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Development Model of Flipped-Guided Inquiry based Learning on Chemical Equilibrium for 11th Grade High School Students

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Abstract— COVID-19 Pandemic caused some big effects to many sectors of live globally, one of them was in education. Like the other countries around the world, Indonesia changed its educational system to be online learning as a preventive step of spreading the virus. Online learning had become a new challenge for teachers and students to find a proper learning in this situation. The aims of this study are to develop and reveal the validity and practicality of model Flipped-Guided Inquiry based Learning that developed for high school learning. This study is Research and Development (RnD) with Plomp development model. The subjects of this study are 11th grade high school students, chemistry teachers and chemistry lecturer in Universitas Negeri Padang. The instrument used are validity sheet for validity test and practicality sheet for practicality test. Validity test is done on two lecturers and one teacher and three students in one-to-one evaluation. Practicality test is done on fifteen 11th grade students in SMAN 8 Padang. Based on analysis, the validity obtained is 0,86 which states this study is valid and the practicality obtained is 0,84 which states this study has high practicality. The result of this study shows if the model developed are valid and practical to be used in chemistry learning in high school.

Keywords— Guided Inquiry, Flipped lassroom, FGIL, Chemical Equilibrium

I. INTRODUCTION

COVID-19 pandemic that attacks all around the world gives some effects to many sectors, one of them is in educational sector. In order to prevent the spreading of this virus, most of the countries change their learning system to be online learning (Di Pietro et al.). This step is also followed by Indonesia.

Online learning becomes a new challenge for teachers and students. Teachers have to prepare the learning material by spending a lot of time to make it accessed online by students. This emergency situation makes the learning done as teacher-centered learning, that causes some difficulties for teachers to control their students' understanding. In the other hand, the limitted time makes the learning less optimal.

Flipped classroom is a way to reduce learning time that spent by teachers as the center. Flipped classroom is a model from blended learning that combine synchronous and asynchronous learning (Chaeruman). In this kind of learning, the material that commonly delivered directly in classroom is changed to be onle before the class time (Reynders and Ruder). So that the students can optimalize their time to apply the knowledge in the classroom (Jdaitawi).

This learning can be integrated with active and collaborative learning for students, such as guided inquiry learning model in chemistry learning. Chemistry learning involves mental that relate to idea representation and phenomena that

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need high cognitive level (Mawardi). In guided inquiry learning, teachers guide the students in learning process to help them emphasize the process skills and conceptual understanding, and implement this understanding in order to solve the problem (Mawardi and Fitriza).

Guided inquiry learning that implemented in student worksheet shows some positive result in some chemistry topics, such as in chemical equilibrium that shows practical for first year college students (Kardena and Mawardi), buffer solution (Mawardi et al.), colligative properties of solution (Piawi and Nizar, Umar Kalmar, Mawardi) and colloid system (Damaianti et al.) shows practical and effective result for high school learning. The student worksheet based on guided inquiry by class and laboratory activity on reaction rate and chemical bonding shows practical and effective to be applied in learning (Repdayanti et al.; Zammiluni et al.). Learning module on colloid system based guided inquiry learning also shows feasible to be used in high school learning. Besides, Flipped-Guided Inquiry based Learning (FGIL) on chemical equilibrium for first year college students shows valid and practical result (Aumi and Mawardi).

In chemistry, chemical equilibrium is a suitable topic to be applied with guided inquiry model. It has some characteristics, which are: (1) almost all of concepts learned are abstract concept, such as the concept when a reaction is in the equilibrium and equilibrium shifting. (2) need a mathematical skill to solve the problem in chemical equilibrium, such as to determine the equilibrium cinstant in certain concentration. (3) The concepts in the previous material form the basis of chemical equilibrium materials, such as the concepts studied in matter of reaction rate (Lukum et al.).

The model is operated using a Learning Management System (LMS) named Edmodo and Zoom meeting. Teacher and students do the learning asynchronously using Edmodo, so that they can access the material wherever and whenever. In synchronoous learning, they use zoom meeting so that they can have virtual learning in the same time.

Based on that, this study aims to develop the flipped-guided inquiry based learning in chemical equilibrium for 11th grade high school students. It is hoped to be valid and practical to be used in online learning in pandemic situation, another particular situation and to support technoloical era.

II. Methodology

This study is a research and development (R&D) with Plomp development model which has three steps. They are preliminary research, development and protoyping stage and assesment phases (Plomp).

