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Flipped Classroom System Based on Guided Inquiry Learning Model Using Discord Application on Reaction Rate

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Abstract

The 4.0 era has made major changes in educational field. Indonesian also seeks to adapt with 4.0 era by presenting merdeka curriculum that requires learning to be student-oriented while still prioritizing the use of technology in learning. This research develops a learning system by combining a flipped classroom with a guided inquiry model using Discord application as a media that is tested until the validity and practicality stages. The product is considered valid if the V≥0.8 result is obtained and very practical if the percentage value of practicality is above 86%. The method used in this research is Educational Design Research (EDR) with the Plomp model. The subjects of this research are 3 chemistry lecturers UNP, 2 teachers and 9 students from SMAN 8 Padang. The data collection instrument in this research was in the form of validity and practicality test questionnaire. Based on the results, the validity value is 0,87 and the practicality value is 90% which indicates the system proves to be valid and very practical. This research is expected to be an alternative solution to create chemistry learning in accordance with the demands of the 4.0 era and the kurikulum merdeka, especially on reaction rate.

Keywords: Flipped Classroom, Guided Inquiry, Discord Application, Reaction Rate

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INTRODUCTION

Now we are in industrial revolution 4.0 era (Herpika & Mawardi, 2021). The industrial revolution 4.0 has made major changes in the field of technology that have an impact on changes in other fields including education. Developments of technology have gone digital and utilized the internet (Indarta et al., 2022). The biggest challenge of this era is to improve the education system that is able to adopt and implement the integration of technology into learning process (Pratiwi & Mawardi, 2022). One of the efforts made by the Indonesian government to adapt with 4.0 era is to present the "Merdeka Curriculum" which was initiated directly by the Minister of Education, Culture, Research and Technology of Indonesia (Kemendikbud Ristek RI), Nadiem Makarim. Merdeka curriculum requires learning to be more oriented to the needs of students (student centered learning) while still prioritizing the use of technology in the learning process. One of the efforts that teachers can make for student centered learning is by implementing blended learning (Indarta et al., 2022).

Blended learning is learning that combines face-to-face learning in the classroom with online classes where both collaborate with each other (Samala et al., 2020). There are four blended learning models according to Clayton, namely rotation, flex, A La Carte, and enriched virtual. In the rotation model, there are four sub-models, one of which is the model that will be used in this research, namely the flipped classroom model (Powell et al., 2015).

In a flipped classroom, activities that are typically completed in class are completed at home, while activities that are typically completed at home are converted into class activities (Agustini, 2021; Sunarto, 2021). There are two conditions that the flipped classroom is implemented: synchronously and asynchronously (Mawardi et al., 2021). Synchronous learning happens at the exact same time but not always in the same location. Whereas asynchronous learning is a process that involves learning at different times and locations (Chaeruman et al., 2013). Flipped classroom learning is known to be student-centered so that it can make learning more effective (Fautch & M, 2015). The implementation of flipped classroom which consists of two learning conditions is known to increase students' learning activities and can incease learning outcome if we compare with traditional learning (Waer & Mawardi, 2021). This increase in learning activity is of course also supported by good learning planning by the teachers (Fitriani et al., 2022; Mujiyati, 2020).

Teachers must be innovative in plan the learning to be interesting and interactive for students, so that a learning model is needed to can realize this (Djidu et al., 2021; Sitanggang et al., 2022). One of the learning models that can be used to increase student motivation in learning is guided inquiry learning model (Bilad, Anwar, et al., 2022; Syafei & Mawardi, 2022). Guided inquiry have five syntaxes, namely orientation, exploration, concept formation, application, and closing (Ekayanti et al., 2022; Fani & Mawardi, 2022). The guided inquiry model has been proven to be able to make students more active in learning and have higher learning motivation so that the learning outcomes obtained also increase (Bilad, Doyan, et al., 2022; Mawardi et al., 2016; Suhirman & Ghazali, 2022; Verawati et al., 2022; Verawati & Hikmawati, 2021). This guided inquiry model can be applied to various chemical subject matter, one of which is the reaction rate. The reaction rate is one of the subjects studied in the odd semester of class XI SMA/MA. Sub topics in reaction rate include the concept of reaction rate, collision theory, factors that affect the reaction rate, reaction rate equation, and reaction order. Reaction rate is classified as abstract material so that many students have difficulty in understand the material (Pahriah & Hendrawani, 2019).

