J. Pijar MIPA, Vol. 17 No.3, May 2022: 361-368 ISSN 1907-1744 (Print)
DOI: 10.29303/jpm.v17i3.3476 ISSN 2460-1500 (Online)

FLIPPED CLASSROOM LEARNING SYSTEM BASED ON GUIDED INQUIRY USING MOODLE ON ACID-BASE SOLUTIONS

Vira Gita Fani and Mawardi Mawardi*
Chemistry Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Indonesia
*Email: mawardianwar@fmipa.unp.ac.id

Received: April 16, 2022. Accepted: May 1, 2022. Published: May 31, 2022

Abstract: This study aims to develop a digital learning system that can be used during a pandemic and meet the demands of the industrial revolution 4.0 by determining its validity and practicality. The type of research in this research is Educational Design Research (EDR) using the Plomp development model. The research was conducted at a public high school (SMA Negeri 8 Padang) in the academic year 2021/2022. Data was collected using a validated questionnaire and a practicality questionnaire. The results showed that the learning system obtained average content validity of 0.87 with a valid category and average media validity of 0.88 with a valid category. The results of the practicality test for students have average practicality of 90% in a very practical category and average practicality for teachers of 92% in a very practical category. Overall, the research results show that developing a flipped classroom learning system based on guided inquiry using Moodle on acid-base solution material is valid and practical.

Keywords: *Flipped Classroom, Guided Inquiry, Moodle, Acid-Base Solution.*

INTRODUCTION

The COVID-19 pandemic has had an impact on the world of education. One of the policies issued by the Indonesian government to prevent the spread of the Covid-19 virus is to shift the face-to-face learning system to a technology-based distance learning system (online learning). The implementation of online learning impacts the learning process because online learning is carried out by utilizing technology networks [1]. It encourages educators to understand and use technology in the learning process to create a dynamic learning environment. The online/digital learning system is part of the learning demands in the era of the industrial revolution 4.0.

Industrial revolution 4.0 has disrupted various fields of life, one of which is education [2]. Education is one of the main pillars for the progress of a nation that must adapt to technological developments [3]. The result of technology will open a new paradigm in learning methods and automatically shift traditional learning methods [4]. Education in the industrial revolution 4.0 era emphasizes the 4 C skills: creativity, communication, collaboration, and critical thinking. Critical thinking is a characteristic of education that needs to be developed digitally and requires active student involvement [5]. One of the learning models that can actively involve students in learning is the blended learning model [4].

Blended learning is a learning model that can combine face-to-face teaching methods with computer-assisted teaching methods, both offline and online [6]. The application of the blended learning model can improve the learning experience of students, which allows them to be actively involved during the learning process, both classroom learning and distance learning using technology [7]. Blended learning is classified into several models: rotation model, flex model, self-blend model, and enriched-virtual model. The rotation model consists of four submodels: station rotation, lab rotation, flipped classroom, and individual rotation [8].

The flipped classroom is one part of the blended learning model, which is developing rapidly in education [9]. Flipped classroom (reverse class) is a learning model in which students receive subject matter at home through electronic media, then the time in class is used for direct practical activities. The flipped classroom is learning that focuses on students and is very dependent on students' independent learning abilities by incorporating technology into the learning process [10]. The rotation model is suitable for use in learning because this model can be adapted to the policies of educators and allows students to do learning anytime and anywhere [8].

The learning demands of the 2013 curriculum are learner-centered learning with a scientific approach [11]. The 2013 curriculum demands and trains students in critical thinking, creativity, collaboration, and communication [12]. In the 2013 curriculum, there are four learning models with a scientific approach, one of which is inquiry learning. Inquiry learning has four levels: confirmation inquiry, structured inquiry, guided inquiry, and open inquiry [13].

Guided inquiry is an inquiry that is one level more complex than structured inquiry. In guided inquiry, the teacher asks questions. Then students investigate by determining the procedure (method) of the questions given so that at the end of the investigation, students can make conclusions [13]. In guided inquiry learning, the teacher is not a source of

knowledge, but the teacher is placed as a facilitator and motivator [14]. The steps of guided inquiry learning start from the orientation, exploration and concept formation, application, and closing stages [15]. Inquiry learning with the type of guided inquiry is suitable for use in the learning process because guided inquiry requires students to observe, ask, conclude, associate, and communicate and can guide students in finding concepts by answering key questions [16].

