Bridging learning gaps through Discord: peer-to-peer learning in computer graphics education

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Abstract

Purpose – This study examines how Discord facilitates peer-to-peer learning in a university-level computer graphics course. It explores how the platform supports student engagement, peer feedback and mentorship in a technical, project-based setting. By analyzing survey responses and server engagement metrics, the study highlights Discord's role in enhancing collaboration and academic outcomes through interactive peer learning.

Design/methodology/approach – This study adopts a mixed-methods approach, combining quantitative and qualitative data. An anonymous survey was conducted with 111 students to assess their experiences with peer learning on Discord, focusing on engagement, feedback and mentorship. Server engagement metrics, including message counts and channel activity, were analyzed to measure participation patterns. Open-ended survey responses were thematically analyzed to identify recurring themes related to collaboration and challenges. Data collection occurred over four weeks, and statistical analysis was performed to summarize the findings.

Findings – The study found that Discord significantly enhances peer-to-peer learning by fostering collaboration, mentorship and constructive feedback in a university-level computer graphics course. Students frequently sought and provided assistance through the platform, with senior peers playing a vital mentorship role. Engagement metrics revealed high activity levels in academic channels, emphasizing Discord's utility in technical, project-based tasks. Peer feedback was rated as valuable and complementary to instructor input. However, challenges included managing the volume of content and maintaining academic focus within Discord's informal environment. These findings highlight Discord's potential for fostering effective peer learning when used with clear structure and moderation.

Practical implications – Educators can leverage Discord to enhance peer-to-peer learning and collaboration in technical, project-based courses. By integrating Discord into their teaching strategies, they can foster real-time interaction, mentorship and constructive feedback among students. To maximize its effectiveness, it is important to provide structure and moderation—such as setting clear guidelines and dedicating specific channels for academic discussions—to manage content volume and maintain academic focus. Institutions should consider training faculty on effectively implementing Discord or similar platforms, not only recognizing the potential challenges but also the significant benefits in student engagement and learning outcomes.

Originality/value – This study offers unique insights into the use of Discord as a peer-to-peer learning tool in a university-level computer graphics course. By combining survey data with engagement metrics, it provides a comprehensive analysis of how Discord's features support mentorship, collaboration and feedback in technical, project-based education. The findings emphasize Discord's potential to address diverse skill levels and foster interactive learning environments. This research contributes to the growing literature on digital platforms in

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Availability of data and material: The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to privacy concerns, individual student survey responses remain anonymous and are not publicly accessible.

Ethical statement: Ethical considerations included anonymizing data and obtaining informed consent, ensuring participant confidentiality and unbiased responses.

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education, showcasing practical strategies for integrating Discord to enhance student engagement and learning outcomes in similar academic settings.

Keywords Peer support, Student engagement, Higher education, Digital environment, Online interactive resources

Paper type Research paper

1. Introduction

The rapid shift to digital learning tools, especially during and after the COVID-19 pandemic, has brought new opportunities and challenges to education. Platforms such as Discord, originally designed for gaming communities, have found their way into academic settings, offering a flexible space for collaboration and communication (Schwartz, 2021). Unlike traditional learning management systems, Discord allows students to interact in real-time, using features like chat, voice channels and file sharing, making it a versatile tool for peer-to-peer learning (Vladoiu & Constantinescu, 2020; Schwartz, 2021).

Peer learning, where students help and learn from each other, has long been recognized as an effective educational approach. Vygotsky's Zone of Proximal Development (ZPD) theory, which defines the range of tasks a learner can accomplish with guidance but not independently, supports the idea that students can achieve more when working with more knowledgeable peers (Vygotsky, 1978). This framework is particularly relevant for complex subjects like computer graphics, where peer mentorship and feedback play a critical role in bridging learning gaps. Platforms like Discord offer new ways for students to engage within their ZPD, allowing for both synchronous and asynchronous interaction (Arifianto & Izzudin, 2021; Schwartz, 2021).

Despite its growing use in educational contexts, research on Discord's role in fostering peer learning is still limited. While some studies have explored its effectiveness in enhancing student engagement and collaboration (Ayob, Hadi, Pahroraji, Ismail, & Saaid, 2022; Craig and Kay, 2022), there is a need to examine how platforms like Discord can support technical, project-based courses where peer feedback and mentorship are essential.

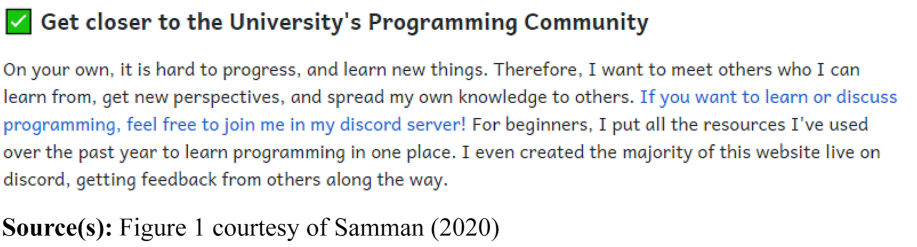
This study aims to address that gap by investigating how Discord supports peer learning in a university-level computer graphics course. Specifically, it looks at how students use the platform to collaborate, seek assistance and provide mentorship and how these interactions impact their learning experience. By analyzing both survey responses and the course Discord server engagement metrics, this study provides a comprehensive look at how Discord functions as a tool for peer learning.

