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Discord-Enhanced Flipped Guided Inquiry Learning: A Modern Approach to Teaching Chemical Bonding to Improve Student Motivation

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Abstract

The Merdeka Curriculum emphasizes independent and student-centered learning. In response to the rapid advancement of digital technology, the integration of technology in the learning process has become essential to achieving instructional goals more effectively. This study aims to develop a learning system based on Flipped Guided Inquiry Learning (FGIL) supported by the Discord application and to analyze its validity and practicality. The developed learning materials focus on the topics of acids and bases as well as the basic laws of chemistry for Phase E students at the senior high school level. This study employed an Educational Design Research (EDR) approach using the Plomp model, which includes the stages of preliminary investigation and prototype development. The research subjects consisted of three chemistry lecturers, two senior high school chemistry teachers, and nine Grade XI students from senior high school in Indonesia. The instruments used included content and construct validity sheets analyzed using Aiken's V formula, along with practicality questionnaires completed by both teachers and students. The analysis results revealed that the developed learning system achieved high validity, with an average Aiken's V score of 0.89 for both content and construct validity. Additionally, the practicality scores reached 92% from students and 96% from teachers, classified as highly practical. These findings indicate that the FGIL-based learning system utilizing Discord is feasible for use in chemistry instruction and has the potential to enhance student engagement and understanding in alignment with the principles of the Merdeka Curriculum.

INTRODUCTION

Chemical bonding is one of the essential topics taught in senior high school chemistry, specifically in Grade X Phase E. It serves as a foundational concept that must be well understood, as it significantly influences students' comprehension of subsequent chemistry topics. These include acid-base reactions, bond energy, and

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thermodynamics, which are all interrelated in the learning progression of chemistry (Sholeh et al., 2022). However, chemical bonding is often considered a challenging topic for students due to its abstract nature (Safitri, 2024). A strong understanding of this concept helps students grasp more advanced materials with ease. In reality, however, many students still experience difficulties in understanding chemical bonding (Togatorop & Kumajas, 2023).

Several factors contribute to the complexity of learning chemical bonding. Its abstract nature makes it difficult for students to differentiate between ionic and covalent bonds. In many cases, students rely heavily on rote memorization, with limited conceptual understanding and inadequate opportunities for discussion (Samosir & Nainggolan, 2022: Sari et al., 2023; Moneke & Nwanneka, 2024; Engkizar et al., 2025). Moreover, their inability to visualize atoms, structures, and how atoms form bonds further complicate their understanding. Thus, it is crucial to apply learning strategies that utilize the three levels of chemical representation: macroscopic, submicroscopic, and symbolic in order to minimize misconceptions and improve students' conceptual understanding.

In line with current technological advancements, various digital tools have been integrated into educational settings, such as Google Classroom, Moodle, YouTube, WhatsApp, Instagram, and even TikTok. Another emerging platform, Discord, which is particularly popular among young people and gamers, remains underutilized in educational contexts (Akem et al., 2025; Efriani et al., 2020; Engkizar et al., 2024; 2025; Astuti et al., 2016; AlGhamdi, 2025; Kuil et al., 2025). Discord offers several advantages, including a simple and practical interface, multi-device accessibility, and diverse communication features. These features include video conferencing, screen sharing, text, image, voice, and video messaging making it a promising platform for interactive learning (Raihan & Putri, 2018). In addition, Discord can be accessed directly via browsers such as Chrome, Firefox, Edge, and Opera without requiring installation. Its integration in education supports flexible, efficient, and interactive learning environments, aligning with the flipped classroom approach.

The guided inquiry learning model emphasizes the process by which students construct and reinforce their understanding through active engagement, inquiry, and exploration based on their perceptions and reasoning (Kunandar, 2011). This model includes the stages of orientation, exploration and concept formation, application, and closure (Putri & Subekti, 2022). In the context of online learning, asynchronous learning is implemented during the preparation, orientation, and exploration stages, while synchronous learning is applied during the application and closure stages (Waer & Mawardi, 2021).

By combining the flipped classroom approach with the guided inquiry learning model, a new learning system called Flipped Guided Inquiry Learning (FGIL) can be developed. This system adopts the structure of guided inquiry learning within the framework of flipped learning and supports the Merdeka Curriculum's emphasis on student-centered learning. The purpose of this study is to examine the validity and practicality of the proposed learning system. The integration of the flipped classroom approach with the guided inquiry learning model results in the FGIL system, which incorporates both synchronous and asynchronous learning components (Nengsih & Mawardi, 2021). This system follows the syntax of guided inquiry learning in the flipped classroom method.

