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Innovative Learning System Design: Integrating Guided Inquiry and Flipped Classroom Using Discord for Fundamental Laws of Chemistry

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Abstract

The material of the basic laws of chemistry is an important foundation in understanding various advanced concepts in chemistry, especially those related to quantitative calculations such as the concept of moles. However, the abstract and mathematical characteristics of the material are often an obstacle for students in understanding the concept thoroughly. The purpose of this research is to develop a guided inquiry-based learning system integrated with flipped classroom assisted by Discord application on the material of basic laws of chemistry in class X phase E SMA/MA. The research employed the Educational Design Research (EDR) method using the Plomp model, which includes three stages: preliminary research, development or prototyping phase, and assessment phase, with limitations up to the small group trial stage (prototype IV). The research subjects consisted of 3 lecturers, 2 chemistry teachers, and 9 students of class XI SMAN 8 Padang. Needs analysis revealed that chemistry learning remains abstract and heavily mathematical, leading to student difficulties and misconceptions. To address this, a learning approach was designed incorporating three levels of multiple chemical representations (macroscopic, submicroscopic, and symbolic) integrated flipped classroom that supports independent learning, with guided inquiry syntax. Discord was selected as the supporting platform due to its comprehensive features that facilitate both synchronous and asynchronous learning. The product was tested through validation by experts and evaluation of students. The results of content validity of 0.89 and construct validity of 0.93 indicate that the product is valid. The practicality value of 93% obtained from the analysis of the practicality questionnaire of teachers and students with a very practical category. These findings suggest that the developed learning system is appropriate for use in chemistry education and can effectively help students independently and meaningfully understand the basic laws of chemistry. Furthermore, this study supports the implementation of the Merdeka Curriculum and the integration of technology-based learning in the digital era.

Keywords: *Learning system, Guided inquiri, Flipped Classroom, Discord. Basic Laws of Chemistry*

I. INTRODUCTION

Chemistry is a branch of science that combines theoretical concepts with mathematical principles (Harefa et al., 2020). Chemistry is an important component in life that explains the structure, properties, composition, and changes and energy of a material (Syukri, 1999). This makes chemistry important to learn. One of the fundamental topics in chemistry that serves as a foundation for understanding more complex concepts is the basic laws of chemistry.The basic laws of chemistry are important to learn because they serve as a foundation for understanding chemical topics that involve calculations, such as the mole concept (Marlina et al., 2018). However, this material is often considered difficult for students to grasp due to its abstract and mathematical nature, which requires higher-order thinking and analytical skills to comprehend and relate the legal concepts presented (Hanum et al., 2017). Additionally, students often experience difficulties due to misconceptions, such as confusing one law with another. Inappropriate or incomplete reasoning also contributes significantly to the emergence of these misconceptions (Fajriani et al., 2019). One effective approach to addressing these challenges is the use of multiple representations in the learning process.

According to Johnstone (1993) understanding chemistry begins by connecting new concepts with prior knowledge stored in memory through the use of multiple representations. These representations are categorized into three levels: macroscopic, submicroscopic, and symbolic (R. P. Sari & Seprianto, 2018). Several studies have shown that difficulties in understanding chemical concepts often arise from students' inability to solve chemical problems, which is largely due to a lack of skill in integrating these three levels of representation (Chittleborough & Treagust D F., 2007). Implementing a learning process that incorporates multiple representations enhances students' mastery of chemical concepts, as it enables them to effectively connect and transition between the different representational levels (Sagita et al., 2017).

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Currently, the implementation of learning processes, including the use of miltiple representations, increasingly incorporates digital technology (Souza & Debs, 2024). One commonly includes used form of technology is the Learning Management System (LMS), which includes platforms such Google Classroom, Google Meet, Edmodo, and Moodle. However, the use of platforms in learning is often limited due to several factors, including high internet bandwidth requirements, minimal real-time interaction between teachers and students, and a predominant focus on delivering information in the form of text, images, audio, or video only (Melfawani et al., 2022; Paramitha et al., 2022). Additionally, the use of social media applications like WhatsApp, which requires substantial storage space, and video conferencing platforms like Zoom, which impose a 40-minute time limit in the free version, present further challenges(Nurmala et al., 2021). To address these limitations, Discord has emerged as a promising alternative (Arifianto & Izzudin, 2021). While originally developed for the gaming community, Discord has proven to be highly adaptable for educational purposes. It offers a comprehensive set of features including text channels, voice channels, file sharing, and video conferencing as well as integration with various other applications. Discord is accessible across multiple devices, including computers, smartphones, and tablets, and it provides a free version that can be used anytime and anywhere (Barnad, 2021; Kruglyk et al., 2020).

The use of the Discord application enables learning to be conducted both asynchronously and synchronously. A learning system that combines these two modes is referred to as flipped classroom integrated learning (Li et al., 2022). The flipped classroom approach reverses the traditional learning process: instructional content that is typically delivered by the teacher in the classroom is instead studied at home, while activities that are usually completed at home are carried out in the classroom under the teacher's guidance (Insani et al., 2022; M. U. Sari & Mawardi, 2022).