2. Course background and the introduction of Discord as a learning tool

Since I began teaching the computer graphics course in 2017, I have observed a wide range of skill levels among my students, particularly in their ability to handle labs, projects and activities involving 3D graphics. Some students demonstrated advanced capabilities, while others struggled, and a portion had little to no prior experience. This diversity in skill levels presented challenges, especially in fostering an environment where students could collaborate and learn from one another effectively.

In 2020, I experienced something that would reshape how I approached teaching this course. While teaching another class, technical writing, I noticed one of my students reporting to his peers, "*If you want to learn or discuss programming, feel free to join me in my Discord server!*" (Figures 1 and 2. Curiously, I joined the mentioned server. I observed seamless collaboration among students, which really intrigued me. It was the first time I was introduced to the Discord platform!

Curious about Discord's potential for my computer graphics course, I enlisted the help of two students who were familiar with Discord. They walked me through the platform, helped me understand its functionality and assisted me in setting up a server specifically for my



Source(s): Figure 1 courtesy of Samman (2020)

Figure 1. A student in a technical writing course reported to his peers, calling to join his programming Discord server

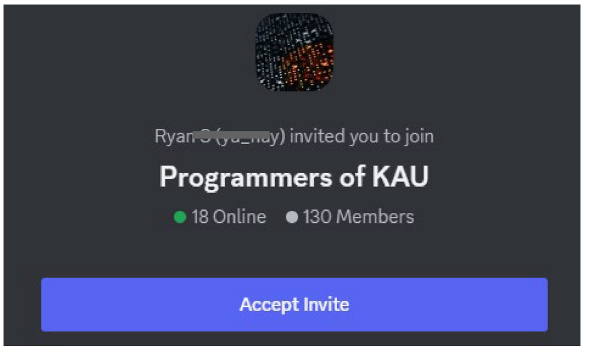


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Figure 2. An invite to join programmers' community on Discord

course. On 16 January 2022, I decided to fully integrate Discord into the computer graphics course, inviting students to join the server from the very first day; see Figure 3.

When I introduced Discord to the class for the first time, I immediately asked which students had experience with the platform. One student raised his hand, and I appointed him as the teaching assistant (TA) for the server. I gave him full permission to restructure the server in a way he felt would appeal to his peers, trusting his expertise. What unfolded next amazed me. The student completely restructured the server and added some engaging features such as bots.

I realized that many students were already familiar with Discord. They were already using the platform to connect with friends and have fun. The transition to using the platform for

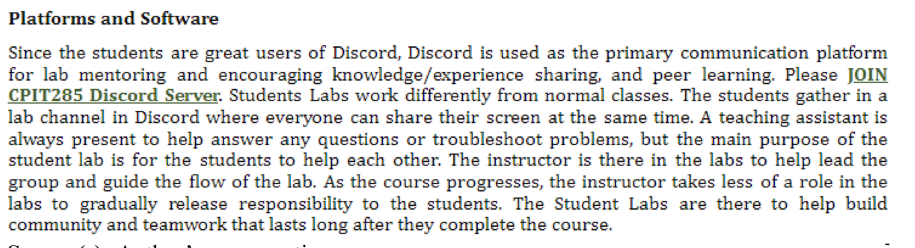

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Figure 3. Invitation for computer graphics students to join the Discord community for lab mentoring and peer learning

academic collaboration felt natural to them. The TA's enhancements to the server only deepened this connection, and since then, I have made it a tradition to appoint a new TA from the student body each semester. These TAs are given creative freedom to enhance interactivity, engagement and the overall design of the server. Each semester, students eagerly look forward to the changes, as the server evolves into a dynamic space for collaboration.