According to the preceding explanation, learning is required to combine a guided inquiry learning model on reaction rate with a flipped classroom system. This learning uses supporting media, namely the Discord application. Previously, development research has also been conducted on the flipped classroom system based on guided inquiry on reaction rate using the Learning Management System (LMS) Moodle and Edmodo (Dwikoranto et al., 2020; Halil, 2020). However, previous research has weaknesses where for now the Edmodo platform has been closed as of September 22, 2022 while the Moodle LMS is also known to have weaknesses. According to Wawan (2006), the weaknesses of the Moodle LMS include requiring a stable internet network to access it, slow access time because it has a small bandwidth, and does not support several existing web browsers (Nurkhalik & Syaichudin, 2014). Therefore, it is necessary to further develop this learning system using other supporting applications, which is Discord, so that it is expected to be able to perfect previous studies. Discord is one of the social media that was originally used by gamers to interact and communicate. But it turns out that Discord has many features that can support the learning process so that it can be developed into learning media (Salim & Si, 2021).

This research is expected to have a positive impact, especially on students and teachers in realizing technology-based learning in schools that can improve the various abilities of students according to the demands of the merdeka curriculum and the demands of the industrial revolution 4.0 era, especially in chemistry learning and reaction rate material. The purpose of this research is to develop a flipped classroom learning system based on guided inquiry using Discord application on reaction rate material for class XI SMA/MA as well as assessing the level of validity and practicality so that later the results can be an alternative support for chemistry learning, especially on reaction rate material.

METHOD

The type of research used in this study is development research, specifically Educational Design Research (EDR) uses the Plomp model which consists of three stages namely (1) preliminary research, (2) development or prototyping phase, and (3) assessment phase (Syafei & Mawardi, 2022).

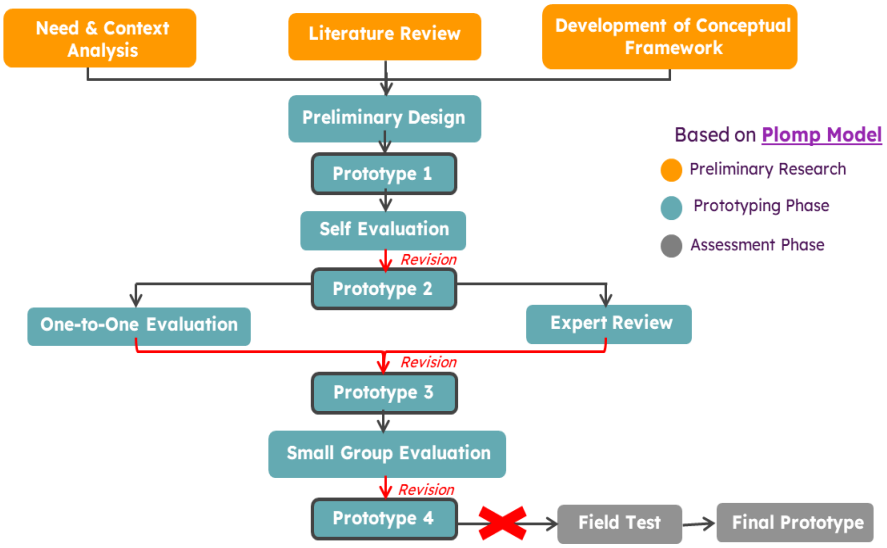

Figure 1. Plomp Development Steps

However, this research will be limited to the small group practicality test only or until prototype 4 produced. This development research will be conducted at SMAN 8 Padang in the even semester of the 2022/2023 academic year. The subjects in this study consisted of 3 chemistry lecturers FMIPA UNP, 2 chemistry teachers, and 9 students of XI class of SMAN 8 Padang. The reason for choosing three lecturers and two teachers is so that the products developed can be assessed by several experts so that the results obtained are more valid. Three students with high, medium, and low ability levels were selected with the purpose that the results obtained could be representative the students in general.