Applying the guided inquiry learning model in teaching materials on several chemistry topics showed positive results, such as developing Guided Inquiry-Based Worksheets with Classroom and Laboratory Activities on Chemical Bonding Topics showing valid, practical, and effective results in the learning process [17]. In addition, other research on applying the guided inquiry learning model to the Effectiveness of Guided Inquiry-Based Worksheets on Acid-Base Materials has shown beneficial results for students who familiarize themselves with HOTS due to 21st-century learning [18].

Applying flipped classrooms into the learning process and combining it with a guided inquiry learning model can be a solution for education during a pandemic and demands of the industrial revolution 4.0 [19]. The application of the Flipped Guided Inquiry Learning (FGIL) model as a model for digital learning during the Covid-19 pandemic can be applied in chemistry learning. It includes reaction rate material [20], chemical equilibrium material [21], and acid-base solution material [22]. It was developed using the Learning Management System (LMS), Edmodo, and showed valid and practical results. Besides Edmodo, learning systems can also be developed using Moodle [23].

Moodle is an open-source LMS that can be used to deliver web-based online learning materials and multimedia resources [24]. This learning system will be applied to the acid-base solutions topic to see the application in chemistry. Acid-base solution material is one of the chemistry learning materials studied in class XI even semester. Acid-base solution material is one of the materials that is abstract and tends to be difficult for students to understand.

RESEARCH METHODS

This research type is educational design research (EDR) using the Plomp development model developed by Tjered Plomp. This development model consists of preliminary research, prototyping, and assessment stages [25]. The research subjects in this study were content validators, media validators, chemistry teachers, and class XI students at a public high school, SMA Negeri 8 Padang, Indonesia.

Procedure

This research begins by conducting preliminary research, which systematically consists of various analytical activities, such as needs and context analysis, literature review, and conceptual development framework [25].

Table 1. Stages of Developing Flipped Classroom Learning System Based On Guided Inquiry Using Moodle On Acid-Base Solutions Material

Preliminary Research		1. Conduct a literature study of relevant studies. 2. We conducted structured interviews with three chemistry teachers in 3 different schools.
Prototyping	Prototype I	1. Replacing the conventional Moodle display with a more attractive appearance. 2. Design of flipped classroom learning system based on guided inquiry using Moodle on acid-base solution material. **Revision**
	Prototype II	Self-evaluation **Revision**
	Prototype III	1. Expert review 1) Content validation was carried out by six validators. 2) Media validation was carried out by six validators. 2. One-to-one evaluation, conducted on three students of class XI SMAN 8 Padang **Revision**
	Prototype IV	Small group evaluation 1. The practicality of 15 students of class XI SMAN 8 Padang. 2. The practicality of three high school chemistry teachers. **Revision**

Preliminary research is a primary research stage where problems are identified. The researcher conducted literature of relevant studies and structured interviews with chemistry teachers at SMA Negeri 7 Padang, SMA Negeri 8 Padang, and SMA Negeri 10 Padang. In the prototyping stage, the researcher develops the product by conducting a formative evaluation developed by Tessmer. The evaluation

consists of self-evaluation, expert review, one-to-one evaluation, and small group. The assessment phase is the final stage of research that aims to conclude whether the product developed can overcome the problems that have been identified. In this study, the researchers limited the research to the small group stage at the prototyping stage. The next researcher will carry out the assessment phase.

Instruments

The final product of this research is a flipped classroom learning system based on guided inquiry using Moodle on acid-base solution material, which a valid and practical. The instruments used in this study were the validation questionnaire and practicality questionnaire. The validation questionnaire used content validation and media validation. The content validation questionnaire contains 24 statements with four assessment aspects: content feasibility, presentation, graphic, and linguistic. The media validation questionnaire contains 18 statements with two assessment aspects consisting of visual aspects and ease of use aspects. The practicality questionnaire contains 16 statements with three assessment aspects: ease of use, time efficiency, and benefits.

