International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 6 Issue 5, May - 2022, Pages: 53-56

The System of Flipped Classroom Based on Guided Inquiry Learning on Redox Reactions and Electrochemistry Using Moodle

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Abstract: *Blended learning is commonly used in recent year to support teaching and learning activities. It is supporting the growth of industrial revolution 4.0 and at the same time also the answer for conducting teaching and learning activities during COVID-19 pandemic. The research goals to develop a system of flipped classroom based on guided inquiry learning on redox reactions and electrochemistry using Moodle as a learning management system that is valid and practical to support the teaching and learning activities for students and teacher. The research is an educational design research (EDR) using Plomp model consists of three stages: preliminary research, development or prototyping phases, and assessment phase. The preliminary research consists of needs and context analysis, literature review and the development of theoretical framework. The prototyping phase consists of prototype I until prototype IV with formative evaluation for each. In the prototype II, the validity of learning system was determined with the average validity score of 0.88 and is valid. In the prototype III, the practicality of learning system was determined with the average of practicality score of 85% is practical.*

Keywords—Guided Inquiry Learning; Flipped Classroom; Learning Management System; Moodle

1. INTRODUCTION

The growth of industrial revolution 4.0 affected most of the life sectors. One of them is in the educational sector, where the learning process is integrated with cyber technologies and is expected to equalize educational quality. One of the driving factors for accelerating the implementation of industrial revolution 4.0 in the educational sector, particularly in Indonesia, is the COVID-19 pandemic [1]. The teaching and learning activities in the COVID-19 pandemic is based on Community Activities Restrictions Enforcement, or CARE (*Pemberlakuan Pembatasan Kegiatan Masyarakat*, referred to as PPKM), and a Joint Ministerial Decree (*Surat Keputusan Bersama*, referred to as SKB) of four ministers that are determined by the level of the pandemic situation in a certain region. In the region with CARE levels 1 and 2, the teaching and learning activities is done by restricted face-to-face learning. Whereas, for the region with CARE levels 3 and 4 the teaching and learning activities is done by online learning [2].

One of the learning systems that support the teaching and learning activities in the COVID-19 pandemic and accelerate the implementation of industrial revolution 4.0 in the educational sector is blended learning. Blended learning is the learning process combining face-to-face learning and online learning with web-based technologies, several pedagogical approaches, and two conditions of learning, which known as synchronous and asynchronous to create harmony of learning and assignment [3]–[5]. In synchronous learning, students and teachers can be in the same location or in different locations that communicate and interact through software that supports learning activities. In asynchronous learning, teaching and learning activities are done independently outside the schedule of learning and supported by a learning management system such as Moodle [6].

Flipped classroom is one of the models of blended learning where the content load of learning generally taught in face-to-face learning is reversed with asynchronous learning and the homework activities usually done in the outside class are done in the class synchronously [7]. Flipped classroom is fitted with one of the characteristics of 2013 curriculum, which is based on a scientific approach. One of the learning models in the 2013 curriculum is guided inquiry learning.

Guided inquiry learning is generally used in chemistry learning. Guided inquiry learning constructs students' understanding based on prior knowledge, experiences, skills, and attitudes that follow the learning cycle: exploration, concept formation, and application that connect the concepts and multiple representations to achieve the interconnection between conceptual and procedural knowledge [8], [9]. There are some studies that show guided inquiry learning yields as a good combination for learning topics in chemistry, such as flipped classroom based on guided inquiry learning using Edmodo as learning platform for chemical equilibrium, chemical bonding, chemical kinetics and molecular geometry shows valid and practice result[10]–[13], and learning system of flipped classroom based on guided inquiry learning using Moodle for thermochemistry and salt hydrolysis that shows valid and practice result [14], [15].

One of the topics in chemistry that students' having fairly difficulties to understand is electrolysis cell [16]. Electrolysis cell is a part of redox reactions and electrochemistry topics. Redox reactions and electrochemistry consists of balancing redox equations, the principal of voltaic cell, the use of voltaic cell, factors that affect corrosion, how to cope with corrosion, electrolysis, and Faraday's law.

Learning management system is used as online learning platform that also known as e-Learning. One kind of learning management system that generally use in teaching and learning activities is Moodle. Moodle provide the learning set to support inquiry and discovery learning process and also to create collaborative learning between students independently or as supporting the conventional learning [17]. It is convenient to provide learning process such as flipped classroom based on guided inquiry.

