Development of the Learning System of Flipped-Guided Inquiry-Based Learning (FGIL) Using Moodle on Chemical Equilibrium material

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Abstract. The Covid-19 pandemic in Indonesia has impacted the education sector, requiring learning activities to be shifted online. So that it becomes a new challenge for teachers and students to be able to carry out learning according to this situation and with the demands of the digitalization revolution 4.0. This study aimed to develop and determine the validity and practicality the Learning System of *Flipped-Guided Inquiry-Based Learning* (FGIL) using Moodle on chemical equilibrium material. This research is a Research and Development (R&D) with a Plomp development model. The subjects of this research are students of class XI SMAN 8 Padang, chemistry teachers, and lecturers in the chemistry department of FMIPA UNP. The research instruments used were validity sheets for validity testing and teacher and student response questionnaires for practicality tests. The average value obtained from 5 validators is 0.90 with a valid category. The average value obtained from the practicality test is 85%, with a very practical category. The results of the validity and practicality show that the learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) using Moodle on chemical equilibrium material developed is valid and practical.

Keywords: *Chemical equilibrium, Flipped-Guided Inquiry Based Learning, Learning system, Moodle*

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INTRODUCTION

In March 2020, the corona virus infected 2 cases for the first time in Indonesia. As a result of this outbreak, Indonesia has been disrupted in various aspects of life, especially in education. The Indonesian government has issued a policy that requires learning and teaching activities to be shifted to online learning (Indrawati, 2020). Online learning provides a new challenge for an educator in dealing with the difficulty of daily learning activities (Kurniawan & Purnomo, 2020). In addition to the problem of teaching students, and monitoring learning activities, teachers will also have difficulty distributing teaching materials to students as material that students will study during learning. This situation will undoubtedly be an obstacle in carrying out learning. In addition, the learning process will of course, only be centered on the teacher because students will have difficulty asking questions about material they do not understand, and it will be difficult for them to discuss with their group friends. therefore, this situation will undoubtedly result in learning activities will not run smoothly maximum (Juliya & Herlambang, 2021).

Behind the problems caused by the pandemic in the education sector, this emergency also has a positive impact, one of which is a trigger for accelerating digital transformation, which is in line with the demands of the era of the industrial revolution 4.0. The development of the use of technology will provide opportunities for teachers to be able to offer learning resources to their students for learning activities (Jama, 2018). Based on this, a new learning orientation will be formed, namely student-centered learning, namely learning centered on the students. *Student-centered learning* is one learning implementation using a blended learning model whose learning activities combine face-to-face learning and virtual face-to-face learning. Based on the learning orientation to carry out student-centered learning, the suitable model to use is the *flipped classroom* model (Kurniawati, 2019). The *flipped classroom* is one of the blended learning models where the learning process combines synchronous and asynchronous learning (Chaeruman, 2019). Of course, it is interpreted as an inverted class which is a learning process that is usually delivered directly by the teacher at school during study hours, now it is shifted to online learning before learning hours take place. (Mudarwan, 2018). According to Barringer (Umar, 2016), *flipped classroom* learning will be able to provide many opportunities for students to develop critical and independent thinking skills in the exploration process and, at the same time, increase student activities through collaboration and interaction with study groups in the learning process so that *flipped classroom* learning is one of the models in the learning process is a scientific approach.

The learning process in accordance with this scientific approach includes learning that will require students to think critically and systematically in solving a problem whose solution is not easy to see with the naked eye and also challenging to understand (Yunus Abidin, 2016). The learning model in accordance with flipped classroom learning with this scientific approach and can support the learning process is a guided inquiry learning model. Using a guided inquiry model will make active learning, where students will be able to build and find a concept through their understanding and then connect it with the previous knowledge they have gained (Hanson, 2014). This guided inquiry model is a suitable model to be implemented during a pandemic like today because students will be asked to be more active to be able to develop their ability to solve problems and get concepts from the results of critical, independent, and creative thinking (Aumi & Mawardi, 2021). Using this guided inquiry learning model, of course, will also familiarize students to be able to think more critically, be able to assume and be responsible for achieving understanding independently to solve a problem (Mawardi, Aisyah & Yani, 2020). According to Zubaidah (Muhiddin & Mustari, 2021) The learning model is a series of activities carried out by the teacher to present learning material. Thus, the learning model is usually referred to as the process before, during, and after learning. In addition, the learning model is also related to facilities that are directly or indirectly used in the learning process. One of the learning models that has received serious attention from educational activities and observers is the inquiry learning model. This model emphasizes critical and analytical thinking to seek and find solutions to a problem.

