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ANALYSIS OF STUDENT ENGANGEMENT AND PERCEPTIONS OF COMMUNITY OF INQUIRY (CoI)-BASED BLENDED LEARNING IN THE CHEMICAL SEPARATION SUBJECT ON CHROMATOGRAPHY

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ABSTRACT

Learning in higher education has often been conducted solely through face-to-face, teacher-centered approaches. Implementing Community of Inquiry (CoI)-based blended learning in chromatography is crucial as it offers students a novel learning experience. This pre-experimental study, utilizing a one-group pretest-posttest design, aimed to describe students' perceptions of CoI-based blended learning in chromatography. Data were collected using a questionnaire comprising 34 statements. The results indicated that students had a neutral perception of CoI-based blended learning. While a community of inquiry has been established, it has not yet reached its full potential, as students have not fully experienced social presence in the learning process.

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INTRODUCTION

Learning in higher education is often predominantly conducted through face-to-face, teacher-centered sessions, exemplified by the Chemical Separation course in the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang (UM), Indonesia. In these traditional classroom settings, students benefit from direct instruction, with critical information delivered by the lecturer, allowing students to concentrate solely on the presented material (Pay, 2016; Booth, 2023). However, Anthony et al. (2019) and BakarNordin and Alias (2013) highlight that face-to-face learning is constrained by time limitations. According to Hidalgo (2010), this mode of learning has several drawbacks. Firstly, inflexibility in scheduling, as session times are predetermined. Secondly, restricted interaction between lecturers and students, confined to classroom hours. Peno (2021) asserts that prolonged engagement between lecturers and students can significantly enhance students' comprehension of the subject matter. Integrating internet technology into education can mitigate these limitations by facilitating continuous interaction between lecturers and students, as well as among students themselves, regardless of time and location (Bencheva, 2012; Wiratomo & Mulyatna, 2020).

Blended learning, a hybrid educational model, integrates internet technology with traditional classroom methods, combining face-to-face learning and online components (Garrison & Kanuka, 2004; Garrison & Vaughan, 2008; Müller & Mildenberger, 2021; Zhang et al., 2022). Link and Wagner (2009) describe blended learning as incorporating a variety of activities, including in-person meetings, online learning, and learning communities. The online segment of blended learning encompasses both asynchronous and synchronous interactions. According to Freeman et al. (2000), asynchronous meetings allow lecturers and students to engage at different times, with lecturers providing resources, tests, and assignments online that students can access at their convenience. In contrast, synchronous meetings require real-time interaction, which can be facilitated through text chat, audio conferences via telephone, and video conferences via web platforms or in-person discussions. The implementation of synchronous, asynchronous, and face-to-face components in blended learning is flexible and can be tailored to meet specific educational needs. There are no strict guidelines for the proportion of face-to-face and online activities (Aycock et al., 2002; Unger et al., 2022).

Blended learning is founded on a constructivist learning perspective, emphasizing the development of concepts through active engagement and interaction (Garrison & Vaughan, 2008; Müller & Mildenberger, 2021). This educational approach integrates two fundamental ideas of higher education: community and inquiry. The community aspect highlights the social dimension of education, particularly the role of interaction in creating shared knowledge. Inquiry refers to the process of knowledge construction through investigation. This framework, known as the Community of Inquiry (CoI), comprises three interconnected elements: teaching presence, social presence, and cognitive presence. These elements mutually influence each other. For instance, the selection of appropriate teaching methods (teaching presence) directly impacts student learning outcomes (cognitive presence). Additionally, interactions among students and between students and lecturers (social presence) also affect learning outcomes (cognitive presence) (Asalla et al., 2014; Setyosari et al., 2020). CoI-based blended learning aligns with the characteristics of higher education, fostering interaction and collaboration in the knowledge-building process (Müller & Mildenberger, 2021).

Blended learning is particularly suitable for subjects with extensive and complex material, as it allows students to access a wide array of learning resources via internet technology. One such subject in higher education is chromatography, a topic covered in the Chemical Separation course. Chromatography, a rapidly evolving separation method, presents a broad range of material due to continuous scientific advancements. Internet technology facilitates access to the latest information and research in this field. Understanding chromatography requires more than memorizing definitions and applications; it necessitates critical thinking to grasp abstract concepts such as two-phase equilibrium, the theory of speed, retention time, retention volume, and band broadening in chromatograms, among others (Fitriana, 2012; Wahyu & Bagus, 2020). To aid students in comprehending these intricate concepts, visualization tools like videos or animations can be employed, enhancing the learning experience through appropriate media.

Blended learning employs various online learning media to enhance the educational experience (Castro-Rodríguez et al., 2021), one of which is Edmodo. Edmodo is particularly effective for asynchronous meetings, offering features such as Assignment, Files and Links, Quiz, Polling, Gradebook, Library, Awards Badges, and Parents Codec, all of which facilitate interaction and resource sharing between lecturers and students. Additionally, this research integrates Facebook to complement Edmodo, leveraging its chat feature for real-time discussions. McCarthy (2010) highlights Facebook as an ideal social media platform for blended learning environments. Its Multichat feature enables synchronous meetings, providing a space for dynamic online discussions among lecturers and students, as well as peer-to-peer interactions.

