An Exploration of Types of Online Group Presence Using Connectivism Theory

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ABSTRACT

This research investigates the autonomy, connectedness, diversity, and openness of online group work in the context of Connectivism, a networked learning theory focused on digital environments. A quantitative survey of 286 Malaysian and Indonesian university learners was carried out with a 23-item Likert-scale questionnaire adapted from Aderibigbe (2021) covering teaching presence (diversity/openness), cognitive presence (autonomy), and social presence (connectedness). Results indicated strong perceptions of teaching presence (highest mean = 4.4) for its clarity and direction, whereas autonomy was variable (mean = 3.0–4.0), with difficulty in initiating discussion. Connectedness (mean = 2.8–3.9) indicated good collaboration but low emotional awareness. Moderate correlations (r = 0.39–0.44) among all constructs highlighted their interdependence, which supports Connectivism's principles. The research recommends pedagogical strategies to support autonomy, facilitate emotional engagement, and capitalize on teaching presence for inclusive online collaboration, contributing to the ongoing discussion on digital learning frameworks.

Keywords: Connectivism, Online Group Work, Teaching Presence, Autonomy, Collaborative Learning.

INTRODUCTION

Background of Study

Effective online group work relies on cultivating from elements of autonomy, connectedness, diversity and openness. Autonomy is defined as empowers individuals to take ownership of their learning and contributions, fostering motivation and engagement in digital collaboration (Deci & Ryan, 2000; Xie et al., 2021). Meanwhile, connectedness is defined as a sense of belonging and social presence within the group and then helps counteract the isolation that can arise in virtual settings (Rovai, 2002; Kreijns et al., 2003). On the other hand, Van Knippenberg & Mell (2016) defined diversity as variations in cultural backgrounds, perspectives, and expertise, enriches problem-solving and innovation, yet requires deliberate strategies to ensure all voices are heard. Finally, openness is defined as demonstrated through transparent communication and shared resources, strengthens trust

and facilitates collective knowledge-building (Dillenbourg, 1999; Garrison et al., 2000). While these factors enhance collaboration, they also introduce challenges, such as reconciling individual independence with group cohesion and navigating conflicts stemming from diverse viewpoints.

Statement of Problem

In today's digitally driven world, examining autonomy, connectedness, diversity and openness in group online work remains essential, as virtual teamwork becomes increasingly central to education, workplaces, and social interactions. Autonomy such as the ability to self direct plays a crucial role in empowering individuals to take initiative and adapt to flexible digital workspaces (Deci & Ryan, 2000; Sull et al., 2022). According to Chiu (2022), without proper guidance, excessive independence can result in disengagement, highlighting the need for research on how to maintain a balance between freedom and responsibility. Connectedness, or the sense of belonging and interaction among group members, is equally vital, especially as remote collaboration reduces in-person connections. While research shows that effective communication tools and social presence strengthen teamwork, disparities in digital access and inconsistent participation can undermine cohesion (Lowenthal & Snelson, 2017; OECD, 2021). Diversity encompassing cultural backgrounds, cognitive approaches, and disciplinary perspectives serves as a catalyst for innovation and enhanced problem-solving in virtual teams. Stahl et al. (2021) state that, this same diversity can also lead to communication barriers, misinterpretations, and interpersonal tensions, underscoring the need for more comprehensive research on strategies to promote inclusive and harmonious digital collaboration environments. Openness, characterized by transparent dialogue and the free exchange of ideas, serves as a fundamental driver of effective collaboration in virtual teams. This principle fosters trust and enables the synergistic combination of diverse perspectives that leads to innovative solutions (Leonardi & Treem, 2020). However, implementing open collaboration practices presents complex challenges, as people often face difficult situations like idea theft, privacy concerns, and fairness issues (UNESCO, 2023). As digital collaboration evolves with advancements like AI and the metaverse, Dwivedi et al. (2022) suggest the need of continued research into these dimensions is necessary to ensure that group work online remains productive, inclusive, and adaptable in an ever-changing technological landscape. Hence, this research will explore more autonomy, connectedness, diversity and openness in group online work in this current digital technology era.

Objective of the Study and Research Questions

This study is done to explore group work online using Connectivism. Specifically, this study is done to answer the following questions;

How do learners perceive their autonomy in group work online?

How do learners perceive their connectedness in group work online?

How do learners perceive their diversity & openness in group work online?

Is there a relationship between all components in group work online?