The *guided inquiry* learning model is also very effective in the field of chemistry because using this model in learning activities will be able to encourage students to be able to use learning resources and be able to work together and discuss in groups (Aini, Fitriza, Gazali, Mawardi, & Priscylio, 2019). Many chemical materials can be applied with this *guided inquiry* model. Still, there are chemistry materials which some of the materials require abstract concepts and are challenging to understand and observe microscopically, namely in chemical equilibrium materials (Rizky, 2013). Students will undoubtedly experience difficulties understanding abstract concepts in chemical equilibrium material. An appropriate model is needed with a platform that can apply and facilitate the implementation of this *guided inquiry* model (Aini, N., & Yonata, 2020).

Based on research that has been carried out in learning activities with emergency conditions like today, we can apply it by combining the *Flipped Classroom* model and the *guided inquiry* model. Combining these two learning models, it will certainly make learning more effective because the steps of guided inquiry carry out learning carried out in two learning settings, namely synchronously and asynchronously. So that by combining these two models, a *Flipped Guided Inquiry-Based Learning* model is produced (Ramadianti & Mawardi, 2021).

In implementing *flipped classroom* learning, of course, a container or technology integration will be needed so that knowledge can be carried out (Basilaia & Kvavadze, 2020). So a *Learning Management System* (LMS) is required which will make it easier for teachers to carry out learning and help students to learn actively (Dhika, Destiawati, Surajiyo, & Jaya, 2021). The application of this *Flipped Guided Inquiry-Based Learning* model can be applied to chemistry learning, namely in one of the chemical materials, namely the reaction rate and using the Learning management system of Edmodo , Edmodo can be applied to run asynchronous learning or before learning takes place, so a different *learning management system* (LMS) is needed that can support synchronous learning using the Zoom cloud meeting application (Aumi & Mawardi, 2021). So we need a *learning management system* (LMS) that can help learning that is carried out synchronously and asynchronously using a learning management system with more exclusive features and more supportive of learning with these two learning settings, namely by using Moodle (Mas'ud & Surjono, 2018).

So in this research that this *Flipped Guided Inquiry-Based Learning* model can be developed into an learning system of *Flipped Guided Inquiry-Based Learning* (FGIL) using Moodle, wherein Moodle there will be features that support synchronous and asynchronous learning following the steps of guided inquiry. The researchers conducted development research by combining the *Flipped Classroom* model with the guided inquiry model with the title "Development of the Learning System of *Flipped-Guided Inquiry-based Learning* (FGIL) Using Moodle on Chemical Equilibrium Material. " In its application, a *Learning Management System* (LMS) will be used. Moodle for students and teachers to carry out more practical learning. The purpose of this research is to develop and determine the validity and practicality of the *Flipped-Guided Inquiry-based Learning* (FGIL) learning system using Moodle on chemical equilibrium material.

RESEARCH METHOD

The research method used in this research is by using the Research and Development (R&D) method. The research and Development (R&D) method is a research method that is usually used in development research to make a particular product. After the product is made, the product will be tested for validity and practicality. This research was conducted at SMA Negeri 8 Padang. In this study, the subjects were lecturers of the Department of Chemistry, FMIPA UNP, Chemistry teachers, and students at SMA 8 Padang. The object of research in this research is the learning system of *Flipped-Guided Inquiry-based Learning (FGIL)* using Moodle on chemical equilibrium material.

The development model used in this study is the Plomp model. The Plomp model used consists of 3 main stages, namely the initial investigation stage (preliminary research), then the development or prototype stage, the trial stage, and the research stage (Plomp & Nieveen, 2013)

The first research stage to be carried out is the preliminary research stage. At this stage, what will be done is a needs analysis, context analysis, literature study, and also conceptual framework (Plomp & Nieveen, 2013).