Asynchronous learning is defined as a learning process in which students engage with instructional materials at different times and locations. In contrast, synchronous learning involves interaction between teachers and students in real-time, although they may not be in the same physical location (Chaeruman, 2019). Flipped classroom learning enhances students' ability to learn independently, which positively impacts their academic performance (Ananda et al., 2023)(Waer & Mawardi, 2021). To make learning more engaging and interactive, it is essential for teachers to adopt innovative instructional models (Yuliandri, 2017). Students also have the flexibility to access and rewatch video materials anytime and anywhere, which helps them think critically and manage their learning pace according to their individual needs (Herpika & Mawardi, 2021). One such model is the guided inquiry model, which supports students in understanding material independently through a sequence of structured key questions, progressing from simple to complex concepts (Kuhlthau, 2010). This model aligns well with the goals of the Merdeka Curriculum, which emphasizes independent learning, with the teacher serving primarily as a facilitator (Zainuri, 2023a). Guided inquiry consists of five syntactic stages: orientation, exploration, concept formation, application, and closing(Aumi & Mawardi, 2021; Hanson, 2005). Learning through this model encourages students to become more active, motivated, and capable of improving their academic outcomes (Handri et al., 2023; Putri & Gazali, 2021).

Based on the explanation above, this study was conducted with the aim of developing a guided inquiry-based learning system integrated with a flipped classroom approach, supported by the Discord application, for teaching the basic laws of chemistry in Phase E of SMA/MA. The study also aimed to assess the validity and practicality of the developed learning system. It is expected that this research will have a positive impact on both teachers and students by enhancing independent and technology-based learning, in alignment with the objectives of the Merdeka Curriculum and the demands of the current digital era.

II. METHODS

This study uses a type of development research or called Educational Design Research (EDR) or educational design research with the development of the Plomp model including 3 phases, namely preliminary research (initial investigation phase including needs and context analysis, literature review, and developing a conceptual framework), Development or prototyping phase (development and prototyping phase that occurs iteratively), and Assessment phase (evaluation/assessment phase) (Plomp & Nieveen, 2013).

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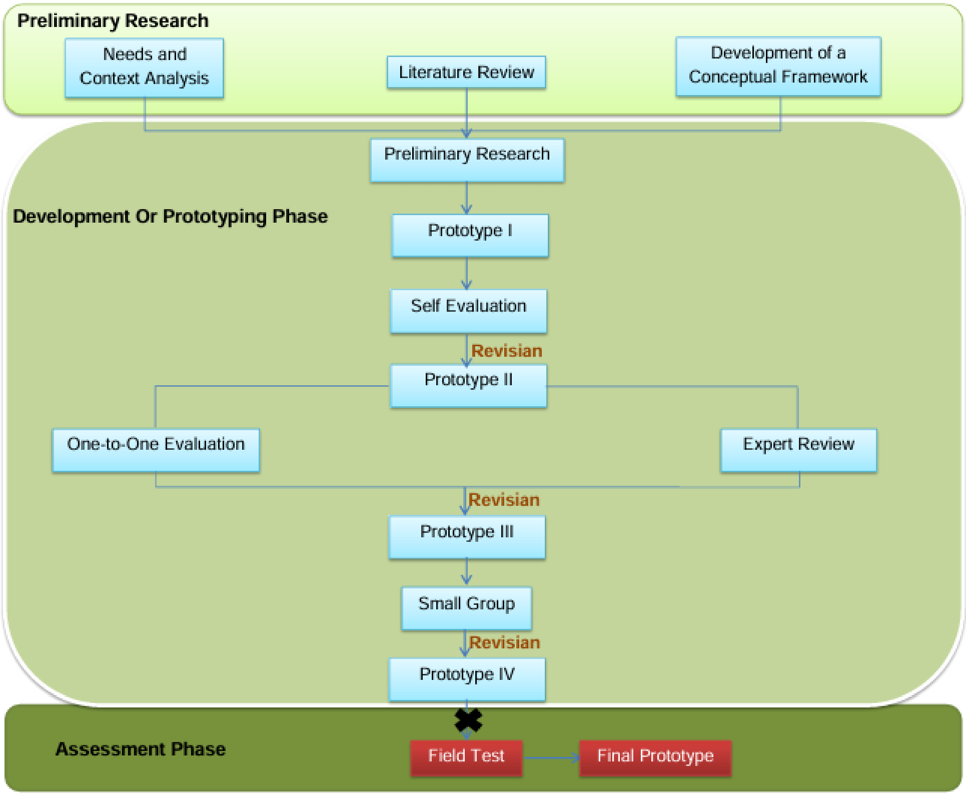

Fig 1. Stages of EDR

In the preliminary stage (initial investigation), a needs and context analysis was conducted, followed by a literature review and the development of a conceptual framework (Plomp & Nieveen, 2010). The needs analysis aimed to identify the conditions, requirements, and core issues present in schools, particularly related to the topic of the basic laws of chemistry. Subsequently, a literature review was carried out using various sources such as articles, books, and theses to explore potential solutions to the problems identified in schools. These sources served as references relevant to the development of the learning system. Finally, the information and data gathered from the needs and context analysis and the literature review were synthesized into a conceptual.

The next phase is the development or prototyping stage, which consists of four stages: Prototype I, Prototype II, Prototype III, and Prototype IV. Each prototype undergoes continuous revision to minimize errors and improve the product. Prototype I represents the initial design of the product. Prototype II is developed based on a self-evaluation of prototype I. Prototype III is the result of an expert review and one-to-one evaluation. The expert review involves input and assessment from subject matter experts, media experts, and technical experts who provide suggestions for improvement this stage is also referred to as the product validation phase. The one-to-one evaluation involves interviews with three students who have different levels of cognitive ability-high, medium, and low. This evaluation is conducted after the students have observed, understood, and practiced using the learning system with the assistance of the Discord application. Finally, prototype IV is developed through product testing in a small group setting to assess the practicality of the learning system, followed by further revisions as necessar (Plomp & Nieveen, 2010).

