International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

http://ijpsat.ijsht-journals.org
Vol. 27 No. 2 July 2021, pp.382-387

The Development of Flipped-Guided Inquiry Based Learning System on Redox and Electrochemical Reactions for Class XII SMA

Lolita Rizkivany[1], Mawardi Mawardi[*1]

Department of Chemistry, Faculty of Mathematics and Sciences,

Padang State University, Indonesia

Abstract— The Covid-19 pandemic has surged several of countries around the world, including Indonesia. The Covid-19 pandemic has affected various fields of our life including education sector. It leads to the change of the learning system from offline learning to online learning. In addition, the 2013 curriculum applies the learner-centered learning. Therefore, this study is aimed to develop a guided inquiry-based flipped classroom learning system on a chemistry school material about redox and electrochemical reactions and to measure the level of validity and practicality of this type of learning system. This research is conducted Research and Development (R&D) with the Plomp development model. The research instruments are in the form of validation sheets and practicality questionnaires. Based on the results of the analysis for the validity of the questionnaire, it can be obtained value of 0.86 in the validity category. Furthermore, the results of the analysis for the practicality test can be obtained that 86% in the very practical category from the students and 94% in the very practical category from the teachers. The results of this study is to indicate that the learning system developed is valid and practical and to indicate that it can be used as a solution in the implementation of online learning.

Keywords— Guided Inquiry, Flipped Classroom, Redox and Electrochemical Reactions

I. INTRODUCTION

The Covid-19 pandemic has surged several of countries around the world, including Indonesia. The Covid-19 pandemic has affected various sector of our life like economic, social, and educational sector [1]. It leads to the change of the learning system from offline learning to online learning [2].

One of the learning solutions that can be used in online learning and can be applied in the era of the industrial revolution 4.0 to reach the demands of the 21st century is the blended learning model. In blended learning system, there are two learning conditions; asynchronous and synchronous [3]. One of the practical way to implement the blended learning is to use the flipped classroom model [4]. Flipped classroom is also known as the reverse classroom learning. In this flipped classroom model, the school activities that are usually carried out in class and the homework activities that are usually done are being reversed [5].

Flipped classroom learning can apply the learner-centered learning by following the demands of in 2013 Curriculum. One of the learning models that are based on 2013 Curriculum is the guided inquiry learning model. Guided inquiry is an active learning model. The students can build their own knowledge by connecting it with the prior knowledge [6]. The guided inquiry learning model can increase student activities, motivations, learning outcomes. It can bring the students to be actively involved in the learning process [7], [8].

Corresponding Author: Mawardi

The implementation of Flipped-Guided Inquiry Based Learning System has given a positive impact on chemistry learning about salt hydrolysis [9], colligative properties of solutions [10], chemical bonds [11] and chemical equilibrium [12]. It shows valid and practical results. In addition, Flipped-Guided Inquiry Based Learning (FGIL) chemical kinetics material for the first year students shows valid, practical, and effective results. It can be applied by the lecturers in the learning [13]. Flipped-Guided Inquiry Based Learning System can increase the interaction between the teachers and the students and can also improve students' thinking skills [14]. Flipped-Guided Inquiry Based Learning System can improve learning outcomes. It has given a positive impact on students attitudes and effective in improving students' skills [15].

To carry out online learning, we need to use an online system to support the online learning process, called as the Learning Management System (LMS). In this research, Edmodo and Zoom Cloud Meeting are the types of LMS used. Teachers and students are doing the learning asynchronously by using the Edmodo application, so that they can access it anytime and anywhere. Meanwhile, for doing the learning synchronously, they can use the Zoom Cloud Meeting application to held face-to-face meeting, so that they can carry out the learning system virtually at the same time.

Based on the background above, this study is aimed to develop a guided inquiry-based flipped classroom learning system on redox and electrochemical reactions for class XII SMA. Researcher hopes that this learning system is valid and practical to use in online learning in the conditions of the Covid-19 pandemic and in the face of the digital-based industrial revolution 4.0 era.

II. METHODOLOGY

The type of research that is used in this research is Research and Development (R&D). The development model that is used in this study is the Plomp model developed by Tjeerd Plomp. Ploomp model consists of 3 stages. The first stage is preliminary research; this stage is about the needs and context analysis, literature study, and conceptual framework development. The second stage is the development or prototyping, at this stage a formative evaluation is carried out for each prototypes, including self-evaluation, expert assessment, and individual and small group evaluations which aims to measure the level of validity and practicality of the learning system being implemented. Developed. The last stage is the assessment phase [16]. The instruments that are used in this research are validation sheets and practicality questionnaires.

