

Development Of A Guided Inquiry-Based Flipped Classroom Learning System On Thermochemical Material

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Abstract— Due to the Covid-19 pandemic, learning activities are carried out online or *online*. In addition, the 2013 curriculum demands learner-centered learning. Therefore, it is necessary to conduct research that aims to develop a learning system *flipped classroom* guided inquiry based on Thermochemistry material and test the validity and practicality of the resulting learning system. The type of research is *Research and Development* (R&D) with the Plomp model stages, namely: (1) *preliminary research*, (2) *development or prototyping phase*, and (3) *assessment phase* (not carried out). The research data from the validation questionnaire were analyzed using the formula Aiken's *V*, while the practicality questionnaire data was analyzed by percentage. Based on the results of the study, the learning system developed was valid with an average value of 0.87 while the average value of media validity was 0.87 and the learning system was said to be very practical in its use with an average value of 88% from educators and students is 87%. From the tests that have been carried out, this learning system can be used as an alternative to the implementation of online learning.

Keywords— *Flipped Classroom, Guided Inquiry, Thermochemistry.*

I. INTRODUCTION

At the end of 2019, the covid-19 virus has emerged that has shaken the whole world. The impact of this pandemic is quite large; one of the impacts is on the education sector. According to Bao, W. (2020) educators and students as important actors in education are forced to make a fairly large transition that has never been done before, namely carrying out the learning process that is usually done in schools into an online learning process.

In this case, educators are required to innovate and adapt related to the use of available technology sharing to support the online learning process (1). online learning is a fairly effective way of carrying out the learning process even though teachers and students are in different places (2). One of the learning processes that can be carried out during this pandemic is using *blended learning*. Learning *blended learning* is learning that combines learning *synchronous* (performed at the same time) and learning *asynchronous* (can be done at a different time and place) (3).

One form of learning from *blended learning* is the *flipped classroom*. A *flipped classroom* is teaching called reverse class, namely learning that is done outside the classroom and learning that is carried out in the classroom (4). Several studies have been carried out related to classroom learning *flip speed*. A *flipped classroom* is a learning that can improve students' creative attitudes, responsibility, and skills in learning (5).

Referring to the 2013 curriculum, in the learning process it is very demanding that students become the center of learning and not

teachers. Therefore, in the implementation of the process of learning it is highly recommended to use a scientific approach or also called a scientific approach which is student-centered learning in acquiring knowledge, skill, and attitudes (6). One of the learning models that can be used in this study is the guided inquiry learning model. The guided inquiry learning process can make students accustomed to studying and solving problems, thinking critically, assuming, being responsible for achieving understanding independently, and can increase student activities, and make students actively involved in the learning process (7).

To support this guided inquiry-based flipped classroom learning activity, an LMS (Learning Management System) is needed in its implementation. The LMS that can be used in this study is Edmodo and Zoom Meeting. Edmodo is used for asynchronous activities and zoom meeting cloud is used for synchronous activities. Edmodo is an internet-based learning application developed as a learning platform that is used for interaction between students and teachers in various educational content, managing projects or assignments. Edmodo is designed as well as possible so that it can support the learning system (8). Furthermore, synchronous learning activities can be carried out using the zoom meeting cloud. Zoom meeting cloud is an application that can support the implementation of virtual face-to-face learning. Through the zoom application, educators and students can interact virtually at the same time even in different places. Zoom meeting and Edmodo are some of the Information and Communication Technologies (ICT) to adapt to the 4.0 revolution era. (9).

Based on the description above, the researcher wants to research the development of a guided inquiry-based flipped classroom learning system on thermochemical material. This learning system has not been widely applied in West Sumatra, especially in thermochemical material. The researcher hopes that this guided inquiry-based flipped classroom learning system can be used as a reference and can be applied to learning that aims to facilitate the implementation of online learning and maintain student-centered learning.

II. METODOLOGY

Research Development is a process of developing a product or making product improvements that already exist (10). The type of research used in this research is research and development (R&D). The development model used in this study is an adaptation of the development model developed by Tjeerd Plomp. The Plomp development model is divided into 3 stages, namely the *Preliminary Research, Development or Prototyping Phase*, and the *Assessment Phase* (11).

