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Learning System with Digital Literacy Based on Guided Inquiry Integrated Flipped Classroom Using Discord Application on Colloid

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Abstract: This research aims to produce an integrated flipped classroom learning system based on guided inquiry using Discord application on colloid material for first year students using the Plomp development model developed by Tjeerd Plomp. The research instrument used a validation sheet filled in by 5 UNP chemistry lecturers, an interview sheet for assessment at the one-to-one evaluation stage which contained several questions with answers in the form of explanations from 3 students, a practicality sheet filled out by 9 students then content validity and constructs were analyzed using Aiken's V scale, and practicality was analyzed using practical percent. The results of the analysis of the content and construct validity data obtained were stated to be valid with a value of V = 0.84 and 0.91, as well as the results of the practicality test data analysis obtained a P value (%) of 93 in the very practical category. So that an integrated learning system is produced, flipped classroom based on guided inquiry using the Discord application on colloidal material which is used as an alternative method in the learning process in lectures.

Keywords: Colloid; Digital literacy; Discord application; Flipped classroom; Guided inquiry

Introduction

Indonesia is currently entering the era of revolution 4.0. This revolution is characterized by the fusion of technology and blurring the lines of physical, digital, and biological space. In this era of the industrial revolution 4.0, fewer and fewer activities are physically bound to geographic locations. This is because all human activities are converting from manual to digital (Sumartono & Huda, 2020). The relationship between the world of education and the industrial revolution 4.0. is that the world of education is required to keep up with rapidly developing technology and utilize information and communication technology as more and more sophisticated facilities to facilitate the learning process. In addition, Pranaja and Astuti in (Putriani & Hudaidah, 2021) suggest that it is hoped that with the use of information and communication technology, the learning mindset can shift from teacher centered to student centered.

Lukum (2019), argues that education in the era of the industrial revolution 4.0 is seen as the development of three major 21st century competencies, namely the competencies of thinking, acting and living in the world. Thinking competencies include critical thinking, creative thinking, and problem solving. Competencies of action include communication, collaboration, digital literacy and technological literacy. Meanwhile, competencies for living in the world include initiative, self-direction, global understanding and social responsibility. This era will induce an educational revolution into education 4.0 which demands fundamental changes in the learning process. This is in accordance with the demands of the Merdeka Learning curriculum - Merdeka Campus.

The learning process in the Merdeka Campus is one of the manifestations of student-centered learning which

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is very essential. Learning in the Merdeka Campus provides challenges and opportunities for the development of innovation, creativity, capacity, personality, and student needs, as well as developing independence in seeking and finding knowledge through the realities and dynamics of the field such as ability requirements, real problems, social interaction, collaboration, self-management, performance demands, targets and achievements. Through the Merdeka Belajar program that is well designed and implemented, students' hard skills and soft skills will be formed strongly (Kemdikbud, 2020). In addition, teachers are required to be able to create fun learning and apply the right learning model so that it is centered on students, one of which is by implementing blended learning (Indarta et al., 2022).

Blended learning combines face-to-face activities and computer-based learning either offline or online. This learning model is considered effective because it is able to minimize the shortcomings of each model so that students can benefit from both face-to-face and technology-based learning models. Learners can still communicate with teachers directly and on the other hand they also have the flexibility to access a variety of learning resources from the virtual world. Blended learning is the answer to the learning model that suits the characteristics of 21st century learners (Puspitarini, 2022).

Blended learning has four types of models that can be used in learning. One type of blended learning model is the rotation model. In this rotation model, student learning methods are rotated according to the teacher's schedule or discretion. The rotation model has four types of submodels, one of which is the flipped classroom (Herpika & Mawardi, 2021).

One way to implement a blended learning process is by using a flipped classroom learning system (Ninda & Mawardi, 2022). The flipped classroom learning system can help students to be more active in the learning process. Not only that, flipped classroom can improve students' cooperation when discussing in class. Students can also re-watch the learning video anytime and anywhere. Flipped Classroom encourages students to think and adjust students' learning styles by setting the pace of learning (Herpika & Mawardi, 2021).