LITERATURE REVIEW

Theoretical Framework of the Study

Connectivism, introduced by Siemens (2005), emerges as a learning theory tailored to the realities of the digital era. It reconceptualizes learning as a process of connecting specialized nodes or information sources across a network. This paradigm shift moves away from viewing learning as solely residing within the individual and instead acknowledges the externalization of knowledge through technological networks and digital tools (Dunaway, 2011). The core of connectivism lies in its understanding of learning as the ability to form, navigate, and maintain connections, especially within virtual environments where knowledge is constantly evolving. This framework becomes particularly relevant in online learning environments where learners engage with multiple streams of data, collaborate across geographies, and utilize diverse digital platforms to access and construct knowledge (Goldie, 2016).

Connectivism is grounded in the belief that knowledge is distributed across a network of connections and that learning involves constructing and traversing those networks (Husaj, 2015). Unlike traditional learning theories that focus on internal processing (e.g., cognitivism) or behavioral outcomes (e.g., behaviorism), connectivism situates learning within a digital ecosystem. The learner is not just a receiver of knowledge but an active agent navigating nodes of information, whether these are people, documents, forums, or databases (Voskoglou, 2022). This theory further posits that knowing where to find information and who to connect with ('know-where' and 'know-who') is just as important as 'know-what' and 'know-how' (Homaid, 2019). The theory reflects the growing complexity of today's learning environments and the need to understand learning as a fluid, adaptive, and collaborative process.

The application of connectivism to online education reveals a compelling alignment between the theory's premises and the needs of digital learners. Online learning environments require learners to engage with constantly shifting information and to make decisions about what is relevant, credible, and applicable (Goldie, 2016). Through the lens of connectivism, learning in such environments is no longer limited to acquiring static content. Instead, it emphasizes developing the skills to discern, filter, and connect knowledge across platforms and media (Herlo, 2017). Learners in these environments must continuously refine their networks of knowledge through digital interactions, forums, and collaborative activities. Therefore, connectivism supports a reimagining of pedagogy in online settings, one that prioritizes connectivity, flexibility, and student agency.

Connectivism distinguishes itself from classical theories like behaviorism, cognitivism, and constructivism by shifting the focus from individual cognition to networked knowledge construction (Kop & Hill, 2008). While behaviorism focuses on stimulus-response patterns and cognitivism centers on mental processing, constructivism emphasizes learners' construction of knowledge through interaction and reflection (Efgivia et al., 2021). In contrast, connectivism introduces a broader scope, acknowledging the digital, distributed, and socially situated aspects of learning. It recognizes the increasing role of technological tools, social networks, and virtual collaboration in shaping how individuals learn, communicate, and evolve in the 21st century (Abu-Rasheed et al., 2023).

As digital content grows exponentially and becomes more fragmented, connectivism offers a framework that accommodates this complexity by emphasizing the continuous learning process over static knowledge (Goldie, 2016). The theory posits that the ability to adapt, unlearn, and relearn is more important than mastering fixed content. Haythornthwaite (2019) argues that in an environment where information rapidly becomes outdated, learners must develop meta-cognitive and navigational skills to keep up with the ever-changing knowledge landscape. Connectivism, therefore, shifts pedagogical focus toward fostering digital literacy, information evaluation, and autonomous learning, all critical components for success in online education.

Beyond its cognitive implications, connectivism also intersects with social and critical pedagogies. While social constructivism emphasizes collaboration within defined learning communities (Palincsar, 1998), connectivism extends this by considering broader, more fluid interactions across global digital networks (Lunevich, 2022). It supports the development of collective intelligence and diverse perspectives by enabling access to global information and diverse thought communities. Furthermore, connectivism's emphasis on democratizing knowledge and fostering equity through connectivity aligns with critical digital pedagogy goals, which seek to empower marginalized voices and promote global citizenship in online learning contexts (Tschofen & Mackness, 2012).

Online group work is a practical application of both connectivist and constructivist principles. It promotes deeper learning, critical thinking, and collaborative meaning-making (Hartford, 2005; Bach & Thiel, 2024). Students engaging in group discussions and projects benefit from exposure to multiple viewpoints and the opportunity to co-construct knowledge. These collaborative interactions enhance learning outcomes by encouraging accountability, reflection, and engagement. Furthermore, they foster a learning community that is essential for student retention and satisfaction in online courses (Ding, 2018).

Group work in digital learning spaces contributes to a sense of belonging and ownership among students, which in turn motivates them to participate more actively (Donelan & Kear, 2023). Collaborative activities empower students to take responsibility for their learning and help build essential soft skills like communication,

leadership, and time management (McKay & Sridharan, 2023). Moreover, collaborative experiences have been shown to increase learners' engagement and academic achievement, particularly when roles and tasks are clearly defined and supported by the instructor (Gaad, 2022).