Data Analysis

Data validity analysis was carried out using Aiken's V formula. The Aiken's V formula is as follows.

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

Information:
s : r - lo
lo : lowest validity
c : highest validity
r : value given by validator
n : number of validators

The range of the V index is 0 to 1. The validity can be accepted if the V index value meets the minimum value of validity based on the validity coefficient. This study uses six validators. In this case, the common value of V is 0.79 [26]. The level of validity of the developed learning system will be seen after being converted to the categories in table 2.

Table 2. Validity level conversion

Interval	Validity
V < 0,79	Valid
V ≥ 0,79	Invalid

The practicality test determines whether the developed learning system meets the practicality criteria. Practical data analysis was carried out using the following modified practicality percentage formula from Purwanto.

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

Information:
NP : The percent value sought
R : Score obtained
SM : Maximum ideal score
100 : Fixed number

The level of practicality of the guided inquiry-based flipped classroom learning system will be seen after being converted to categories such as the table below.

Table 3. Practicality level conversion

Value	Practicality
86% - 100%	Very practical
76% - 85%	Quite practical
60% - 75%	Practical
55% - 59%	Less practical
≤ 54%	Not practical

RESULTS AND DISCUSSION

Preliminary Research

The purpose of conducting preliminary research is to identify problems in the field and get an overview of the product's characteristics that will be developed to be a solution to the issues found. In the needs analysis, the activities carried out were conducting literature-relevant studies and conducting structured interviews with three chemistry teachers at SMA Negeri 7 Padang, SMA Negeri 8 Padang, and SMA Negeri 10 Padang.

Based on the data collection results by conducting literature of relevant studies, information was obtained that the demands of learning the 2013 curriculum are student-centered learning. The emergence of the Covid-19 pandemic at the end of 2019 significantly impacted life, especially in education. The biggest impact of the Covid-19 pandemic on education is the transition from the face-to-face learning system to a technology-based distance learning system (online learning) [27].

Based on interviews with chemistry teachers at three schools in Padang, several problems were found: (1) During the current pandemic, educators have not been able to fully implement student-centered learning, (2) The policy of reducing lesson hours has resulted in more learning time. Shorter than usual to optimize learning, the teacher only provides essential material, (3) The use of LMS that is not optimal makes it difficult for teachers to design learning systems and build communication between educators and students.

Based on the results of the literature review that has been carried out, the above problems can be overcome by implementing a combination learning system between the flipped classroom and the guided inquiry learning model, which is implemented using Moodle. The flipped classroom is the most applicable blended learning model for online learning [28]. The guided inquiry learning model is a series of

learning activities that involve students in active learning, thinking critically, and seeking and finding solutions to problems independently [29]. Moodle is a learning management system (LMS) that supports the implementation of e-learning. It is open-source software because it has interactive features such as assignments, quizzes, communication, collaboration, and the central part that can upload various formats of learning materials [24].

Prototyping Stage

Prototype I

In this stage, the researchers developed a learning system designed using the Moodle learning management system (LMS) through the website https://viraffstudy.club. The learning system is created using a guided inquiry learning model with learning time settings adjusted to the synchronous and asynchronous stages of the flipped classroom model. The initial design of the learning system was carried out by replacing the conventional Moodle display with a more attractive appearance so that it could easily be used as a virtual classroom. Display content in Moodle can be seen in Figure 1.

Figure 1 shows the display of content in Moodle. The introductory part of the learning activities begins with the opening remarks and the delivery of the title of the subject matter of learning. Asynchronous activities consist of orientation, exploration and concept formation, and application stages. Synchronous activities consist of closing). Attendance is performed on each asynchronous and synchronous activity.