At preliminary research, needs and context analysis, literature study, and conceptual framework development were conducted (Insani et al., 2022). At the need and context analysis stage, interviews were conducted with 3 chemistry teachers with the aim of knowing the problems experienced by teachers and students at school related to the learning process on reaction rate. Furthermore, the literature study stage is carried out by collecting sources that are relevant to the research to be carried out (Syafei & Mawardi, 2022). Then a conceptual framework will be designed which will be used as the basis for designing the development of a learning system for reaction rate using the Discord based on guided inquiry integrated with a flipped classroom.

After completing the preliminary research, we will enter to development or prototyping phase. This stage is done by analyzing, designing, evaluating, and revising the developed product. There are four prototypes that will be produced through a series of formative evaluations, namely prototype 1 which is the initial design of the product, prototype 2 from the results of self evaluation, prototype 3 as the results of one-to-one evaluation and expert review revision, and prototype 4 which is the revised result of the small group test (Siregar & Mawardi, 2022)

Data Collecting Instruments

The data collection instruments used in this study consisted of observation interview sheets, self evaluation questionnaires, one-to-one evaluation questionnaires, for validity instruments in the form of content and construct validity questionnaires, and practicality instruments in the form of teacher and students practicality questionnaires.

Data Analysis Techniques

The technique for validity test used the Aiken's V formula:

$$V = \frac{S}{n(c-1)}$$

$$S = r - lo$$

Information:
S : the score assigned by the validator minus the lowest score of the category
lo: the lowest assessment number (in this case = 1)
c : the highest validity assessment number (in this case = 5)
r : the number chosen by the validator
n : number of validators

The criteria for the level of validity according to Aiken are listed in Table 1.

Table 1. Aiken's V Chategory (Siregar & Mawardi, 2022)

Aiken's V Scale	Description
V ≥ 0.80	Valid
V < 0.80	Invalid

Meanwhile, the following formula was used to analyze the practicality:

$$NP = \frac{R}{SM} x\ 100$$

Information:
NP : desired percentage of value
R : the obtained raw score
SM: the desired maximum score on the test in question
100 : set number

The criteria for the level of practicality can be seen in Table 2.

Table 2. Practicality Level Criteria (Yunus & Sardiwan, 2018)

Percentage	Description
86%-100%	Very Practical
76%-85%	Practical
60%-75%	Quite Practical
55%-59%	Less Practical
≤ 54%	Not Practical

RESULTS AND DISCUSSION

Preliminary Research

The first step was a need and context analysis by interviewing chemistry teachers in 3 different schools in Padang. The results of the interviews mentioned that currently schools in Padang already use the merdeka curriculum as their curriculum. Chemistry teachers in these three schools also said that in the implementation in class, they have used learning models (usually discovery and guided inquiry) with discussion methods so that learning is student-centered even though the implementation in the classroom is sometimes not optimal yet. In addition, the three teachers also said that they had used applications such as Google Classroom, WhatsApp, and Youtube during online learning in the Covid-19 era and some had heard about Learning Management System (LMS) such as Moodle and Edmodo but none of them knew the Discord application. This is in line with what Purba (2021) said about the applications that are

often used in learning during covid-19 (Purba, 2021). All three teachers said they were interested in using Discord for learning if it could indeed increase students' learning activities. Therefore, learning with the guided inquiry model combined with a flipped classroom using Discord is expected to be an alternative solution in learning to fulfill the demands of merdeka curriculum and the current industrial revolution 4.0 era.

After carrying out a needs analysis, a context analysis will then be carried out on the reaction rate. The details of the topic to be studied in the reaction rate start from explaining the concept of reaction rate, explaining collision theory, explaining the factors that affect the reaction rate using collision theory, explaining the reaction rate equation, determining the reaction order based on experimental data, and determining the reaction rate constant based on experimental data.

