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Development Of Guided Inquiry-Based Flipped Classroom Learning System On Reaction Rate For 11th Grade Senior High School Students

Ramadhansyah, Mawardi Mawardi*

Departement of Chemistry, Universitas Negeri Padang
Padang, Indonesia

***Abstract*— The Covid-19 pandemic has caused many life changes, including education. Learning that was previously done face-to-face must be done online. The guided inquiry was a student-centered learning model, in which the students can build their own concepts so that learning can be more meaningful. In order to support this, a flipped classroom was needed that allowed teachers and students to optimize study time. This study aimed to develop and reveal the validity and practicality of the guided inquiry-based flipped classroom learning system on the reaction rate material for 11th-grade high school students. This research used a Research and Development (RnD) with the Plomp development model. The subjects of this study were students of class XI SMA, chemistry teachers, and chemistry lecturers at Padang State University. The instruments used were validity sheets for validity test and practicality sheets for practicality test.**

***Keywords*—Covid-19, Flipped Classroom, Guided Inquiry, Reaction rate.**

I. INTRODUCTION

The Covid-19 pandemic has caused many changes in life, including in the field of education. In Indonesia, learning was carried out face-to-face before the Covid-19 came. When Covid-19 came, the students and educators were asked to comply with the Covid-19 protocol in the learning process which resulted in the learning process remotely [1].

In the transition from face-to-face learning to online learning (*online*), the educators should be able to adjust the learning system so that the learning process continued while it was still having the 5M principles, namely *Mengamati* or observing, *Menanya* or asking questions, *Mengumpulkan informasi* or gathering information, *Menalar* or reasoning, and *Mengkomunikasikan* or communicating. To reach this principle, according to [2] learning can be done with a blended learning system. It combined face-to-face system with e-learning using video conference and chat.

Blended Learning was a learning process that has two types of learning conditions, namely synchronous and asynchronous. Synchronous was the learning process between educators and students at the same time, while asynchronous learning was learning that occur anytime and anywhere. In online system learning, it can be carried out using a Learning Management System (LMS). The LMS used in synchronous activities was zoom cloud meetings and asynchronous activities can be used with Edmodo. According to [3] blended learning has 4 types of learning models that can be used, one of which was the rotation model. In addition, the rotation model also has 4 submodels, namely station rotation, lab rotation, flipped classroom, and individual rotation.

Corresponding Author: Mawardi

The flipped classroom was one part of blended learning which was currently growing quite large in the field of education [4]. Flipped classrooms can be used in the learning process because according to [5] flipped classrooms can make students active in the learning process, support working together in team and class discussions, the students can re-watch learning videos wherever and whenever, encourage students to think, and students can regulate the speed of learning and it can use various learning strategies.

In order to make the learning process centered on the learner (student center), it can use a scientific approach. The scientific approach has 4 types of learning models, which were discovery learning, project-based learning, problem-based learning, and inquiry learning [6]. Furthermore, inquiry learning with the type of guided inquiry can be used because according to [7] the guided inquiry learning process required students to be able to observe, ask, conclude, associate, and communicate. It also can guide students in finding concepts from answering the key questions. Guided inquiry is an active learning learning system, where students can build their own understanding, by connecting with prior knowledge [8]. In addition, guided inquiry is an effective learning system in chemistry learning, because it can encourage students to use learning resources and work in groups [9]. By using guided inquiry students can develop critical thinking skills and problem solving abilities [10]. Moreover, in order to support online learning, so that it used the Edmodo Learning Management System and Zoom Meeting. Thus, research was conducted on the development of a guided inquiry-based flipped classroom learning system on the reaction rate material for senior high school students.

II. METHODOLOGY

This research used research and development (R&D). In this study, the development model used was the Plomp model. In essence, research and development methods were research methods used to make a particular product and test the practicality and effectiveness of the product. The Plomp model consisted of 3 main stages, which were the initial investigation stage, the development or prototype stage, the trial, and research stage [11].

At the initial investigation stage, there was a needs analysis, context analysis, literature study, and conceptual framework development. The needs analysis was done by looking at the description of the condition. Then, at the development or prototype stage, a formative evaluation was carried out which consisted of self-evaluation, expert review, one-to-one test, and also small group test.

III. RESULT AND DISCUSSION

Result

Pandemic Covid-19 led to many changes in life including in education. In Indonesia, learning was carried out face-to-face before the spread of the Covid-19 virus. When Covid-19 came, the students and educators were asked to comply with the Covid-19 protocol by carrying out online learning from their respective homes. In order to support optimal online learning as well as face-to-face learning, a new learning system was needed. For this reason, it was necessary to review some of the literature on the application of the flipped classroom into the learning process and combine it with the guided inquiry learning model so that a new model was formed which was called the guided inquiry-based flipped classroom learning system.

In the next development stage, after conducting preliminary research, it was making prototype 1. Making prototype 1 was done by designing guided inquiry learning using a multi-visual representation model (including the macroscopic, microscopic, and submicroscopic sections). Models can be images, graphs, data tables, or videos. The model was used by students to explore learning topics based on key questions. After the learning design was made, it was converted into a digital version on Edmodo so that it can be applied in online learning. Reverse-guided inquiry-based learning contained two learning settings, namely asynchronous and synchronous. Asynchronous was done using LMS Edmodo. It consisted of the orientation stage, exploration, and formation of concepts and applications. In addition, synchronous learning consisted of a closing stage using Zoom meetings.