In this *Preliminary Research* stage, the stages carried out are needs and context analysis, literature study, and the formation of a conceptual framework. At the stage of needs and context analysis, it is done by analyzing common problems that occur in chemistry learning, especially on thermochemical material in the field. The next stage is the literature study. This stage is carried out to find and understand various sources related to the development that will be carried out, and to find solutions to existing problems through scientific journals. From the literature study that has been carried out, it can be seen that the transition to the online (online) distance teaching and learning process during the covid-19 virus pandemic can be done by implementing learning *flipped classroom* guided inquiry-based. After carrying out the literature study stage, the next stage is the formation of a conceptual framework to produce a guided inquiry-based learning system.

The next stage is to carry out the *Development or Prototyping Phase*. At this stage, the resulting product will be evaluated using formative evaluation. This formative evaluation has 3 stages, namely self-evaluation (*self-evaluation*), expert assessment (*expert review*), and test individual (*one to one*). The prototype formation stage produces four types of prototypes. The result of this prototype I am a product of a learning system *flipped classroom* guided inquiry-based. Then the next stage is to carry out *self-evaluation activities*, from this activity the results of the revision produce prototype II. To produce prototype III, the next stage is conducting expert *review activities* and *one-to-one evaluation activities* by interviewing three-class XI students. And the expert assessment was carried out by 6 validators consisting of 3 learning system validators and 3 learning system media validators. After being assessed and revised, prototype III is produced. At a later stage, trials carried out activities of small groups (*small groups*) which aims to determine the practicality of the guided inquiry-based learning system that has been generated. This small group trial was conducted on 3 educators and 15 students. The improvement results from this test resulted in a prototype IV.

III. RESULT AND DISCUSSION

Based on the research that has been done using the Research and Development (R&D) type of research, which uses the stages of the Plomp model. The stages of the Plomp model are limited to the prototype stage. This research was conducted at SMA N 8 Padang which resulted in a guided inquiry-based flipped classroom learning system on thermochemical material.

In this research, the first step is Preliminary Research. Preliminary Research is divided into three stages, namely needs and context analysis, literature study, and the formation of a conceptual framework. From the analysis that has been done, it can be seen that the impact of the pandemic Covid-19 in the field of education that the learning process is transferred to the learning process online. Many educators are still unable to adapt to online learning so that the learning process becomes less effective and especially in learning chemistry. One of the chemistry lessons that need to be understood is Thermochemistry. And from the literature review that has been done, it can be seen that online learning can be implemented in manner blended learning by combining the face-to-face learning process with learning activities using the internet. Learning blended learning is learning that combines learning synchronous (performed at the same time) and learning asynchronous (can be done at a different time and place) (12). Learning blended learning is one of the government's efforts to introduce the learning of the industrial revolution era 4.0 through System SPADA (Indonesia Online Learning System) (13, 14).

Blended learning consists of many models. One part of blended learning is the flipped classroom (15). A flipped classroom is teaching called reverse class, namely learning that is done outside the classroom and learning that is carried out in the classroom. Flipped classroom is a learning that can improve students' creative attitude, responsibility, and skills in learning. And to support the learning process in a scientific approach, an appropriate learning model is needed so that students can construct their knowledge. The learning model that can be used is guided inquiry. The syntax of guided inquiry is orientation, exploration and concept formation, application, and closing (16).

Based on the description above, the learning that can be used is the flipped classroom learning system based on guided inquiry. To be able to support this learning, one of the LMS (Learning Management System) that can be used is Edmodo in learning asynchronous and zoom meeting cloud in learning synchronous. In this learning system activity, learning is asynchronous carried out in orientation, exploration and concept formation, and application activities. For learning, it is synchronously carried out in the closing activity.

