

Improvement of Student Learning Outcomes Using E-Worksheets Assisted Live Worksheets on Basic Chemistry Laws Material

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Abstract: This study investigates the improvement of student learning outcomes using e-worksheet media with Live Worksheets. Conducted as Classroom Action Research (CAR), it involved 38 students from class X-7 at SMA Negeri 18 Surabaya. Data collection included observation techniques and learning outcome tests aimed at assessing teacher and student activities. The observation data were analyzed using a percentage formula for relevant activities over two meetings. Learning outcome tests measured improvements after cycles I and II, analyzed for the percentage of classical completeness in learning outcomes. Results indicated that teacher activity increased from 91% in cycle I to 100% in cycle II, while student activity rose from 79% to 89%, which falls into the very practical category. Additionally, learning outcomes improved significantly, increasing from 50% before the intervention to 79% in cycle I and 89% in cycle II, which is $\geq 75\%$. These findings demonstrate the effectiveness of e-worksheet media in improving educational engagement and achievement. The study concludes that technology-based learning innovations can effectively address educational challenges and recommends further development of interactive learning tools across various subjects and educational levels.

Keywords: Chemistry Laws; Learning Outcomes; Live Worksheets.

Introduction

Learning is a process that includes a series of activities of teachers and students with a mutual relationship that takes place in an educational situation to achieve a goal [1]. The continuity of the learning process is closely related to the interaction between teachers and students [2]. Thus, it can be concluded that the teaching and learning process is a series of activities between educators and students, where students play a role as subjects in the teaching process. The activeness of students will make the learning process effective and efficient, so that it can improve learning outcomes [3], [4].

Learning outcomes are a specific and valid statement stating the changes that occur in students after following a learning process that measures cognitive, psychomotor and attitude aspects. The improvement of learning outcomes is greatly influenced by the selection of learning methods and media used by teachers [5], [6], [7].

Learning media is a tool, means, or technology that helps convey messages or materials and facilitates understanding from teachers to students (or vice versa) [4]. Interesting learning media can stimulate students' thoughts, feelings, interests, and attention so that the learning process is effective [8]. Types of learning media include visual media, audio media, audiovisual media, print media, and digital interactive media [9]. Teachers can determine the right learning media by considering the learning objectives, student characteristics, and the availability of facilities and technology. The application of interesting learning media

will create a fun learning experience that is able to improve student learning outcomes [9].

In today's digital era, the development of educational technology is expanding. Technological developments have brought significant changes in the world of education, including in learning methods. Technology allows the teaching and learning process to be more interactive, flexible, and easily accessible to anyone, anytime. Various digital platforms, such as e-learning, interactive learning apps, and educational social media, have helped improve student understanding through more engaging and innovative approaches, one of which is the development of technology-based learning media, also known as Live Worksheets. Live Worksheets is an interactive application in which material can be inserted in the form of sentences, images, MP3/voices, videos, and other symbols that add to the uniqueness of the student worksheet [10]. Live Worksheets development turns static worksheets into dynamic worksheets, where students can instantly answer questions, select options, or even work on questions with audio and video. Some of the student worksheet activities that can be added in Live Worksheets are descriptions, matchmaking, multiple choice, pairing, checks, short fills, open-ended questions, learning videos, and other forms, according to the educator's activities [11]. The advantages of Live Worksheets include increasing student engagement with an interactive e-worksheet format, facilitating various learning styles, and presenting material in several interesting forms and can be added worksheets with automatic assessments so that students get immediate feedback after work. The existence of student worksheets assisted by Live

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Worksheets makes media innovations that teachers can use to create a fun learning experience for students [11].

The current independent curriculum, learning focuses on students that encourages creativity, innovation, and flexibility in learning so that students can learn according to their abilities and interests [12]. Teachers as facilitators can design learning that is able to achieve learning goals and improve student learning outcomes [13]. Based on the researcher's observations and interviews with chemistry teachers of SMA Negeri 18 Surabaya, class X-7, Mr. Purwo Rahadityo, S.Si. stated that chemistry is one of the subjects that is difficult for students to understand because of a lack of interest and motivation to learn chemistry. The characteristics of students in grades X-7 that are difficult to condition in the classroom become ineffective and give rise to the stigma that chemistry is difficult and unpleasant it resulting in low grades achieved by students.

