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Development of Blended Learning-Oriented Worksheets to Train Students Metacognitive Skills on The Rate of Reaction Material

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Abstract: During the Covid-19 pandemic, blended learning became one of the innovations in learning. This study aims to develop blended learning-oriented worksheets to train students' metacognitive skills on the rate of reaction material. This research method uses the ADDIE model. The instruments used are validation sheets, pre-test and post-test sheets of metacognitive skills, student response questionnaire, student activity observation sheets, and metacognitive inventory questionnaires. The research subjects were 15 students of class XI-MIPA 6 SMAS Al-Islam Krian. The student worksheets produced are very valid, with the average content and construct validation results being 87-88%. The practicality of worksheets gets a percentage > 81%, which is a very practical category. The effectiveness of worksheets is obtained based on the N-Gain score of pre-test and post-test gets moderate and high results. Thus, conclude that the blended learning-oriented worksheets are very valid, very practical, and effective.

Keywords: students' worksheet, blended learning, metacognitive skills, rate of reaction.

Abstrak: *Pada masa pandemi Covid-19 ini blended learning menjadi salah satu inovasi dalam pembelajaran. Penelitian ini bertujuan untuk mengembangkan lembar kerja siswa berorientasi blended learning untuk melatihkan keterampilan metakognitif siswa pada materi laju reaksi. Metode penelitian ini menggunakan model ADDIE. Instrumen yang digunakan adalah lembar validasi, lembar pre-test dan post-test keterampilan metakognitif, angket respon peserta didik, lembar observasi aktivitas peserta didik dan angket inventori metakognitif. Subjek penelitian berjumlah 15 siswa kelas XI-MIPA 6 SMAS Al-lslam Krian. Lembar kerja yang dihasilkan sangat valid dengan hasil rerata validasi isi dan konstruk adalah 87-88%. Kepraktisan lembar kerja mendapatkan persentase > 81%, berada pada kategori sangat praktis. Keefektifan lembar kerja ditentukan berdasarkan hasil N-Gain pre-test dan post-test yang mendapatkan hasil sedang dan tinggi. Dengan demikian, disimpulkan bahwa lembar kerja siswa berorientasi blended learning adalah sangat valid, sangat praktis dan efektif.*

Kata Kunci: *lembar kerja peserta didik, blended learning, keterampilan metakognitif, laju reaksi.*

▪ INTRODUCTION

Education is the most fundamental thing for the progress of a nation. Through education, quality and competent human resources can be created in their fields (Widyawati & Nasrudin, 2019). The Covid-19 pandemic has undeniably brought a huge impact on changes in people's life patterns as well as in the world of education. Face-to-face learning in schools are replaced by long-distance learning with Blended or even online learning (Ramadhani, 2020) to break the chain of virus spread (Bayham & Fenichel, 2020). This causes technology to become an inseparable part today (Chidayati, Distrik, & Abdurrahman, 2021). However, changes in the education system

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suddenly cause various obstacles so that learning becomes ineffective and inmaximal (Ginting, Tjandra, & Wianto, 2021).

Improvements in the education system are urgently needed, especially in the post-pandemic era. Blended learning can be one of the solutions and innovations in post-pandemic learning (Singh, Steele, & Singh, 2021). Through Blended Learning, a teacher can combine conventional classes with online learning (Harahap, Nasution, Manurung, & rer. nat., 2019). According to (Irsalina & Dwiningsih, 2018), Blended Learning is one of the effective and efficient alternatives that can be taken and applied in a coordinated manner to achieve learning objectives, including chemistry learning.