This research aimed to develop and determine the validity and practicality of a system of flipped classroom based on guided inquiry learning using Moodle as a learning management system on redox reaction and electrochemistry.

2. Research Method

The research is educational design research (EDR) using the Plomp model, which consists of three phases in design research: preliminary research, development or prototyping phases and assessment phase [18]. The research was running for the first two phases. The research had been conducted in two schools; Islamic and public senior high schools in Padang and Bukittinggi, West Sumatera, Indonesia.

2.1 Preliminary Research

The preliminary research phase consists of needs and context analysis, literature review, and the development of a theoretical framework. A need analysis is concerned with the perception of users' current situation and how to get to a more desirable situation. The goal of context analysis is to investigate the problem environment and draw up the scope with a theoretical framework. The method to obtain needs and context analysis is through interviews. A literature review is used as a scientific knowledge base [19].

2.2 Development or Prototyping Phase

Development or prototyping phase consists of 3 prototypes. Prototype I is a result of design the system of flipped classroom based on guided inquiry learning, determine the learning outcomes, learning activities, make the key questions to form the concept and make questions and exercises. Prototype I is evaluated by self-assessment and the revision of prototype I become prototype II. Prototype II is assessed by expert appraisal for validity of products and one-to-one evaluation. The result and suggestions from expert appraisal and one-to-one evaluation is to be a prototype III. Prototype III is evaluating the practicality of the product by using small group of students. The revision of prototype 3 will be a product for prototype 4.

3. Result and Discussion

3.1 Preliminary Research

The preliminary research began with a needs and context analysis conducted through interviews with several chemistry teachers who faced teaching and learning activities during the COVID-19 pandemic based on CARE that dynamically changed fast and was a demand for 2013 curriculum performed active learning based on scientific approach. In the learning activities based on CARE, students and teachers must ready to face online learning or face-to-face learning rapidly. The load of content in redox reactions and electrochemistry is numerous and the topics are the types of high-abstract topics with which some of students find it difficult. Based on needs and context analysis, the system of flipped classroom based on guided inquiry learning on redox reactions and electrochemistry using a learning management system such as Moodle allows to be developed as the desirable solution for those problems.

The knowledge base according literature review is to understand the activity of blended learning with using one of the models that is flipped classroom. Flipped classroom is a part of sub-model in rotation model according to Clayton Christensen [20]. Flipped classroom integrated with guided inquiry learning according to Hanson [9] and learning management system such as Moodle would be come to a learning system. The content load of redox reactions and electrochemistry is about balancing redox equation, voltaic cell, corrosion, electrolysis cell and Faraday's law [21]–[23].

The theoretical frameworks of the research are following below,

Fig. 1. *Theoritical framework*

3.2 Development or Prototyping Phase

The result of preliminary research is the system of flipped classroom based on guided inquiry learning that had been evaluated and assessed through prototyping phases with several formative evaluation that are self-evaluation, expert appraisal and one-to-one evaluation, and small group evaluation.

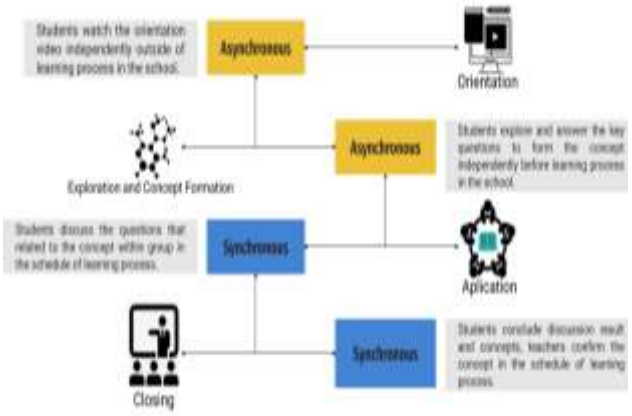

Fig. 1. *Systems of flipped classroom based on guided inquiry learning*

Prototype I was the preliminary product that designed as the result of preliminary research phases. The product is evaluated by self-evaluation and resulting prototype II. The formative evaluation of prototype II was doing with one-to-one evaluation on three students. The result is the key questions were good enough to guide them forming a concept and answer the application questions. The learning system was evaluated by expert appraisal that obtained average validity score of 0.88 based on Aiken validity scale [24] which in the valid category.