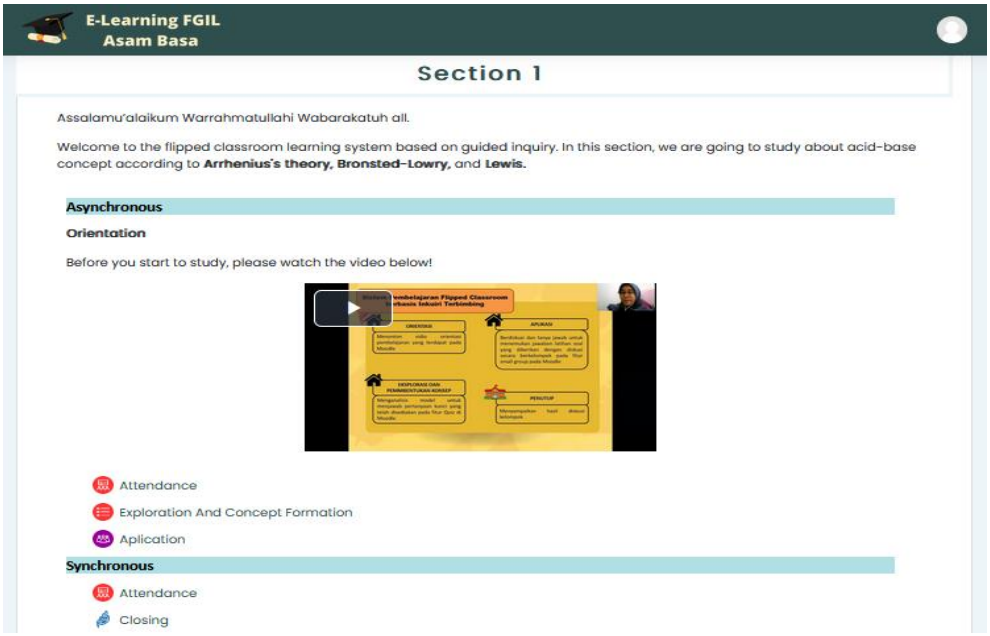

Figure 1. Content display on Moodle

The content display is structured based on the guided inquiry syntax. The orientation stage is presented in the form of a video uploaded on the Course Moodle homepage. In the exploration and concept formation stage, the teacher offers models (pictures, tables, data) and key questions that guide students in finding concepts [30]. The exploration and concept formation stages are carried out using the Quiz feature. The characteristics of inquiry learning involve students in active learning that emphasizes questions, data analysis, and critical thinking [13]. An example of the model used in the exploration and concept formation stage can be seen in Figure 3.

Students work on practice questions carried out in groups on the Forum feature at the application stage. The closing stage can be done using the Jitsi feature (virtual synchronous) or done face to face in class (live synchronous).

According to the flipped classroom model, the guided inquiry syntax is structured in two learning conditions, namely synchronous and asynchronous. The orientation, exploration and concept formation, and application stages are carried out asynchronously, while the closing stages are carried out synchronously. Combining asynchronous and synchronous learning can increase students' motivation and interest in learning to improve learning outcomes [7]. The guided inquiry-based flipped classroom model cycle can be seen in Figure 4.

.

ISSN 1907-1744 (Print)
ISSN 2460-1500 (Online)

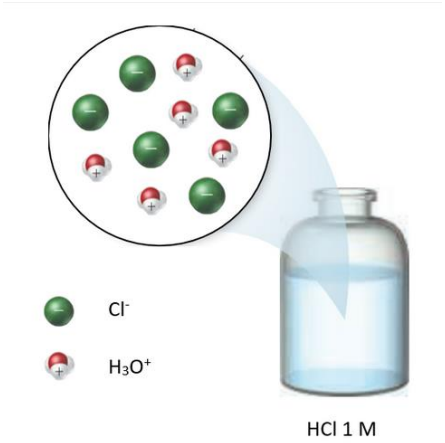

Figure 3. Example of the model used in the exploration and concept formation stage