One of the models that can apply the scientific approach is the Guided Inquiry model. Guided inquiry is a learning model that helps students understand and discover concepts based on their own understanding with prior knowledge (Hanson, 2013). Guided inquiry is a model that can increase student activeness in learning, encouraging students to actively participate in the learning process (Guswita & Mawardi, 2021). The syntax of inquiry learning starts from orientation, exploration, concept formation, application, and closing. The guided inquiry model has been proven to be able to make students more active in learning and have higher learning motivation so that the learning outcomes obtained also increase (Asra et al., 2016). This guided inquiry model can be applied to various chemical subject matter, one of which is colloidal material.

Colloids are one part of chemistry that plays an important role in various fields in everyday life. There are also characteristics in real life in the form of light beam scattering by colloidal particles and water purification techniques that implement colloidal properties in the form of adsorption and coagulation (Lestari et al., 2022). But not many students understand this because their understanding or mastery of the material is not optimal, so they need to actively learn independently to solve a more complex problem to explore understanding of the material.

Based on the results of interviews with 4 UNP Chemistry Lecturers that learning at Padang State University has used the independent campus independent learning curriculum and learning in general has taken a student centered learning approach, such as group discussions, applying case method and PjBL models during the learning process. Lecturers and students in general have used social media in their daily lives, such as WhatsApp and Youtube, but have not utilized it optimally in the learning process because they still do not know that social media applications are capable of running learning models and have many features so that they can support the learning process based on the learning model syntax, one example of a social media application is discord. The use of Discord in Indonesia as a learning media is still relatively small (Tjahjadi et al., 2021). One of them is in learning chemistry, especially in colloidal material. Therefore, this can be an opportunity to develop a chemistry learning media using social media to attract interest in learning and carry out student-oriented learning, especially in colloidal material.

Discord is one of the social media that was originally used by gamers to interact and communicate. However, it turns out that Discord has many features that can support the learning process so that it can be developed into learning media (Salim, 2021). Discord can be used as a medium in learning by creating material content in the form of text, images or videos on one server so that all the necessary educational content can be well structured and the necessary information can be found easily. Discord applications can be combined with other learning media, which makes this application flexible and user-friendly, offering a variety of potential advantages for use as a digital tool in educational environments (Odinokaya et al., 2021). Based on the

above background, it is necessary to design a learning system that supports Revolution 4.0 and is in line with the demands of the independent learning curriculum.

Method

The type of research used in this study is Educational Design Research (EDR). EDR is a research conducted to develop an integrated flipped classroom learning system based on guided inquiry using Discord application on colloid material for first-year students. The development model applied in the research uses the Plomp model design developed by Tjeerd Plomp. This model consists of three stages, namely: (1) Preliminary Research, (2) Development or Prototyping Phase, and (3) Assessment Phase (Plomp & Nieveen, 2013).

The evaluation contained in this development research is a formative evaluation, to be precise, namely the micro stage at the development and prototyping phase, and the semi-summative evaluation at the assessment phase. In the preliminary research stage, needs and context analysis, literature review, and developing a conceptual framework are conducted. The needs analysis aims to bring out and determine the basic problems faced by learners and teachers so that the development of a learning system is needed. At this stage, the evaluation criteria are emphasized on content validity.

Furthermore, in the development or prototyping stage, the design and construction/realization of the design that has been made and revised based on formative evaluation is carried out. Formative evaluation is grouped into several layers as shown in Figure 1.

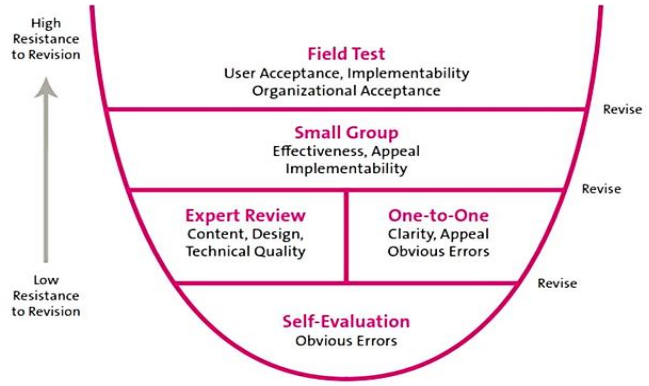

Figure 1. Formative Evaluation Layer (Source: Tessmer, 1993 in Plomp & Nieveen, 2013)

In the figure 1, it can be seen that there are many possible formative evaluation methods to choose from. Formative evaluation will produce prototypes I, II, III, and IV. The evaluation methods used in this research are, first, self-evaluation using a checklist of design characteristics or specifications. Second, expert review, providing assessment and suggestions for the developed product. Third, one to one evaluation, asking for feedback on the developed product through interviews. Fourth, small groups are carried out by giving practicality questionnaires to students. and finally the large group trial (Field Test), to measure the practicality of the products developed.