The next step is literature review by collecting the sources that relevant with the research. According to Paristiowati et al. (2017) the combination of inquiry model with flipped classroom is known to have a good effect on chemistry learning, especially on reaction rate (Paristiowati et al., 2017). Research conducted by Wongwatkit et al. (2017) also showed that students' learning activities were higher in learning with flipped inquiry-based learning with mobility compared to hands-on inquiry-based learning and traditional learning (Wongwatkit et al., 2017). Several studies have been conducted to prove that guided inquiry learning can be a solution in chemistry learning, as a good combination for learning topics in chemistry lessons, such as flipped classroom based on guided inquiry learning using Edmodo as a learning platform on redox reactions and electrochemical (Rizkivany & Mawardi, 2021) showing valid and practical results, and flipped classroom learning systems based on guided inquiry learning using Moodle for reaction rate (Ninda & Mawardi, 2022) and chemical equilibrium (Siregar & Mawardi, 2022) also indicate valid and practical results.

Meanwhile, there are also those who have been tested for effectiveness in learning using the guided inquiry model integrated with the flipped classroom, including the effectiveness of FGIL on acid-base to improve student learning outcomes (Lenggogeni & Mawardi, 2022) and the effectiveness of FGIL based on student worksheets on reaction rate to improve students' critical thinking skills (Khairunnisak et al., 2023) has also shown effective results. Furthermore, research by Dewantara et al., (2020) on the advantages of the Discord application as a learning media includes having many features that can support learning so that it can create interactive learning for students (Dewantara et al., 2020).

The last step in preliminary research is development of conceptual framework. The results design at the development of conceptual framework stage can be seen in detail in the following Figure 1.

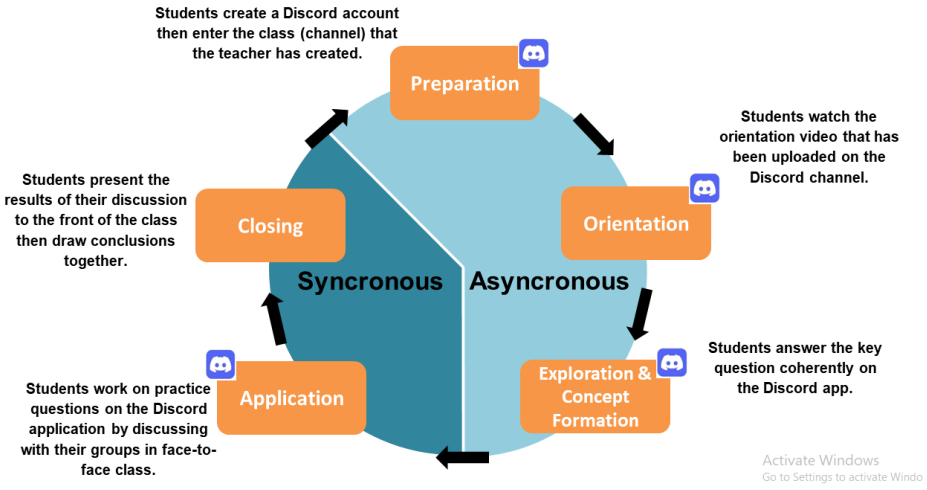

Figure 2. The Cycle of Flipped Classroom System Based on Guided Inquiry Learning Model Using Discord

Learning will be conducted in two conditions: synchronous and asynchronous. The orientation, exploration and concept formation stages will be conducted asynchronously through Discord application, while the application and closing stages will be conducted synchronously or in face-to-face learning. The following describes the stages of guided inquiry in learning integrated flipped classroom using the Discord application.

The first sintax in guided inquiry is Orientation. At this stage students will watch a video uploaded by the teacher on the Discord orientation channel. The teacher makes the video itself. The learning video contains the learning objectives that students want to achieve, motivation and prior knowledge to connect the previous material with the material to be learned.

Exploration and Concept Formation are part of the second syntax. At this stage, learners are usually given a model or information (which can be pictures, diagrams, graphs, tables, data, laboratory activities, etc.) to observe that stimulates them to think through key questions that they must answer. The model given at the guided inquiry stage must have visual representation aspects that represent 3 aspects, namely macroscopic, submicroscopic, and symbolic representations of phenomena (Magdalena et al., 2018). This is the heart of guided inquiry. Providing questions from the model that has been presented can lead students to get concepts independently from the material studied. Key questions are interrelated and start from low cognitive level to high cognitive level. Concept formation is the result of the previous stage, exploration. These two stages occur in line and cannot be separated. The concept formation stage begins when learners explore the model given and they make predictions and draw conclusions to answer the key questions.