Chemistry learning in its application to the 2013 curriculum should give a direct experience and meaningful learning for students. The position of chemistry as a basic science for one branch of Natural Sciences is the basis for other branches of science. Where chemistry examines in terms of structure, composition, properties, bonds, and energy changes involved in it. Many demands for studies in chemistry implicitly require students to develop their thinking skills. So that learning is needed to emphasize the metacognitive ability of students in controlling their thinking processes (Furqoniyah & Azizah, 2016)

Metacognitive is often referred to as *"thinking about thinking"* (Livingston, 1997). But basically, metacognition is consciously controlling one's cognitive abilities, thinking about how to plan, monitor, and evaluate correct strategies that have been carried out to solve a problem (Azizah & Nasrudin, 2018). This opinion is in line with Slavin (2018), metacognitive relates to how students think about their way of thinking and their ability to use certain learning strategies appropriately (R. E Slavin, 2018). There are 3 skills that refer to the dimensions of metacognitive skills, including planning skills, monitoring skills, and evaluating skills are necessary to trained (Mahmuda & Azizah, 2020). Metacognitive skills are closely correlated with constructivism theory. Students as learners must be able to revise old information into new information that is simpler and easier to accept. In other words, students can construct their knowledge and determine which strategies are appropriate in solving a problem (Robert E Slavin, 2013).

In helping students find problem-solving, it is necessary to have media that can guide them step by step, such as student worksheets. Student worksheets and their assessments can be implemented using blended learning (Crawford & Jenkins, 2018). Student worksheets that are integrated into blended learning can be in the form of e-worksheets and physical worksheets (Sumarmi, Bachri, Irawan, & Aliman, 2021). According to (Lapitan, Tiangco, Sumalinog, Sabarillo, & Diaz, 2021), this blended learning is expected to prepare students to actively participate in learning that requires high-level cognitive abilities (Brandon, 2020). Based on research (Ortega-Morán et al., 2020), some students stated that face-to-face only or just online learning using modules or worksheets is quite bored. However, with blended learning being flexible, students gain more knowledge and are interactive (Alabdulkarim, 2021).

The results of pre-research questionnaires had given to students of class XII MIPA 3 SMAS Al – Islam Krian, the average results of students' metacognitive skills on the Planning Skill 30,4%, on the Monitoring Skill 42,6%, and Evaluating Skill 35,3%. Based on these results, it is necessary to have a strategy in learning such as student worksheets to train students' metacognitive skills. More than 60% of students explained that they were rarely given learning media such as worksheets. In addition, from the pre-research that has been carried out as many as 56% of students stated that

the rate of reaction material is one of the chemical materials that are considered difficult. The difficulty of the material is not unreasonable, but some concepts require more understanding than just listening to the material in class (Izzah & Azizah, 2019). By doing practicum and accessing learning material from various sources such as the internet, students will more understand the matter (Nuraini, Distrik, & Suana, 2018). Especially if given an interlude online and offline, it will be able to provide interesting and not boring variations of learning.

Fun learning is certainly not useful if it cannot have a good impact on students. Learning media such as student worksheets should generate motivation, self-efficacy, and student confidence in learning (Hallinger, Hashemi, & Kouhsari, 2018). By developing student worksheets that are integrated with metacognition, it will help students construct their abilities so that they become critical and reflective human automatically successful learners (Trisna, Budayasa, & Siswono, 2018). Training metacognitive skills will foster independent learning in students (Abdelrahman, 2020). Metacognitive skills can reflect how students plan, implement and monitor strategies, assess their work, and even others (Carvalho & Santos, 2022).

In general, worksheets given in the printed form are still considered to be less effective and less practical when used in learning during a pandemic (Herawati, Gulo, & H, 2016). To adapt to the current online learning conditions, need innovation to make interactive worksheets that not only be used in face-to-face learning, but also adapt to electronic-based learning. From these various descriptions of the problem, it is necessary to research the development of Blended learning-oriented worksheets to train students' metacognitive skills on the rate of reaction material. Through this development research, it is expected to be able to support a more effective and efficient learning process and guide students in learning well so that they get satisfactory learning outcomes.

▪ METHOD

Research Design

This research method is a research of development where the development research will produce a blended learning-oriented worksheet to train students' metacognitive skills in the rate of reaction material. The ADDIE model uses in this research. Several stages of development start from the analysis stage, design, development, implementation or trials of using worksheets, and Evaluation of worksheets that tested (Cahyadi, 2019). The research was limited to 15 students class XI-MIPA 6 SMAS Al-Islam Krian with One Group Pretest-Posttest research design.