At the last stage, the Assessment phase is a semi-summative evaluation to conclude whether the developed materials can solve the specified problems. The evaluation criteria in the assessment phase are the level of practicality and efficiency (Plomp and Nieveen, 2013). The validity analysis technique uses Aiken's V scale, where at the end of processing a V value is obtained which is called the validator agreement index. Aiken's formula is as follows:

$$V = \frac{\sum s}{[n\,(c-1)]} \quad (1)$$

$$s = r - lo \quad (2)$$

Description:
s : r - Io
r : the value given by the validator
Io : lowest validity value
n : number of expert validators
c : highest validity score

Table 1. Classification Level of validity

Interval	Category
V ≥ 0.8	Valid
V < 0.8	Not valid

(Aiken, 1985)

The assessment of the practicality sheet was obtained from the student response questionnaire which was analyzed using the following formula.

$$p = \frac{f}{N} \text{ x } 100 \quad (3)$$

Description:
p = final score
f = score acquisition
N = maximum score

Table 2. Category of practicality level

Interval	Category
80 - 100	Very high
60 - 80	High
40 - 60	Moderately high
20 - 40	Low
0 - 20	Very low

(Gitnita et al., 2018)

Result and Discussion

The type of research used in this study is Educational Design Research (EDR). This research aims to produce an integrated flipped classroom learning system based on guided inquiry using Discord application on colloid material for first year students using the Plomp development model developed by Tjeerd Plomp. This model consists of three stages, namely: (1) Preliminary Research, (2) Development or Prototyping Phase, and (3) Assessment Phase (Plomp & Nieveen, 2013). Through the above stages, the following research results were obtained.

In the preliminary research stage, the needs analysis was carried out through a structured interview method, where before conducting an interview with the resource person, the interviewer must prepare the question format first. Based on the results of interviews with 4 UNP Chemistry Lecturers, Padang State University has used the independent campus independent learning curriculum and learning in general has taken a student centered learning approach. Lecturers and students in general for daily activities have used social media such as WhatsApp and Youtube but have not utilized it optimally in the learning process. Therefore, this can be an opportunity to develop a chemistry learning media using social media to attract interest in learning and carry out student-oriented learning. The flipped classroom learning system based on guided inquiry using discord application is designed to support more interactive learning for students.

Context analysis is carried out by analyzing Colloid material as selected material, analysis is carried out on university textbooks, and literature studies. Then an analysis of the general chemistry Semester Learning Plan (RPS) was also carried out to observe the scope of material studied in Colloid material. At the literature study stage, it is carried out to find and understand the sources and references related to the development activities to be carried out. Sources and references can be in the form of books, journals, and sources from the internet.

Based on research (Lo & Hew, 2017), in his research "A Critical Review Of Flipped Classroom Challenges In K-12 Education: Possible Solutions And Recommendations For Future Research" states that learning with a flipped classroom approach encourages active learning that requires students to solve problems with what they learned before learning in the classroom. Based on research Nurcahyo et al. (2020), in his research "Approaching the Concept of Independent Learning in Fine Arts Learning in the industrial era 4.0" learning using e-learning in the independent curriculum provides more opportunities for students to work flexibly wherever, whenever, and however. Theoretical matters can be discussed outside the classroom before learning takes place, so that when learning in the classroom takes place it is used as a consultation session and discusses something that is not yet known.

Mawardi et al. (2020), in their research on "Effective of student worksheet based guided inquiry on acid base material to improve students higher order thinking skills (HOTS)" stated that learning with learning using guided inquiry-based LKS is able to improve HOTS abilities in students, especially at the level of analyzing, and evaluating. Other related research states that learning with a flipped classroom system based on guided inquiry using a learning management system (LMS) type Moodle can be used as a solution for active and interactive learning in thermochemistry, chemical equilibrium, redox reactions and electrochemistry, and colloids (Insani et al., 2022; Ismail & Mawardi, 2021; Siregar & Mawardi, 2022; Sitanggang et al., 2022).