Analysis of the needs of the researchers was carried out by looking at the description of the conditions by conducting observations by interviewing three high school chemistry teachers in Padang and analyzing related to the learning process on chemical equilibrium material under the current conditions. At the context analysis stage, namely by analyzing the curriculum, by examining and analyzing more deeply the part of the curriculum used in the school that will be tested for research. Analysis in this part of the curriculum is analyzed in the form of essential competencies (KD) and learning material where the chemical equilibrium material contained in KD 3.8 Explains the equilibrium reaction in the relationship between reactants and reaction products and KD. 3.9 analyzes the factors that influence the shift in the direction of the equilibrium and its application in industry. The next stage that the researcher carried out was a literature study at this stage of literature study which would be carried out by studying existing references so that with these references, they would be able to understand the needs of teachers. The facts of the observations obtained in the needs analysis it is then adjusted to the concerns that have been received. The last is the conceptual framework, which can be developed based on the problems that have been identified and analyzed and have been linked to existing theories and references. From this conceptual framework, it can be analyzed by determining which is the central concept that will be intended and can be studied by students and by designing it systematically according to the order in which it is presented.

Then, at the development or prototype stage, at this stage, several formative evaluations will be carried out. The formative assessment that will be carried out by the researcher consists of self-evaluation, expert review, one-to-one test, and also a small group (Plomp & Nieveen, 2013).

At the evaluation stage used the instrument of validity and practicality. The validity instrument used was a material content validity questionnaire, material expert would assess the material content validity questionnaire. The material content validity questionnaire was used to find out whether the product content was suitable for use and also to find out whether the system developed was suitable for implementation in school learning . In the instrument of content validity, the aspects assessed are content feasibility, construct feasibility, languange component, and the graphic component.

The content validity questionnaire will be assessed by five material experts, namely three chemistry lecturers and two chemistry teachers. If the validation questionnaire has been collected, then data analysis will be carried out and in this analysis, each statement will be assessed by the validator and will be analyzed using the Aiken V formula. The Aiken V formula used to analyze is as follows:

$$V = \frac{\sum s}{n(c-1)}$$
$$s = r - lo$$

Information :

S = the score that has been determined by the validator minus the lowest score in the category used ($s = r - l_o$),

L_o = low validity rating (in this case = 1)

c= The highest validity rating score (in this case = 5)

r_e=Number given by an appraiser/validator

The learning system will be valid if it is obtained according to the validity criteria based on the Aiken V scale, the validity assessment criteria based on the Aiken V scale are as follows:

Table 1. Index Aiken V

Index Aiken V	**Validity category**
V < 0,8	invalid
V ≥ 0,8	valid

In an assessment calculation based on this V index, if the calculation result has a value < 0,8, it is categorized as invalid, and the V index value is more significant than 0.8, then it is said to be valid, so that the learning system of *Flipped Guided Inquiry-Based Learning* (FGIL) using Moodle can be done by practicality or doing product trials on product development.

The practicality instrument is carried out using a student response practicality questionnaire and a teacher response practicality questionnaire. Sixteen students will fill out the student response practicality questionnaire. Where previously, students have tried the learning system developed. The assessment of the practicality sheet was obtained from the provision of teacher response questionnaires and student response questionnaires which were analyzed and calculated based on the Likert scale value. In Lestari (2020), the results from this practicality sheet are calculated using the formula :

$$P = \frac{f}{N} \times 100$$

information :
P = Percentage of the number of respondents' answers to the questionnaire
f= total score obtained
N= total ideal score and all items
Then, the results of this practicality test with the practicality sheet converted into qualitative data can be seen in Table 1 as follows:

Table 2. Criteria For Practicality (Lestari, 2020)

Percentage	**value**	**category**
$80 \le P \le 100$	Very high	Very practical
$60 \le P \le 80$	High	Practical
$40 \le P \le 60$	sufficient	quite practical
$20 \le P \le 40$	Low	impractical
≤ 20	very low	very impractical

RESULT AND DISCUSSION

This research aims to develop a learning system of *Flipped-Guided Inquiry-Based learning* (FGIL) using Moodle on chemical equilibrium material. It will be able to determine the level of validity and practicality of the system that researchers developed. In research that has been carried out using the Plomp model, which consists of several stages, the results obtained will be described as follows:

Preliminary Research

The Covid-19 pandemic has impacted various fields, including the field of education in Indonesia. With the spread of this virus, the Indonesian government issued a policy of shifting learning into an online system (Abidah, 2020). With the transfer of learning to online learning, of course, a learning system is needed that can support online learning to be carried out optimally. In the preliminary research stage, the following will be carried out:

Needs Analysis

This needs an analysis step, namely by making observations by interviewing three high school chemistry teachers in the Padang area. The researcher also conducted interviews with chemistry teachers at SMAN 8 Padang, chemistry teachers at SMAN 7 Padang, and chemistry teachers at SMAN 10 Padang. By conducting interviews related to the condition of schools and students and analyzing the learning process on chemical equilibrium material with current conditions (Aulia & Mawardi, 2021). in an emergency during the COVID-19 pandemic and the high demands for digitalization during the era of the industrial revolution 4.0 at present, of course, will result in arguing that learning that is usually done face-to-face is now done online (online) and a learning system is needed that is can make students the center of learning. Therefore, a *guided inquiry* model was designed to be combined with a *flipped classroom* to help the learning process run during an emergency like today. This stage is also carried out to determine what information is needed in the learning process so that research and development can be carried out support online learning (Deviana, 2018).

Context Analysis

In this step, the context analysis in this research and development will be carried out by examining the part of the curriculum used by schools (Fitri, Yuanita, & Maimunah, 2020). The curriculum analyzed is the curriculum by the school curriculum that will be tested, namely at SMA 8 Padang. What is carried out in this curriculum analysis is to study the scope of the learning objectives to be achieved and the materials and strategies chosen as the basis for developing tools in the process. Learning. So that an analysis will be carried out in the form of Basic Competence (KD) and learning material where the syllabus is written on the chemical equilibrium material contained in KD 3.8. Explaining the equilibrium reaction in the relationship between reactants and reaction products and KD. 3.9 analyzes the factors that influence the shift in the direction of the equilibrium and its application in industry. From KD 3.8 and KD 3.9. a Competency Achievement Indicator will be derived with learning objectives in each KD

Literature Study

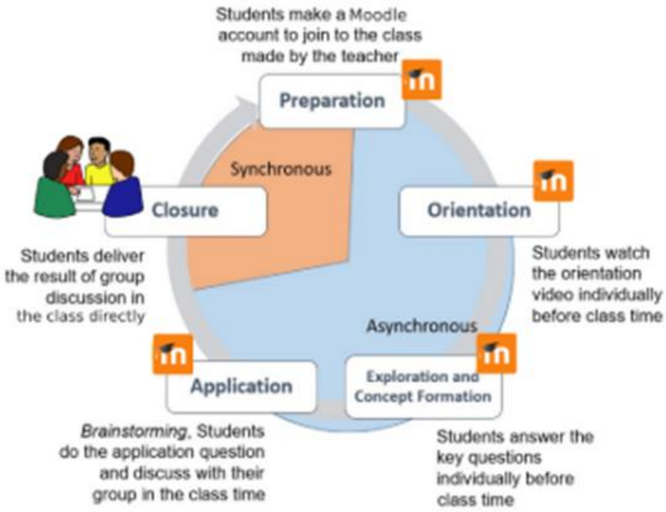
At the literature study stage, it will be done by studying existing references so that with these references, you can understand the needs of educators. The facts of the observations obtained in the needs analysis are then adjusted to the concerns that have been received. At this stage, a search for understanding sources related to the development that will be carried out is also carried out, as well as to find solutions to problems, namely through scientific journals (Ramadhansyah & Mawardi, 2021). From this literature study, it can be seen that online learning activities during this pandemic can be carried out by implementing *blended learning* that combines synchronous and asynchronous learning with a reverse learning system (*Flipped Classroom*). And also, based on one of the development models, namely the Plomp development model, we can know that guided inquiry learning is one of the suitable models to use in the proper blended learning process; this can be transferred from a process that is usually done offline to a learning process that can be done online with the *flipped classroom* system. And also, with the shortcomings or obstacles obtained from the needs analysis in terms of the LMS used, then with an online learning system that requires LMS support that can make learning more comfortable, flexible, and practical, it can be applied using the *learning management system* of Moodle which has the following more complete features than other LMS.