Research Instruments

This research needs research instruments. A research instrument is a tool to measure phenomena or problems observed and investigated specifically (Arikunto, 2019). The research instruments used were student response questionnaire sheets, validation questionnaires sheets, pretest and posttest activity observation sheets, and metacognitive inventory questionnaire sheets (Schraw, Dennison, & R, 1994).

All research instruments developed by the author were validated by three experts and declared valid because they got a percentage > 61%. The student response questionnaire contains positive and negative statements regarding the content and constructs of the student worksheets, and the average validation result is 83.8%. Examples of a positive statement are "The material in the student worksheets is easy to

understand", and a negative statement such as "The presentation of student worksheets are not interesting" so, to analyze a negative statement, students' responses will get the opposite value. The pretest and posttest sheets of metacognitive skills get an average validation result of 83.3%. This test was used to measure the extent of students' metacognitive skills before and after the limited trial on the rate of reaction material.

As for the student activity observation sheet, the validation results were 84.0%. The student activity observation sheet is divided into two parts, online and offline learning activities. All student activities are associated with relevant metacognitive skills, for example in offline activities students can do reaction rate factor practicum according to teacher directions. This activity fulfills the dimension of metacognitive skill on monitoring skills, meaning that if students are able to do the practicum well, one of the metacognitive skills has been trained. If the above-mentioned instrument was developed by the author, it is different from the metacognitive inventory questionnaire adapted from (Schraw et al., 1994), which contains 20 statements and is divided into 3 parts, on the dimensions of planning skills 7 statements, monitoring skills 7 statements, and evaluating skills 6 statements. For example, the statement on the planning skill dimension is “I ask myself questions about the material before I start working on the rate of reaction problem” Next, on the monitoring skill dimension “I ask myself what is the best way or strategy for me to do when learning something new”, and then on the dimension of evaluating skills “I know how well I did after solving the rate of reaction problem”. These statements can analyze the extent to which students' metacognitive awareness has been achieved through limited trials.

Data Analysis Techniques

The research data obtained was analyzed descriptively quantitatively. The data was measured to define the validity, practicality, and effectiveness of the worksheets in training students' metacognitive skills on the rate of reaction material. The validity of the blended learning-oriented worksheets was obtained from the validation results of three validators, two lecturers and a chemistry teacher. Then calculated the percentage score of the validation sheet based on content and construct validity and then measured using a Likert scale. The interpretation of the validity score of the blended learning-oriented worksheet is in the very invalid category if it gets a percentage (0-20%), invalid (21-40%), sufficiently valid (41-60%), valid (61-80%), and very valid (81-100%) (Riduwan, 2016).

Worksheets can be said to be valid if it gets a percentage of > 61%. The practicality of the blended learning-oriented worksheets measured use a student response questionnaire sheet which contains questions on contents and constructs of the worksheets. The assessment is given a score for positive statements in the form of decent high points (1) if you give a "yes" answer and (0) if you give a "no" answer. If the percentage of positive responses is > 61%, it means that the worksheets developed are practical.

These results are supported by online and offline student activity sheet data. The student observation data sheet aims to observe whether the students' activities during the meeting fulfill three metacognitive skills, planning skills, monitoring skills, and evaluating skills. Analysis of the student activity observation sheets using the Guttman scale. The effectiveness of the worksheet is determined based on the metacognitive skills pretest and posttest results after a limited trial to 15 students in senior high school

(Nunaki, Damopolii, Kandowangko, & Nusantari, 2019). The results of this data will be tested for normality and then calculated N-Gain followed by paired t-test.

Students' metacognitive skills are declared trained or even improved if the N-gain value obtained is in the medium category ($0,3 \leq g \leq 0,7$) and high ($g > 0,7$) (Hake, 1998). The students' metacognitive inventory questionnaire supports these data. The results of the metacognitive inventory questionnaire will show students' metacognitive skills after the trial by blended learning-oriented worksheets.

▪ RESULT AND DISCUSSION

This study uses the ADDIE research model with research stages Analyze, Design, Develop, Implementation, and Evaluation. In the Develop stage, a Blended Learning-Oriented worksheet is developed, according to the rate of reaction material. From this stage, four student worksheets were produced, including the concentration factor, the surface area factor, the temperature factor, and the catalyst factor. Then the results of the worksheets will be validated by two lecturers in chemistry department and a chemistry teacher. The 15 students of class XI MIPA 6 SMAS-Al Islam Krian have been given a limited trial At the implementation stage. This implementation stage aims to determine the practicality and effectiveness of blended learning-oriented worksheets to train students' metacognitive skills on the rate of reaction material. The last stage is evaluation, which is the post-research stage carried out by researchers to correct deficiencies in the worksheets.