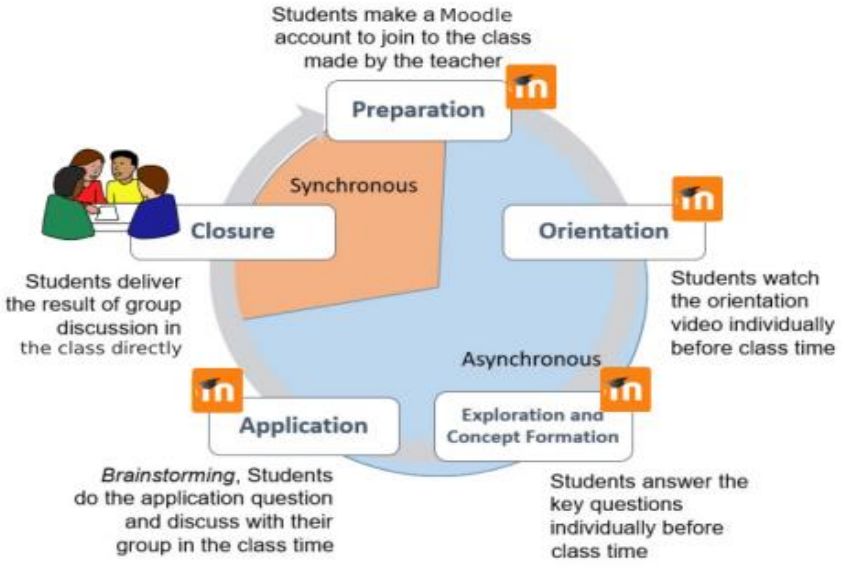

Figure 4. The Cycle of Guided Inquiry-Based Flipped Classroom Model [23]

Prototype II

The results of the prototype I that have been developed are then evaluated (formative evaluation) through self-evaluation. The instrument used is a checklist. The aim is to find out the completeness of the design components developed previously.

Prototype III

The prototype II developed is then evaluated through expert review by six content validators and six media validators and individual evaluation (one-to-one evaluation) by three students to get a valid development product. The results of the content validity analysis are shown in Figure 4.

Overall, based on the assessment results of 6 validators on the product, the average value of the Aikens V index is 0.87. Based on table 2, content validation is included in the valid category. Thus, the learning system developed can be declared content valid. The results of the media validity analysis are shown in Figure 6.

Overall, based on the assessment results of six media validators on the product, the average value of the Aiken V index is 0.88. Based on table 2, media validation is included in the valid category. Thus the learning system developed is declared media valid.

Prototype II, which has been valid in content and media, is then revised again based on suggestions and inputs given by experts before being tested in one-to-one evaluations. A one-on-one test was conducted on three students of class XI SMA Negeri 8 Padang with different genders and ability levels so that the selected sample could represent the target population. Based on the results of the one-to-one evaluation, it is shown that the learning system developed has a clear display, clear orientation video sound, easy-to-understand language, clear instructions, and easy-to-understand models and key questions.