Given that the current teaching approach in the Chemical Separation course at the Department of Chemistry, UM, is limited to face-to-face classroom interactions, implementing CoI-based blended learning for the chromatography subject is considered crucial. This new learning approach can create a fresh atmosphere and provide novel experiences for students. These new experiences inevitably lead to varying perceptions among students regarding the applied learning methods. Student perceptions reflect their opinions about the learning process, and initial negative perceptions could potentially impact their future academic success. Conversely, positive perceptions are expected to enhance student success. Various studies indicate that students generally have positive perceptions of blended learning. For instance, research by Kumar et al. (2021) and López-Pérez et al. (2011) found that students viewed blended learning favorably, as it reduced dropout rates and improved learning outcomes. Similarly, Anthony et al. (2022) and So and Brush (2008) reported positive student perceptions of collaborative learning in a blended learning environment, attributing this to increased social presence and student satisfaction.This research aims to describe students' perceptions of CoI-based blended learning in the subject of chromatography. Understanding these perceptions will help lecturers gauge the extent to which a community of inquiry is established during the learning process. Additionally, insights gained from student perceptions can assist lecturers in refining the design and implementation of their teaching methods, thereby enhancing learning outcomes, student motivation, and overall satisfaction with the learning experience.

METHOD

This study employs a pre-experimental design, specifically a one-group pretest-posttest design. The subjects of this research were 29 fourth-semester students from the H offering of the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang (UM), Indonesia. The research was conducted over four weeks, encompassing eight sessions that included face-to-face meetings, asynchronous online sessions via Edmodo, and synchronous online meetings through Facebook.

The instruments utilized in this research include both treatment and measurement tools. The treatment instruments consist of Learning Implementation Plans (Rencana Pelaksanaan Pembelajaran – RPP) and Student Worksheets (Lembar Kerja Mahasiswa – LKM). The measurement instrument is a perception questionnaire regarding CoI-based blended learning, adapted from Arbaugh et al. (2008). This questionnaire comprises 34 statement items, divided into 13 items on teaching presence, 9 items on social presence, and 12 items on cognitive presence. Responses to the questionnaire are based on a Likert scale, with scores ranging from 1 to 4, where 1 indicates "strongly disagree" (SD), 2 indicates "disagree" (D), 3 indicates "agree" (A), and 4 indicates "strongly agree" (SA).

Before being utilized as research instruments, these tools underwent validity and reliability testing. Content validity and item validity were specifically assessed in this research. The content validity test results for the RPP, LKM, and the perception questionnaire were 77.64% (high criteria), 85.83% (very high criteria), and 76.79% (high criteria), respectively. The reliability test results indicated that the perception questionnaire had a Cronbach's Alpha reliability coefficient of 0.883. According to Fraenkel et al. (1993) and Sileway (2019), a research instrument is considered reliable if the Cronbach's Alpha value exceeds 0.7.

The student perception data obtained from the perception questionnaire on CoI-based blended learning was analyzed descriptively through several steps. Initially, the maximum and minimum scores for all student responses were determined. Subsequently, the range of scores was calculated by subtracting the minimum score from the maximum score, dividing the result by 3 to gauge the distribution of student perceptions. This range was then used to classify student responses into negative, neutral, and positive criteria aligned with

each element of the CoI framework. Finally, the percentage of students expressing negative, neutral, and positive perceptions was determined by comparing the number of students falling into each category against the total number of respondents.

RESULTS

The research findings classify students' perceptions of CoI-based blended learning into negative, neutral, and positive criteria based on the following data: 19 students, comprising 65.50%, expressed positive perceptions of teaching presence (Table 1); 19 students, also representing 65.50%, held neutral perceptions of social presence (Table 2); and 21 students, accounting for 72.40%, reported positive perceptions of cognitive presence (Table 3). Overall, the data reveals that 17 students, constituting 58.62%, maintained neutral perceptions of CoI-based blended learning (Table 4).

DISCUSSION

Student Perceptions of Teaching Presence in CoI-based Blended Learning

The research results in Table 1 indicated that 65.50% of students had a positive perception of teaching presence. Teaching presence encompasses the design and organization of learning, facilitating discourse, direct instruction, and assessment. In this study, the learning activities were structured in accordance with the categories and indicators of teaching presence. This positive perception suggests that students have recognized the effectiveness of the teaching methods. Specifically, students felt that the lecturer communicated learning objectives clearly, which helped them prepare for the subject matter. Additionally, students appreciated the guidance provided by lecturers in understanding concepts and completing assignments. This is crucial in a blended learning environment where direct interaction with lecturers is not always possible. An essential aspect of teaching presence is the leadership exhibited by educators (Asalla et al., 2014; Setyosari et al., 2020). Effective educator leadership is vital for guiding students towards the learning objectives of CoI-based blended learning, thereby enhancing their understanding of the material and enriching their learning experience (Setyosari et al., 2020).