A previous study conducted by Waer & Mawardi, (2021) successfully integrated the guided inquiry model and flipped classroom approach in teaching colligative properties. The study reported a validity score of 0.81 (categorized as valid) and a practicality score of 87 (categorized as practical), demonstrating that the model was both valid and practical for instructional implementation.

METHODS

This study employed Educational Design Research (EDR) as the research methodology, which is commonly used in the development of educational innovations. The development process followed the Plomp model, Preliminary Research, Development or Prototyping Phase, and Assessment.

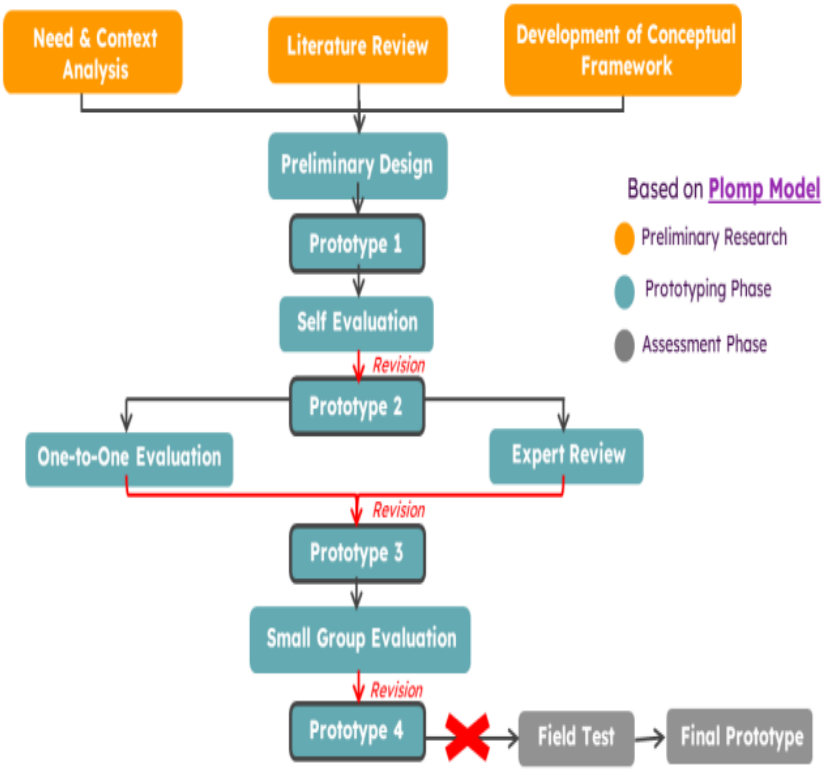

Fig 1. FGIL research procedure using discord

This study utilized primary data obtained from several instruments. The data consisted of interview results collected during the preliminary research phase involving chemistry teachers and students from three senior high schools in Padang, as well as validation and practicality questionnaires distributed to the research subjects. These subjects included three lecturers from the Department of Chemistry, Faculty of Mathematics and Natural Sciences at Universitas Negeri Padang, two chemistry teachers, and tenth-grade students from Senior High School 8 Padang.

The collected data were analyzed using descriptive statistics to obtain percentage values and mean scores. The validity of the developed product was assessed by expert validators through a questionnaire using a Likert scale. The validators provided scores based on specified criteria and submitted an overall evaluation. The validity data were analyzed using Aiken's V formula, which is expressed as:

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

Explanation:
S = Score set by the validator minus the lowest score in the category
r = as the score of the chosen category and, as the lowest score in the score category
n = many validators
c = many categories selected (highest validity score).

To analyze the practicality of the developed system, students completed a response questionnaire using a Likert scale. The scores were analyzed using the following formula to determine the percentage:

$$NP = \frac{R}{Sm} x\ 100$$

Explanation:
NP = Percentage value sought/expected
R = Raw score obtained by the student
SM = Ideal maximum score of the relevant test
100 = Fixed number

RESULT AND DISCUSSION

Prelimenary research

From the results of the observations conducted, several significant gaps in chemistry education in schools in Padang have been revealed. These findings are crucial for designing innovative solutions in the future. The representation of the investigation results shows that the guided inquiry learning model has not been implemented evenly. This becomes a constraint because the inquiry model is very important for developing students' critical thinking and problem-solving skills. In addition, the learning media used do not yet fully encompass various representations, especially at the submicroscopic level. However, the understanding of abstract chemistry concepts heavily relies on students' ability to visualize particles and their interactions at the atomic and molecular levels. And this indicates the need for the development of more comprehensive and innovative teaching materials.