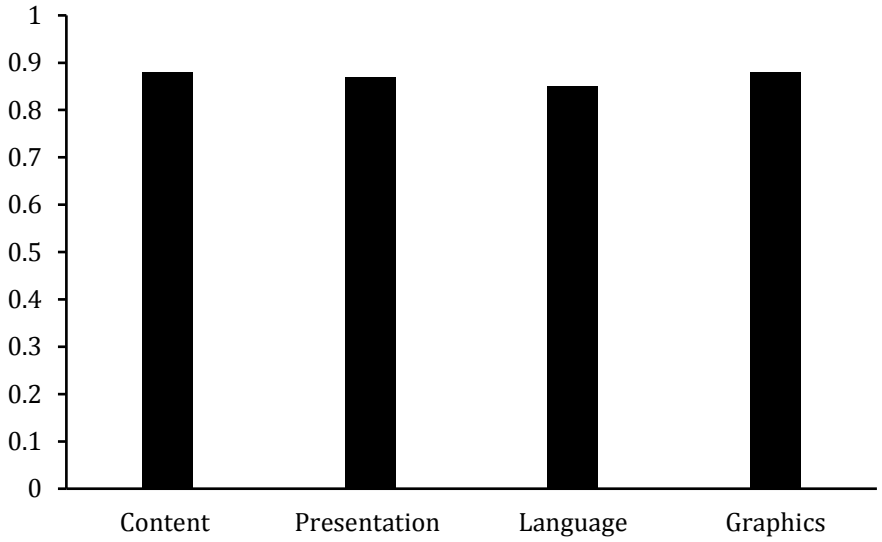

Figure 5. Content validation results

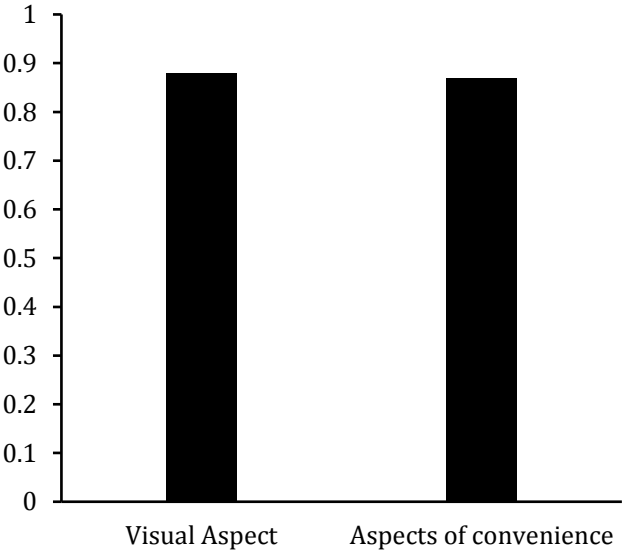

Figure 6. Media validation results

Prototype IV

The development product that has been declared valid is then evaluated in the small group evaluation. The samples used in this evaluation were 15 students of class XI SMAN 8 Padang and three chemistry teachers. The results of the practical analysis of students are shown in Figure 7.

Based on Figure 6, the average value of the percentage of small group practicality tests on students is 90%. At the same time, the average value of the rate of small group practicality tests on teachers is 92%. Based on table 3, the practicality of chemistry students and teachers is included in the very practical category.

The results of the practicality test for students and teachers illustrate that the presentation of the material and the model used are easy to understand. The key questions given can lead students to find and understand the concept of an acid-base solution. Thus the learning system developed is declared practical.

The guided inquiry syntaxes contained in each learning activity can help train students' critical thinking skills and independent learning abilities. Systematics consists of learning based on synchronous and asynchronous stages of the flipped classroom providing good time efficiency in learning so that the learning process can run more optimally. The learning process is made more accessible by the features in Moodle.

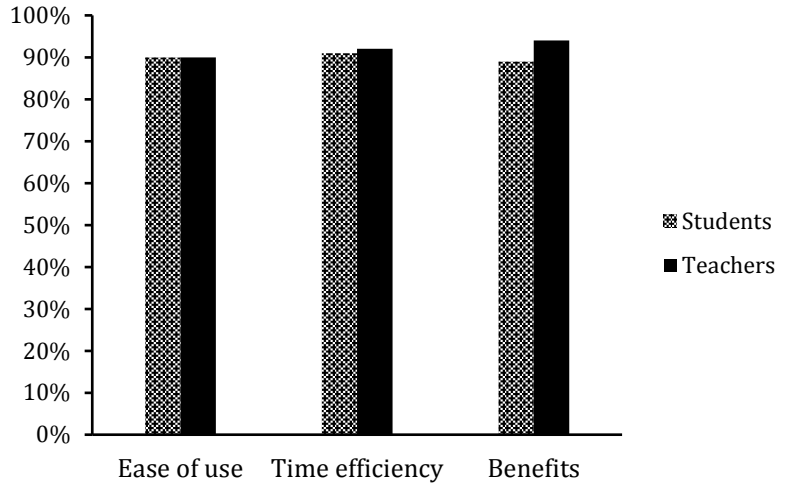

Figure 7. Small-Group Practical Results

CONCLUSION

The results showed that the learning system obtained average content validity of 0.87 with a valid category and average media validity of 0.88 with a valid category. The results of the practicality test for students have average practicality of 90% in a very practical category and average practicality for teachers of 92% in a very practical category. Overall, the research results show that developing a flipped classroom learning system based on guided inquiry using Moodle on acid-base solution material is valid and practical.