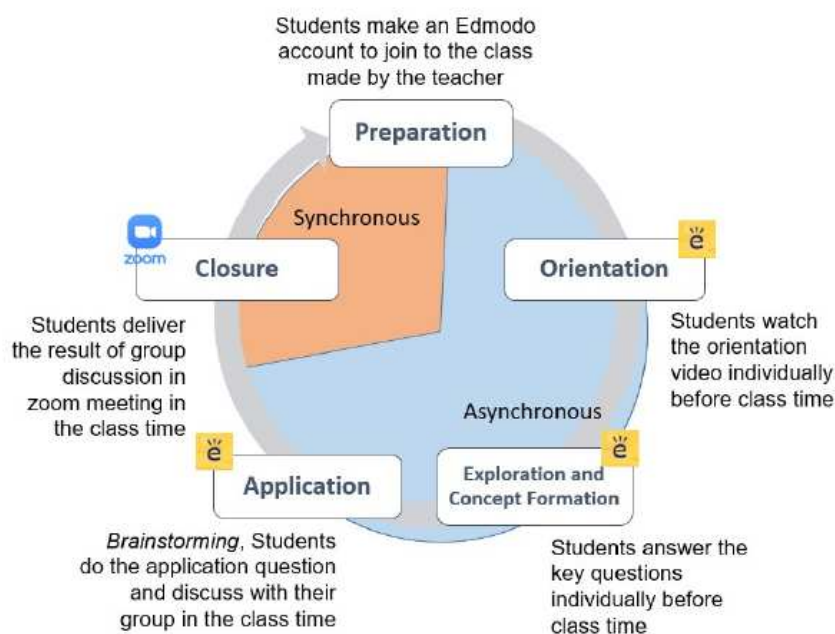


Figure 1. Stages of the-based flipped classroom learning system guided inquiry (17)

At the orientation stage, students are given an orientation video that has been entered into Edmodo. Orientation is the stage where students prepare to learn. The videos provided can contain explanations of motivation, initial knowledge, or learning objectives, given in the form of videos that can contain explanations of motivation, initial knowledge (18). The next stage is exploration and concept formation. At this exploration stage the activities carried out are: students are given a series of models or information and key questions that are already available (19) on Edmodo. Based on this model, key questions are given that can lead students to find concepts independently. At the application stage, students will be given practice questions that aim to strengthen and expand students' understanding of thermochemical material. At this stage, students are instructed to discuss in groups

the small group features that are available on Edmodo. At the closing stage, students will communicate the results they have obtained and educators will confirm the truth of the concepts that have been obtained. At the closing stage, students will communicate the results they have obtained and educators will confirm the truth of the concepts that have been obtained.

At the stage of forming the *prototyping phase*, four types of prototypes will be produced, namely prototype I, prototype II, prototype III, and prototype IV. The prototype I am a prototype resulting from the design and realization of the preliminary study stage (*preliminary research*). The results of the prototype I that have been made are formative tests in the form of self-evaluation. If there are deficiencies, improvements are made to produce prototype II. To improve the products that have been produced, formative evaluation activities are carried out with expert assessments. The assessment instrument for the learning system *flipped classroom* based on guided inquiry on the thermochemical material used is the validation sheet. The expert assessment was carried out by 6 validators consisting of 3 learning system validators and 3 learning system media validators. The value of the validity of the learning system obtained can be seen in table 1 and the value of the validity of the learning system media can be seen in table 2.

The validation results will be calculated using the Aiken's V formula, as follows:

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

Table 1. Learning System Validation Results

NO	Rated Aspect	Value	Category
1	Content Eligibility	0,91	Valid
2	Construction Eligibility	0,92	Valid
3	Language	0,94	Valid
4	graphics	0,92	Valid
Average		0,92	Valid

Table 2. Results of the Validation of Learning System Media

NO	Rated Aspect	Value	Category
1	Content Eligibility	0,91	Valid
2	Construction Eligibility	0,93	Valid
Average		0,92	Valid

Next, a one-to-one trial phase was carried out on three students. This stage aims to see the response of students to prototype II that has been produced. From the results of the interview, it is known that the learning system has a video display that can be seen clearly and easily in Edmodo. The language used in the video and key questions is clear and easy to understand. In addition, the model used in exploration and concept formation activities can assist in answering key questions. From the results of expert assessments and one-to-one trials, if necessary, improvements will be made which will produce prototype III.