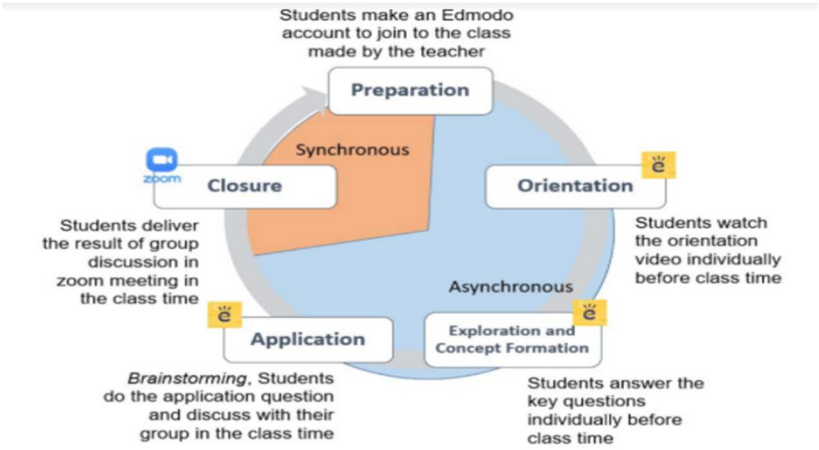

Figure 1. The steps of the flipped classroom learning system based on guided inquiry

Furthermore, prototype 1 was carried out self-evaluation so that it produced prototype 2. At this stage, one-to-one evaluation was carried out on three students through interviews. The results showed that the orientation video, questions, and models used were clear and easy to understand. In addition, validation from expert reviews was also carried out in prototype 2. From the validity test, it was obtained the validity value of 0.85 which was in the valid category. This showed that in terms of content feasibility, the components of presentation, language, and graphics that were developed have valid categories. The results of one-to-one and expert reviews evaluation produced prototype 3.

Table 1. Results of the validity of expert reviews

No	Aspect Assessed	V	Category validity
1	Eligibility contents	0.83	Valid
2	Construction feasibility	0.89	Valid
3	Linguistic component	0.86	Valid
4	Graphic component	0.83	Valid
Average of overall V		0.85	Valid

Prototype 3 was then tested in a small group evaluation to determine the level of practicality of the products developed. At this stage, it was carried out on fifteen students from grade 11 of SMAN 8 Padang. Based on the research that was conducted, it was obtained the practicality value of 87 in the practical category. Based on the students' opinions given during the small group evaluation, it was found that the guided inquiry-based flipped Classroom learning system can help them to understand the topic of reaction rates in online learning. After that, prototype 3 was revised to produce prototype 4.

Table 2. Practical results from small group evaluation

No	Aspects Assessed	Percentage	Practicality Category
1	Ease of Use	89%	Very Practical
2	Time Efficiency	86%	Very Practical
3	Benefits	87%	Very Practical
Overall Percentage		87%	Very Practical

Discussion

From table 1, it can be seen that the results of the validity test of the guided inquiry-based learning system on the reaction rate material for 11th grade of senior high school students, according to the expert, it was obtained a value of V = 0.85 with a valid category. It showed that the developed model was valid in terms of content feasibility, construction feasibility, language, and graphics.

In terms of content feasibility, the inquiry-based flipped classroom learning system has an average V of 0.83 with a valid category, meaning that the orientation delivered via video was following the material which was being taught. Models (pictures, tables, etc.) which used to answer key questions were appropriate to the material being taught and can be explored to answer key questions. The key questions contained in the exploration stage (in Edmodo) can lead students to explore the model. The combination of models with key questions can guide students to find concepts and the exercises. The questions contained in Edmodo can strengthen it also and strengthen the concepts for students.

In terms of construction feasibility, the guided inquiry-based flipped classroom learning system has an average V of 0.89 with a valid category. It means that the learning design based on the guided inquiry learning cycle contained in the Edmodo LMS made it easier for students to access learning. The orientation video had a clear picture and sound quality, the presentation of questions with models (pictures, tables, etc.) made it easier for students at the exploration stage. The key questions given were ranging from simple to complex. Presenting the application stage in the Edmodo small group feature allowed students to discuss among group members, and the closing stage which was carried out directly using LMS zoom meetings allowed students to confirm the concepts obtained with the teacher directly.

In terms of language, the flipped classroom learning system based on guided inquiry had an average V value of 0.86 with a valid category. It means that the language used in the orientation video and key questions was correct according to Indonesian spelling rules.

Furthermore, in terms of the graphic component, the guided inquiry-based flipped classroom learning system obtained a V value of 0.83 with a valid category. It can be concluded that the models (videos, pictures, tables, etc.) presented in Edmodo can be seen clearly.

The developed model had a very high practicality category in terms of student and teacher assessments. The practicality of student responses showed that the average P value obtained was 87 which was included in the high category. As for the results of teacher responses, the average P value obtained was 92 in the high category too. Based on the results obtained, it can be seen that the developed model was easy to use by students and teachers. It also made the learning process more efficient because students can learn at their own pace.

In terms of ease of use, the average P value was 96 with the high practicality category. It showed that the learning steps based on the model (video, picture, table, etc.) and key questions were easy to understand. So, this also indicated that the language used in Edmodo was easy to understand.

It can be seen from time efficiency, it showed that learning had been efficient. This can be seen from the P value of 80 with the high practicality category. By using this model, students can control their speed to learn the material.

Finally, in terms of benefits, students were taught to understand concepts easier, the models seen (videos, pictures, tables, etc.) can help them answer key questions and they can strengthen their understanding by doing exercises. The average P was 93 which belongs to the very high practicality category.

IV. CONCLUSION

Based on the research that has been done, it can be concluded that:

1. A guided inquiry-based flipped classroom learning system on the reaction rate material for 11th-grade high school students can be developed.
2. The guided inquiry-based flipped classroom learning system on the rate material developed has a validity value of 0.85 with valid criteria and a practicality value of 87 with a very high practicality category.

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