The types of data collection instruments used in this study include an observation sheet and teacher interview, a self-evaluation questionnaire, and a one-to-one evaluation questionnaire. For the validity assessment, instruments include content validity and construct validity questionnaires. The data analysis technique for the validity test employs Aiken's V formula, as follows:

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

$$s = r - lo$$

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Where:
s = The difference between the validator's score and the lowest score in the questionnaire
r = Validator score
lo = Lowest score in the questionnaire
V = Validity index
n = Number of validators
c = Number of categories of answer options chosen by the validator

Table 1. Criteria index validitas aiken's for five validators

Aiken's V Index	Validity Category
V ≥ 0.80	Valid
V < 0.80	Invalid

Practicality instruments were obtained through teacher and student practicality questionnaires. The practicality test was measured using a Likert scale, calculated with the following formula:

$$\text{Practicality Score} = \frac{\text{Total score obtained}}{\text{Highest possible score}} \times 100\%$$

The criteria for the level of practicality of the Likert scale can be seen based on the following table:

Table 2. Category of practicality level.

Values	Practicality category
86% - 100%	Very practical
76% - 85%	Practical
60% - 75%	Practical enaugh
55% - 59%	Not practical enaugh
≥ 54%	Not practical

III. RESULTS AND DISCUSSION

1. Preliminary Research

Needs and context analysis is the first step in developing the learning system. The needs analysis was conducted through interviews with three teachers from different schools: SMAN 10 Padang, SMAN 8 Padang, and SMA Pertiwi 1 Padang. Based on the results of these interviews, all three teachers reported that they had implemented the *Kurikulum Merdeka* in their teaching. However, the student-centered approach required by the curriculum has not been fully optimized (Zainuri, 2023). This is primarily due to student-related challenges in lower-performing schools, such as a lack of motivation, poor study habits, and disruptive behavior. Although the teachers employed a variety of learning models such as Project-Based Learning, Cooperative Learning, Guided Inquiry, and Discovery Learning these approaches have not been implemented effectively. Furthermore, two of the three teachers had used social media as a learning tool, but found it to be less effective in supporting the learning process. In this context, Discord is seen as a promising solution, as it offers a social media platform that can better support and accommodate student learning activities. The implementation of learning using Discord combined with flipped guided inquiry learning is highly effective in the learning process. Several previous studies have shown that learning through flipped guided inquiry learning can improve students' learning outcomes (Akmar et al., 2024; Amien et al., 2024; Violin et al., 2024).

After conducting the needs analysis, the process continued with a context analysis. At this stage, the selection of learning material was carried out, and the chosen topic was the basic laws of chemistry. This topic was selected because it is considered difficult for students to understand due to its abstract and calculation-heavy nature, as well as the frequent occurrence of misconceptions (Fajriani et al., 2019; Fauzan et al., 2023) . Following this, an analysis of the Learning

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Outcomes for Phase E of SMA/MA was conducted, based on Bloom's Revised Taxonomy (Kemendikbudristek, 2024). From this analysis, the Learning Objectives and the Flow of Learning Objectives were then designed in alignment with the selected topic. The formulation of learning objectives and the sequence of learning objectives based on the analysis of learning outcomes is carried out in three stages (Miterianifa & Zein, 2016). First, the use of operational verbs in the learning objectives was deemed inappropriate and therefore needed to be revised. After a review, the number of learning sessions was adjusted by reducing three meetings to two in order to better align with the established learning objectives.

Several previous studies have served as references in the preparation of this development research. For instance, research conducted by Cheng et al (2019) on flipped classroom learning demonstrated positive effects on students' cognitive learning outcomes. Additionally, learning through Discord has been shown to create an active and engaging learning environment (Wiles & Simmons, 2022). This is further supported by studies on Process Oriented Guided Inquiry Learning (POGIL), which significantly enhances students' chemical literacy and scientific skills (Puspitasari et al., 2024). An update study by Siregar & Mawardi (2022) examined the development of a guided inquiry-based flipped classroom learning system using Moodle, specifically focused on chemical equilibrium material. The system was found to be valid and practical, with an average validity score of 0.90 from five validators (categorized as valid) and an average practicality score of 85%, classified as very practical. However, their study faced limitations in implementation, primarily due to the use of a paid platform that required a stable internet connection. To address these challenges, this research introduces an updated approach by utilizing Discord as the learning platform. Discord offers a free and accessible alternative that supports both synchronous and asynchronous learning, making it a more practical and flexible option for classroom implementation.

Discord is equipped with comprehensive features, including voice channels, video, image and text sharing, as well as screen sharing. Most importantly, the application offers a free version, making it accessible without subscription fees, although it still requires an internet connection. Learning through Discord creates an active and engaging learning environment that can enhance students' learning motivation and improve their academic performance.After conducting the needs analysis and literature review, a conceptual framework was developed to identify, define, and explain the key concepts relevant to the research topic.