Here, the researcher sees several problems that cause students to find it difficult to understand chemistry subjects, namely difficult initial impressions of chemistry, lack of interest and attention of students during the learning process, the selection of media that tends to be monotonous, and the lack of motivation of teachers to invite students to be actively involved in chemistry learning in the classroom. Some of these problems result in the learning process being less interesting and feeling bored in the learning process [13]. Students tend to only listen when the teacher presents the learning material without responding, so that at the end of the learning process, students easily forget the material taught by the teacher [14]. So that the goal of the end of learning is not maximally achieved, as evidenced by the results of daily assessments or joint assessments, which get many results under the minimum achievement criteria, with classical completeness of 50%. With this problem, it is necessary to conduct more in-depth research on the selection of interactive learning models and media that are able to create students' learning activity and motivation, so that learning goals are achieved and learning outcomes of students in grades X-7 are achieved in chemistry. The learning model that supports the achievement of this is discovery learning [15].

The discovery learning model is an active learning approach where material or content is not given directly by the teacher at the beginning of learning, but through exploration, discovery, and hands-on experience. The results of Imro'atul Azizah and Dina Mardiana's research show how the active involvement of students is in seeking information, understanding concepts, meanings, and relationships through an intuitive process until finally concluding the concept of material [16]. In addition, this model also develops social skills by working in groups, so that it is able to increase students' interest and motivation. The syntax of discovery learning is stimulation, problem identification, data collection, data processing, and a conclusion drawn. To support this research, an e-worksheet is prepared to adjust the syntax of discovery learning.

Therefore, based on the problems faced by students, the researcher found a solution to implement an innovative e-worksheet assisted by Live Worksheets, which is interesting to improve the learning outcomes of students in grades X-7 of SMA Negeri 18 Surabaya in chemistry subjects on the topic of Basic Law of Chemistry.

Research Methods

The type of research design used in this study is Classroom Action Research; the researcher is directly involved in the learning process in the classroom. Classroom action research includes qualitative research, where the discussion is in the form of a description. Classroom Action Research (CAR) is carried out by observing the learning process through actions that are deliberately applied and occur collectively in the classroom. This research aims to increase the effectiveness of learning through certain actions that take place in the classroom. The main goal is to solve real problems in learning and increase the involvement of teachers in the development of their profession [17],[18].

The design of the CAR can be seen in the following figure:

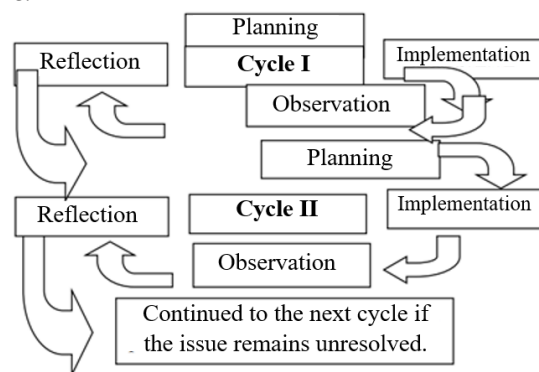


Figure 1. CAR Research Design

The CAR method consists of a series of four activities carried out in a repetitive cycle. In this cycle, there are four main activities in each cycle, namely planning, acting, observation, and reflection [14]. The cycle of CAR consists of several stages that take place repeatedly until the learning problem is resolved. Each cycle begins with planning, where researchers design actions to be applied in the classroom. In this case, the researcher designed learning tools, one of which is an e-worksheet, which is validated using a mode method, and the e-worksheet data analysis technique is said to be valid if the mode ≥ 4 [19].

The action is then implemented in the implementation stage, and then observed in the observation stage to collect data on the effectiveness of the action that has been taken. Furthermore, the observation results are analyzed in the reflection stage to evaluate the success of the action as well as determine whether improvements or follow-up actions are needed. The results obtained came from student observation sheets and cognitive writing tests.

Data on relevant activities of students in this research were obtained from filling out activity observation sheets for 2 meetings. The data obtained is then searched for percentages. The learner-relevant activity formula is obtained using the following formula:

$$\% \text{Relevant activities} = \frac{\text{The amount of activity that arises}}{\text{Overall activity count}} \times 100\%$$

Activities can be interpreted based on the criteria and guidelines below:

Table 1. Average Interpretation of Activity Data

Average (%)	Criteria
0 – 40	Impractical
41 – 55	Less practical
56 – 70	Quite practical
71 – 85	Practical
86 – 100	Very practical

[20]

Next is to conduct a classical completeness analysis of students. The learning outcomes of students can be said to be complete if the total score is equal to or more than the KKM (minimum learning completeness), which is ≥ 75 . The formula for classical completeness is as follows.

$$\% \text{Completeness} = \frac{\text{The number of students who passed}}{\text{The total number of students}} \times 100\%$$

E-worksheet can be said to be effective if the percentage of classical completeness obtains a score of $\geq 75\%$ [20].