Conceptual framework

The conceptual framework can usually be developed based on problems that have been identified and analyzed and have been linked to existing theories and references. From this conceptual framework, it will be analyzed by determining what the main concepts are and what students will learn and design them systematically according to the order in which they are presented. From the needs analysis, it can be found that the COVID-19 outbreak causes the current problems and, in conjunction with the UNP Research RENSTRA drives education by the demands of the industrial revolution 4.0 era (Surani, 2019), causing the learning process not to work. As usual, due to the distance learning policy, which resulted in learning being transferred to the network (online). To continue learning with a learning model that is expected to be student-centered and by the 2013 curriculum, which is commonly used during face-to-face learning, a learning system is needed that can be applied when learning takes place online (Gaja & Mawardi, 2021).

Based on the literature found that online learning can be used with *flipped classroom* learning strategies and *guided inquiry* learning models. And also, based on the literature, using Moodle will make it easier for students to learn and make it easier for teachers to design a lesson.

During the preliminary research stage or initial investigation, the design learning system of *Flipped-Guided Inquiry-based Learning* (FGIL) was also carried out. This learning system is, of course, adapted to the stages of syntaxes of guided inquiry and the flipped classroom learning phase. To find out how this learning system can be described by the steps of the *Flipped-Guided Inquiry-based Learning* (FGIL) learning system using Moodle as a *Learning Management System* as its implementation, which can be seen in the picture one.



Picture 1. Flipped-Guided Inquiry-Based Learning (FGIL) Cycle (Ismail & Mawardi, 2021)

Prototyping Phase

At the next stage of development, namely the step of making a prototype. At the prototyping phase, this phase consists of four prototypes evaluated formatively on each prototype. The resulting prototype is as follows:

Prototyping 1

In making prototype 1, this was done by designing *guided inquiry* learning using a multi visual representation model (macroscopic, microscopic, and submicroscopic) (Zagoto & Dakhi, 2018). At this learning design stage, the model used can be in the form of images, graphs, data tables, or videos. Based on this model, students will be able to explore learning based on critical questions that have been made based on the model. After the learning design is made, the teaching that has been designed is applied to the Moodle version so that online learning can be used according to the invention. The learning system of *Flipped-Guided Inquiry-based Learning* (FGIL) is involved in two learning settings, namely asynchronously and synchronously. This asynchronous and synchronous learning will be carried out using *learning management system* (LMS) moodle.

Learning will be carried out by the learning steps of guided inquiry, namely orientation, exploration and concept formation, application, and closing (Hanson, 2014). Asynchronous learning is applied at the orientation stage, exploration, concept formation, and synchronous application and learning stages will be used at the closing stage. After the design is complete, prototype one is generated.

Prototyping 2

The results of prototype one were also self-evaluated using a checklist system to see the completeness and completeness of the learning system created (Nisak & Istiana, 2017). Based on the *self-evaluation* results, revisions will be made to the deficiencies and errors that are still present in the product. After the modification, all components in the checklist table have been declared complete. So prototype two is produced.

Prototyping 3

To produce prototype 3, the results of prototype two will then be assessed by material experts from 3 chemistry lecturers and two chemistry teachers. The expert assessment aims to measure the level of validity of the learning system being developed. After processing the data, it can be seen that the value of the truth of the material is in the correct category. The data can be seen in table 3. Then at this stage, a one-to-one evaluation of 3 students was also carried out. Furthermore, a revision of prototype two is also needed to improve the quality of the prototype to produce a valid prototype 3.

Table 3. Material expert validity results

Percentage	Value	category
Content	0,86	Valid
constructs	0,89	Valid
Language	0,91	Valid
Graphics	0,92	Valid
Average	0,90	Valid

Based on the results of validation by five material experts who were assessed, it was obtained for the feasibility of the content to get a validity value of 0.86 with a valid category, for the feasibility of constructs to get a validity value of 0.89 with a valid category, for the language component to get a validity value of 0.91 with a valid category. For the graphic detail, the validity value is 0.90 with a valid category. The average obtained from the validity of the developed product is 0.90 with a valid category. This shows that the product produced is feasible to be used in the learning process.