At a later stage, trials carried out activities of small groups (*small groups*) which aims to determine the practicality of the guided inquiry-based learning system that has been generated. This small group trial was conducted on 3 educators and 15 students. The average practicality value by educators is 93% in the very practical category and the average practicality value by students is 87% in the very practical category. A product is said to be very practical if the result percentage is 86% to 100% (20).

For practicality results, it can be seen using the following formula:

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

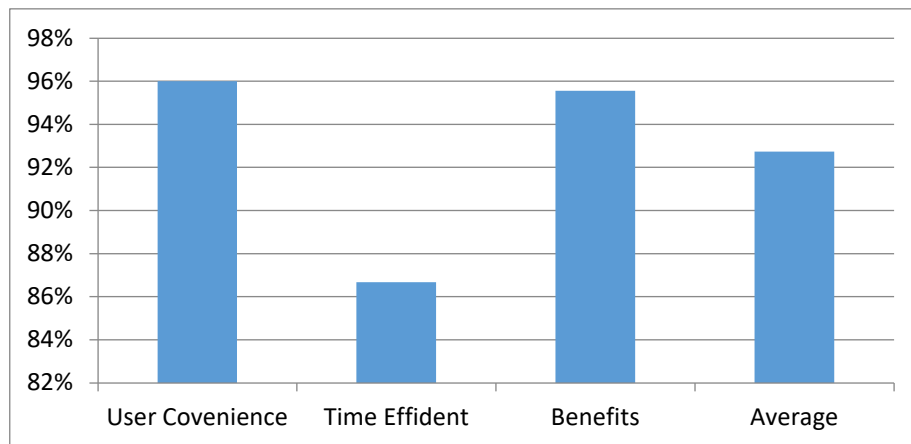


Figure 2. The test results practicalities Educators Learning System

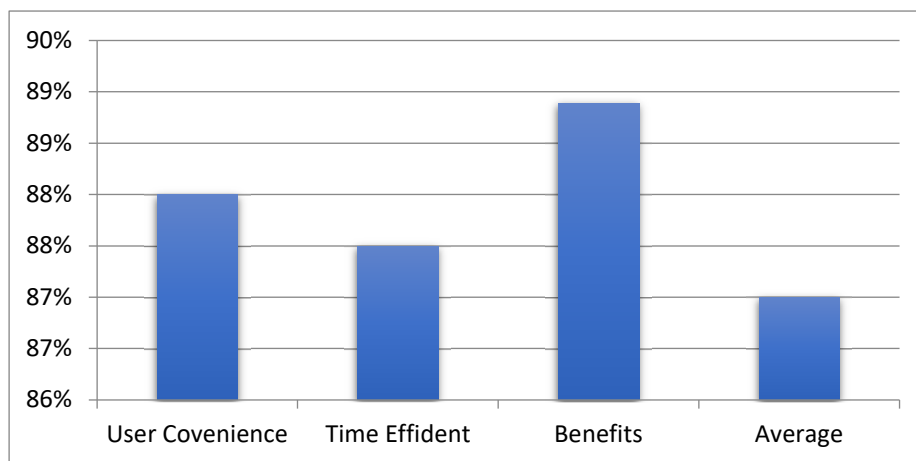


Figure 3. Practical Test Results of Student Learning System Validity

Seen in table 1 above, the average value of V for the learning system and learning media is 0.92 in the Valid category, respectively. A product is said to be valid if the value of V is greater than 0.8 then the component is included in the valid category (21). Aspects assessed in the guided inquiry-based flipped classroom learning system that have been validated are content feasibility, construction feasibility, language, and graphics. From the aspect of content feasibility, it can be seen that the average value of V is 0.91 with a valid category. That is, the orientation delivered through the video is in accordance with the material being taught, the models (pictures, tables, etc.) used for key questions are in accordance with the material being taught, scientifically correct, and can be explored to answer key questions. The key questions contained in the exploration stage (in Edmodo) can guide students to explore the model, the combination of the model with key questions can guide students to find concepts, and exercises and questions contained in Edmodo can strengthen the concept.