The next sintax is Application. To solidify and strengthen understanding of the concepts that have been obtained, then students will be given practice questions at the application stage. Learners will later answer this exercise question by discussing with the group that has been formed before. This activity is carried out directly in offline classes or online with the discussion feature on the Discord server.

The final stage of guided inquiry learning is closing. In this stage, students will report the results of their group discussions by presenting them to the class. Furthermore, validation and reflection will be carried out with the teacher to assess whether the results or answers obtained are correct or not.

Development or Prototyping Phase

At this phase, the developed product is subjected to a formative evaluation through a series of activities to obtain a valid and practical final prototype. Prototype 1 is produced from the design that has been made at the preliminary research stage starting from initial observations, needs and context analysis, literature study, and conceptual framework development. The resulting product is termed a preliminary design in the form of a flipped classroom learning system based on guided inquiry on reaction rate integrated into Discord. The following is an example of the initial product design developed.

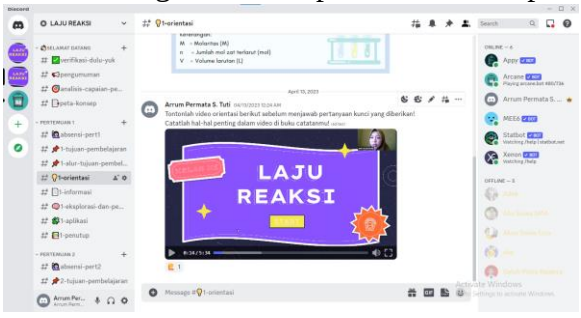

Figure 3. Discord Display at Prototype 1

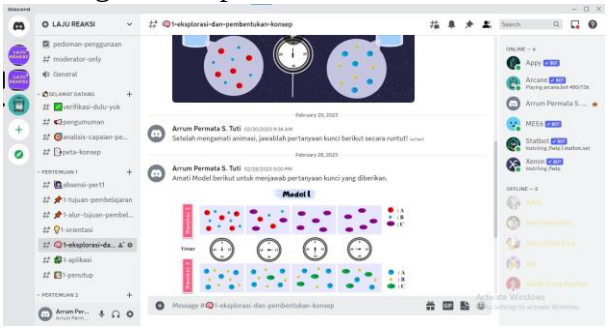

Figure 4. Model in Exploration and Concept Formation Stage at Discord

This preliminary product will enter the first formative evaluation stage, namely self evaluation where the self will assess the product that has been developed by filling out a self evaluation questionnaire so that prototype 2 is produced.

After obtaining prototype 2, the product will enter the one-to-one evaluation stage and the expert review stage. For the one-to-one evaluation stage, the activities carried out are interviewing three students of class XI IPA SMAN 8 Padang who have different abilities (low, medium, and high) regarding the products that have been developed. Three students were selected who had high, medium, and low abilities with the aim that the results obtained could represent students as a whole. From the results of the interview, it was found that the product developed had a clear appearance, the language used in the orientation video was simple to comprehend, the sound was clear, and the instructions provided helped students in answering key questions. The model in the exploration stage given is also clear and colorful so that it looks attractive and is able to help learners in answering the key questions given. There were no difficulties experienced by them when using Discord because the instructions on each syntax were clearly given.

In line with the one-to-one evaluation, expert review was also conducted to five validators, which in this case consisted of three lecturers from the Department of Chemistry FMIPA UNP and two teachers from SMAN 8 Padang. The assessment by these experts was carried out to measure the level of validity of the product that had been developed. This validation process uses two questionnaires, namely content validity sheets and construct validity sheets. The aspects assessed on content validity include content, presentation, language, and graphics, while the aspects assessed on construct validity are appearance and convenience.

The average content validity obtained was 0,86. The following are details of the validated components and their scores. While the average obtained on construct validity is 0,88. From the table 1 and 2 obtained the average V value for 5 validators is 0,87. The results obtained are ≥ 0.8 which indicates valid based on the Aiken's V scale.