Prototyping 4

The results of the evaluation at this stage will also carry out a small group evaluation where the developed learning system is tested on 16 students who are divided into four small groups. Then after trying the learning system, students will then be asked to fill out a student response questionnaire which will later be used to obtain a level of practicality. After processing the data with the response questionnaire, it will be known that the practicality value is 85% and can be categorized as very practical. The data can be seen in table 4.

At this stage, three high school chemistry teachers were also asked to fill out a teacher response questionnaire to obtain practicality. After processing the data, the practicality value is 90% with the very practical category. The data can be seen in table 5.

After analyzing the results of practicality and the acquisition of student scores in the small group trial against prototype III, it can be seen that prototype III has a practical category with an average percentage value of 85. After small group trials have been carried out then the resulting prototype four is valid and practical.

Table 4. Small group practicality result

Aspect	Practicality	category
Ease of use	85%	Very practical
Time efficinecy	86%	Very practical
Benefits	83%	Very practical
Average	85%	Very practical

The results of the small group trial with the number of respondents, namely 16 students, three aspects are measured, each of which is obtained, namely for the ease of use aspect, it gets a percentage of 85% with a very practical category. Then for the element of time efficiency, it gets 86% with a very practical category. For the last part, namely the benefit aspect, the rate is 83% with a very practical category. Based on the three factors that have been measured, the average for the practicality of student responses is 85% with a very practical category. This shows that the product developed is suitable for use in the learning process.

Table 5. Teacher Practicality result

Aspect	Practicality	category
Ease of use	92%	Very practical
Time efficinecy	90%	Very practical
Benefits	89%	Very practical
Average	90%	Very practical

Practicality tests were also carried out with three chemistry teachers; three aspects were measured, each obtained. The ease of use aspect received 92% very practical category. Then for the element of time efficiency, it gets a ratio of 90% very practical category. For the last part, namely the benefit aspect, the rate is 89% very practical category. Based on the three factors that have been measured, the average for the practicality of student responses is 90%, very practical category. This shows that the product developed is suitable for use in the learning process.

The research has produced a product in the form of a *Flipped-Guided Inquiry-Based Learning (FGIL)* learning system using Moodle on chemical equilibrium material. The learning system itself is an organized combination of human elements, materials, facilities, equipment, and procedures, where these elements will interact with each other to achieve a goal (Yunus Abidin, 2016). A learning system used for learning activities by the teacher will be sound if the implementation of learning using the learning system meets three categories, namely attractiveness, benefits, and efficiency. So if one of the three categories is not met, the learning system used can be categorized as a learning system that is not good (Andriani, 2015).

In previous research, the *Flipped-Guided Inquiry-Based Learning* model can be run using Edmodo and with additional assistance applications, namely, zoom cloud meeting. So in further development research, this research will develop a learning system of *Flipped-Guided Inquiry-Based Learning* using the Moodle as a learning management system, which will be more practical than previous research, which still uses Edmodo and additional applications such as zoom. In the learning system developed, we will only use one learning management system, namely Moodle. Because in Moodle, there are various features needed by teachers to run learning synchronously or asynchronously. In this developed learning system, Moodle is used as a *Learning management system* to implement learning with the *Flipped-Guided Inquiry-Based Learning* model. So that in its application, the learning will be carried out synchronously and asynchronously in Moodle. Moodle is an application that is considered very helpful for teachers in providing education in this blended learning period. Due to the availability of various features, the teacher will be able to design their learning with the elements in Moodle. The synchronous learning or virtual face-to-face implementation, zoom cloud meetings are no longer needed because Moodle already has a *video conference* feature that can be used for virtual face-to-face with students. By using new learning innovations using Moodle, it will be easier for students and teachers to carry out learning activities.