A. Validity of Blended Learning Oriented Worksheets

The purpose of this validation process is to determine whether the worksheets are appropriate based on the content validity and construct validity (linguistics, presentation, and graphics). The average validation results from three validators showed in table 1 below.

Table 1. The average result of worksheet validation

Validity Aspect		Average (%)			
		Worksheet 1	**Worksheet 2**	**Worksheet 3**	**Worksheet 4**
Content Validity	Content and Blended Learning suitability	87	89	88	88
Constructs Validity	Linguistic	90	90	88	83
	Presentation	87	85	88	88
	Graphics	87	82	83	88
	Average	88	87	87	87

The results of data processing in table 1 can be seen that in terms of content validity worksheets 1-4 got a high score in the range of 87-89% which indicates the worksheet developed fulfills the material of reaction rate factors and meets the blended learning. Furthermore, if analyzed in terms of construct validity, the linguistic aspects of worksheets 1 and 2 get the highest score, which is 90%. In developing a learning device or media the use of good and easily accessible language is an important factor in measuring the effectiveness of these teaching materials (Auliya & Dwiningsih, 2019).

While the validation results in terms of presentation and graphics are in the very valid category. Graphic design from the cover to the presents and layout of the attractive worksheet can stimulate student learning motivation (Adi et al., 2021).

Figure 1. Worksheets cover

Overall, the four worksheets had produced to train students' metacognitive skills on the rate of reaction were declared very valid because they get a percentage of > 81% (Riduwan, 2016), evidenced by the average validity score obtained in worksheet 1 of 88%, worksheet 2 of 87%, worksheet 3 of 87%, and worksheet 4 of 87%. Thus, the blended learning-oriented worksheets which were developed fulfill all aspects of validity so that it is feasible to use (Bahri, Idris, Muis, Arifuddin, & Fikri, 2021).

2. The practicality of The Blended Learning-Oriented Worksheets

The blended learning-oriented worksheets that have been tested on limited trial, then analyzed its practicality using a questionnaire sheet of student responses to the developed LKPD and an observation sheet of student activities based on the emerging metacognitive skills. The practicality of the worksheets can be declared practical if it gets a percentage > 61% (Riduwan, 2016).

The results of student responses to the worksheets developed on content criteria, linguistic criteria, presentation criteria, and graphics criteria get a high average result, which is in the range of 90-96%. On the content criteria, 96% of students gave a positive response another 4% gave a negative response. As many as 100% of students stated that using blended learning worksheets helps students determine learning objectives and do practicum well on the reaction rate factor. Negative responses from students, some stated that it was difficult to determine the best learning strategy, but most were able to do this. The description shows that the blended learning worksheets content was practical in training students' metacognitive skills. Furthermore, if viewed from the perspective of constructs, the linguistic criteria get the average percentage of 93%, the presentation criteria of 95%, and the graphic criteria of 95%.

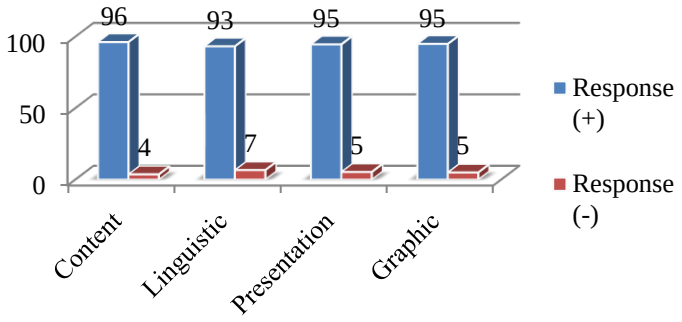

Figure 2. The results of students' responses questionnaire

According to the student's response questionnaire results, it concluded that the worksheets that have been developed and tested on a limited trial get a positive response > 61%. The data is supported by the student activity observations from two observers. The results of the observation sheet on online and offline learning students get a percentage of 100% relevant activity on three metacognitive skills dimensions. In the planning skills dimension, students analyze, identify and plan to solve the problem in a day life phenomenon that teachers give using their prior knowledge (Azizah & Nasrudin, 2021). In the dimension of Monitoring skills, students are allowed to monitor problem-solving strategies by conducting practicum and determining the conclusions. The last dimension is evaluating skills, where students are trained to evaluate their previously selected strategies.