In terms of construction feasibility, this learning system has an average V of 0.92 in the valid category. This means that the learning design is based on a guided inquiry learning cycle, the Edmodo application that has been previously socialized makes it easier for students to access learning; The orientation video has a clear picture and sound quality; presentation of key questions accompanied by models (pictures, tables, etc.) to facilitate students in the exploration stage; key questions given ranging from simple to complex; The presentation of the application stage in the Edmodo small group feature allows students to discuss among

group members; and the closing stage which is carried out directly using the application, Zoom Meeting allows students to confirm the concepts obtained with the teacher directly.

In terms of language, this learning system has an average V value of 0.94 in the valid category. This means that the language used in the orientation video is valid, and the language used in the key questions is a good and correct language according to the Indonesian spelling rules. According to Wicaksono (2016), the use of language is one of the determinants of success in learning activities. In terms of graphics, this guided inquiry-based flipped classroom learning system obtained a V value of 0.83 in the valid category, indicating that the models (pictures, tables, etc.) presented in Edmodo can be observed clearly.

In table 2 above, the aspects assessed in the guided inquiry-based flipped classroom learning media that have been validated are the feasibility of the content and the feasibility of construction. The content feasibility aspect has an average value of V, which is 0.91. This means that the media used, namely the Edmodo application, has features that can support the implementation of learning online in a flipped classroom based on guided inquiry. These features include the feature small group for creating study groups, the featured quiz for entering models and key questions for the exploration and concept formation stage in Edmodo, the feature assignment that can be used to enter exercises in Edmodo, and so on.

In the practicality test shown in Figure 2 and Figure 3, the aspects assessed are ease of use, time efficiency, and benefits. The aspect of convenience relates to the ease of use of the learning system flipped classroom guided inquiry-based in learning online. From the aspect of user convenience based on the assessment of educators and students, it can be seen that the value of practicality is categorized as very practical. This means that both educators and students can easily use Edmodo in implementing learning flipped classroom guided inquiry-based. In the aspect of time efficiency, it is related to the use of learning time with a learning system flipped classroom guided inquiry-based. From the aspect of time efficiency based on the assessment of educators and students, it can be seen that the value of practicality is categorized as very practical. That is, the use of this guided inquiry-based learning system has very good time efficiency. While the benefits aspect relates to the benefits obtained through learning with a learning system flipped classroom guided inquiry-based. From the aspect of benefits based on the assessment of educators and students, it can be seen that the value of practicality is categorized as very practical.

IV. CONCLUSION

1. The learning system *flipped classroom* based on guided inquiry on thermochemical material for class XI that has been developed as a valid category with an average value of learning system validity that is 0.87 and the average value of the validity of the learning system media is 0.87 with a category valid.
2. Based on the assessment of the small group trial(*small group*) can be seen that the learning system *flipped classroom*-based on material thermochemical guided inquiry that has been developed to have a very high level of convenience with value - average for educators response is and to the response of the learner is.

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REFERENCES

- [1] Bao, W. (2020). covid-19 and online teaching in higher education : A case study of Peking University. March, 113–115. <https://doi.org/10.1002/hbe2.191>
- [2] Ahmed, S., Shehata, M., & Hassanien, M. (2020). Emerging Faculty Needs for Enhancing Student Engagement on a Virtual Platform. MedEdPublish, 1–5. <https://doi.org/https://doi.org/10.15694/mep.2020.000075.1>
- [3] Verawardina, U., Asnur, L., Lubis, A. L., & Hendriyani, Y. (2020). Reviewing Online Learning Facing the Covid-19 Outbreak. 12(3), 385–392
- [4] Chaeruman, U. A. (2013). Merancang Model Blended Learning Designing Blended Learning Model. Jurnal Teknodik, 17(4), 053. <https://doi.org/10.32550/teknodik.v17i4.577>