ACKNOWLEDGEMENTS

This research cannot be separated from the assistance of various parties, either directly or indirectly. In this opportunity, the researcher would like to express his gratitude to:

1. Mr. Dr. Mawardi, M.Si as the supervising lecturer.
2. Mrs. Guspatni, S.Pd, M.A., Mrs. Okta Suryani, M.Sc, Ph.D, Mrs. Trisna Kumala Sari, M.Si, Ph.D, Mr. Hary Sanjaya, M.Si, Mr. Fadhli Ranuharja, S. Pd, M.Pd.T, and Mr. Bayu Ramadhani Fajri, S. St., M. Ds, as content validators and media validators.
3. Mrs. Dra. Asra, M.Pd, Mrs. Elvi Yanti, S.Pd, and Mrs. Fitrianis, S.Pd as chemistry teachers and content validators.
4. Mr. Zahroni, M.Pd as Principal of SMA Negeri 8, has given research permission to researchers.
5. Class XI SMA Negeri 8 students have helped researchers carry out research.

REFERENCES

[1] Dewi, W. A. F. (2020). Dampak COVID-19 terhadap Implementasi Pembelajaran Daring di Sekolah Dasar. Edukatif J. Ilmu Pendidik. 2(1), 55–61

[2] Afrianto. (2018). Being a Professional Teacher in the Era of Industrial Revolution 4.0: Opportunities, Challenges and Strategies for Innovative Classroom Practices. English Lang. Teach. 2(1), 1–13

[3] Dito, S. B. and Pujiastuti, H. (2021). Dampak Revolusi Industri 4.0 Pada Sektor Pendidikan: Kajian Literatur Mengenai Digital Learning Pada Pendidikan Dasar dan Menengah. J. Sains dan Edukasi Sains. 4(2), 59–65.

[4] Heriyanto, A. S., Satori, D. Komariah, A. Character education in the area of industrial revolution 4.0 and its relevance to the high school learning transformation process. 24(5), 327–340.

[5] Facione, P. A. (2011). Critical Thinking : What It Is and Why It Counts. Insight assessment, 1–28.

[6] Ihsan, M. S., & Jannah, S. W. (2021). Development of interactive multimedia based on blended learning to improve student science literacy during the covid-19 pandemic. Jurnal Pijar Mipa, 16(4), 438-441.

[7] Oktaria, S. D., Asri, B, & R. Eko. (2020). Model Blended Learning Berbasis Moodle. Bengkulu:

[8] Watson, J., Powell, A., Staley, P., Patrick, S., Horn, M., Fetzer, L., Hibbard, L., Oglesby, J., Verma, S., Education, M., C, T. O. C.-I. N. B., Kuehn, B. L., Ed, D., Archibald, D., Barbour, M. K., Leary, H., Wilson, E. V., & Ostashewski, N. (2015). Blending Learning: The Evoluation of Online and Face-to-Face Education from 2008-2015. In iNACOL, The International Association for K–12 Online Learning

[9] Aris, S. R. S., Salleh, M. F. M., & Ismail, M. H. (2020). Guided Cooperative Flipped Classroom Approach in Learning Molecular Orbital Theory. International Journal of Academic Research in Business and Social Sciences, 10(14), 200–212

[10] H. Syakdiyah, B. Wibawa, and Z. Syahrial,

"Flipped Classroom Learning Innovation as an Attempt to Strengthen Competence and Competitiveness of Students in the 4.0 Industrial Revolution Era," Form. J. Ilm. Pendidik. MIPA, vol. 9, no. 4, pp. 267–280, 2020, doi: 10.30998/formatif.v9i4.2929.

[11] Permendikbud, "Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 36 Tahun 2018 Tentang Perubahan Atas Peraturan Menteri Pendidikan dan Kebudayaan Nomor 59 Tahun 2014 Tentang Kurikulum 2013 SMA/MA," jdih.kemdikbud.co.id, 2018.

[12] Dotimineli, D. & Mawardi, M. (2021). Development of STEM Integrated PBL-Based Student Worksheets in Energetic Materials of First-Year Students. J. Phys. Conf. Ser. 1788(1)

[13] Banchi, H., & Bell, R. (2008). The Many Levels of Inquiry-NSTA-article. In Science and Children (pp. 26–29).