In the aspect of content, the validity score is 0.91 in valid the category. The content in the learning system is appropriate with basic competences, learning outcomes, and learning model.

In the presentation aspect, the validity score is 0.88 in the valid category. The presentation in the learning system covers the learning cycle of guided inquiry learning, the learning stages, orientation videos, model for exploration and concept formation, questions in application stages and closing stages.

In the linguistic aspect, the validity score is 0.89 in the valid category. In the graphic aspect, the validity score in 0.83 in the invalid category. The graphic of learning system was considered not very clear the sequence of learning activities were not organized well.

In the aspect of visual, the validity score is 0.89 in the valid category. The visual aspects assessed the features, color composition, visual graphic, video quality, voice quality and the setting of learning stages

In the last aspect is assessed about simplicity, the validity score is 0.90 in the valid category. Simplicity aspect consists of manual guided learning, notification, discussion feature, interaction between students and teachers and another feature. The result of revision on prototype II is prototype III.

Table 1: Validity based on expert appraisal

No	Aspects	Score	Category
1	Content	0.91	Valid
2	Presentation	0.88	Valid
3	Linguistic	0.89	Valid
4	Graphic	0.83	Invalid
5	Visual	0.89	Valid
6	Simplicity	0.90	Valid
Average		**0.88**	**Valid**

The prototype III was evaluated by practicality questioner in small group scale. This stage was done on twenty students from two schools; Islamic and public senior high schools in Padang and Bukittinggi. The average practicality score obtained is 85% with in practical category. In the simplicity and merit aspects, the practicality scores are 87% and 86%, respectively. In the time efficiency aspect, the practicality score is 81% in the practical category.

Table 2: Practicality based on small group evaluation

No	Aspects	Score	Category
1	Simplicity	87%	Very practical
2	Time efficiency	81%	Practical
3	Merit	86%	Very Practical
Average		**85%**	**Practical**

4. CONCLUSIONS

The system of flipped classroom based on guided inquiry learning on redox reactions and electrochemistry topics using Moodle as a learning management system could be developed and is proven to be valid in content, presentation, linguistics, visual, and simplicity with an average score of 0.88. The learning system is determined practice in simplicity, time efficiency, and merit in the learning process, with an average score of 85%.

5. REFERENCES

[1] Kementerian Pendidikan Kebudayaan Riset dan Teknologi, "Kebijakan Kemendikbud di Masa Pandemi," 2020. https://gtk.kemdikbud.go.id/read-news/kebijakan-kemendikbud-di-masa-pandemi.

[2] Kementerian Pendidikan Kebudayaan Riset dan Teknologi, "Pelaksanaan Pembelajaran Tahun Ajaran

Baru 2021/2022 Mengacu pada Kebijakan PPKM dan SKB 4 Menteri," 2021. https://www.kemdikbud.go.id/main/blog/2021/08/pelaksanaan-pembelajaran-tahun-ajaran-baru-20212022-mengacu-pada-kebijakan-ppkm-dan-skb-4-menteri.

[3] C. R. Graham, "Blended Learning Systems: Definition, Current Trends and Future Directions," in *Handbook of blended learning: Global Perspectives, local designs*, San Fransisco: CA: Pfeiffer Publishing, 2003.

[4] L. C. Yamagata-lynch, "International Review of Research in Open and Distributed Learning Blending Online Asynchronous and Synchronous Learning Blending Online Asynchronous and Synchronous Learning," vol. 15, no. 2, pp. 190–212, 2014, doi: https://doi.org/10.19173/irrodl.v15i2.1778.

[5] J. C. Cronje, "Towards a New Definition of Blended Learning," vol. 18, no. 2, pp. 114–121, 2020, doi: 10.34190/EJEL.20.18.2.001.

[6] E. Murphy, M. A. Rodríguez-manzanares, and M. Barbour, "Asynchronous and synchronous online teaching: Perspectives of Canadian high school distance education teachers," vol. 42, no. 4, pp. 583–591, 2011, doi: 10.1111/j.1467-8535.2010.01112.x.

[7] J. O. Flaherty and C. Phillips, "Internet and Higher Education The use of fl ipped classrooms in higher education : A scoping review," *Internet High. Educ.*, vol. 25, pp. 85–95, 2015, doi: 10.1016/j.iheduc.2015.02.002.