Technological advancements have made it easier to conduct meaningful and structured online group work. Synchronous tools like Zoom and asynchronous platforms like forums and wikis allow for flexible collaboration across different time zones (Ilie, 2023). These platforms not only support communication but also enable documentation, feedback, and peer evaluation. Studies have shown that technology-enhanced group work improves higher-order thinking and promotes sustained intellectual engagement (Chounta, 2019). Digital tools also help scaffold learners' understanding by providing timely resources, structured workflows, and visual representations of shared knowledge (Duvall et al., 2020).

Despite its many benefits, online group work presents several challenges. Students may struggle with unclear communication, unequal participation, or lack of digital readiness (Rienties et al., 2012). Research also suggests that asynchronous and synchronous collaboration have differing impacts on student performance and emotional engagement (Peterson et al., 2018). For group work to be effective, educators must carefully design tasks that promote positive interdependence, accountability, and inclusive interaction (Khalil & Ebner, 2017). Understanding students' perceptions and experiences with group activities is vital in developing supportive online environments that maximize the potential of collaborative learning (Standl et al., 2021).

Past Studies

According to Cherney et al. (2018), online group work is a pedagogical tool that allows students to work together on shared learning tasks. Because of its many benefits, it is widely regarded as a best practice in online education (Bailey & Card, 2009) and is becoming more and more valued as an active learning strategy in online courses.

Anyau (2023) investigates the students' perspectives on their usage of learning strategies which focus on social presence, cognitive presence, and teaching presence in online group projects. In online group work, the study seeks to determine how students view these three forms of presence—cognitive, social, and instructor presence and whether they are related. A quantitative survey was completed by 200 undergraduate students from a public university. The study tool consisted of a four-section online survey or questionnaire with a five-point Likert scale. Aderibigbe's (2021) instrument changed for this survey. There were four parts to the survey: Section A asked about the participants' demographics, while Section B examined social presence, Section C examined cognitive presence, and Section D examined teaching presence. This paper's findings have important ramifications because they give teachers valuable information for creating more effective online collaborative exercises, direct researchers towards more research into the interactions and impacts of various presences and enable students to become more involved and productive in online group projects. In addition to recommending that future research identify additional types of presence, conduct comparative analyses, increase sample size and faculty diversity, and revise questionnaires for enhanced reliability, the study's implications imply that its findings provide insightful information for academicians and students.

Pizzo (2025) explores how small-group online project-based learning can be a creative way to help social work students grow as leaders. It examines the leadership experiences of Master of Social Work (MSW) and Bachelor of Social Work (BSW) students who chose to take on leadership positions in an online project-based group work programme. Concerns about the need for greater real-world, experiential leadership training in the current social work courses are the focus of the study. The study's participants comprise 39 Master of Social Work (MSW) and Bachelor of Social Work (BSW) students who chose themselves to be leaders in the online project-based group work program. The study examined the students' leadership experiences using a theoretical framework for experiential learning, and theme analysis was used to examine the data. The study's conclusions showed two main themes about how students viewed their learning outcomes: developing new leadership abilities and improving their current ones. The study also discovered that students' confidence in advocating for social work values in their communities grew. The importance of project-based group work experiences in cultivating leadership abilities in an online setting is eventually highlighted by this study. To help students further improve their leadership abilities, the implications of this article indicate that social work courses should provide opportunities for practical learning through group projects and practice.

The social, cognitive, and instructional presences examined by Anyau et al. (2023) can be seen as essential informational and human nodes in a connectivism framework, as well as the dynamic connections that make up and support learning in an online group network. Meanwhile, according to Pizzo (2025), the development of leadership skills through online project-based learning represents students' increasing capacity to manage and navigate intricate networks of people and information by recognising connections and assisting in the linking of specialised knowledge sources for their group.