The framework was developed based on the results of the analysis conducted at the needs and context analysis stage, then supported by literature studies to produce a conceptual framework that describes a summary of the thinking process related to the reason for the research.

Furthermore, in the development or prototyping stage, this stage is carried out to produce a description of the product to be developed in the form of one learning cycle. The result of this design is a complete product that will be developed in the form of Prototype I. The product is designed based on guided inquiry integrated with flipped classroom for blended learning with the following cleaning cycle.

The learning process is implemented by combining two phases of learning, namely learning outside the classroom (Asynchronus) and learning in the classroom (Synchronus). Asynchronous learning is carried out in the preparation, orientation, and exploration and concept formation stages, while synchronous learning is carried out in the application and closing stages.

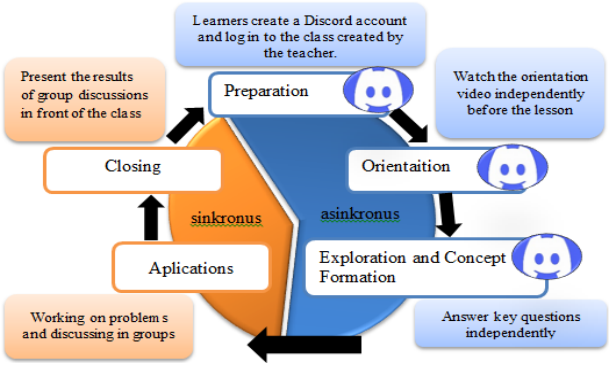

Figure 2. Learning cycle based on guided inquiry model integrated with flipped classroom using Discord application (Source: Aumi & Mawardi, 2021)

In the preparation stage, lecturers make preparations in terms of material and create servers, channels, and categories on Discord for colloid material. After that, the lecturer asked students to create Discord accounts, and students were also asked to join the colloid server according to the link provided by the lecturer. At this stage, the lecturer also made an orientation video that was in accordance with the material, then the video was uploaded to Discord. Learning is carried out with the stages / syntax of guided inquiry. The syntax/stages of the guided inquiry model are orientation, exploration and concept formation, application, and closing.

The learning process is implemented by combining two phases of learning, namely learning outside the classroom (Asynchronus) and learning in the classroom (Synchronus). Asynchronous learning is carried out in the preparation, orientation, and exploration and concept formation stages, while synchronous learning is carried out in the application and closing stages. The following is the interconnection between Guided inquiry, Discord and Flipped Classroom as shown in figure 3.

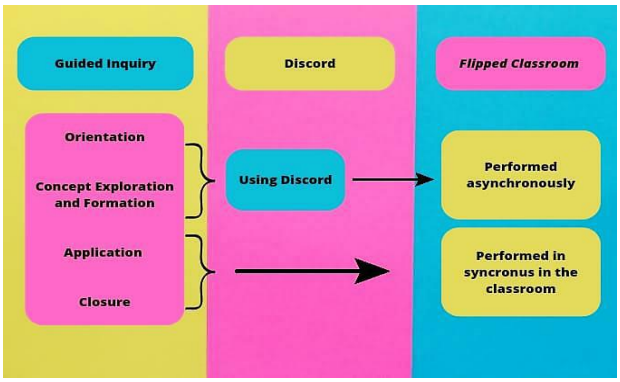

Figure 3. Interconnection between Guided inquiry, Discord and Flipped Classroom in FGIL

The first stage of orientation, at this stage is carried out asynchronously or remotely by students in their respective homes. At this stage the lecturer provides an orientation video on Discord. The following orientation video display is in the following figure 4.

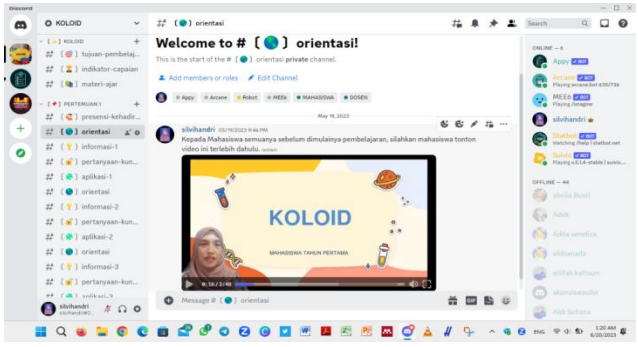

Figure 4. Orientation video view on Discord

The second stage is exploration and concept formation. At this stage, it is carried out asynchronously or remotely by students at their respective homes. Students are asked to answer key questions that have been provided in Discord. The following display example is in the following figure 5.