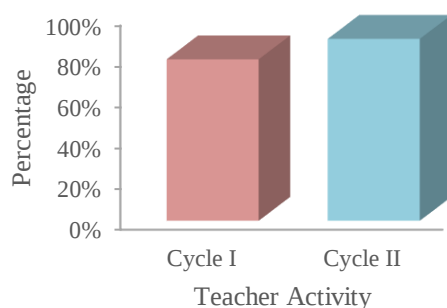
Then, the action is implemented in the implementation stage, which is then observed in the observation stage to collect data on the effectiveness of the action that has been taken. Furthermore, the observation results are analyzed in the reflection stage to evaluate the success of the action as well as determine whether improvements or follow-up actions are needed. If the problem has not been solved, the next cycle begins with a re-planning based on the results of previous reflections, and this process continues to be repeated until the research objectives are achieved [17].

Results and Discussion

This research was carried out for two cycles. Based on the data obtained during the study, it can be described as follows.

Teacher Activities

Teachers carry out learning activities, namely introduction, core activities, and closing, in accordance with the design that has been prepared in the teaching module I and teaching module II [18]. The success of this learning is supported by learning media and the use of Live Worksheets. The following is a comparison of the implementation and management of learning that has been carried out by teachers during cycle I and cycle II.

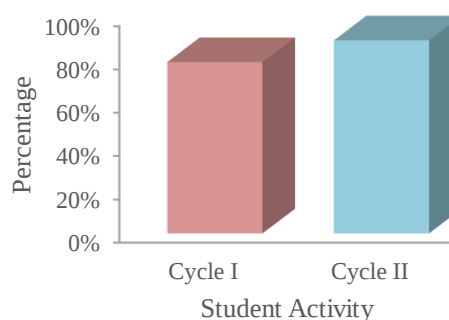
**Figure 2.** Teacher Activity Diagram

Based on the figure above, teachers' activities in implementing and managing learning during the two cycles show an increase. This is evidenced by the score obtained in the first cycle, which is 91%, which is included in the very practical category. In cycle II, a score of 100% was obtained, which was included in the very practical category. The score range between cycle I and cycle II was 9%. Based on this data, it illustrates that the teacher's activities in implementing e-worksheet assisted by Live Worksheets for each individual on the basic law of chemistry material are included in the very practical category.

The success of teacher activities in learning is also influenced by various supporting factors that are interrelated. One of the main factors is the teacher's professional competence, which includes in-depth knowledge of the material and good pedagogic skills to create effective learning [21]. The support of adequate school facilities and infrastructure, as well as collaboration between teachers and the school, greatly supports the smooth running of teaching and learning activities [22]. Finally, careful learning planning and the use of technology in the classroom are also important factors that can improve the quality of learning [23]. All of these factors contribute to the success of teachers' activities in creating effective and enjoyable learning experiences for students.

Student Activities

Based on the results of observations during the learning process, student activities showed an increase after the use of e-worksheet media assisted by Live Worksheets was implemented. During learning activities, students are actively involved and carry out learning activities in accordance with the expected goals. The observations made also show the progression of each cycle, which can be seen in the diagram below.

**Figure 3.** Student Activity Diagram

The observation results showed an increase in student activities during the learning process. In the first cycle, the students' activity score reached 79%, which was included in the good category. In the first cycle, some students still experienced difficulties in processing data on the e-worksheet properly. This affects the involvement of student activities in learning activities in cycle I. However, in cycle II, there was a significant increase with a score of 89%, which is included in the very good category. The difference in activity increase from cycle I to cycle II was 10%, which shows that almost all students have shown their involvement

in learning very well in the form of being able to analyze the information obtained, ask discussion questions, and answer questions on the e-worksheet completely. From this data, it can be concluded that the use of e-worksheet media assisted by Live Worksheets in learning the basic law of chemistry class X-7 at SMA Negeri 18 Surabaya contributes greatly to the increase in student activities.

This is in accordance with previous research by [24], which stated that the use of Live Worksheets media has a positive effect on increasing student activities in learning. According to Ausubel's theory of meaningful learning, the success of students' learning activities lies in the meaning of the teaching materials received or learned by students [25].

Other factors that support student activities are the digital skills of each student in using technology, information, and communication devices, as well as school facilities and infrastructure, which include the availability of technology facilities and a stable internet connection [26], [27].