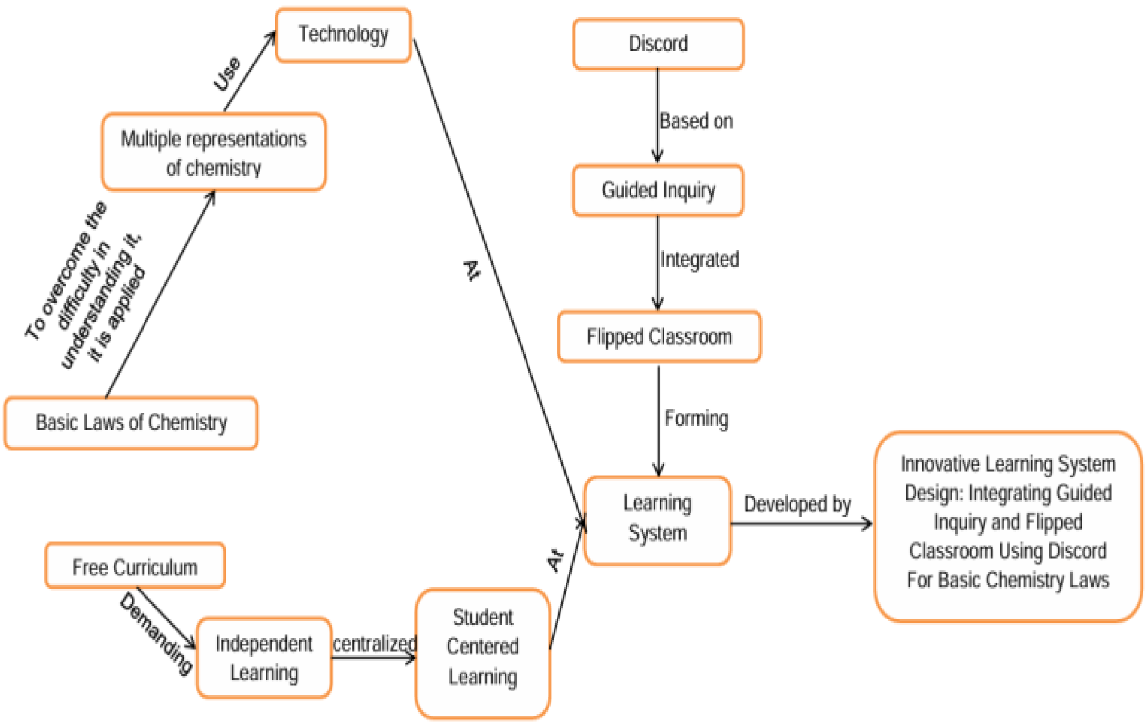

Fig. Conceptual Framework
(Delfianza et al., 2023; Tuti et al., 2023)

2. Development or Prototyping Phase

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a. Prototipe I

The initial step in developing this learning system was to gain a thorough understanding of the guided inquiry learning model. This was essential to gather detailed information about guided inquiry, particularly the five syntactic stages that would serve as the foundation for designing the learning system. In addition, an informational section was incorporated into the learning design to support student understanding (Maypalita & Zainul, 2017) . The development of the learning design, integrated with the guided inquiry model, begins with the orientation stage, which includes instructional videos. These videos are prepared in advance and uploaded to the designated orientation channel on Discord. They present the learning objectives, the flow of learning objectives, explanations of prerequisite materials, and motivational content to engage students. The next stages are exploration and concept formation. At this point, key questions are systematically designed, progressing from simple to complex. These questions are constructed using various models such as images, tables, and graphs. By working through these key questions, students are guided toward forming concept (Yani et al., 2019).

Following the exploration and concept formation stages, students are given practice questions to be completed in groups using the Discord application. These practice questions are designed to reinforce students' understanding of the concepts learned. After completing the group work, students present the results of their discussions to the class, followed by a session where they draw conclusions collaboratively. Once the guided inquiry-based learning system integrated with the flipped classroom approach assisted by the Discord application has been fully designed, including the development of student worksheets and a user guide for the Discord platform, the materials are uploaded to Discord. The content is organized according to the appropriate categories and channels that have been previously set up in the application.