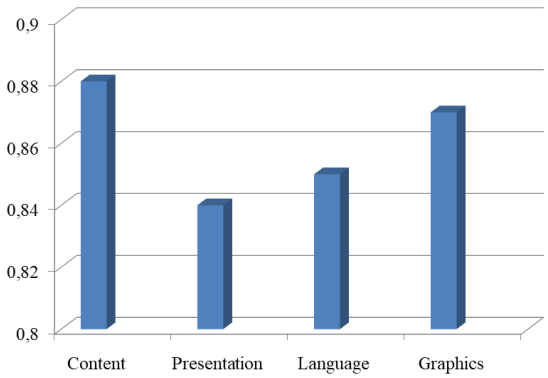

Figure 5. Content Validity Results

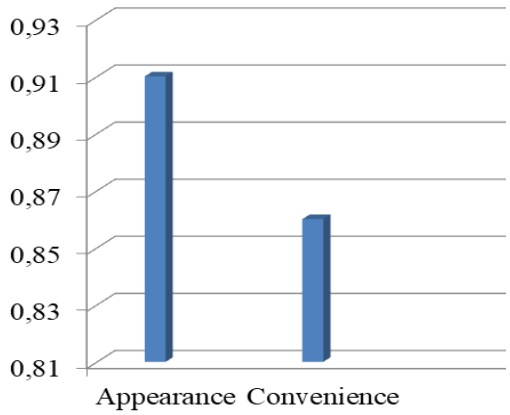

Figure 6. Construct Validity Results

The validators also provided suggestions related to the developed product so that revisions to the product were needed. The following is one example of the revised results of the product that has been commented on by the validator.

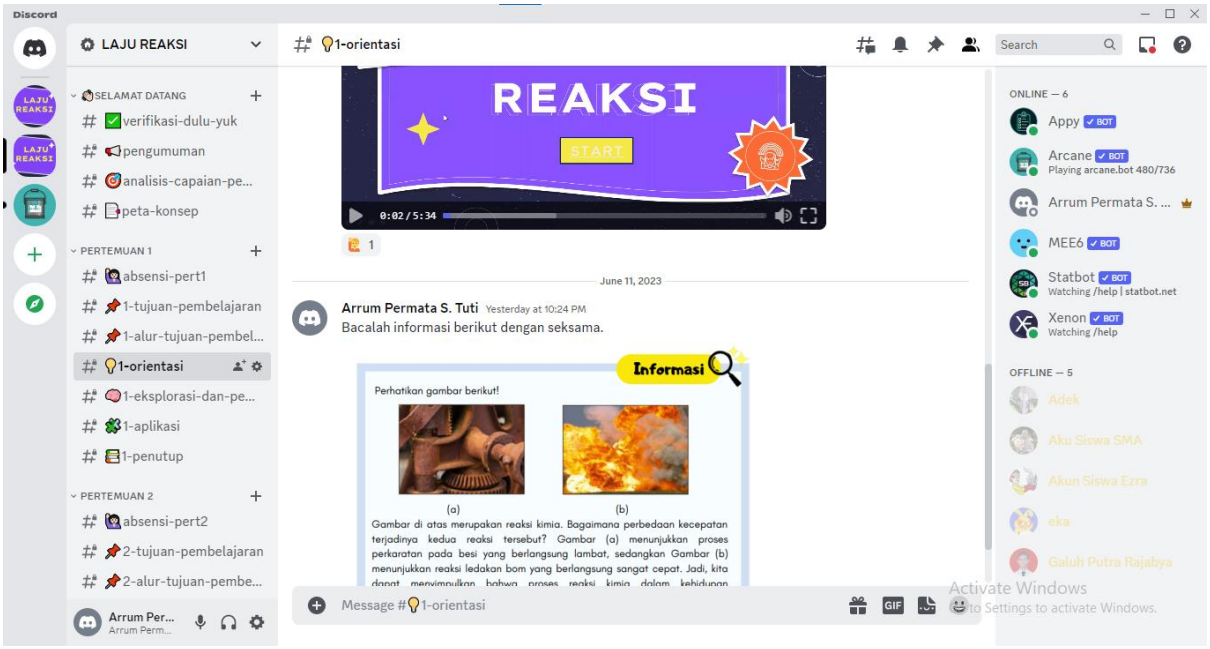

Figure 7. Discord Display After Revision

Previously, a sub-section of the orientation syntax, information, was placed in a separate channel, but after validation, the validator suggested that the information stage should be in the orientation channel instead of a separate channel.