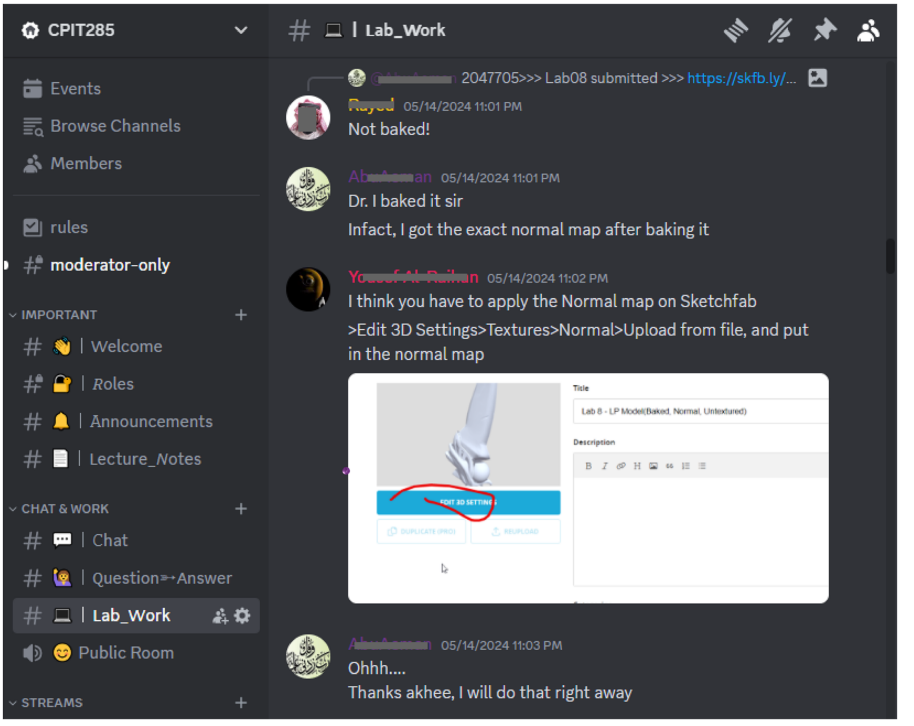
Figure 4 below demonstrates a typical interaction on the course Discord server, where students collaborate to resolve technical issues. In this example, a peer provides step-by-step guidance and a screenshot to clarify the application of a normal map in Sketchfab. This showcases how real-time collaboration enhances problem-solving efficiency.

My observations of the students' engagements are what ultimately motivated me to conduct this study. I want to document and share this experience with my colleagues and the broader educational community in the hope that others might find value in using platforms like Discord to enhance peer learning.

3. Literature review

3.1 Online learning platforms in education

The use of online platforms in education has become essential, especially following the COVID-19 pandemic. Tools like Zoom, Microsoft Teams and Discord have emerged as crucial solutions for fostering collaboration and engagement in virtual classrooms (Vladoiu and Constantinescu, 2020). Initially developed as a gaming platform, Discord has gained attention for its versatility in educational contexts (Schwartz, 2021). Discord's popularity among students stems from its



Source(s): Author's own creation

Figure 4. Screenshot of the computer graphics course Discord server

origins as a platform designed for gaming and entertainment, making it both familiar and appealing. Its informal and engaging nature allows educators to connect with students through a medium they already enjoy, seamlessly transitioning from entertainment to education. Its flexibility supports a range of collaborative practices, from real-time discussions to long-term project management (Ayob *et al*., 2022). In contrast, platforms like Zoom, Microsoft Teams and Slack are primarily designed for formal communication and professional collaboration, which can feel less relatable to students. Compared to Microsoft Teams, which excels in structured workflows and institutional integration, and Slack, which offers similar real-time collaboration features but restricts message history in its free version (Slack, 2025), Discord uniquely combines structure with informality. Features such as voice channels, unlimited message history and customizable bots foster real-time collaboration and peer-to-peer learning. However, its casual nature requires clear moderation to maintain academic focus.

Recent research confirms that students widely accept Discord as an alternative online learning medium. Arifianto and Izzudin (2021) utilized the technology acceptance model (TAM) to explore students' perceptions of Discord in educational settings. Their findings indicate that students appreciate Discord for its ease of use, intuitive interface, and comprehensive features, especially during the pandemic. These features allow students to communicate, share resources and engage in collaborative tasks efficiently (Arifianto and Izzudin, 2021).

Another study by Craig & Kay (2022) conducted a systematic review of Discord's application in higher education. The review highlights key benefits, such as improved social presence, enhanced student engagement and ease of communication within asynchronous and synchronous environments. However, the study also notes the challenges of managing potential distractions and technology issues, both of which can hinder student engagement (Craig and Kay, 2022). Despite these challenges, Discord has proven to be an effective tool in supporting peer-to-peer learning and communication in both traditional and virtual classrooms.

3.2 The role of the ZPD in collaborative learning

Vygotsky's ZPD (1978) highlights the gap between what learners can achieve independently and what they can accomplish with guidance from more knowledgeable peers or instructors. This concept underscores the importance of collaborative learning environments where students receive peer support to advance their knowledge and skills. The current study aims to explore how peer-to-peer learning facilitated through Discord supports student development in computer graphic education.

De Marsico, Giarlini, Sterbini, & Temperini, 2017 demonstrated that adaptive group formation in online learning environments enhances learning by forming groups based on students' cognitive abilities. This approach aligns with the current study's focus on Discord, where students with varying skill levels collaborate and provide peer support in a digital environment. This form of collaboration is key to bridging the knowledge gaps that students face when working on complex tasks, such as those found in computer graphics (De Marsico *et al*., 2017).

Havnes (2008) focused on peer-mediated learning beyond the curriculum and highlighted the importance of peer collaboration within the ZPD. Havnes' study shows that peer learning occurs not only through structured educational activities but also through student-driven interactions that create new learning opportunities. Discord's flexible communication tools, such as real-time chat, support this type of learning by enabling students to collaborate on tasks they may not be able to complete independently. This study is highly relevant to the present research, as it demonstrates how digital platforms like Discord facilitate peer-mediated learning (Havnes, 2008).