The validatity results will be calculated by using the Aikens V formula, as shown below:

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

And to calculate the practicality results, the researcher uses the following formula:

$$NP = \frac{\mathrm{R}}{SM} \times 100$$

To determine the validity category, researcher is obtained it from table 1 and the practicality category are obtained from table 2.

Table 1. The Validity Category

No.	Aikens V Skale	Validity
1.	V ≤ 0,4	Low
2.	0,4 < V < 0,8	Middle
3.	0,8 < V	Valid

Table 2. The Practicality Category

No	Value	Practicality
1.	86%-100%	Very Practical
2.	76%-85%	Practicality

3.	60%-75%	Middle
4.	55%-59%	Low
5.	≤54%	Not Practical

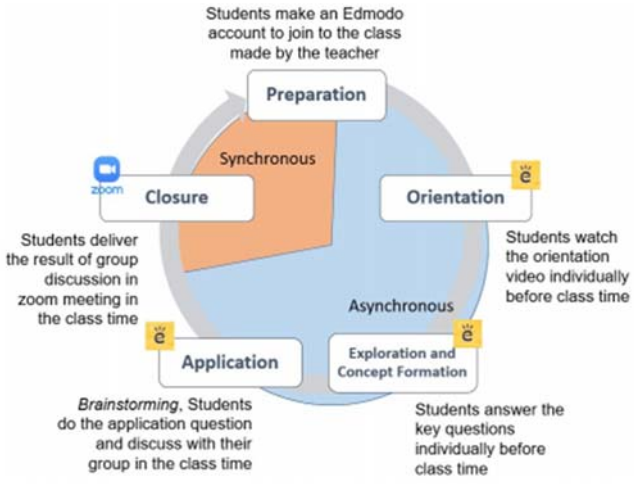
III. Result And Discussion

Result.

Preliminary Research. The first stage is preliminary research. This stage is about the needs and context analysis, literature study, and conceptual framework development. Needs analysis is conducted to find out the basic problems that the teachers and the students faces in the learning redox and electrochemical reaction materials for class XII at school. The studies that are conducted that the reference sources that the researcher finds related to the research. From the studies references, it can be obtained that flipped classroom learning and guided inquiry can be one of the solution in implementing digital-based online learning that is centered on students based on the 2013 Curriculum.

Prototyping Phase. In this stage, a formative evaluation is carried out for each prototypes. The first activity that is carried out to this research is to design a flipped classroom based on guided inquiry on redox and electrochemical reactions. The flipped classroom with guided inquiry is carried out in two learning conditions; asynchronous and synchronous. In this learning system, the stages of guided inquiry of asynchronous are the orientation, exploration, concept formation and application stages by using Edmodo. Moreover, the closing stage is carried out synchronous learning by using zoom cloud meeting.

For more details can be seen in Figure 1 as the result of the learning system design is prototype 1.



Picture 1. The Cycle of Flipped-Guided Inquiry Based Learning System.

The result of prototype 1 is conducted by doing self-evaluation with a checklist system to see the completeness of the learning system and then revised it to produce prototype 2. In prototype 2, an expert assessment is needed from 2 chemistry lecturers and 1 chemistry teacher. The aim of the expert assessment is to measure the level of validity of the learning system that is being developed. At this stage, one-of-one evaluation is done on 3 students. Furthermore, the revision of prototype 2 is needed to improve the quality of the prototype to produce a valid prototype 3. The results of the evaluation at this stage can be seen in table 3.

Table 3. The Validity Results Based on Expert Assessment

No	Aspects	Validity	Category
1	Material components	0,79	Middle
2	Presentation components	0,82	Valid
3	Language components	0,89	Valid
4	Graphic components	0,83	Valid
Average		0,83	Valid

In prototype 3, a valid learning system is already produced, then a small group trial is evaluated with 15 students of class XII SMA. Next, the students are asked to fill out the student response questionnaires that are used to obtained the level of practicality of the developed learning system. After processing the data, it can be seen that the practicality value was 86% with a very practical category. The data can be seen in table 4. At this stage, 3 high school teachers are asked. Therefore, the data processing can be carried out to obtain the practicality value of 94% in very practical category. The data can be seen in table 5.

Table 4. The analysis results of the students questionnaire

No	Aspects	Validity	The Practicality Category
1	Simplicity	87%	Very practical
2	Efficiency	87%	Very practical
3	Benefits	85%	Practical
Average		86%	Very practical

Tabel 5. The analysis results of the s questionnaire

No	Aspects	Validity	The Practicality Category
1	Simplicity	95%	Very practical
2	Efficiency	90%	Very practical
3	Benefits	94%	Very practical
Average		94%	Very practical

Disccusion.