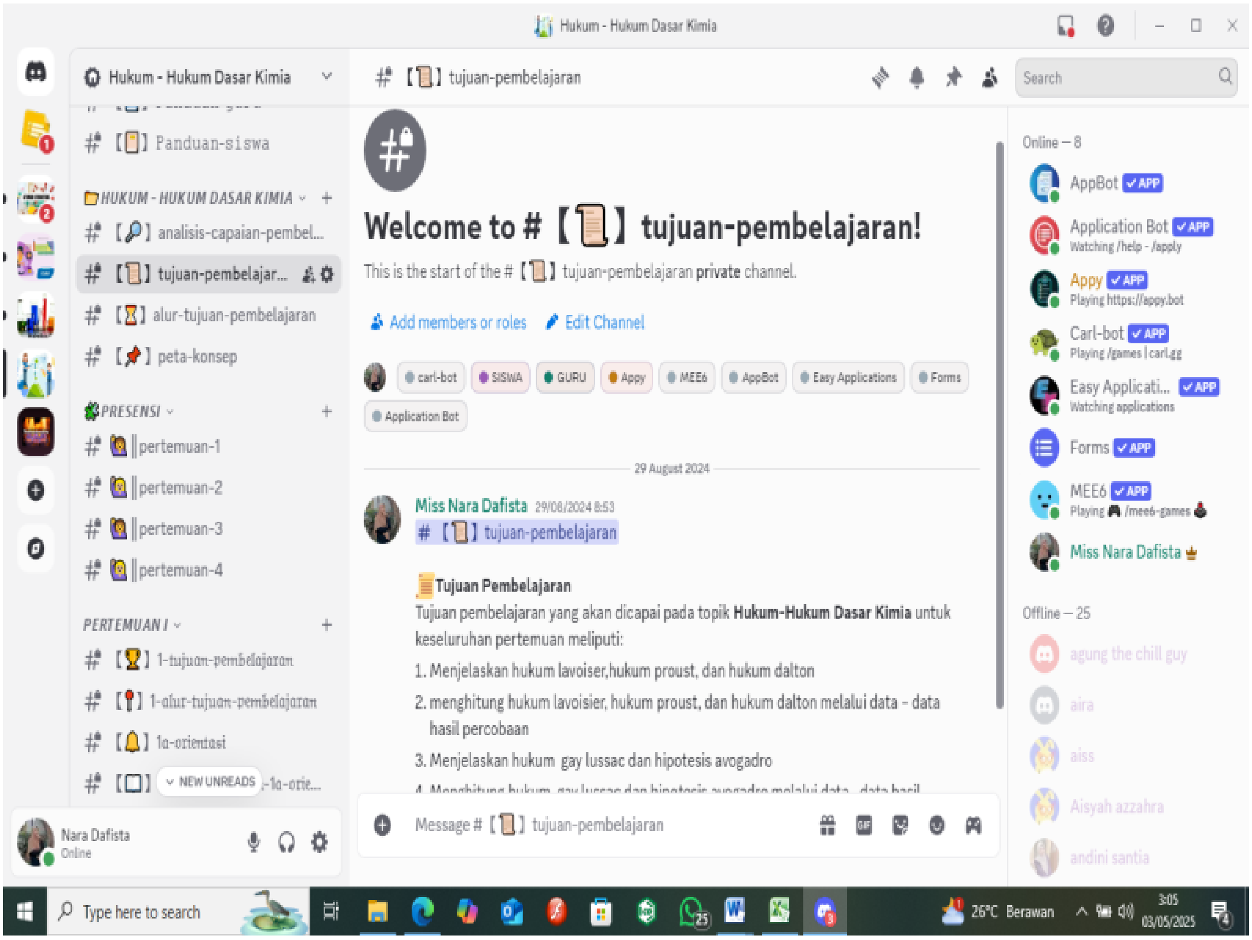

Fig 3. Learning design view on uploaded to Discord

The learning design is integrated with the flipped classroom model, which consists of two phases: asynchronous and synchronous learning. Asynchronous learning takes place during the orientation, exploration, and concept formation stages, allowing students to engage with the material at their own pace. In contrast, synchronous learning is conducted

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during the application and closing stages, where real-time interaction between students and teachers occurs to reinforce understanding and conclude the learning process (Nengsih & Mawardi, 2021).

The following is the initial design of guided inquiry-based learning system integrated with flipped classroom assisted by Discord application:

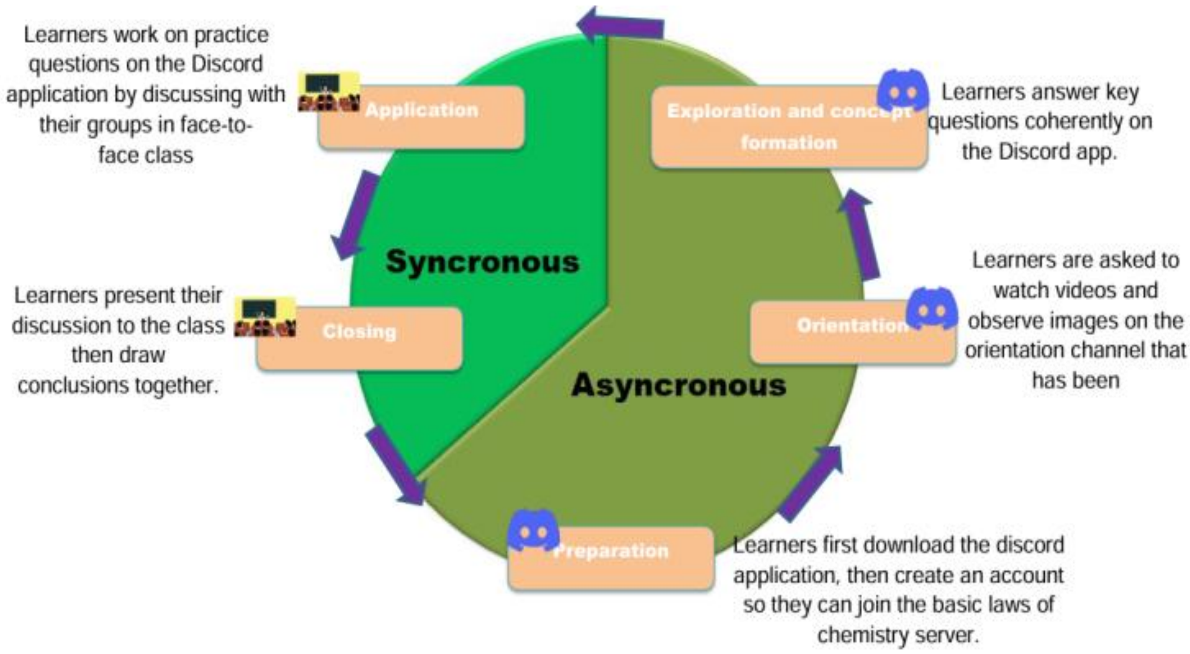

Fig 4. Preliminary design of guided inquiry-based learning system integrated with flipped classroom assisted by discord application
(Aumi & Mawardi, 2021; Ismail & Mawardi, 2021; Khairunnisak et al., 2023)

b. Prototype II

After Prototype I is developed, a self-evaluation is conducted by the researcher to review the learning design. This evaluation aims to identify any potential shortcomings or areas for improvement in the developed learning system. The process involves checking and completing a self-evaluation sheet. Based on the results of the self-evaluation, it was concluded that the learning system design, which had been uploaded to Discord, was implemented properly and showed no significant deficiencies. The completeness and quality of the design were achieved through prior revisions made during the development process. As a result, the learning system design that successfully passed the self-evaluation stage is referred to as Prototype II.

c. Prototype III

Prototype II, once developed, underwent formative evaluation in the form of validation tests, which included expert review and one-to-one evaluation. The product validation was conducted by a panel of five experts: 3 lecturers from the Department of Chemistry, FMIPA UNP, and 2 chemistry teachers from SMAN 8 Padang. The evaluation focused on assessing both the content validity and construct validity of the developed learning system. Before completing the validation sheet, the validators first reviewed the learning system through the Discord application. Following this, the lecturers and teachers assessed the product and filled out the validity evaluation form. The results were then analyzed using Aiken's V formula with input from the five validators. The content validity score was obtained based on the following data:

Table 3. Based Construct Validity Analysis Results

Assesment Aspects	V	Categories of Validity

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Content Component	0,86	Valid
Presentation Component	0,91	Valid
Language Component	0,86	Valid
Graphick Component	0,93	Valid
Average	**0,89**	**Valid**

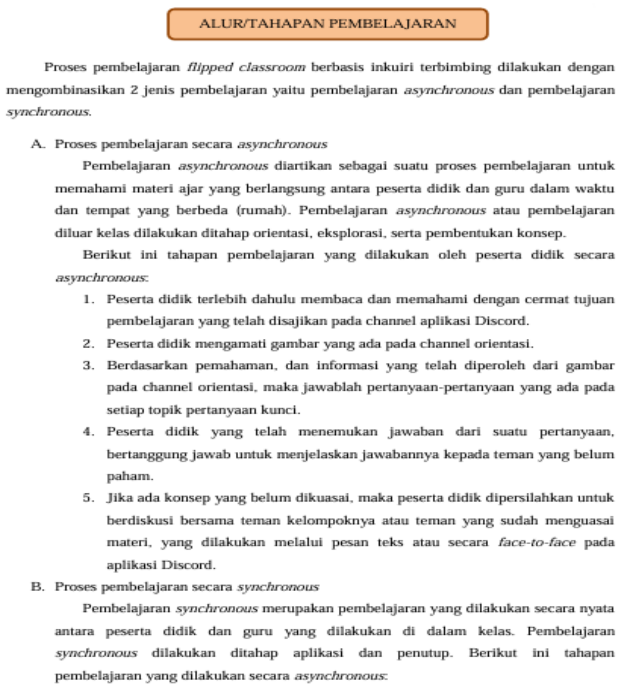
Based on Table 3, the average construct validity value is 0.89. According to the validity index criteria, if **V ≥ 0.80**, the product is considered valid. Then for construction validity in the display aspect, the average validity value (V) is 0.94 and 0.92 for the ease of use aspect, with an average content validity value obtained of 0.93 which also states that the product is valid. The data display of the results of the construct validity test can be seen based on the following Table:

Table 4. Based Content Validity Analysis Results

Assesment Aspects	V	Categories of Validity
Display Component	0,94	Valid
Convenience Component	0,92	Valid
Average	**0,93**	**Valid**

Based on Table 4, the average content validity score for all components is 0.93, which falls into the valid category according to the validity index criteria.

The achievement of high average scores for both content and construct validity, which were deemed valid, cannot be separated from the revisions made in response to the suggestions and comments provided by the validators particularly regarding context validity. At this stage, product revisions were carried out twice. The first revision involved improving the clarity of orientation images, as recommended by the validators. The second revision included the addition of a learning design flow within the product, which integrates the flipped classroom approach with the guided inquiry model. This addition was made to help guide students through the learning process in a more structured manner. The following is the added learning design flow in the developed learning system:


ALUR/TAHAPAN PEMBELAJARAN

Proses pembelajaran *flipped classroom* berbasis inkuiri terbimbing dilakukan dengan mengombinasikan 2 jenis pembelajaran yaitu pembelajaran *asynchronous* dan pembelajaran *synchronous*.

A. Proses pembelajaran secara *asynchronous*

Pembelajaran *asynchronous* diartikan sebagai suatu proses pembelajaran untuk memahami materi ajar yang berlangsung antara peserta didik dan guru dalam waktu dan tempat yang berbeda (rumah). Pembelajaran *asynchronous* atau pembelajaran diluar kelas dilakukan ditahap orientasi, eksplorasi, serta pembentukan konsep.

Berikut ini tahapan pembelajaran yang dilakukan oleh peserta didik secara *asynchronous*:

1. Peserta didik terlebih dahulu membaca dan memahami dengan cermat tujuan pembelajaran yang telah disajikan pada channel aplikasi Discord.
2. Peserta didik mengamati gambar yang ada pada channel orientasi.
3. Berdasarkan pemahaman, dan informasi yang telah diperoleh dari gambar pada channel orientasi, maka jawablah pertanyaan-pertanyaan yang ada pada setiap topik pertanyaan kunci.
4. Peserta didik yang telah menemukan jawaban dari suatu pertanyaan, bertanggung jawab untuk menjelaskan jawabannya kepada teman yang belum paham.
5. Jika ada konsep yang belum dikuasai, maka peserta didik dipersilahkan untuk berdiskusi bersama teman kelompoknya atau teman yang sudah menguasai materi, yang dilakukan melalui pesan teks atau secara *face-to-face* pada aplikasi Discord.

B. Proses pembelajaran secara *synchronous*

Pembelajaran *synchronous* merupakan pembelajaran yang dilakukan secara nyata antara peserta didik dan guru yang dilakukan di dalam kelas. Pembelajaran *synchronous* dilakukan ditahap aplikasi dan penutup. Berikut ini tahapan pembelajaran yang dilakukan secara *asynchronous*:

Fig. 5 Learning Design Flow

The next stage is the one-to-one evaluation. This evaluation was conducted through interviews with three Grade XI students from SMAN 8 Padang who had previously studied the topic of the basic laws of chemistry. The students were selected based on different cognitive ability levels high, medium, and low. The purpose of the interviews was togather

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student feedback on prototype II, focusing on aspects such as appearance, language clarity, the instructional model, and the guidance provided on the Discord platform. The interviews were conducted after students had explored the learning system on Discord. Based on the results, all three students regardless of their cognitive ability stated that the visual elements, language, instructions, and learning model used were clear and easy to understand. They also mentioned that the system helped them answer the key questions effectively and that they experienced no difficulties in using the platform. As a result, prototype II, having passed both the expert review and one-to-one evaluation stages, is refined into a valid Prototype III.

d. Prototype IV

The The practicality stage was carried out through a small group trial of the developed product. The trial involved 9 grade XI students and 2 chemistry teachers from SMAN 8 Padang. Based on the results of the practicality questionnaires completed by both students and teachers, the average student practicality score was 92%, which falls into the "very practical" category. Similarly, the average teacher practicality score was 94%, also categorized as "very practical".The results of this small group practicality test are presented in Figure 6.