Based on the validation results, the developed product can enter the next stage, namely the practicality stage through the small group test. The small group test was conducted to 9 students of SMAN 8 Padang and 2 chemistry teachers of SMAN 8 Padang. Easy usage, time efficiency, and benefits are the criteria used to evaluate practicality. The product developed has an 90% practicality percentage, according to the practicality test results which is categorized as very practical so that it can be used in learning.

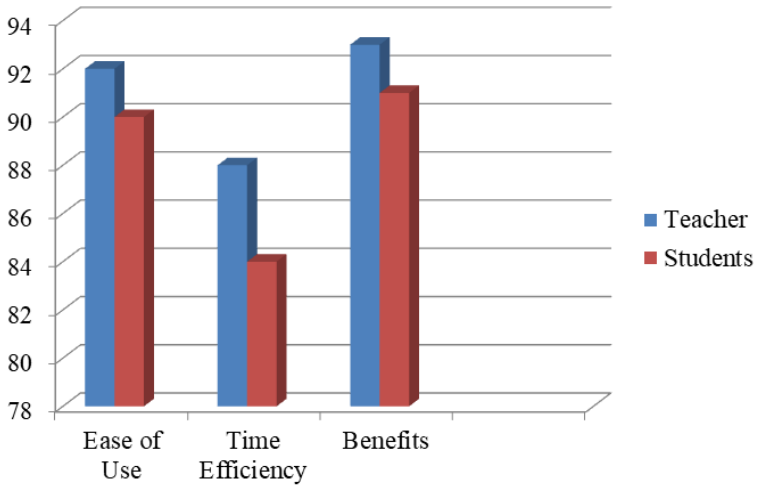

Figure 8. Average Practicality Results

Prior studies by Ninda & Mawardi (2022) on a guided inquiry-based flipped classroom learning system employing LMS Moodle for reaction rate has an average validity result of 0.91 and a practicality level of 90.5% (Ninda & Mawardi, 2022). These results are known to be higher than the guided inquiry-based flipped classroom system research on reaction rate using Discord. However, learning with Discord can still be used as an alternative learning because it also has high valid and practical numbers.

The results of practicality of several students when answering key question in a given model can be seen in the following Table 3. As previously stated the model given must represent three components of chemical representation is what helps students find concepts in the macroscopic, sub-microscopic and symbolic worlds. Without these three things students will have misconceptions, and with the help of chemical representations, learning will be more meaningful. Here is one example of a model that has been designed:

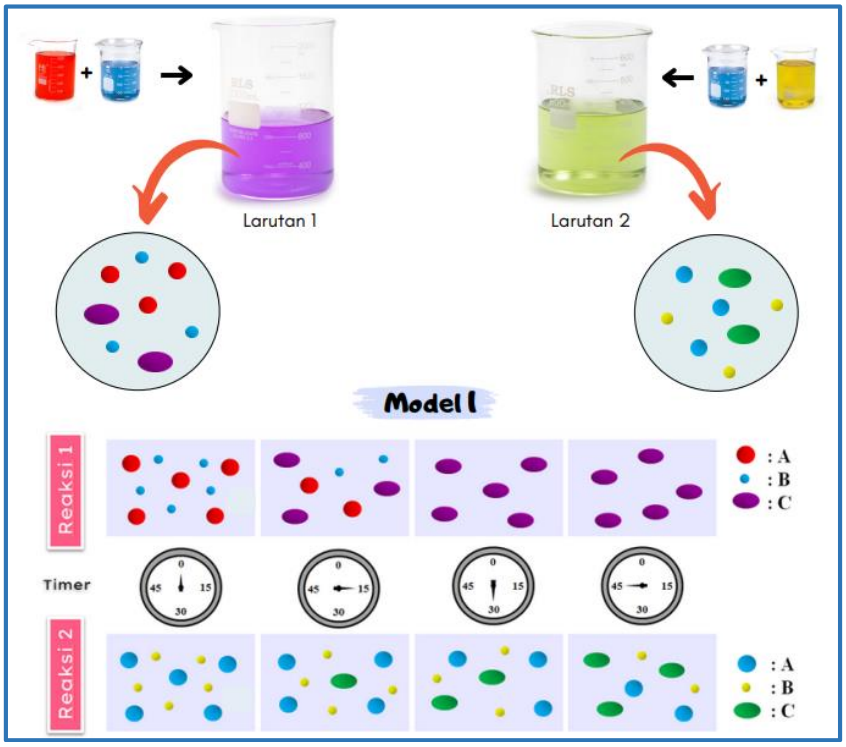

Figure 9. Model Representation at the Exploration and Concept Formation Stage

The answers of three students were analyzed to determine their level of understanding of the given model. The description of students' understanding is described in the following table.

Table 3. Description of Student Answers to the Model in Figure 3

Students	Answer
1	At time 0 seconds the number of reactants in reactions 1 and 2 is the same. After the first 15 seconds, 3 products were formed in reaction 1 and 1 product in reaction 2. And after the second 15 seconds, all reactants in reaction 1 formed products, while in reaction 2 only 2 products were formed and there were still reactants remaining. This indicates that reaction 1 proceeds faster than reaction 2.
2	In reaction 1 after 30 seconds all the reactants successfully formed products, while reaction 2 only produced 2 products. It can be concluded that reaction 1 is faster than reaction 2.
3	Reaction 1 proceeds faster than reaction 2.

Figure 9 is one of the models provided to answer the key question when students are exploring and forming concepts. Students are expected to answer key questions to get the concept of the understanding of the reaction rate itself. From the analysis of students' answers, it is known that student 1 has a higher level of thinking than other students' answers because the answers he gave were clear and in accordance with the textbook. While student 2 has a moderate ability in finding concepts about the reaction rate because the answers he gave were still less than perfect but close to the textbook. Meanwhile, student 3 has a low understanding

ability because his answer is not able to clearly describe what phenomena he observed in terms of submicroscopic phenomena (Siregar & Mawardi, 2022).

According to Waer & Mawardi (2022), it can be concluded that in answering the key question students must be given a clear model and represent 3 levels of chemical multirepresentation. The model must represent macroscopic, submicroscopic, and symbolic representations so that the understanding obtained is truly in accordance with the existing concepts. In addition, the key questions given must be coherent starting from questions with easy to difficult levels so that students can find concepts independently. Students are expected to answer key questions correctly, not only by using images that can be seen by the eye (macroscopic), but also in terms of molecular representation (submicroscopic). Because when given a macroscopic image only, there are still students who answer that the image given is a colorful syrup, this shows that macroscopic information has not been able to help students in finding concepts. Submicroscopic information is also important because by looking at the molecules and the time the reaction occurs, the concept of reaction rate can be determined. In addition, symbolic representation of the symbol or description of a compound is also important, this is where the function of the symbol is so that the concept that students find is intact so that it becomes an appropriate conclusion. The combination of these three components of chemical representation is what helps students find concepts in the macroscopic, sub-microscopic and symbolic worlds, without these three things students will experience misconceptions, and with the help of chemical representations, learning will be more meaningful (Waer & Mawardi, 2021).

CONCLUSION

Flipped classroom based on guided inquiry learning model using Discord on reaction rate proved to be developable and valid in terms of content, presentation, language, graphics, appearance, and convenience with an average score is 0,87. The practicality value in relation to ease of use, time efficiency, and benefits in the learning process, with an average average score of 90%. These results show that the system can be used in chemistry learning.

RECOMMENDATION

This research is expected to be continued to test its effectiveness on a wider scale so that it can be used as an alternative media in teaching reaction rates by teachers in schools. Another note is that the teacher must ensure that each student has good internet access during learning and the teacher must be able to condition the class during learning. Meanwhile, students are expected to follow the learning steps well in order to create active and interactive learning so that in the end the learning outcomes obtained are also high.

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