Recent studies have expanded on Vygotsky's ZPD to include collaborative digital platforms. Moon, McNeill, Edmonds, Banihashem, and Noroozi (2024) explored the role of asynchronous gamified platforms in enhancing peer learning, highlighting how platforms like Discord can provide an interactive space where students can work collaboratively. Moon's

research supports the current study's emphasis on using Discord to enhance collaborative learning in technical courses. Likewise, Kumar (2021) studied real-time digital tools and their role in collaborative learning, emphasizing the importance of immediate feedback and support in group-based tasks. This echoes how Discord's real-time chat and media-sharing features enable continuous peer interaction, facilitating learning through scaffolding.

3.3 Peer-to-peer learning on discord

Peer feedback is essential in educational settings as it provides immediate and constructive input that enhances student understanding and performance (AlGhamdi, 2023). Muck & Kluge (2021) found that peer learning activities, such as structured feedback and collaborative projects, significantly improve cognitive and metacognitive skills. Discord's features make it easier for students to engage in discussions and improve their work based on peer input.

Almomani (2024) emphasized that interaction is one of the core affordances of Discord in educational contexts. The platform's ability to facilitate continuous peer engagement through its communication tools allows students to share knowledge, provide feedback and work collaboratively. This interaction aligns with Vygotsky's scaffolding model, where students support each other in advancing through their learning tasks (Almomani, 2024).

Mentorship plays a vital role in peer-to-peer learning environments. Senior students or those with more expertise, often act as mentors, guiding less experienced peers through complex tasks. This mentorship aligns with Vygotsky's scaffolding concept, where learners benefit from guidance provided by more knowledgeable individuals. Din (2017) explored the role of peer tutoring in online environments, showing that both synchronous and asynchronous support from peers enhances learning outcomes. Discord's ability to support real-time and delayed interactions makes it an ideal platform for peer tutoring, particularly in courses where students require immediate assistance, such as computer graphics.

Almomani (2024) also noted that students often assume mentorship roles within Discord communities, providing real-time guidance to their peers. This aligns with the ZPD framework, where students learn through interaction and collaboration with more knowledgeable peers. The platform's features allow for effective mentorship, with students able to offer assistance and advice to their classmates on challenging tasks (Almomani, 2024).

3.4 The affordances of discord in educational contexts

Discord offers a range of affordances that make it a suitable tool for education. Almomani (2024) categorizes these affordances into core, assistive and innovative types. Core affordances include basic communication tools like text, voice and video channels, which facilitate real-time collaboration and communication. Assistive affordances include bots and tools that automate tasks, enhancing project management and organization. Innovative affordances refer to the platform's flexibility, allowing users to create custom features that can improve the learning experience by supporting task automation and content management (Almomani, 2024).

Craig and Kay (2022) emphasized the importance of these affordances in supporting learning environments. Discord's ability to enhance social presence and interaction makes it an effective platform for peer-to-peer learning, especially in courses that require continuous collaboration. However, the platform's informal nature can also present challenges, such as managing distractions, which need to be addressed to ensure productive learning outcomes (Craig and Kay, 2022).

The above-reviewed literature highlights the growing role of online platforms like Discord in facilitating peer learning in higher education. By integrating Vygotsky's ZPD framework and utilizing Discord's affordances, students can engage in peer-to-peer learning, mentorship, and real-time interaction, all of which contribute to improved learning outcomes. Despite the challenges associated with managing distractions, Discord's features and flexibility make it a powerful tool for enhancing student engagement and collaboration in technical courses like computer graphics.

4. Methodology

4.1 Participants

A total of 167 students were eligible to participate in this study, all of whom were members of the computer graphics course Discord server; see Figure 5. Of these, 111 students completed the survey, providing valuable insights into their experiences with Discord for peer-to-peer learning. However, due to the anonymous nature of the survey, no demographic data from the actual participants was collected to ensure their privacy and allow them to respond freely without concern about identification.

Despite this, descriptive statistics of the eligible population were obtained from the Discord server's statistical data. These statistics provide a useful understanding of the general population using the server, offering context about the larger group from which the survey participants were drawn. The data includes information about gender, time since joining Discord, time since joining the course Discord server and roles within the server.

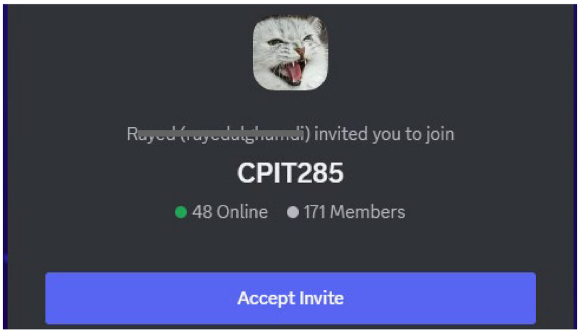
Table 1 below presents the demographics of the eligible population. Notably, all 167 eligible participants were male, and most had been on Discord for several years before joining the course's server. A significant number of students joined the course Discord server in recent academic terms (2023, Term 2 and 2024, Term 1), while roles within the server were dominated by senior students, many of whom likely served as peer mentors or leaders. Although these statistics do not directly correspond to the 111 participants, they offer valuable context for understanding the larger group using the Discord platform.