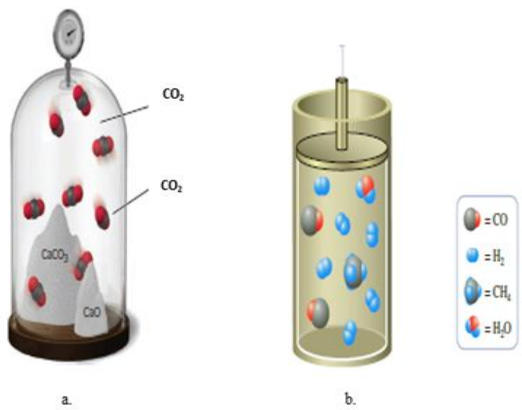
This reasearch uses the Plomp development model, whose stages consist of the stages described above previously (Plomp & Nieveen, 2013). The learning system developed is a learning system whose learning will be applied by the steps of *guided inquiry* with two learning settings with its application using Moodle. The learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) uses this Moodle; the learning activities are carried out according to *the flipped-guided inquiry-based learning* syntax, as shown in picture 1. Based on picture 1, learning has the same stages as the guided inquiry steps, namely: orientation, exploration and concept formation, application, and closing (Hanson, 2014). The implementation of the learning steps uses two learning settings by the *flipped classroom* model, namely synchronously (face to face/online) and asynchronously using the *Learning Management System* of Moodle (Casadonte, 2016).

The learning stages in the learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) using this moodle are the first, namely orientation. At this orientation stage, it is presented in the form of a video, which the footage contains motivation (Achmat Mubarok, 2022) by providing an overview of chemical phenomena that occur in everyday life, so that students can be motivated in studying chemicals (Maya, Murningsih, Masykuri, & Mulyani, 2016). Initial knowledge and learning objectives, where we will upload the orientation video into Moodle, and students will be able to watch the orientation video. At this stage, it is carried out asynchronously so that students can watch the orientation video that the teacher gives before learning takes place.

The second stage in this learning system is exploration and concept formation; then, students will be asked to answer critical questions and analyze the model (pictures, tables, etc.) presented (Rizkivany & Mawardi, 2021). and later, based on the model presented, students will be able to find answers to the fundamental questions raised in the quiz feature on Moodle. This exploration and formation stage is carried out asynchronously and is done independently by students so that students can find their concepts with flexible time.

The next stage is the application stage. At this stage, students will be given practice questions, and in the process, the practice questions at this stage are by discussing with each group on the discussion forum feature on Moodle. This stage aims to strengthen the concepts that students have found in the exploration and concept formation stage (Winata & Mawardi, 2021). This application stage is carried out asynchronously so that the discussion learning process can be effective because the learning time at school is only approximately 30 minutes per lesson. Students can discuss with sufficient time (Herpika & Mawardi, 2021).

The last stage in this learning system is the closing stage. At this stage, one of the group members becomes a representative to convey the discussion results to his group. Then at this stage, a meeting will also be carried out with the teacher to conclude the lessons that the students have learned. At this closing stage, it will be carried out synchronously, whether it is face-to-face at school or face-to-face via the *video conference* feature on Moodle.



Picture 2. Gambar senyawa dalam reaksi kesetimbangan dengan fasanya (a) (Amateis, 2018) & (b) (Gammon, 2017)

One of the models used in this *guided inquiry* learning can be seen in picture 2. In the picture, students can distinguish the phases in the compounds contained in the chemical equilibrium reaction shown. From the model used, key questions will be presented to guide students in getting the concept so that the critical questions used must, of course, be by the model to be used. The model used must be presented in 3 representations, namely macroscopic, microscopic and symbolic. So that by using the model displayed with these three representations, it will be easier for students to understand chemical phenomena, and students will be able to build their concepts. The three representations used in the model will make it easier for students to understand the key questions and imagine the chemical phenomenon, the models used microscopic, microscopic, and symbolic images will be taken from general chemistry books. Likewise, other models, such as graphs and tables, will also be taken from chemistry books so that the truth of the model will be by the phenomena described by expert writers.

The learning system of *Flipped-Guided Inquiry-based Learning* (FGIL) using Moodle on chemical equilibrium material has been tested for validity and practicality. From the data in table 3, it can be seen that the validity results based on material expert are 0.90 with valid categories. Based on the results of the validity, it shows that the learning system developed is already sound in terms of the feasibility of content, presentation components, language components, and graphics components.

Based on the content feasibility aspect, the learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) using Moodle gets a validity value, namely the valid category. From the results of the validity of the content feasibility, it can be said that the learning system developed is accordance with the material being taught, as well as the model used and the suitability of the key questions to find concepts and practice questions in the application on Moodle can strengthen students concepts.