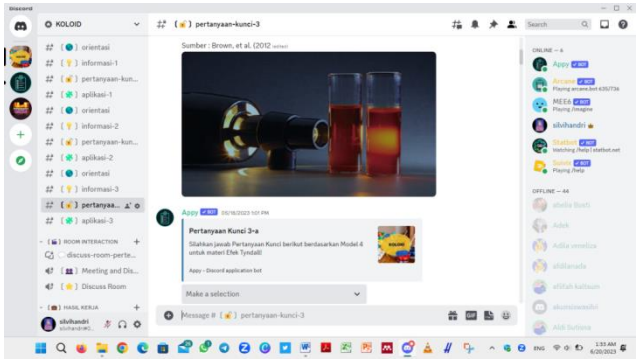

Figure 5. Display of exploration and concept formation syntax on Discord

The third stage is application. At this stage contains questions or practice questions related to the material being studied. The questions are done face-to-face on campus. So this stage can include asynchronous and synchronous in the flipped classroom system. In this application stage, it will prove whether students have understood the concept of the material that has been given so that learning objectives are achieved. Here is an example of the display in the figure 6.

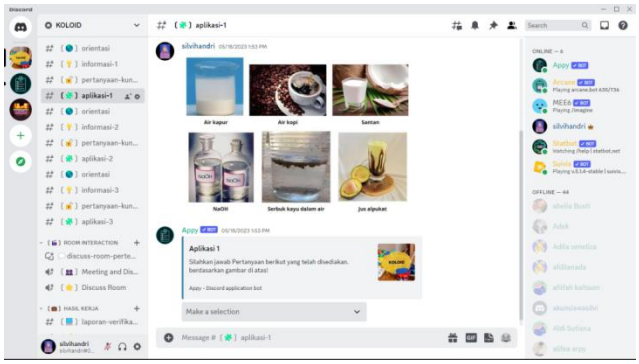

Figure 6. Application syntax view on Discord

The last stage is closing. This stage is carried out synchronously in the classroom during on-campus learning. At this stage the group representatives present the results of their discussion and explain the conclusions of the learning that has been done. The result of this design is a complete product that will be developed in the form of Prototype I.

Furthermore, revising the product on the results of the formative evaluation based on the deficiencies found, then prototype II was produced and the next step

was carried out, namely self evaluation. This stage is the product assessment stage carried out by the researcher using the checklist method during the recheck on prototype I.

At the expert review and One-to-One evaluation stage, formative evaluation was carried out in the form of one-on-one trials and expert assessment of prototype II. In the evaluation, the assessment is carried out by providing assessments and suggestions for products developed scientifically by 5 UNP Chemistry lecturers by paying attention to four aspects, namely aspects of the content component, presentation component, linguistic component, and graphic component for content validity and conducting an assessment for construct validity.

Data processing of content validation and construct validation using Aiken's V formula with 5 validators can be said to be valid if V ≥ 0.8 (Aiken, 1985). Based on the results of the validity analysis of all aspects of prototype II, it was found that content validity had an average validator agreement index, V = 0.91 with a valid category. The results of the product content validity test can be found in the following figure 7.