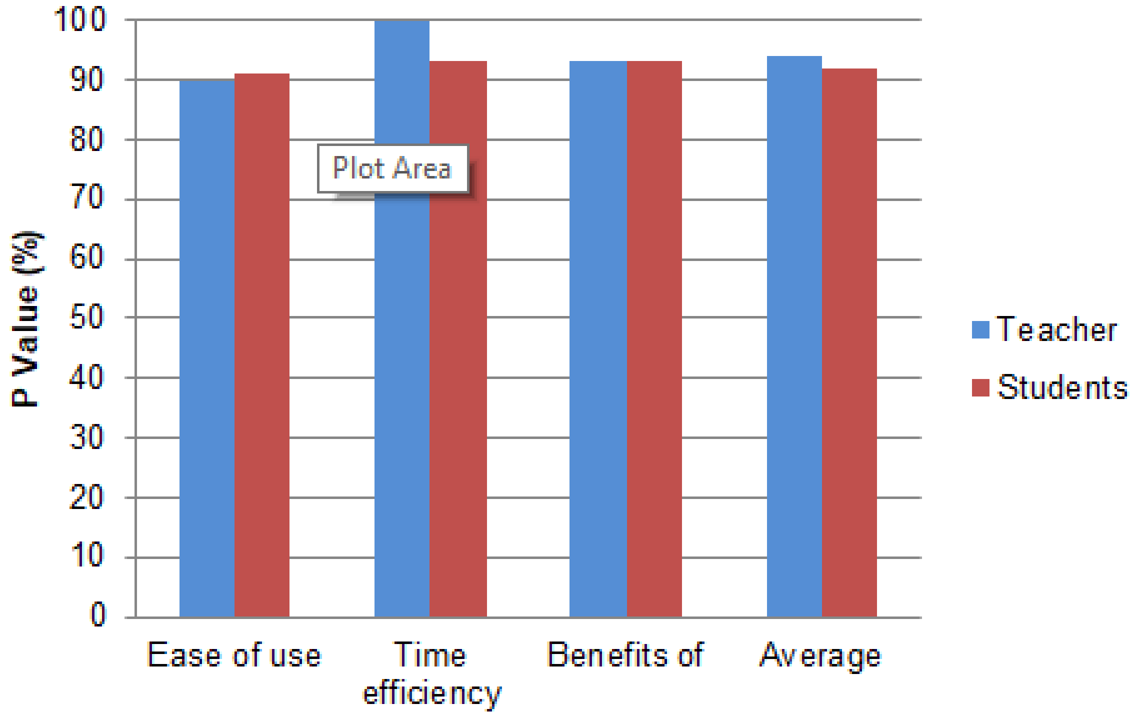

Figure 6. Each analysis of small group practicality test

Based on Figure 6, the overall practicality score of the product is 93%, indicating that the developed learning system is highly practical in terms of ease of use, time efficiency, and usefulness. Following this, further revisions were made based on the practicality results to produce Prototype IV, which is both valid and practical, with a reduced error rate.

The practicality of a learning system lies in the ease of use of the product or method, as well as its effectiveness in facilitating the achievement of predetermined learning objectives. If there are suggestions and comments from teachers or students, Prototype IV will be revised accordingly to produce a version that is not only valid and highly practical but also has a lower error rate. Based on the average practicality score obtained from the teachers, it can be concluded that the developed learning system is feasible for use in the classroom. This is further supported by positive feedback from the chemistry teachers at SMAN 8 Padang, who stated that the use of the Discord application in learning is a novel approach that should be appreciated, as it utilizes a platform familiar to students in their daily lives. This relevance, they noted, helps to increase student motivation. Similarly, students also gave positive responses to the developed learning system, highlighting its clarity, usefulness, and ease of use.

Chemical models and diagrams offer visual cues at various levels of representation, particularly at the submicroscopic level. Instructional aids such as diagrams, tables, and images help students visualize abstract concepts,

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allowing them to develop accurate mental models. This process enhances conceptual understanding and reduces the likelihood of misconceptions or errors in learning.