4.2 Instruments and tools

To collect data on student experiences with peer-to-peer learning on Discord, a survey was designed specifically for this study. The development process of the survey involved several key steps to ensure that it accurately captured the intended data on peer interactions and the educational utility of Discord.

The survey items were developed by drawing from established research on peer learning and feedback in digital platforms (Topping, 2005; Nicol & Macfarlane-Dick, 2006). The items focused on several key areas, including the effectiveness of peer feedback on Discord, the role of experienced students in supporting their peers and the overall impact of Discord on student engagement and collaboration. These elements were tailored to reflect the context of the computer graphics course.

A pilot study was conducted with 13 students to assess the clarity and relevance of the survey items. These participants completed the survey and provided feedback on any questions that were unclear or seemed redundant. Based on their feedback, some questions



Source(s): Author's own creation

Figure 5. A screenshot of the course Discord server with a total number of 171 members including three bots and the instructor

Table 1. Descriptive statistics of eligible population on Discord server

Info	Variable	Frequency (N)	Percentage (%)
Gender	Male	167	100
	Female	0	0
Time joining Discord	7–8 years ago	46 (34,12)	27.5
	5–6 years ago	42 (18,24)	25.1
	3–4 years ago	43 (16,27)	25.7
	1–2 years ago	28 (12,16)	16.8
	Less than a year	8	04.7
Time joining course Discord server	2022, term1	28	16.8
	2022, term 2	21	12.5
	2023, term 1	25	14.9
	2023, term 2	61	36.5
	2024, term 1	32	19.1
Role on the course Discord server (as per term 1, 2024)	Teacher aid	5	02.9
	Senior	131	78.4
	Current	31	18.5

Source(s): Author's own work

were refined to better reflect the diversity of experiences with Discord. This process helped ensure that the final survey was user-friendly and adequately covered the study's objectives.

The reliability of the survey was assessed using Cronbach's alpha, resulting in a score of 0.80. This indicates a high level of internal consistency, confirming that the survey items reliably measured the key concepts of peer learning and student engagement on Discord.

The final survey consisted of both closed-ended and open-ended questions. The closed-ended questions used either a frequency scale or a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." Open-ended questions allowed participants to provide more detailed feedback on their experiences. The specific survey items are listed in Table 2 below.

In addition to the survey, server metrics from the Discord platform were collected to provide an objective measure of student engagement and interaction patterns. Metrics such as the number of messages sent, participation in various channels and media sharing were tracked to understand the levels of student activity on the server. These metrics provide a detailed look at how students engaged with the platform throughout the course.

4.3 Data collection and analysis

Data collection was conducted for four weeks during the first semester of 2024. The survey was distributed through the Discord server, and responses were collected anonymously via Google Forms to ensure participant confidentiality. The survey consisted of both closed-ended and open-ended questions, using a five-point Likert scale and frequency scale for quantitative responses and free-text fields for qualitative insights. These items were designed to assess key aspects of peer learning, including feedback, mentorship and collaboration.

Server metric data were extracted directly from the Discord platform using its built-in analytic tools and custom bots configured to track specific engagement indicators. Metrics collected included the total number of messages sent, the distribution of messages across channels (e.g. "Lab_Work" and "General Chat") and the volume of media shared. These data provided a detailed view of interaction patterns, highlighting which channels were most active and the types of engagement occurring. To ensure data accuracy, metrics were cross-verified with Discord's built-in server insights feature.

The quantitative data from the surveys were analyzed with the assistance of an artificial intelligence (AI) tool (OpenAI's ChatGPT-4o). Descriptive statistics, including means and

Table 2. Survey instrument items

Theme	Survey instrument item	Scale
	How often do you ask for help from your peers on Discord when working on difficult tasks?	frequency
Peer support and collaboration	The help I receive from my peers on Discord enables me to understand and complete tasks that I would struggle to finish on my own	five-points Likert
	I actively offer help to my peers on Discord when they face challenges with course assignments	five-points Likert
	Senior or more experienced students on Discord provide useful guidance that helps me improve my work and understanding	five-points Likert
Feedback and learning	The feedback I receive from peers on Discord helps me improve my understanding and performance on assignments	five-points Likert
	The feedback provided by my peers on Discord is constructive and helps me identify areas where I need to improve	five-points Likert
	Peer feedback on Discord complements the feedback I receive from the instructor, helping me improve my performance	five-points Likert
Discord features and learning tools	Which Discord features (e.g. real-time chat, voice channels and file sharing) are most helpful for collaborating with peers?	five-points Likert
	I find it easy to seek help from peers on Discord when I encounter difficulties with course material	five-points Likert
	I find Discord more effective for peer learning and collaboration than other platforms (e.g. Blackboard and Google Classroom)	five-points Likert
Challenges in using discord	The casual environment of Discord sometimes makes it difficult to stay focused on academic discussions	five-points Likert
	I find it difficult to manage or follow conversations and resources on Discord due to the volume of content	five-points Likert
	What challenges or difficulties have you faced when using Discord for course-related activities?	Open-ended
Overall experience and suggestions	Using Discord has improved my overall learning experience in this course	five-points Likert
	I would recommend using Discord for future courses to facilitate peer-to-peer learning	five-points Likert
	What suggestions do you have to improve the use of Discord for peer-to-peer learning in this course?	Open-ended

Source(s): Author's own work

standard deviations, were calculated to summarize student perceptions across various survey items. The AI tool was used to process and calculate these statistics based on the data provided by the researcher. It facilitated the calculations and provided an overview of the data. The analysis focused on key metrics, such as student engagement, peer feedback and the use of Discord features for collaboration. While the AI tool assisted in processing the data, the researcher maintained oversight and reviewed all calculations to ensure accuracy and alignment with the study's objectives.