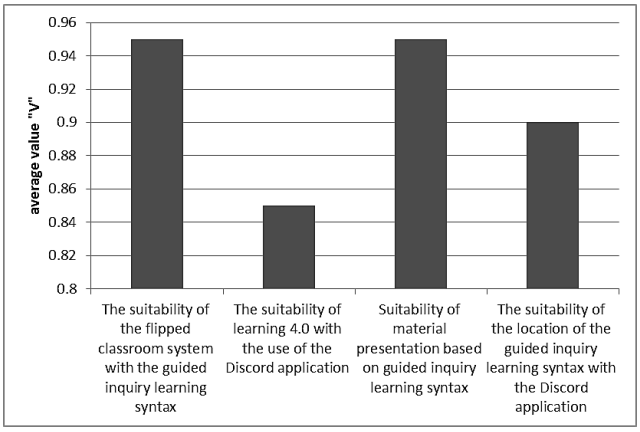

Figure 7. Content validity analysis results

Based on Figure 7, it can be concluded that the results of content validity regarding the suitability of the flipped classroom system with guided inquiry learning syntax obtained a V value of 0.95 with a valid category, the suitability of learning 4.0 with the use of Discord applications obtained a V value of 0.85 with a valid category, the suitability of presenting material based on guided inquiry learning syntax obtained a V value of 0.95 with a valid category, the suitability of the location of the guided inquiry learning syntax with the Discord application obtained a V value of 0.90 with a valid category. So that the average V for content validity is 0.91 with a valid category. While the results of the product construct validity analysis obtained the average value of the validator agreement index, V = 0.84 with the valid category. The results of the product construct validity test can be found in the following figure 8.

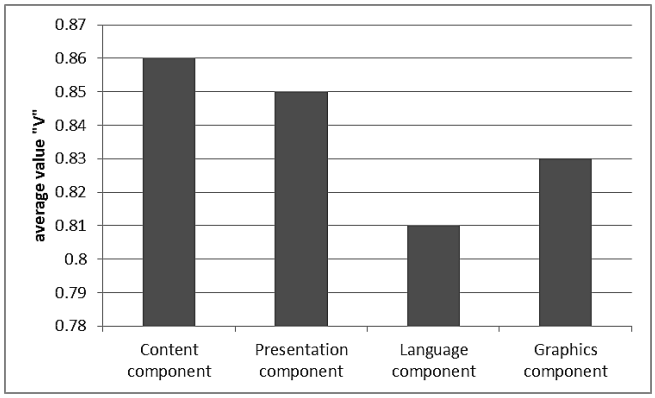

Figure 8. Construct validity analysis results

Based on Figure 8, it can be concluded that the validity in the content component aspect obtained a V value of 0.86 with a valid category, the presentation component aspect obtained a V value of 0.85 with a valid category, the linguistic component aspect obtained a V value of 0.81 with a valid category, and the graphic component aspect obtained a V value of 0.83 with a valid category. So that the average V for construct validity is 0.84 with a valid category.

At the same time, a one-to-one evaluation was carried out on 3 students from the class of 2019. Data was obtained from interviews with 3 students after using prototype II.

Based on the results of the interview, it was found that the appearance, images, information and sound of the orientation video on Discord were clear. The features and commands given at the learning stage are also clear and have been equipped with attractive logos. The language used in the orientation video and questions is easy for students to understand in understanding the material studied. The instructions given are clear and easy for students to understand to follow each learning step.

The models given for each key question are clear and can help students in answering key questions so that they can find concepts related to the material being studied. At first, students experienced difficulties and obstacles due to Discord using English. However, this can be overcome by the Discord features that are not too difficult, and the instructions given clearly can help students understand each learning step and the material being studied. Based on the opinions of validators and individual evaluations, revisions will be made which will result in Prototype III.

After producing prototype III, then the small group stage was carried out. This stage is an evaluation stage carried out by 9 chemistry students class of 2019 in the form of a product practicality assessment based on a

research instrument in the form of a valid practicality questionnaire. The results of the small group practicality test can be seen in the following figure 9.

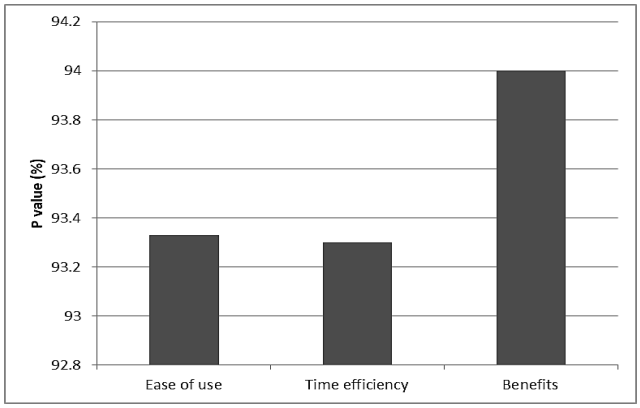

Figure 9. Analysis of small group practicality test

Based on Figure 9, it can be concluded that the results of the small group practicality test regarding ease of use obtained a P (%) value of 93.33 with a very practical category, the time efficiency aspect obtained a P (%) value of 93.30 with a very practical category, the benefit aspect obtained a P (%) value of 94 with a very practical category. So that the average P (%) value obtained is 93 with a very practical category. Then the assessment and suggestions for improvement obtained become guidelines for further product revision so as to produce prototype IV.

