class also falls into the positive category. These findings indicate that students responded positively to the use of e LKPD with Liveworksheets based on Discovery Learning and that the strength of this positive response was greater than that observed for printed LKPD based on Discovery Learning.

CONCLUSION

Results of the study indicate a significant difference in creative thinking skills between students who learned using e LKPD with Liveworksheets based on Discovery Learning and students who learned using LKPD based on Discovery Learning. Paired sample t tests on pretest and posttest data produced Sig. 2 tailed

values of 0.000 < 0.05, which confirms that both forms of instruction improved creative thinking skills, with greater improvement observed in the class that used e LKPD with Liveworksheets. Analysis of collaboration scores also shows a significant difference between students who used e LKPD with Liveworksheets based on Discovery Learning and students who used LKPD based on Discovery Learning, with a Sig. 2 tailed value of 0.000 < 0.05. Students in both classes gave positive responses to the learning activities on the salt hydrolysis topic, and the level of positive response was higher in the experimental class that used e LKPD with Liveworksheets based on Discovery Learning.

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