The research that has been done has produced a product in the form of a Flipped-Guided Inquiry Based Learning System on redox and electrochemical reactions. This study uses the Plomp development model which consists of several stages that have been described previously. The learning system is carried out according to the stages in the guided inquiry model. Flipped-Guided Inquiry Based Learning System can encourage the students to be active in the learning process [17]. The first learning stage is the orientation stage. It is presented in the form of a video containing motivation, initial knowledge, or learning objectives uploaded to Edmodo.

The second stage is for exploration and concept formation. In this stage, the students are asked to analyze the model/information (pictures, tables, etc.) to find answers to key questions in the quiz features in the Edmodo application. The next stage is the application stage. At this stage, students are asked to do the exercises by discussing them with their group members. The discussion activities is in the form of comments column. This stage is aimed to strengthen the concepts that have found by the students. This application stage is posted by the teacher on the assignment feature in the Edmodo application. The last stage is the closing stage

that is held by using zoom cloud meeting. At this stage, the representatives of each groups presents the results of their group discussions and discusses together to conclude the lessons that they have been learned.

Flipped-Guided Inquiry Based Learning System on the redox and electrochemical reaction materials has been tested for its validity and practicality. From the data in table 1, it can be seen that the validity results based on the expert assessment are 0.86 and can be said that it is valid. It shows that the learning system that has been developed is valid in terms of the feasibility of content, presentation components, linguistic components, and graphic components.

In terms of content feasibility, Flipped-Guided Inquiry Based Learning System obtains a value of 0.89 and can be categorized as valid. This means that the orientation video and the model provided are compatible to the material being taught, the suitability of the model with key questions to find the concept, and the exercises that are given in Edmodo can strengthen the students' concepts.

In terms of the presentation component, an assessment of the suitability of the learning design was carried out based on the guided inquiry learning cycle. In addition, an assessment was also carried out on the presentation of orientation videos that had clear image and sound quality, the presentation of questions accompanied by models (pictures, tables, etc.) discussion, and the presentation of the closing stage was carried out using a zoom cloud meeting to allow students to confirm the concepts they had acquired. Based on Table 1, the results of the presentation component analysis obtained a V value of 0.83 with a valid category.

In terms of the linguistic component, the analysis obtained a V value of 0.86 with a valid category. This means that the language used in the orientation video can be understood and the suitability of the language used in the key questions with the Indonesian writing rules. In terms of the graphical component of the learning system developed, the V value of 0.83 was obtained with a valid category. This means that the model given to Edmodo can be clearly observed by students.

The development of a Flipped Classroom Learning System Based on Guided Inquiry on Redox Reaction and Electrochemical Materials for Class XII SMA/MA has a high level of practicality. It can be seen from the practical analysis of the responses from the teachers and the students. There are three aspects that are assessed in the practicality test; simplicity, time efficiency, and benefits. The simplicity aspect is related to easy way to use the Flipped-Guided Inquiry Based Learning System in online learning. Meanwhile, the time efficiency is related to the use of time in the developed learning system. Last, the benefit aspect relates to the benefits obtained from the Flipped-Guided Inquiry Based Learning System. The results of data analysis that have been carried out have obtained the practicality value based on student responses of 86% in the very practical category and the practicality value based on the teacher's response of 94% in the very practical category. Based on this conclusion, it can be said that Flipped-Guided Inquiry Based Learning System is practical in the terms simplicity, time efficiency, and benefits in carrying out online learning.

IV. Conclusion

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

1. Flipped-Guided Inquiry Based Learning System on redox reactions and electrochemistry for class XII SMA/MA can be developed.
2. Flipped-Guided Inquiry Based Learning System is produced the validity category with a value of 0.86 and the level of practicality category as very practical with an average 87% from students and 94% from teachers.

Acknowledgment

Thanks to Mrs. Dr. Asra, M.Si as a chemistry teacher who has provided his knowledge helping the researcher in doing this research. Thanks to Padang State University, the teachers and students at SMAN 8 Padang who has participated in this research.

References

[1] D. P. Widyaningrum, “Pengaruh Zoom meeting pada Pembelajaran Jarak Jauh Berbasis E-Learning dalam Meningkatkan Kemampuan Kognitif Peserta Didik,” *J. Adm. dan Manaj. Pendidik.*, vol. 1, no. 2, pp. 62–77, 2020.