Conclusion

The Learning System with Digital Literacy Based on Guided Inquiry Integrated Flipped Classroom Using Discord Application on Colloid Material for First Year Students developed has a content validity value and construct validity of 0.84 and 0.91 with a valid category, a practicality value of 87.9 with a very practical category.

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Author Contributions
All author contribute the research article with their respective responsibilities namely Mawardi Mawardi, conceptualization, methodology, validation supervision, review and editing; Mawardi Mawardi; formal analysis, validation; Mawardi Mawardi, formal analysis, validation; Silvi Handri, investigation, data curation, writing—original draft preparation, editing and project administration.

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Conflicts of Interest
The authors declare no conflict of interest.

References

Aiken, L. R. (1985). Three Coefficients for Analyzing The Reliability and Validity of Ratings. *Educational and psychological measurement, 45*(1), 131–142. https://doi.org/10.1177/0013164485451012

Asra, Dj, L., & Mawardi. (2016). Peningkatan Aktivitas, Motivasi, dan Hasil Belajar Siswa dengan Pendekatan Inkuiri Terbimbing di SMA Negeri 8 Padang. *Eksakta*, *1*, 75–81. Retrieved from https://ejournal.unp.ac.id/index.php/eksakta/article/view/6105

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 Science and Technologies (IJIPSAT)*, *26*(4), 142–147. http://dx.doi.org/10.52155/ijpsat.v26.1.2952

Gitnita, S., Kamus, Z., & Gusnedi. (2018). Analisis Validitas, Praktikalitas, dan Efektivitas Pengembangan Bahan Ajar Terinntegrasi Konten Kecerdasan Spiritual pada Materi Fisika Tentang Vektor dan Gerak Lurus. *Pillar of Physics Education, 11*(2), 153–160. http://dx.doi.org/10.24036/3282171074

Guswita, Z., & Mawardi, M. (2021). Validitas dan Praktikalitas Flipped Classroom Berbasis Inkuiri Terbimbing Pada Materi Larutan Asam Basa. *Jurnal Pendidikan Tambusai*, *5*(2), 2992–2997. Retrieved from https://jptam.org/index.php/jptam/article/view/1331

Hanson, D. M. (2013). *Instructor's Guide to Process Oriented Guided Inquiry Learning*. Pacific Crest. Retrieved from https://pcrest.com/PC/Reflections/issue26/316032.pdf

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 Science and Technologies (IJIPSAT)*, *27*(1), 232–236. https://doi.org/10.52155/ijpsat.v27.1.3062

Indarta, Y., Jalinus, N., Waskito, Samala, A. D., Riyanda, A. R., & Adi, N. H. (2022). Relevansi Kurikulum Merdeka Belajar dengan Model Pembelajaran Abad 21 dalam Perkembangan Era Society 5.0. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(2), 3011–3024.

https://doi.org/10.31004/edukatif.v4i2.2589

Insani, M., Mawardi, M., & Ismail, I. A. (2022). The System of Flipped Classroom Based on Guided Inquiry Learning on Redox Reactions and Electrochemistry Using Moodle. *System, 6*(5), 53–56. Retrieved from http://ijeais.org/wp-content/uploads/2022/5/abs/IJAPR220510.html

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 Science and Technologies (IJIPSAT)*, *30*(1), 280–287. https://doi.org/10.52155/ijpsat.v30.1.3907

Kemdikbud, D. (2020). *Latar Belakang Kampus Merdeka*. Republik Indonesia. Retrieved from https://kampusmerdeka.kemdikbud.go.id/web/about/latar-belakang

Lestari, Y. W., Sartika, R. P., Enawati, E., & Muharini, R. (2022). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Problem Based Learning (PBL) pada Materi Koloid. *Edukatif: Jurnal Ilmu Pendidikan*, *4*(4), 5342–5351. https://doi.org/10.31004/edukatif.v4i4.3227