Overall, students can follow each stage of metacognitive skills well. Learning with blended learning-oriented worksheets by utilizing Microsoft Teams as an LMS (*Learning Management System)* to create interactions between students related to rate factor material and assisted by live worksheets as a medium for delivering online worksheet. A visualization of the appearance of the discussion forum and online worksheet is presented in Figures 3 and Figure 4 below.

Figure 3. The Microsoft Teams overview

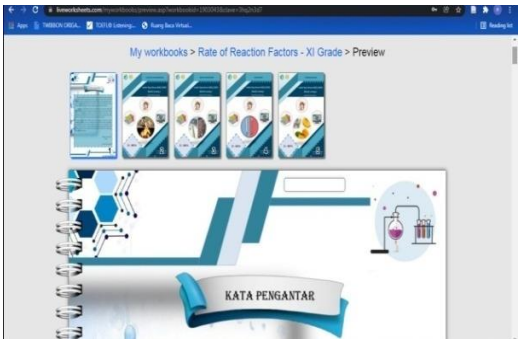

Figure 4. Online worksheet (Liveworksheet)

In online learning, using online worksheets, students can answer questions given anytime without being limited by time and space, so learning is more flexible and easy. In line with research conducted by (Bahri et al., 2021), online learning combined with face-to-face learning will both support and complement each other in achieving learning objectives. Based on the student responses and student activity observation sheets are getting a percentage of > 81%. So, the blended learning-oriented worksheets are stated

very practical to train students' metacognitive skills on the rate of reaction material (Riduwan, 2016).

3. The Effectiveness of the Blended Learning Oriented Worksheet

The results of data analysis from the pretest and posttest of metacognitive skills were used to show the effectiveness of blended learning-oriented worksheets, which analyze by increasing the N-Gain Score. Before performing the N-Gain Scores, sure that the data are normally distributed based on the Kolmogorov Smirnov test using the IBM SPSS Statistics 23 application. If the data fulfill this requirement, the data analysis continues using the N-Gain score (Lutfi & Tjahjani, 2013). The normality test results of pre-post tests show in table 2.

Table 2. Normality result of pretest and posttest using One-Sample Kolmogorov-Smirnov Test

	Pretest Metacognitive Skills	Posttest Metacognitive Skills
Asymp. Sig. (2-tailed)	,108	,060

a. Test distribution is Normal.

Based on the result from table 2 above, obtained Asymp. Sig. (2-tailed) of the pretest and posttest normality test > 0,05, it means that the data is normally distributed. Next, proceed with the analysis of increasing metacognitive skills using the N-Gain scores. Pretest and posttest of metacognitive skills result analyzed from the third metacognitive dimension are planning, monitoring, and evaluating then calculated on the average. The average pretest and posttest for each metacognitive skill dimension calculated the N-Gain Score in table 3 below.

Table 3. N-Gain Score pre-test and post-test

Metacognitive Skills Dimension	Pretest	Posttest	N-gain	Category
Planning skills	24	76	0,68	Medium
Monitoring skills	33	88	0,82	High
Evaluating skills	14	88	0,86	High

Increases in students' metacognitive skills can be seen from the results of the gain score. The N-Gain Score obtained is in the medium category on planning skills is 0,68, while in the high category on Monitoring skills is 0,82 and Evaluating skills is 0,86 (Hake, 1998). In the dimension of Monitoring and Evaluating Skills, students are in the high category because these skills are learned in offline learning experiments through direct laboratory experiments. By doing learning with this investigation, it can increase the learning motivation of students to be able to monitor and develop their learning strategies well (Chen, Huang, & Chou, 2016). Thus, it shows that train metacognitive skills by these worksheets, students can manage, monitor, and choose the best strategy to solve problems in their learning process.