The qualitative data from open-ended survey responses were also analyzed with the assistance of ChatGPT-4o. Thematic analysis was conducted to identify recurring themes related to peer feedback, mentorship and collaboration. ChatGPT-4o was used to scan the responses and assist in recognizing patterns, highlighting common phrases and topics discussed by the students. Once ChatGPT-4o identified potential themes, the researcher reviewed and refined these themes to ensure they accurately represented the students' experiences. The final interpretation and categorization of themes were performed by the researcher, ensuring that the thematic analysis maintained its rigor and accurately captured the nuances of the qualitative data.

4.4 Ethical considerations

All participants provided informed consent before participating in the survey. Data collected from Discord was anonymized to protect student privacy, and participation in the study was

voluntary. Students were informed of their right to withdraw from the study at any time without any consequence.

OpenAI's ChatGPT-4o was used as a supplementary tool to assist with data processing in both the quantitative and qualitative analyses. The researcher maintained full responsibility for overseeing the process, ensuring the accuracy of the AI-generated outputs and interpreting the results. The AI tool facilitated the analysis, but all final decisions regarding data interpretation were made by the researcher to uphold scientific rigor and integrity.

5. Results

5.1 Survey results

A total of 111 students participated in the survey, providing valuable insights into their use of Discord for peer-to-peer learning. Survey results highlight the importance of peer support, feedback and Discord's features in learning.

As shown in Table 3, students often sought help from peers, with a mean score of 4.2 out of 5 (SD = 0.85), and most students agree that peer support enables them to complete challenging tasks (M = 4.3, SD = 0.78). Peer mentorship from senior students was rated particularly high, with an average score of 4.5 (SD = 0.70), indicating that experienced students play a significant role in guiding others.

In Table 4, students generally rated peer feedback as helpful, with a mean score of 4.1 (SD = 0.76). Peer feedback was seen as constructive, complementing the feedback provided by instructors (M = 4.2, SD = 0.72). These results suggest that students value both the formal and informal feedback mechanisms provided by the platform.

Table 5 shows that students rated Discord highly for collaboration, with an average score of 4.4 (SD = 0.66). Real-time chat and voice channels were frequently mentioned as key tools that enhanced peer-to-peer learning. Furthermore, Discord was generally viewed as more effective for peer learning than traditional learning management systems like Blackboard.

Table 3. Peer support and collaboration survey results

Survey item	M	SD
How often do you ask for help from your peers on Discord when working on difficult tasks?	4.2	0.85
The help I receive from my peers on Discord enables me to understand and complete tasks that I would struggle to finish on my own	4.3	0.78
I actively offer help to my peers on Discord when they face challenges with course assignments	3.9	0.92
Senior or more experienced students on Discord provide useful guidance that helps me improve my work and understanding	4.5	0.70

Source(s): Author's own work

Table 4. Feedback and learning survey results

Survey item	M	SD
The feedback I receive from peers on Discord helps me improve my understanding and performance on assignments	4.1	0.76
The feedback provided by my peers on Discord is constructive and helps me identify areas where I need to improve	4.0	0.79
Peer feedback on Discord complements the feedback I receive from the instructor, helping me improve my performance	4.2	0.72

Source(s): Author's own work

Table 5. Discord features and learning tools survey results

Survey item	M	SD
I find it easy to seek help from peers on Discord when I encounter difficulties with course material	4.3	0.74
Discord's features (e.g. real-time chat, voice channels and file sharing) help collaborate with peers	4.4	0.66
I find Discord more effective for peer learning and collaboration than other platforms (e.g. Blackboard)	4.1	0.80

Source(s): Author's own work

While survey responses highlight students' perceptions of peer learning and collaboration on Discord, engagement metrics offer an objective perspective on how these interactions unfolded. By analyzing total messages, channel activity and media sharing, the engagement metrics provide deeper insights into the platform's role in facilitating student collaboration.

5.2 Discord engagement metrics

To complement the survey results, engagement metrics from the Discord server were analyzed. These metrics provide a quantitative measure of how students interact on the platform, focusing on total messages, help exchanges and channel usage. The statistics presented in Table 6 below cover five semesters, spanning from the creation of the server in January 2022 to the current semester (Semester 1, 2024), offering a comprehensive view of student engagement over time.