In preliminary research, need and context analysis, literature review and conceptual framework development are done. Context and need analysis is done by seeing the field condition that related to the online learning of chemistry. Literature review is done to search and understand the source related to the further development and solving the problem by scientific journal. Then after the problems identified and related to the theory, conceptual framework is developed.

Then in development and protytping phase, formative evaluation in every protoype is done. The first evaluation is self evaluation that will obtain protytpe 2. Then expert review on two chemistry lecturer and a chemistry teacher and one-to-one evaluation on three students are done to determine the validity of the model. The revision obtained is prototype 3. Then small group evaluation on fifteen students is done to obtain prototype 4 and to define the practicality of its.

III. Result And Discussion

Result

During COVID-19 pandemic learning system in Indonesia is conducted to be an online learning. From this situation, teachers and students need a new system that can support the learning process to reach optimal result as good as in face-to-face learning. Then one way to face this condition that conducted by reviewing some literatures is by implementing flipped classroom into learning process and combining it with guided inquiry learning model. This combination is developed to be a new model called as flipped-guided inquiry based learning.

The steps for developing after doing the pleminary research is making prototype 1. Firstly, a guided inquiry learning is designed involving the model such as multirepresentation visual (including macroscopic, microscopic and submicroscopic level) in it or using graphics, tables or video. The models are used for students exploring the topic based

on the key questions guidance. After the learning design is made, it's converted into the digital version in Edmodo so that it can be applied in this online learning.

Flipped-guided inquiry based learning contains two learning settings, which are asynchronous and synchronous. Asynchronous is done using LMS Edmodo. It consists of the stages of orientation, exploration and concept formation and application. Moreover, synchronous learning consists the closing stages using Zoom meeting.

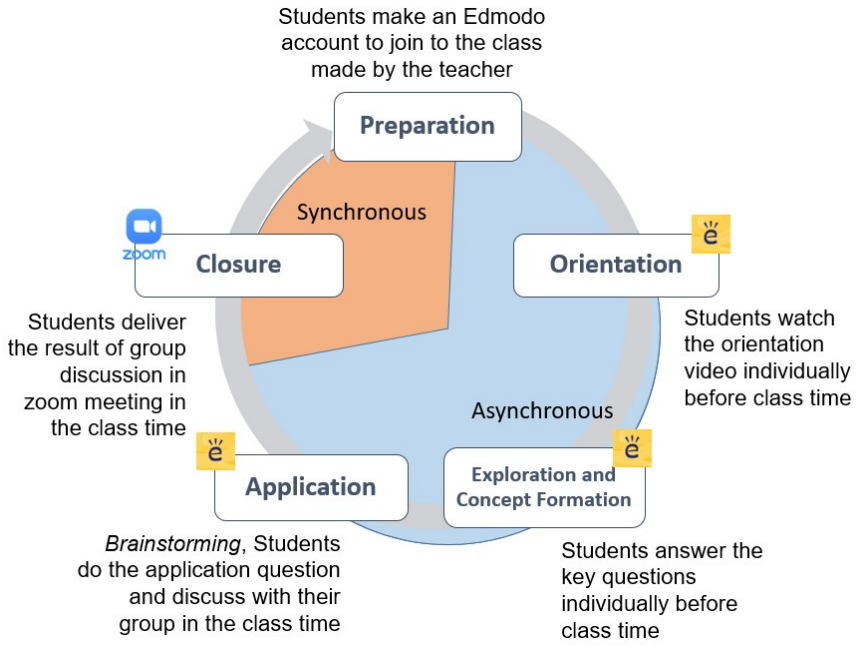

Fig 1. Flipped-guided inquiry learning model cycle

The prototype 1 then being self-evaluated and the revision result is called as prototype 2. In this stage, one-to-one evalution is done on three students by interview. The result showed if the sound of orientation video, question and model chosen have clear and easy to understand. But they suggest to maximize the quality of video. Besided that, validation from expert review is also done in this prototype. From the validity test, the value of validity obtained is 0.86 which is in the valid category. This indicates that in terms of content feasibility, construction, language and graphics the model developed have a valid category. The result of one-to-one evaluation and expert review produced prototype 3.