In line with (Azizah & Nasrudin, 2021), reveals that metacognitive skills correlate with self-regulated learning can increase student self-motivation beliefs, self-control, mastery of the concept, and help students to face other problems independently. In the previous research, blended learning will increase participants' motivation to learn

independently so that they can organize and develop their best learning strategies (Vanslambrouck et al., 2019). Then, the pretest and posttest results were tested with One sample Paired t-test to know a significant difference between the pretest and posttest scores.

Table 4. One sample paired test results

Paired Samples Test		Paired Samples Test 95% Confidence Interval of the Difference		T	Sig. (2-tailed)
		Lower	Upper		
Pair 1	Pre Test - Post Test Metacognitive Skills	-63,708	-54,158	-26,470	,000

Based on the results of the paired t-test show that significant value < 0,05. It indicates there is a difference average between the pre-test and post-test. Furthermore, reveal that blended learning-oriented worksheets can improve metacognitive skill shown on their learning outcomes. The results obtained with the metacognitive questionnaire inventory or MAI (Metacognitive Awareness Inventory) developed by Schraw and Dennison contains 20 statements covering all three dimensions of metacognitive skills (Schraw et al., 1994). The MAI was given to participants after the postest, showing that students' metacognitive skills are in a good category (70-75%), which means they have improved (Riduwan, 2016). MAI results are present in Figure 5 below. Based on the description above, blended learning-oriented worksheets can be declared effective use in chemistry learning, especially on the rate of reaction material.

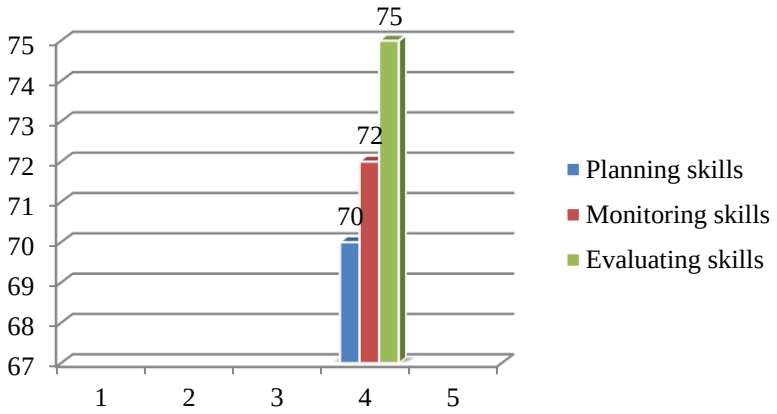

Figure 5. MAI score in percentage

▪ CONCLUSION

Based on the research result, the development of blended learning-oriented worksheets to train students' metacognitive skills on the rate of reaction material is suitable for use in learning because it has fulfilled the required criteria of validity, practicality, and effectiveness. In terms of validity worksheets, get an average percentage on worksheets 1-4 is 88%, 87%, 87%, 87%, which are declared very valid. Blended learning-oriented worksheets are stated very practical, obtained from the observation sheets on online and offline of students activity 100% carried out and the

results of the student response questionnaire getting a percentage of 96% content, 93% linguistic, 95% presentation, and 95% graphic. Blended learning-oriented worksheets in practicing metacognitive skills are stated effective based on the N-Gain Score of the dimensions of skill planning 0,68 (medium category), monitoring skills 0,82 (high category), and skills evaluating 0,86 (high category).

Through this research, it can provide new solutions and innovations in education, especially in chemistry learning during the Covid-19 pandemic which requires students to study from home. If students' metacognitive skills have been trained, they don't just wait for instructions from the teacher in learning new knowledge. Students already have an inner awareness to prepare themselves to learn, so that students can become independent learners with the teacher's role as a facilitator. Based on the results of this study, there are some limitations, it is possible there was a bias on the data result because taking with a small participant. For future research, it is hoped that it will not only train metacognitive skills but also students' metacognitive knowledge. In addition, trials can be carried out with large-scale trials to obtain more accurate and effective results.

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