Based on the validity of the construct feasibility, the learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) using Moodle gets a validity value, namely the valid category. It can be concluded that the presentation of the learning design is appropriate based on the *guided inquiry* cycle.

In terms of language components, the learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) using Moodle gets a validity value, namely the valid category. This means that the language used in the orientation video can be understood, and the suitability of the language used in the critical questions with Indonesian and the writing rules. Judging from the graphic component of the learning system developed, the V value was 0.83 with a valid category. This means that students can observe the model given in the Moodle as a *Learning Management System.*

The learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) using Moodle on chemical equilibrium material has a high level of practicality. This can be seen from the practical analysis of the responses from teachers and students. Three aspects are assessed in the practicality test; ease of use, time efficiency, and benefits. The service element is related to the ease of use of *flipped-guided inquiry-based learning* in online learning, namely obtaining a practicality value of 85% with a very practical category. While time efficiency related to the use of time in the developed learning system is getting 86% with with a very practical category, in the last aspect, namely the aspect of benefits related to the benefits obtained from the learning system, namely 83% with a very practical category . From the data analysis results that have been carried out, the learning system developed receives a practical value based on student responses, 85% with a very practical category, and a practical matter based on teacher responses, which is 90% with a very practical category. Based on these conclusions, we can say that this learning system of *Flipped-Guided Inquiry-Based Learning* (FGIL) is helpful in terms of ease of use and time efficiency and beneficial in carrying out online learning.

After finding that the learning system is valid and practical based on the data analysis carried out, we can also say that learning with Moodle is the right *learning management system* to use because of the availability of features that are more complete than previous learning management and will make it easier for teachers to provide lessons and materials to students. Likewise, students will find it easy to access learning because they use a *learning management system* that is a Moodle.

This learning system of *Flipped-Guided Inquiry-based Learning* (FGIL) is different from applying the ordinary *guided inquiry* model. If we usually use a student worksheet, this time, we will use a method using Moodle. Of course, this will be more practical than the usual student worksheets. In everyday learning activities, the student worksheets will be done by students at school during the learning process. In contrast to the learning system of *Flipped-Guided Inquiry-based Learning* (FGIL), in its application, it will be carried out in Moodle. The stages of guided inquiry, such as orientation, exploration and concept formation, application, and closing, will be applied in Moodle. The presentation of orientation is also different in this learning system, if in ordinary learning using an orientation guided inquiry model such as motivation, apperception and also the opening of learning will be given directly at school and also chemical phenomena will be presented on student worksheets. So in this learning system presented using video, the teacher will make an orientation video which contains an opening, motivation, apperception and explanation of the material connection with chemical phenomena that has been presented using video. The video will contain chemical animations with models that are in accordance with general chemistry books and also other animations that can describe chemical phenomena related to chemical equilibrium materials. This orientation video will be displayed on Moodle and students just need to press the video and watch it easily.The process of working on the stages will be carried out before the learning takes place and after the learning takes place.

Such orientation, exploration, and formation of concepts and applications will be carried out before learning occurs. The purpose of carrying out learning before learning takes place is so that students can find their ideas and can work on the key questions available in the Moodle feature freely without any time constraints and can be done anywhere and anytime. Likewise, at the application stage, students will find it easier to discuss because of the availability of discussion forums that have been grouped individually. Of course, students will not be challenged to locate and find the group. So, before learning takes place, students have built and discovered their concepts and understandings, so when the closing stages are carried out at school, students will easily convey the results of discussions that will be carried out on the video conference feature during learning hours. At this stage, conclusions will also be drawn from the results of the debate, and the teacher will emphasize, rebuttal, and also justify student answers.

CONCLUSION

From the development of *Flipped-Guided Inquiry-based Learning* (FGIL) learning system using Moodle on chemical equilibrium material it can be developed. The learning system is proven to be usable and feasible to be used as a learning system in schools by getting a positive response from the use of products developed with obtained a validity value from a material expert of 0.90 with a valid category and can be said to be feasible to use as a learning system. Also, the level of practicality obtained a percentage of 85% with a very practical category, so it can be said that this learning system is practical to use in the learning process at school.

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