Student Learning Outcomes

The completeness of the minimum criteria used at SMA Negeri 18 Surabaya is 75. After taking the learning outcome test, students are categorized as complete if they have a score that exceeds the minimum criteria, which is ≥ 75 . The learning outcome test contains multiple-choice questions with a total of 10 questions in each cycle. The explanation of the learning outcome test material in cycle I contains Lavoisier, Proust, and Dalton's legal material. Meanwhile, Cycle II contains the laws of Gay-Lussac and Avogadro.

Before learning that implemented e-worksheet assisted by Live Worksheets in cycles I and II, the acquisition of learning outcome tests in the previous material showed that the completeness of student learning outcomes had a percentage of 50%. This result is included in the poor category. This percentage was obtained by 19 out of 38 students in grades X-7 who had not completed the learning outcome test questions in the previous material, namely the nomenclature of compounds and chemical reaction equations.

After learning that implements e-worksheet assisted by Live Worksheets in cycles I and II, the acquisition of learning outcome tests conducted by students in cycle I shows that 79% of students have achieved the minimum criteria. The results of the completion percentage are in the good category. This percentage was obtained based on data, namely, as many as 30 out of 38 students in grades X-7 have achieved completeness of learning outcomes. Furthermore, in the second cycle, it showed that 89% of students had reached the minimum criteria. The results of the completion percentage are included in the very good category. In this cycle, as many as 34 out of 38 students have achieved completeness.

The acquisition of the learning outcome test shows that the learning process using e-worksheet assisted by Live Worksheets has improved. The range of learning outcomes from cycle I to cycle II is as much as 10%. For more clarity, you can see the diagram below.

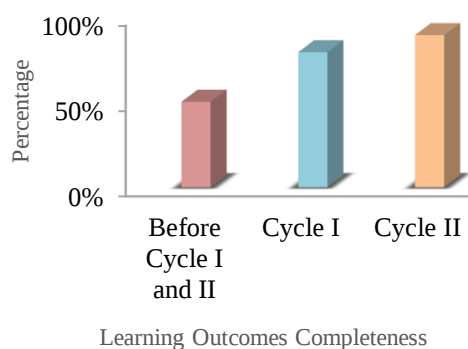


Figure 4. Learning Outcomes Completeness Diagram

Based on figure 4 above, it can be concluded that the learning outcomes of students before using e-worksheet with learning using e-worksheet assisted by Live Worksheets have increased, from 50% including the poor category, to 79% in the first cycle including the good category, and 89% in the second cycle including the very good category. Overall, students have been able to complete the learning outcome test questions with complete criteria. Therefore, the next cycle is stopped. Based on the results of the research that has been carried out, it can be concluded that the learning outcomes of students in grades X-7 of SMA Negeri 18 Surabaya using e-worksheet assisted by Live Worksheets in learning have been declared to have increased.

This is supported by the results that state that the use of Live Worksheets media can improve students' cognitive learning outcomes [28]. The results of the study stated that the learning outcomes of students using Live Worksheets media can be proven through an increase in classical completeness seen in the comparison of students' classical completeness between pre-cycle, cycle 1, and cycle 2 [29]. According to the theory of learning constructivism, it states that a person must actively build their own knowledge so that it can affect the improvement of learning outcomes [25].

Clark and Mayer (2003) also stated that an understanding of how cognitive processes interpret visual and auditory information can influence learning. Other factors that support the successful implementation of e-worksheet assisted by Live Worksheets on improving student learning outcomes include learning resources, school environment, school culture, teacher and student communication that can form positive interactions in it [30], [31].

Conclusion

This study explores the use of e-worksheet assisted by Live Worksheets as an innovative interactive learning media for chemistry subjects in class X-7 at SMA Negeri 18 Surabaya. The results indicated significant improvements in both teacher and student activities, as well as student learning outcomes. Teacher activity increased from 91% in the first cycle to 100% in the second, while student activity rose from 79% to 89%. Learning outcomes improved from 50% before the study to 79% in the first cycle, reaching 89% in the second cycle. These findings demonstrate that e-worksheet assisted by Live Worksheets effectively enhances

learning engagement and academic performance, positioning this technology-based approach as a promising solution for improving education. Despite limitations like external factors, technological access challenges, and the short study duration, the results suggest potential for further development in interactive teaching methods. Future research could explore more interactive features for e-worksheets and test their effectiveness across different chemistry topics and educational levels.

Author's Contribution

Maulidia Uswatun Khasanah, and Khurota A'yunin: Conceptualization, methodology, writing-original draft preparation; Dwi Arifianti and Yesika Dewi Kusumaningrum: analyzing and processing research data, writing the result and discussion; Ayu Yanuardani: Writing-review and editing; Utiya Azizah: Formal analysis, writing review, validation; Dian Asih and Purwo Rahadityo: Validation.

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