The engagement metrics show active participation, with a total of 7,581 messages exchanged across various channels. The Lab_Work channel was the most active, accounting for 44% of the total messages. This channel was heavily utilized for peer-to-peer problem-solving and technical guidance. The Question→Answer channel made up 21% of the messages and played a complementary role by focusing on specific academic queries and their resolution. In contrast, the "General Chat" channel accounted for 32% of the messages, balancing informal interactions with occasional academic discussions. The "Announcements" channel, though comprising only 3% of the total messages, served as a critical source for course-related updates.

In terms of shared resources, 905 media files were exchanged among students, aiding collaborative learning. This sharing of media files included images, screenshots and resources that enhanced peer feedback and understanding. These metrics provided quantitative evidence of the high engagement levels on Discord and underscored the platform's role in fostering peer learning.

Other metrics that are useful but were not fully captured due to technical difficulties are the reactions to individual submissions. These reactions, which typically serve as a form of feedback (e.g. 👍), are indicative of how students respond to and acknowledge each other's

Table 6. Summary of the computer graphics discord server engagement metrics

Metric	Value
Total messages	7,581
Lab_work channel messages	44% of total messages
Question → Answer channel messages	21% of total messages
General chat messages	32% of total messages
Announcements messages	3% of total messages
Media shared	905

Source(s): Author's own work

work. While detailed tracking of these reactions was not possible, a screenshot as shown in Figure 6 below provides a visual representation of how reactions may contribute to the overall feedback culture on the platform.

5.3 Analysis of open-ended survey responses

Thematic analysis of the open-ended survey responses provided further insights into students' experiences with Discord as a peer learning tool. Three key themes emerged: effective peer feedback, mentorship and support from experienced peers and challenges with managing information.

Many students noted that the feedback provided by peers on Discord was timely and constructive. One student shared, "When I was stuck on creating a normal map for my project, a peer not only explained it but also shared a screenshot of the settings I needed to adjust." Another student emphasized, "The quick feedback I got on Discord felt more like a conversation, which helped me fix errors and understand concepts in real time." The real-time communication features of the platform allowed them to quickly get feedback on assignments and clarify doubts. This immediate feedback loop was particularly valuable for understanding difficult concepts and improving assignment performance.

Another recurring theme was the role of senior students or more experienced peers in providing mentorship. One student described their experience: *"The guidance I received from senior students was better than what I could have imagined in a classroom. They shared practical tips that I immediately applied to my lab work."* This guidance bridged knowledge gaps and fostered collaboration, reinforcing the value of peer-to-peer learning on the platform.

Some students reported difficulty in managing and following conversations on Discord, particularly due to the high volume of messages. The informal nature of the platform, while beneficial for fostering a relaxed learning environment, sometimes made it difficult to stay focused on academic discussions. As one student put it, *"It's easy to miss important updates when the chat is constantly active. Sometimes I had to scroll through tens of messages to find what I needed."* These challenges highlight the need for better organization and moderation to ensure academic focus amidst the informal nature of the platform.

Source(s): Author's own creation

Figure 6. A student submission, highlighting how reaction icons provide quick, informal peer feedback that fosters engagement

5.4 Summary of results

The results of this study suggest that Discord plays a significant role in enhancing peer learning and collaboration in the computer graphics course. Both the survey data and the engagement metrics show high levels of student interaction, particularly in channels dedicated to the lab work. Students consistently rated peer support, feedback and the use of Discord's features as beneficial for their learning experiences. However, some challenges were noted, particularly in managing the content volume and balancing the platform's casual environment with academic discussions.

6. Discussion

6.1 Interpretation of key findings

The findings from the survey and engagement metrics collectively illustrate Discord's capacity to support student collaboration and engagement. The high activity levels in channels such as "Lab_Work" and "Question→Answer" align with students' perceptions of the platform as a valuable tool for seeking peer support and providing feedback. These results emphasize the interplay between structured features and informal interactions in fostering an effective learning environment (Vladoiu and Constantinescu, 2020; Schwartz, 2021). The high mean scores for peer support and mentorship reflect senior students' significant role in guiding their less experienced peers, a dynamic that resonates with ZPD. Within their ZPD, students were able to receive scaffolding from more knowledgeable peers, which helped them complete tasks they would otherwise struggle with independently (Vygotsky, 1978).

The constructive peer feedback provided on Discord further reinforces the platform's potential as an educational tool. Students reported that the feedback they received from their peers helped identify areas for improvement, echoing findings from studies such as those by Nicol and Macfarlane-Dick (2006), which emphasize the role of peer feedback in enhancing learning outcomes. The ability to receive real-time feedback was particularly beneficial for students working on assignments, supporting the idea that immediate feedback is crucial in scaffolding student learning within the ZPD framework (Schwartz, 2021).

The results of this study are consistent with previous research on the use of Discord in educational settings. Arifianto and Izzudin (2021) found that students perceive Discord as an effective platform for collaboration and peer support, especially during periods of remote learning. Similarly, the current study confirms that students find Discord's features to be instrumental in facilitating collaboration regardless of education type. The high engagement levels in channels dedicated to academic support are consistent with findings by Craig and Kay (2022), who highlight Discord's ability to enhance social presence and engagement in asynchronous and synchronous learning environments.