[2] G. Reynders and S. M. Ruder, “Moving a Large-Lecture Organic POGIL Classroom to an Online Setting,” *J. Chem. Educ.*, vol. 97, no. 9, pp. 3182–3187, 2020, doi: 10.1021/acs.jchemed.0c00615.

[3] U. A. Chaeruman, “Merancang Model Blended Learning Designing Blended Learning Model,” *J. Teknodik*, vol. 17, no. 4, p. 053, 2013, doi: 10.32550/teknodik.v17i4.577.

[4] A. Powell *et al.*, "Teacher education and K-12 online learning," *Ina. Int. Assoc. K–12 Online Learn.*, no. July, pp. 1–20, 2020, [Online]. Available: http://files.eric.ed.gov/fulltext/ED560788.pdf.

[5] C. F. Herreid and N. A. Schiller, "Case Studies and the Flipped Classroom," *J. Coll. Sci. Teach.*, vol. 42, no. 5, pp. 62–66, 2013.

[6] D. M. Hanson, "Designing Process-Oriented Guided-Inquiry Activities," *Fac. Guideb. – A Compr. Tool Improv. Fac. Perform.*, pp. 1–6, 2005.

[7] H. Kardena and M. Mawardi, "Development of Guided Inquiry Based Student Worksheet for First College Student," *Int. J. Sci. Res. Publ.*, vol. 10, no. 10, pp. 375–379, 2020, doi: 10.29322/IJSRP.10.10.2020.p10650.

[8] Asra, L. Dj, and Mawardi, "PENINGKATAN AKTIVITAS, MOTIVASI, DAN HASIL BELAJAR SISWA DENGAN PENDEKATAN INKUIRI TERBIMBING DI SMA NEGERI 8 PADANG," *ESAKTA*, vol. 1, pp. 75–81, 2016.

[9] Z. W. Nengsih and M. Mawardi, "EDUKATIF : JURNAL ILMU PENDIDIKAN Pengembangan Sistem Pembelajaran Flipped Classroom Berbasis Inkuiri Terbimbing pada Materi Hidrolisis Garam," vol. 3, no. 4, pp. 1231–1244, 2021.

[10] W. P. Waer and M. Mawardi, "EDUKATIF: JURNAL ILMU PENDIDIKAN Integrasi Model Inkuiri Terbimbing Dan Pendekatan Flipped Classroom Pada Pembelajaran Materi Sifat Koligatif Larutan Untuk Siswa Kelas XII SMA/MA," *J. Ilmu Pendidik.*, vol. 3, no. 3, pp. 1029–1037, 2021, [Online]. Available: https://doi.org/10.31004/edukatif.v3i3.498.

[11] Y. Anjelina, "Chemical Bonding Materials Using Edmodo," no. 6, pp. 29–34, 2021.

[12] U. S. Ramadianti and M. Mawardi, "on Chemical Equilibrium for 11 th Grade High School Students," pp. 23–28, 2021.

[13] V. Aumi and M. Mawardi, "Validity and practicity of Flipped Guided Inquiry based Learning (FGIL) model in chemical kinetics for year 1 students," *Int. J. Progress. Sci. Technol. (IJPSAT*, vol. 26, no. 1, pp. 142–147, 2021, [Online]. Available: http://ijpsat.ijsht-journals.org.

[14] M. P. DeMatteo, "Combining POGIL and a Flipped Classroom Methodology in Organic Chemistry," *ACS Symp. Ser.*, vol. 1336, pp. 217–240, 2019, doi: 10.1021/bk-2019-1336.ch013.

[15] N. Hidayati, Leny, and R. Iriani, "PENGARUH MODEL PEMBELAJARAN INQUIRY BASED LEARNING DENGAN PENDEKATAN FLIPPED CLASSROOM TERHADAP SELF EFFICACY DAN HASIL BELAJAR KESETIMBANGAN ION DALAM LARUTAN GARAM," *Pros. Semin. Nas. Pendidik. Kim.*, pp. 99–107, 2018.

[16] T. Plomp and N. Nieveen, "Educational Design Research Educational Design Research," *Educ. Des. Res.*, pp. 1–206, 2013.

[17] M. Mawardi, A. Fitri, R. Js, and F. H. Yani, "Effectiveness of student worksheets based guided inquiry on acid base material to improve students higher order thinking skill (HOTS)," *J. Phys. Conf. Ser.*, vol. 1481, no. 1, pp. 1–5, 2020, doi: 10.1088/1742-6596/1481/1/012083.