- [5] Watson, J., Powell, A., Staley, P., Patrick, S., Horn, M., Fetzner, 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., & Ostashevski, N. (2015). Teacher education and K-12 online learning. *iNACOL, The International Association for K-12 Online Learning*, July, 1–20. <http://files.eric.ed.gov/fulltext/ED560788.pdf>
- [6] Emparan, Radhiah S., Sabil & Kamarudin. (2020). Flipped Classroom : Penggunaan dan pelaksanaan di Malaysia dari tahun 2014-2019 (Analisis Meta). *International Social Science and Humanities Journal*. Volume 3 No. 4
- [7] Damayanti, H. N., & Utama, S. (2016). Efektivitas flipped classroom terhadap sikap dan ketrampilan belajar matematika di SMK Manajemen Pendidikan, 11(1), 2-7.
- [8] Kardena, H., & Mawardi, M. (2020). Development of Guided Inquiry Based Student Worksheet for First College Student. *International Journal of Scientific and Research Publications*, 10(10), 375–379. <https://doi.org/10.29322/IJSRP.10.10.2020.p10650>
- [9] Ekayati Rini. 2018. Implementasi metode *blended learning* berbasis Aplikasi edmodo. *Journal edutech*. Vol 4 No. 2
- [10] Nengsih, Z W., & Mawardi. 2021. Pengembangan Sistem Pembelajaran *Flipped Classroom* Berbasis Inkuiri Terbimbing pada Materi Hidrolisis Garam. *Edukasi*. Vol. 3 No. 4
- [11] Aumi, V., & Mawardi, M. (2021). *Validity And Practicity Of Flipped Guided Inquiry Based Learning (FGIL) Model In Chemical Kinetics For Year 1 Students*. 4, 142–147.
- [12] Sari, F., & Mawardi. 2021. *Development Model of Flipped-Guided Inquiry based Learning on Chemical Equilibrium for 11th Grade High School Students*. 4, 23 - 28
- [13] Ahmad, I. (2018). Proses pembelajaran digital dalam era revolusi industri 4.0. Direktorat Jenderal Pembelajaran dan Kemahasiswaan. Kemenristek Dikti.
- [14] Herpika, F., & Mawardi, M. (2021). Validity of the Flipped Classroom Learning System Based on Guided Inquiry on Molecular Forms Using Augmented Reality for Class X SMA/MA Students. *International Journal of Progressive Sciences and Technologies*, 27(1), 232-236.
- [15] Mawardi, & Asra. (2011). Inovasi dalam Pembelajaran Kimia, Suatu Tinjauan Teoritis. *Prosiding Seminar Nasional Kimia dan Pendidikan Kimia*, 244–260.
- [16] Hanson, D. M. (2005). Designing Process-Oriented Guided-Inquiry Activities. *Faculty Guidebook – A Comprehensive Tool for Improving Faculty Performance*, 1–6.
- [17] Kemdikbud. 2013. Permendikbud 65 tahun 2013 tentang Standar Proses Pendidikan Dasar dan Menengah. Jakarta: Kementerian Pendidikan dan Kebudayaan
- [18] Sudjana. 2002. Penilaian Hasil Proses Belajar Mengajar. Bandung. Remaja Rosdakarya
- [19] Plomp. (2013). Educational Design Research Educational Design Research. *Educational Design Research*, 1–206. <http://www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ815766>
- [20] Wicaksono, L. (2016). Bahasa Dalam Komunikasi Pembelajaran. *Jurnal Pembelajaran Prospektif*, 1(2), 9–19. <http://jurnal.untan.ac.id/index.php/lp3m%0Ahttp://jurnal.untan.ac.id/index.php/lp3m/article/download/19211/16053>
- [21] Purwanto, N. (2012). *Prinsip-Prinsip dan Teknik Evaluasi Pengajaran*. PT Remaja Rosdakarya.
- [22] Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian: Panduan Penelitian, Mahasiswa, dan Psikometrian* (pertama). Parama Publishing.