However, this study also revealed certain challenges that students face when using Discord for academic purposes. Several students reported difficulties in managing a large volume of content, which sometimes caused them to miss important information. This issue was also highlighted in earlier research by Ayob *et al.* (2022), who noted that the informal nature of Discord can sometimes detract from academic focus. These findings suggest that while Discord is effective in fostering collaboration, careful moderation and structured use are necessary to maximize its educational potential.

6.2 Theoretical and practical implications

The findings of this study strongly align with the ZPD framework. By facilitating real-time interaction, Discord serves as a platform where students can receive timely assistance from their peers. This allows them to extend their learning beyond what they could achieve independently. The concept of scaffolding, central to the ZPD framework, is particularly evident in the role played by experienced students who provided mentorship and guidance to their less experienced peers. This peer-to-peer mentorship helps bridge the gap between what

students can do on their own and what they can achieve with support. This highlights Discord's role in fostering a collaborative learning environment that aligns with the ZPD principles.

Moreover, the study demonstrates how Discord can effectively complement traditional instructor feedback. Students consistently reported that peer feedback on Discord enhanced their understanding of course materials, providing a valuable supplement to formal instructor feedback. This finding aligns with Nicol and Macfarlane-Dick's (2006) assertion that peer feedback is a key component of formative assessment, helping students to improve their performance through regular, informal interaction.

The practical implications of these findings are significant for educators and course designers. Discord offers a flexible, user-friendly platform that can enhance peer learning and collaboration, particularly in technical, project-based courses (Schwartz, 2021). Educators should consider incorporating Discord into their teaching strategies, especially for courses that require cooperation and ongoing feedback. However, to maximize its potential, careful structuring and moderation are essential. Organizing channels by specific topics, such as assignments, Q&A, projects and general chat, can help reduce content overload and make conversations easier to navigate. Pinned messages are also valuable for highlighting key resources, announcements and links, ensuring that essential information remains accessible to all users.

To maintain academic focus, clear guidelines for channel usage should be established, encouraging students to stay on task and participate in discussions relevant to each channel's purpose. Assigning a TA or moderator to monitor activity and gently redirect off-topic conversations can further enhance the effectiveness of Discord as an educational tool. Additionally, experienced students can take on mentorship roles, fostering a supportive community where knowledge-sharing and collaboration thrive. Providing these mentors with guidance on offering constructive feedback ensures that their contributions remain valuable and positive.

By adopting these approaches, educators can create a structured yet flexible learning environment that leverages Discord's informal nature to foster collaboration and engagement while maintaining academic rigor.

6.3 Limitations and future research

While this study provides valuable insights into the use of Discord for peer-to-peer learning, certain limitations are acknowledged. First, the data collected from the survey was self-reported, which may introduce bias, as students could overestimate or underestimate their engagement and learning outcomes. Second, the engagement metrics were limited to quantitative measures of participation, such as message counts and channel activity. While these metrics provide a useful overview of student engagement, they do not capture the quality of interactions or the depth of learning that occurred through these interactions. Future research could employ qualitative methods, such as interviews or focus groups, to gain a deeper understanding of how students use Discord for their learning.

Furthermore, the short-term scope of this study presents a limitation in fully understanding the long-term implications of using Discord as a learning tool. While the results provide valuable insights into student engagement and peer learning within the context of a single semester, they do not account for how sustained use of the platform might affect collaboration, academic performance or student perceptions over time. Longitudinal studies could help address this gap by examining the evolving dynamics of student interactions on Discord across multiple semesters.

Another notable limitation is the lack of demographic data, which was omitted to preserve participant anonymity. While this approach ensured honest responses, it restricted the ability to analyze how factors such as age, prior experience with Discord or academic background might influence student engagement and perceptions of the platform. Future studies could explore ways to balance anonymity with the collection of demographic insights to provide a richer understanding of the user base.

Despite these limitations, the findings of this study offer valuable implications for educators and researchers. By addressing these gaps in future research, a more comprehensive understanding of Discord's potential and challenges in educational settings can be achieved.

7. Conclusion

This paper investigated how Discord might support peer-to-peer learning in a university-level computer graphics course. The findings suggest that Discord is an effective platform for facilitating real-time interaction, peer feedback, and mentorship. Students reported that the platform helped them overcome challenges, improve their understanding of course materials, and collaborate more effectively on complex tasks. One of the key strengths of Discord, as highlighted by the study, is its ability to create an informal yet productive learning environment where students feel comfortable seeking help from their peers. The platform's features, such as real-time chat and file sharing, were instrumental in enhancing student engagement and collaboration. In particular, the role of experienced students as mentors within this digital environment demonstrated the potential for peer-driven learning to complement traditional instructional methods.

These findings have broader implications beyond the context of this specific course. Discord can be leveraged in other technical courses that require collaboration and quick feedback, such as engineering, programming or design courses. By providing a space where students can interact informally yet productively, these platforms can enhance learning outcomes in a variety of disciplines that rely on complex, project-based tasks. Furthermore, Discord offers a sustainable platform for building long-term academic and professional networks. By fostering a culture of collaboration and mentorship, it can support students in developing lifelong skills and connections, making it a valuable addition to the educational landscape.

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