[8] Mawardi and Asra, "Inkuiri Terbimbing sebagai Salah Satu Strategi Pembelajaran Kimia untuk Memenuhi Tuntutan Kurikulum 2013," in *Prosiding Seminar Nasional Pembelajaran Fisika*, 2013, pp. 522–528.

[9] D. M. Hanson, "Designing Process-Oriented Guided-Inquiry Activities," in *Faculty Guidebook – A Comprehensive Tool for Improving Faculty Performance*, Edisi 2., S. W. Beyerlein and D. K. Apple, Eds. New York: Pacific Crest, 2005, pp. 1–6.

[10] U. S. Ramadianti and M. Mawardi, "Development Model of Flipped-Guided Inquiry based Learning on Chemical Equilibrium for 11th Grade High School Students," *Int. J. Progress. Sci. Technol.*, vol. 27, pp. 23–28, 2021.

[11] Y. Anjelina and Mawardi, "Validity of Flipped Classroom Based on Guided Inquiry in Chemical Bonding Materials Using Edmodo," *Int. J. Progress. Sci. Technol.*, vol. 27, pp. 29–34, 2021.

[12] 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.*, vol. 26, no. 4, pp. 142–147, 2021, [Online]. Available: http://www.ijpsat.es/index.php/ijpsat/article/view/2952/1820.

[13] F. Herpika and M. Mawardi, "Validity of the Flipped Classroom Learning System Based on Guided Inquiry on Molecular Forms Using Augmented Reality for Class X SMA/MA Students," *Int. J. Progress. Sci. Technol.*, vol. 27, no. June, pp. 232–236, 2021, doi: 10.52155/ijpsat.v27.1.3062.

[14] I. A. Ismail and M. Mawardi, "Flipped Classroom Learning System Guided Inquiry On Thermochemical Materials For High School Students Class XI," *Int. J. Progress. Sci. Technol.*, vol. 30, pp. 280–287, 2021.

[15] M. U. Sari, "Development of a Guided Inquiry-Based Moodle E-Learning System on the Topic of Salt Hydrolysis," *J. Pendidik. MIPA*, vol. 23, no. April, pp. 244–255, 2022.

[16] A. D. Febyanti, S. Sidauruk, and A. H. Fatah, "Kesulitan Siswa Kelas XII MIA SMA Negeri Di Kota Palangka Raya Tahun Ajaran 2018/2019 Dalam Memahami Konsep Sel Elektrolisis Yang Ditelusuri Menggunakan Instrumen Two Tier Multiple Choiche," *J. Ilm. Kanderang Tingang*, vol. 11, no. 1, pp. 1–13, 2020, doi: https://doi.org/10.37304/jikt.v11i1.68.

[17] W. T. Al-ani, "Blended Learning Approach Using Moodle and Student ' s Achievement at Sultan Qaboos University in Oman," vol. 2, no. 3, 2013, doi: 10.5539/jel.v2n3p96.

[18] T. Plomp, "Educational Design Research: An Introduction," in *Educational Design Research Part A: An Introduction*, T. Plomp and N. Nieveen, Eds. Enschede: Netherlands Institute for Curriculum Development (SLO), 2013, pp. 11–50.

[19] N. Nieveen and E. Folmer, "Formative Evaluation in Educational Design Research," in *Educational Design Research Part A: An introduction*, T. Plomp and N. Nieveen, Eds. Ensched: SLO, 2013, pp. 153–169.

[20] A. Powell *et al.*, *Blending Learning : The Evolution of Online and Face-to-Face Education from 2008 – 2015*, no. July. Vienna: iNACOL, 2015.

[21] T. L. Brown *et al.*, *Chemistry The Central Science*, 14th ed. New York: Pearson, 2018.

[22] N. J. Tro, *Principles of Chemistry: A Molecular Approach*, 3rd ed. Pearson, 2016.

[23] K. Timberlake and W. Timberlake, *Basic Chemistry*, 6th ed. New York: Pearson Education, 2019.

[24] L. R. Aiken, "Three Coefficients For Analyzing The Reliability And Validity Of Ratings," *Educ. Psychol. Meas.*, vol. 45, pp. 131–141, 1985.