In the results, there are also issues in utilizing social media like WhatsApp for learning, where important information shared by teachers is often missed due to the numerous responses and messages from students in the group. This shows that although WhatsApp is easily accessible, its structure does not support organized communication. Then about Discord, in reality, Discord, as a potential social media platform to support the learning process, is not yet well-known by the three schools. Discord offers more structured features such as separate text and voice channels, dedicated discussion rooms, and file-sharing capabilities, all of which can facilitate learning interactions more effectively compared to regular instant messaging applications. Therefore, the implementation of guided inquiry models, the provision of various learning representations, and the more effective use of social media in chemistry education are necessary.

Literature study the learning system is a structured component that includes four important elements: human factors, materials, facilities, equipment, and procedures. Based on the analysis results, it was found that the V values for content and construct validity are 0.88 and 0.89, respectively, both categorized as valid. The practicality results show a score of 92% for students and 93% for teachers, both categorized as practical. Therefore, the learning system created can be relied upon

and is useful for teaching. So the learning system created can be useful and utilized for teaching.

Development or prototyping

Prototype I

This stage, referred to as the preliminary design, began with the development of an initial instructional framework for teaching chemical bonding based on the Flipped Guided Inquiry Learning (FGIL) model. The design was documented in a structured format, which included the cover page, instructional identity, concept map, and detailed learning activities for each session, all aligned with the syntax of guided inquiry.

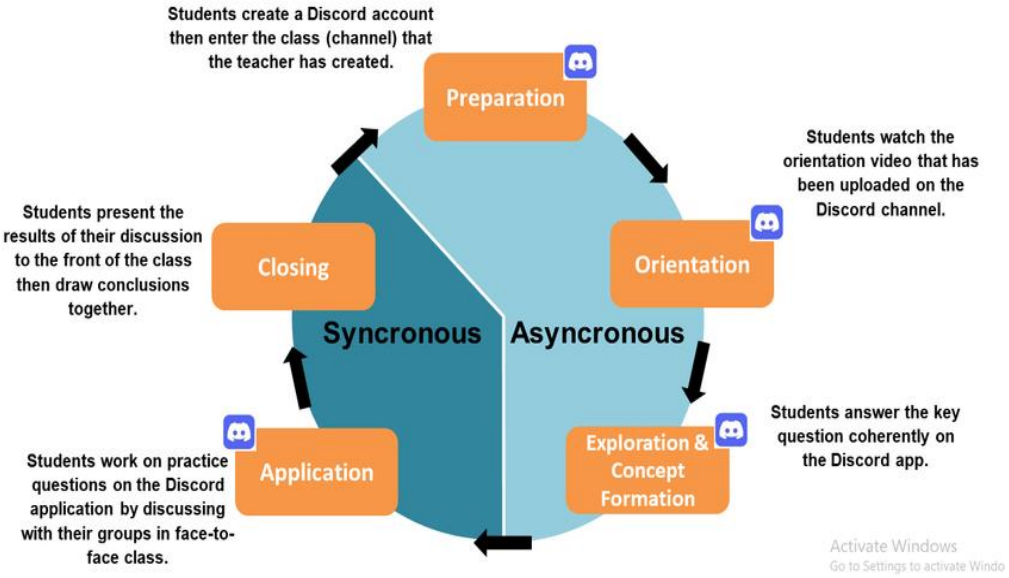

Fig 2. Flipped classroom learning cycle based on guided inquiry

Furthermore, a dedicated Discord server was created to facilitate the chemical bonding lessons, accompanied by a user guide for both teachers and students. In addition to preparing the content on chemical bonding, the researcher developed several channels within the Discord platform, corresponding to Sessions 1 through 3. These channels were organized according to the phases of the guided inquiry syntax, namely: orientation, exploration and concept formation (asynchronous), followed by application and closing (synchronous).

Prototype II

Following the development of prototype I, a formative evaluation was conducted in the form of self-evaluation. This evaluation utilized a checklist assessing the completeness of components within the Flipped Guided Inquiry Learning (FGIL) system using the Discord application, as detailed in the Appendix. Based on the self-evaluation results, it was found that the instructional design was generally complete; however, several technical issues were identified, such as typographical errors and the use of less effective language or sentence structures. These issues were subsequently revised, resulting in the development of prototype II.