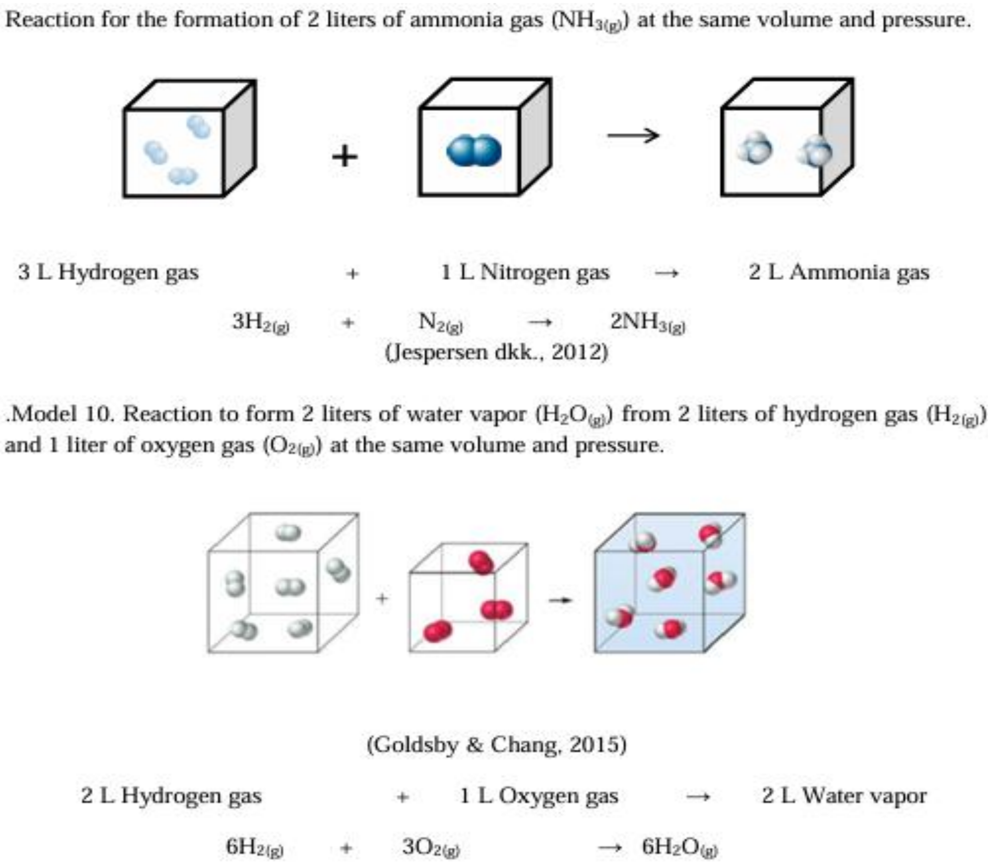

Figure 7. A model that uses 3 levels of multiple representations

Tabel 5. Description of learners' answers to the model in the figure 9

Students	Answer
1	The molecules contained in model 9 are hydrogen, nitrogen and ammonia molecules with the number of atoms in the gas element molecules remaining the same before and after the reaction takes place, the molecules contained in model 10 are hydrogen, oxygen and water molecules with the number of atoms in the gas element molecules remaining the same, this causes that the same volume of gas has the same number of molecules. So it is concluded that at the same temperature and pressure, the same volume of gas contains the same number of particles (molecules).
2	The molecules in model 9 are hydrogen, nitrogen and ammonia molecules, the gas element molecules remain the same before and after the reaction takes place, the molecules in model 10 are hydrogen, oxygen and water molecules with different numbers of atoms in the gas element molecules, this causes that the same volume of gas contains different numbers of molecules.
3	The molecules in model 9 are hydrogen, nitrogen and ammonia molecules while in model 10 there are hydrogen, oxygen and water molecules.

The model is provided to help students answer key questions that guide them toward a deeper understanding of the Avogadro hypothesis. Based on the table, it can be analyzed that Student 1 demonstrates a higher level of thinking compared to the others, as their answers are clear and well-articulated. Student 2 shows a moderate ability to grasp the concept, although their responses are still somewhat incomplete. In contrast, Student 3 displays a lower level of understanding, indicating difficulty in comprehending the Avogadro hypothesis.

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Based on the explanation above, the use of three levels of multiple representations effectively guides students in understanding and constructing concepts, supported by systematically and sequentially arranged key questions. This is reinforced by several previous studies, which have shown that combining the three levels of chemical representation helps students in discovering scientific concepts. These findings are further supported by students' ability to interpret and utilize the provided chemical models (Chittleborough & Treagust D F., 2007). Without such models, students may struggle to grasp concepts and are more likely to develop misconceptions about the material. Therefore, integrating the three levels of chemical representation makes the learning process more meaningful and effective (Ismail & Mawardi, 2021; Waer & Mawardi, 2021).

IV. CONCLUSIONS

This study successfully Innovative Learning System Design: Integrating Guided Inquiry and Flipped Classroom Using Discord for Basic Chemistry Laws. The research employed the Educational Design Research (EDR) method based on the Plomp model, which consists of three stages: preliminary research, development or prototyping phase, and assessment phase, with the process limited to the small group trial stage (Prototype IV). The research subjects 3 three lecturers, 2 chemistry teachers, and 9 grade XI students from SMAN 8 Padang. Validity testing showed strong results, with a content validity score of 0.89 and a construct validity score of 0.93, both categorized as valid based on Aiken's V formula. The practicality test yielded a score of 93%, indicating that the learning system is very practical and suitable for use in the classroom. These results support the conclusion that the learning system is feasible for implementation, as further evidenced by positive feedback from chemistry teachers at SMAN 8 Padang. They noted that the use of the Discord application is a fresh and innovative approach that aligns well with students' digital habits, thus enhancing their motivation to learn. Similarly, students provided comments, stating that learning through Discord made the lessons more engaging, enjoyable, and easier to understand.

In addition, learning through the Discord application supports real-time interactions, making the learning process more dynamic and engaging. However, one student expressed concern that the application could not be used on mobile phones with limited storage capacity. This issue arose from a lack of awareness that Discord can be accessed directly via a web browser, such as Google Chrome, without the need to download the app. Learners can simply create an account and use Discord through its web version. Despite its many advantages, Discord also has certain limitations. These include the inability to upload large files and restrictions on the number of servers a user can join. Nevertheless, the benefits offered by Discord especially in terms of flexibility, accessibility, and interactive featuresmake it a valuable tool for modern, technology-based learning.

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