Student Perceptions of Social Presence in CoI-based Blended Learning

Based on the research results in Table 2, it was found that 65.50% of students had a neutral perception of social presence. The social presence category, as defined by Müller and Mildenberger (2021), includes affective communication, open communication, and group cohesion. In the context of online interactions via Edmodo or Facebook, students are expected to actively participate. This participation is assessed through the frequency of posts, responses to discussions, and demonstration of thinking skills, which collectively represent the categories and indicators of social presence in CoI-based blended learning (Shea et al., 2022).

Table 1. Student perceptions of the learning elements of teaching presence.

Range of Score	Criteria	Number of Students
13–25	Negative	1
26–38	Neutral	9
39–52	Positive	19

Table 2. Student perceptions of the learning elements of social presence.

Range of Score	Criteria	Number of Students
9–17	Negative	1
18–26	Neutral	19
27–36	Positive	9

Table 3. Student perceptions of the learning elements of cognitive presence.

Range of Score	Criteria	Number of Students
12–23	Negative	1
24–35	Neutral	7
36–48	Positive	21

Table 4. Student perceptions of CoI-based blended learning.

Range of Score	Criteria	Number of Students
34–67	Negative	1
68–102	Neutral	17
103–136	Positive	11

In terms of posting frequency, students contribute by sharing ideas or responding to others' ideas, fostering openness in expressing opinions. During discussion responses, students are encouraged to freely react to their peers' posts, often using humor or emoticons on Edmodo or Facebook, while maintaining proper communication ethics. These online meetings offer a platform for each student to present their thoughts and opinions during discussions.

The neutral perception of social presence suggests that students do not yet fully feel its impact in their learning experience. Many students view online or web-based communication as an inadequate medium for social interaction and feel discomfort engaging in conversations through these platforms. This discomfort may stem from unfamiliarity with using Edmodo and Facebook as learning tools. Particularly on Facebook, students are not accustomed to quickly sharing or responding to ideas via chat. In asynchronous settings, students often need more time to formulate their thoughts and consider feedback before posting their comments (Riyadi, 2014; Shi et al., 2021).

Student Perceptions of Cognitive Presence in CoI-based Blended Learning

Based on the research results in Table 3, 72.40% of students had a positive perception of cognitive presence, indicating that students felt cognitively engaged during the learning process. This positive perception aligns well with improved cognitive learning outcomes (Kumar et al., 2021; López-Pérez et al., 2011). In this study, students' cognitive learning outcomes increased, evidenced by a gain score of 0.56, which falls within the medium criteria.

Cognitive presence comprises four stages: trigger, exploration, integration, and application. The trigger stage, which occurs during face-to-face classroom meetings, aims to spark students' curiosity. Students reported that the problems presented by the lecturer during the trigger stage heightened their interest in studying chromatography, reflecting an effective initiation of the cognitive presence process.

The stages of exploration, integration, and application in learning are facilitated through student discussions during asynchronous meetings via Edmodo and synchronous meetings via Facebook. In the exploration stage, students exchange information within their groups, express agreement or disagreement with others' opinions, and incorporate learning resources into their discussion responses. Students reported feeling motivated to delve into the material, utilizing various information sources to address presented problems. The use of relevant information aids them in problem-solving, thereby reinforcing the exploration process.

During the integration stage, students synthesize information and ideas from these discussions, forming coherent understanding and connections between concepts. Finally, in the application stage, students apply their newly acquired knowledge to practical or theoretical problems, demonstrating their understanding and ability to use the material effectively. The structured approach across these stages supports cognitive presence and enhances students' learning outcomes.

At the integration stage, students are required to synthesize ideas gathered during the exploration stage. During asynchronous meetings via Edmodo, not all students in each group reached this stage effectively. However, in synchronous meetings via Facebook, students were more successful in connecting ideas, leading to a deeper understanding of chromatography concepts. Students reported that the integration stage helped them address the problems presented in the lectures.

In the application stage, students were tasked with designing a chemical separation experiment using chromatographic methods. While students felt confident in applying their conceptual understanding to this task, the collected experimental design reports revealed that not all students were able to design chromatographic experiments successfully. Additionally, many students did not use research journals as reference materials for their experimental designs, indicating a gap in utilizing academic resources effectively.

CONCLUSION

Students have given a neutral perception of CoI-based blended learning in the chemical separation subject on chromatography. This neutral perception indicates that while students are experiencing CoI-based blended learning, they have not yet fully recognized its benefits. It also suggests that a community of inquiry is beginning to form but is not yet functioning optimally, as students do not fully perceive social presence during learning. To enhance social presence and maximize the effectiveness of CoI-based blended learning, further research should focus on providing more guidance and encouragement from lecturers. This support can help students become more actively involved in discussions, thereby fostering a stronger sense of community and improving the overall learning experience.

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AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design of the study, as well as to data collection, analysis, interpretation, writing, evaluating, and revising of the manuscript. All authors have approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

All authors of this manuscript have no conflict of interest with other people or organizations that could inappropriately influence or bias the data of the research.

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