Lo, C. K., & Hew, K. F. (2017). A Critical Review of Flipped Classroom Challenges in K-12 Education: Possible Solutions and Recommendations for Future Research. *Research and Practice in Technology Enhanced Learning*, 1–22. https://doi.org/10.1186/s41039-016-0044-2

Lukum, A. (2019). Pendidikan 4.0 di era generasi Z: Tantangan dan solusinya. In *Prosiding Seminar Nasional Kimia Dan Pendidikan Kimia*. *2*, 1-3. Retrieved from https://jurnal.fkip.unmul.ac.id/index.php/kpk/article/view/329

Mawardi, M., Js, A. F. R., & Yani, F. H. (2020). Effectiveness of student worksheets based guided inquiry on acid base material to improve students higher order thinking skill (HOTS) Effectiveness of student worksheets based guided inquiry on acid base material to improve students higher order thinkin. *Journal of Physics : Conf. Series, 1481*(1), 012083. https://doi.org/10.1088/1742-6596/1481/1/012083

Ninda, A., & Mawardi, M. (2022). Entalpi Pendidikan Kimia Validitas dan Praktikalitas Flipped Classroom Berbasis Inkuiri Validity and Practicality of Flipped Classroom Based on Guided Inquiry on Reaction Rate Material Entalpi Pendidikan Kimia. *Entalpi Pendidikan Kimia*, *3*(2), 50–55. https://doi.org/10.24036/epk.v3i2.269

Nurcahyo, L., Makarim, N., & Rupa, P. S. (2020). Pendekatan konsep Merdeka Belajar dalam pembelajaran Seni Rupa di era industri 4.0. In *Seminar Nasional Seni dan Desain 2020*. 143–150. Retrieved from https://media.neliti.com/media/publications/333157-pendekatan-konsep-merdeka-belajar-dalam-a501ea2e.pdf

Odinokaya, M. A., Krylova, E. A., Rubtsova, A. V., & Almazova, N. I. (2021). Using the discord application to facilitate EFL vocabulary acquisition. *Education Sciences, 11*(9), 470. https://doi.org/10.3390/educsci11090470

Plomp, T., & Nieveen, N. (2013). *Educational Design Research: An itroduction*. Educational design research, 11-50. Retrieved from https://digilibadmin.unismuh.ac.id/upload/26518-Full_Text.pdf#page=12

Puspitarini, D. (2022). Blended Learning sebagai Model Pembelajaran Abad 21. *Ideguru : Jurnal Karya Ilmiah Guru*, *7*(1), 1–6. https://doi.org/10.51169/ideguru.v7i1.307

Putriani, J. D., & Hudaidah. (2021). Penerapan Pendidikan Indonesia di Era Revolusi Industri 4.0. *Edukatif : Jurnal Ilmu Pendidikan*, *3*(3), 831–838. https://doi.org/10.31004/edukatif.v3i3.407

Salim, A. (2021). *Penggunaan Media Pembelajaran Discord Untuk Selama Belajar Daring*. Sekolah tinggi agama islam Ma'Arif. Retrieved from https://staimasintang.ac.id/wp-content/uploads/karya-agus.pdf

Siregar, F. R., & Mawardi, M. (2022). Development of the Learning System of Flipped-Guided Inquiry-Based Learning (FGIL) Using Moodle on Chemical Equilibrium material. *Indonesian Journal of Educational Studies (IJES)*, *25*(1), 31–49. https://doi.org/10.26858/ijes.v25i1.33568

Sitanggang, L. O., Asra, & Mawardi. (2022). Flipped Classroom Learning System Based On Guided Inquiry Using Moodle On Colloid. *Studi Keislaman Dan Ilmu Pendidikan*, *10*(2), 278–291. https://doi.org/10.36088/palapa.v10i2.2116

Sumartono, S., & Huda, N. (2020). Manajemen Pendidikan dI Indonesia Sebagai Implementasi Triple Helix untuk Mempersiapkan Revolusi Industri 4.0. *Jurnal Andi Djemma Jurnal Pendidikan*, *3*(1), 74–79. http://dx.doi.org/10.35914/jad.v3i1.340

Tjahjadi, E., Paramita, S., & Salman, D. (2021). Pembelajaran Era Pandemi Covid-19 di Indonesia (Studi terhadap Aplikasi Discord). *Koneksi, 5*(1), 83. https://doi.org/10.24912/kn.v5i1.10165