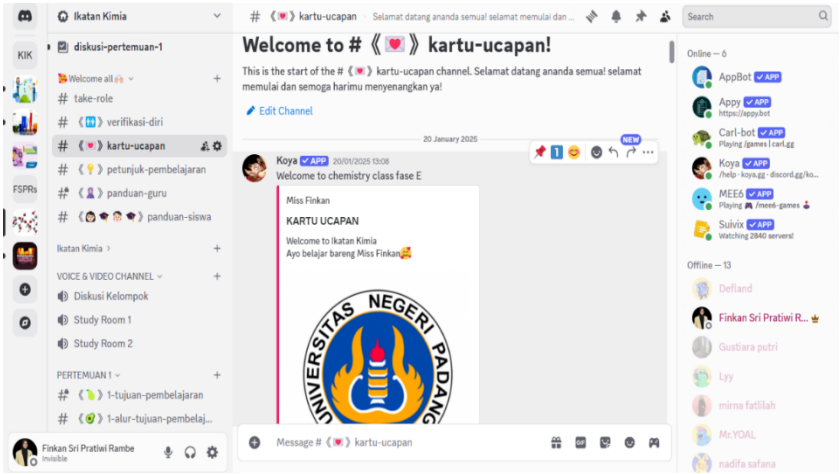

Fig 3. Results after revising the self-evaluation at the orientation on Discord

Prototype III

The product validation stage was conducted by five experts, consisting of three chemistry lecturers from the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang (UNP), and two high school chemistry teachers from Senior High School 8 Padang. The purpose of this validation was to assess the content validity and construct validity of the Flipped Guided Inquiry Learning (FGIL)–based instructional system supported by the Discord application. In the content validity questionnaire, the validators evaluated a total of 24 items. The average scores obtained are as follows:

Table 1. Analysis of content validation results

Assessment Aspects	V	Content Of Validity
Content	0,93	Valid
Presentation	0,85	Valid
Language	0,94	Valid
Graphic	0,87	Valid
Average	**0,88**	**Valid**

Subsequently, for the construct validity questionnaire, the validators provided assessments based on 15 items.

Table 2. Analysis of construct validation results

Assessment Aspects	V	Category Of Validity
Display	0,91	Valid
Convenience	0,88	Valid
Average	**0,91**	**Valid**

Prototype IV

The third prototype was subsequently subjected to small-scale product testing, commonly referred to as the small group trial. This trial involved nine Grade XI Phase F students from Senior High School. The selection of these nine students was based on recommendations provided by the chemistry teacher of the same class. The results of this trial phase are presented in the figure below.

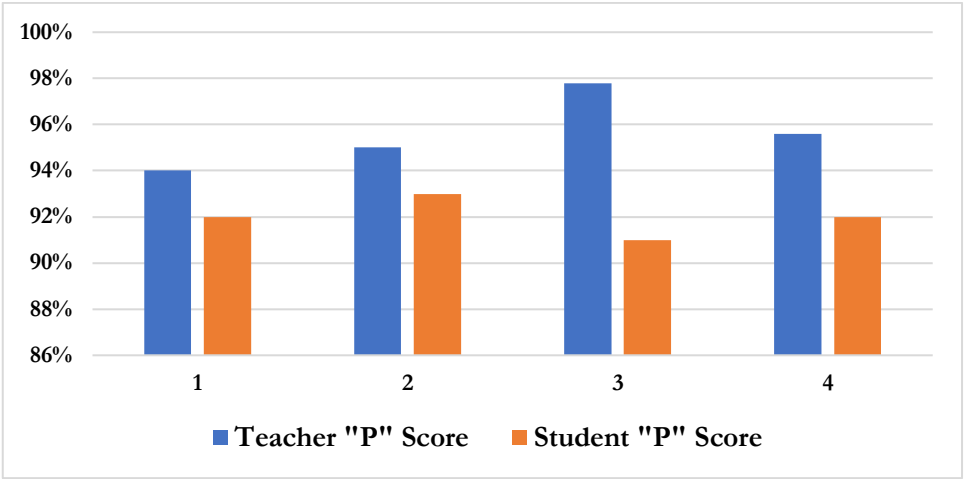

Fig 4. Analysis of student practicality results and teacher practicality results

CONCLUSION

The findings conclude that the Flipped Guided Inquiry Learning (FGIL) system supported by Discord is both valid and highly practical for use in chemistry instruction. With strong validity (Aiken's V = 0.89) and high practicality ratings from both students (92%) and teachers (96%), this learning system is feasible for implementation and holds significant potential to improve student engagement and conceptual understanding, aligning well with the goals of the Merdeka Curriculum.

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DECLARATIONS

Author contribution

Finkan Sri Pratiwi Rambe: data curation, **Mawardi**: writing-original draft preparation, **Arissara Saengngern & Okta Suryani**: conceptualization, **Reza Akmar**: methodology, visualization, editing, analysis.

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The data and the grammatical structure in this article have been validated and verified by English language experts and no AI-generated sentences are included in this article.

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Conflict of interest

The authors declare that this research was conducted without any conflict of interest in the research.

Ethical clearance

The research company has agreed to carry out the research and is willing if the results of this research are published.

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