Table 1. Validity result according to expert review

No	Aspect Assessed	Values	Category
1	Concent Feasibility	0.89	Valid
2	Construction Feasibility	0.85	Valid
3	Linguistic	0.83	Valid
4	Visual	0.86	Valid
	Average	**0,86**	**Valid**

The protype 3 then is tested into small group evaluation to see the practicality of the model. This stage is done on fifteen students of 11th grade SMAN 8 Padang. From the test, it can be seen that the practicality value obtained is 84 with the very high practicality category. Based on the opinions given by the students during small groups, the FGIL model developed can help them to understand the chemical equilibrium topic in online learning. The result of the revision of the prototype 3 resulted in a prototype 4.

Table 2. Practicality Result of Small Group Evaluation

No	Aspect Assessed	Percent Values (P)	Category
1	Ease of Use	79	High
2	Time efficiency	87	Very High
3	Benefits	86	Very High
Average		**84**	**Very High**

Discussion

For achieving learning objectives, learning model is a need as the guidance in learning process itself. In order to this, flipped-guided inquiry based learning model is designed to ease the students achieving the goals in online learning. It has several componets, which are: 1) syntax 2) a social system, or activies between teacher and student, 3) the principle of reaction, there is interaction between teachers and students and it can also be seen from the teacher's response to participant students, 4) support systems, which are the conditions required by a model (technical capabilities and facilities), and 5) instructional impacts and accompaniment impacts (Bruce Joyce, Marsha Weil).

In the process, students are divided into some small group. Each of group does and discusses about the key question given in the small group home by commenting each other post. Teacher guides the discussion by following the comment section of them. The exploration stage is before class time. In the class time, teacher gives the students 30 minutes to do application questions and brainstorming. They are still allowed to discuss with their group. After 30 minutes, synchronous learning held by using zoom meeting. The result of group discussion is delivered in it.

The results of the validity of the model on the chemical equilibrium topic for 11th grade students by experts in table 1 obtain a value of V = 0.86 in the valid category. This indicates that the model developed is valid in terms of content feasibility, construction feasibility, language and graphic.

In terms of content feasibility, it has an average V of 0.89 in the valid category. It means the orientation video is in accordance with the topic being taught and the model (pictures, tables, etc.) used to answer key questions is in accordance with the material being taught and it can be explored to answer the key questions. The key questions involved in the exploration stage can lead to explore the models, the combination of models with key questions can guide the students for finding the concepts, and the exercises of application stage involved in Edmodo can strengthen and solidify the concepts.

In terms of construction feasibility, the FGIL model has an average V of 0.85 in the valid category. This means that the learning design is already based on the guided inquiry learning cycle, Edmodo makes students easier to access learning; The videos have good quality and clear sound; the display of questions accompanied by models (pictures, tables, etc.) make the students easier to explore; the key questions given have started from simple to complex; presenting the application stage on Edmodo's small group feature allows students to have discussions between group members; and the closure using zoom meeting allows students to confirm the concepts obtained with the teacher directly.

In terms of language, the FGIL model has an average V value of 0.83 in the valid category. This means that the language used in the orientation video and in the key questions is correct according to Indonesian spelling rules.

In the terms of visual, the FGIL model obtained a V value of 0.86 in the valid category. It means the models (video, pictures, tables, etc.) that are presented in Edmodo can be observed clearly.

The model developed has a very high category of practicality in terms of student and teacher assessments. The practicality of the students' responses shows that the average P value obtained is 84 which is in the high category. As for the practical results of the teacher's responses, the average P value obtained was 82 in the high category. From the results obtained, it can be seen that the model developed is easy to use by students and teachers. It also makes the learning process more efficient because students can learn at their own learning pace.

In terms of ease of use, it was obtained an average P value of 79 with a high practicality category. This indicates that the learning steps based on the FGIL model and the models (videos, victures, tables, etc.) and key questions are easy to understand. So this also indicates that the language used in Edmodo is easy to understand.

According to time efficiency, it indicates the learning is efficient. It can be seen from the P value of 87 with a very high practicallity category. By using this model, students can control their pace to learn the material.

Last, in terms of benefit, the students taught if it makes them easier to understanding the concept, the models viewed (videos, pictures, tables, etc) can help them to answer the key question and they can strengthen their understanding by doing excercises. The average P is 86 which is very high practicallity category.

IV. Conclusion

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

1. The Flipped Guided Inquiry based Learning model on chemical equilibrium for 11th grade high school students can be developed.
2. The Flipped Guided Inquiry based Learning model on chemical equilibrium that developed has a validity value of 0.86 with valid criteria, and a practicality value of 84 with a very high practicality category.

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