[14] Irham, S. M. (2017). Pengembangan Berbasis Inkuiri Terpandu Lembar Kerja Sifat Koligatif Penyelesaian untuk Pembelajaran Kimia. 57(ICMSed 2016), 38–42.

[15] Hanson, D. M. (2005). Designing Process-Oriented Guided-Inquiry Activities. In Pacific Crest.

[16] Damaianti, O., Mawardi, M., & Oktavia, B. (2019). Development of Guided Inquiry-based Worksheets on Colloidal Material for Chemistry Learning Grade XI in Senior High School. International Jurnal of Progressive Sciences and Technologies (IJIPSAT), 14(1), 13–19.

[17] Zammiluni, Z., Ulianas, A., & Mawardi, M. (2018). Development of Guided Inquiry Based Work Sheet with Class and Laboratory Activity on Chemical Bonding Topic in Senior High School. International Journal of Chemistry Education Research, 2(2), 1–7.

[18] Mawardi, M. Rusiani, J. A. F. and Yani, F. H. Effectiveness of student worksheets based guided inquiry on acid base material to improve students higher order thinking skill (HOTS). Journal of Physics: Conference vol. 1481 01208.

[19] Mawardi, M., Fitriza, Z., Suryani, O., Syafei, S. S., & Aumi, V. (2021). Penerapan Model Pembelajaran Flipped Classroom Berbasis Guided Inquiry (FGIL) Pada Pembelajaran Kimia SMA di Kabupaten Agam Sebagai Model Untuk Pembelajaran Digital di Masa Pandemi Covid 19. Pelita Eksakta, 4(2), 176–180.

[20] Ramadhansyah & Mawardi, M. (2021). Development Of Guided Inquiry-Based Flipped Classroom Learning System On Reaction Rate For 11th Grade Senior High School Students. Int. J. Progress. Sci. 27(2) 597–601.

[21] Ramadianti, U. S., & Mawardi, M. (2021). Development Model of Flipped-Guided Inquiry based Learning on Chemical Equilibrium for 11th Grade High School Students. International Journal of Progressive Sciences and Technologies (IJPSAT), 27(1), 23–28.

[22] Guswita, Z., & Mawardi, M. (2021). Validity of Flipped Classroom on Guided Inquiry in Acid and Base Solution. International Journal of Progressive Sciences and Technologies (IJPSAT), 28(1), 124–127.

[23] Ismail, I. A., & Mawardi, M. (2021). Flipped Classroom Learning System Guided Inquiry On Thermochemical Materials For High School Students Class XI. International Journal of Progressive Sciences and Technologies (IJPSAT), 30(1), 280–287.

[24] Herman Dwi Surjono. (2013). Membangun Course E-learning Berbasis Moodle. Edisi Kedua. In UNY Press.

[25] Plomp, T., & Nieveen, N. (2007). An Introduction to Educational Design Research. Proceedings of the Seminar Conducted at the East China Normal University, Shanghai (PR China), November 23-26, 2007.

[26] Lewis. R. Aiken. (1985). Three Coefficients For Analyzing The Reliability And Validity Of Ratings. Educational and Psychological Measurement, 45, 131–141.

[27] Permendikbud. (2018). Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 36 Tahun 2018 Tentang Perubahan Atas Peraturan Menteri Pendidikan dan Kebudayaan Nomor 59 Tahun 2014 Tentang Kurikulum 2013 SMA/MA. Jdih.Kemdikbud.Co.Id.

[28] Anugrah, A., Ibrahim, N., & Sukardjo, M. (2020). How Flipped Classroom Helps the Learning in the Times of Covid-19 Era? JTP - Jurnal Teknologi Pendidikan, 22(3), 151–158.

[29] Aumi, V., & Mawardi, M. (2021). Validity And Practicity Of Flipped Guided Inquiry Based Learning (FGIL) Model In Chemical Kinetics For Year 1 Students. International Journal of Progressive Sciences and Technologies IJPSAT, 26(1), 142–147.

[30] Piawi, K., Kalmar Nizar, U., & Mawardi, M. (2018). Development of student worksheet based on guided inquiry with class activity and laboratory in thermochemistry material. 679–683.