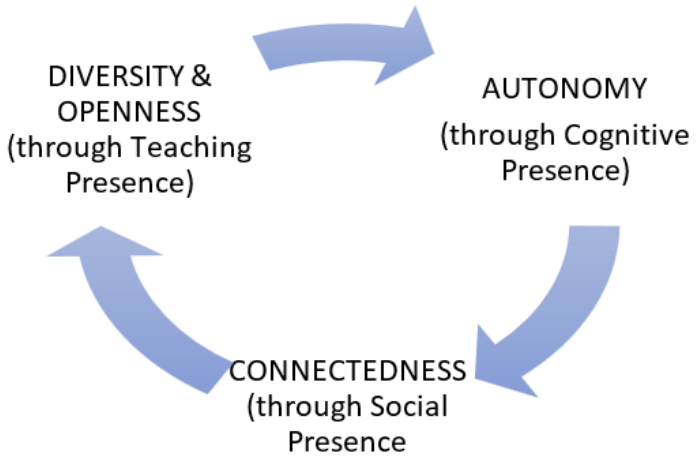
Conceptual Framework of the Study

Fig. 1 shows the conceptual framework of the study. This study is anchored from the theory of Connectivism (Siemens, 2005) to describe the group work interaction via online Aderibigbe (2021). According to Siemens (2005), online interactions need to fulfill four main criteria. The first one is autonomy and this refers to the learner's effort to take charge of their own online learning. This is done both independently and collaboratively in group work. This stage is similar with Aderibigbe's (20201) cognitive presence where the learners decide how much of interaction, he or she makes either with the learning materials or learning tasks via group work. Next, in online group work, learners need connectedness and this is obtained through the social presence the teacher and peers provide. The interaction improves learners' communication and problem-solving skills (Rahmat, 2020)

Lastly, online group work allows for diversity and openness. This is provided by the teacher presence who plans the group work is such a way that team members share ideas and are open to suggestions for improvement throughout the discussions online. This study also explores the relationship of all the factors in group work online.

Fig. 1 Conceptual Framework of the Study

Mapping Presence in Group Work online using Connectivism



METHODOLOGY

This quantitative study is done to explore online groupwork. A convenient sample of 286 participants responded to the survey. The instrument used is a 5 Likert-scale survey. Table 1 below shows the categories used for the Likert scale; 1 is for Never, 2 is for Rarely 3 is for Sometimes, 4 is for Very Often and 5 is for Always.

Table 1 Likert Scale Use

1	Never
2	Rarely
3	Sometimes
4	Very Often
5	Always

Table 2 Distribution of Items in the Survey

Section	Factor For Connectivism (Siemens, 2005)	Elements (Aderibigbe, 2021)	No. Of Items
B	Diversity & Openness	Teaching Presence	8
C	Autonomy	Cognitive Presence	7
D	Connectedness	Social Presence	8
		TOTAL ITEMS	23

The instrument used is a 5 Likert-scale survey and is replicated from Aderibigbe (2021). Table 2 shows the distribution of items in the survey. Section B has 8 items on Teaching Presence. Section C has 7 items on Cognitive Presence and section D has 8 items on Social Presence.

Table 3 Reliability of the Survey

CRONBACH'S LPHA	NO. OF ITMES
.850	**23**

Table 3 shows the reliability of the survey. The analysis shows a Cronbach alpha of .850, thus, revealing a good reliability of the instrument chosen (Jackson, 2015). Further analysis using SPSS is done to present findings to answer the research questions for this study.

FINDINGS

Demographic Analysis

Table 4 Percentage for Demographic Profile

Question	Demographic Profile	Categories	Percentage (%)
1	Gender	Male	33%
		Female	67%
2	Semester	1-3	79%
		4-6	20%
		7 and above	1%
3	Faculty	Science, Engineering & Technology	38%
		Business and Management	59%
		Social Sciences	3%
4	Level of Study	Diploma	26%
		Degree	74%
5	Online Learning Experience	Less than one year	52%
		1 year and above	48%
6	Duration of online learning per week	2-4 hours per week	64%
		5-8 hours per week	26%
		More than 8 hours per week	10%
7	Class type	Mostly lectures	44%
		more activities than lectures	23%
		More lectures than activities	25%
		Mostly lectures	8%

The gender-based distribution of the 286 survey respondents' demographic profiles is shown in Table 4. Among the respondents, there were 33% male students and 67% female students. Most of the respondents are in the early stages of their academic careers with 79% in semesters 1 to 3, followed by 20% in semesters 4 to 6, and only 1% in semesters 7 and above. Regarding the faculty affiliation, the larger group was from the Business and Management programme, with 59% of the respondents, while Science, Engineering, & Technology accounted

for 38% of the participants, and Social Science represented 3%. In terms of academic level, most of the students pursue the degree level with 74%, while the remaining 26% are diploma students. For online learning experience, more than half of students have less than one year of experience, at 52%, while 48% have more than one year of experience. The majority of students learn 2 to 4 hours per week, 64%, while 5 to 8 hours per week is 10%, and more than 8 hours per week is 10%. The distribution of respondents based on the type of class reveals that 44% of the respondents mostly have lectures, while 23% have more activities than lectures. Additionally, 25% of the respondents had more lectures than activities, and 8% had mostly activities.

Descriptive Statistics

Findings for Autonomy

This section presents data to answer research question 1- How does Autonomy influence interaction in online group work?

Fig. 2 Mean of Autonomy in Group Work Online

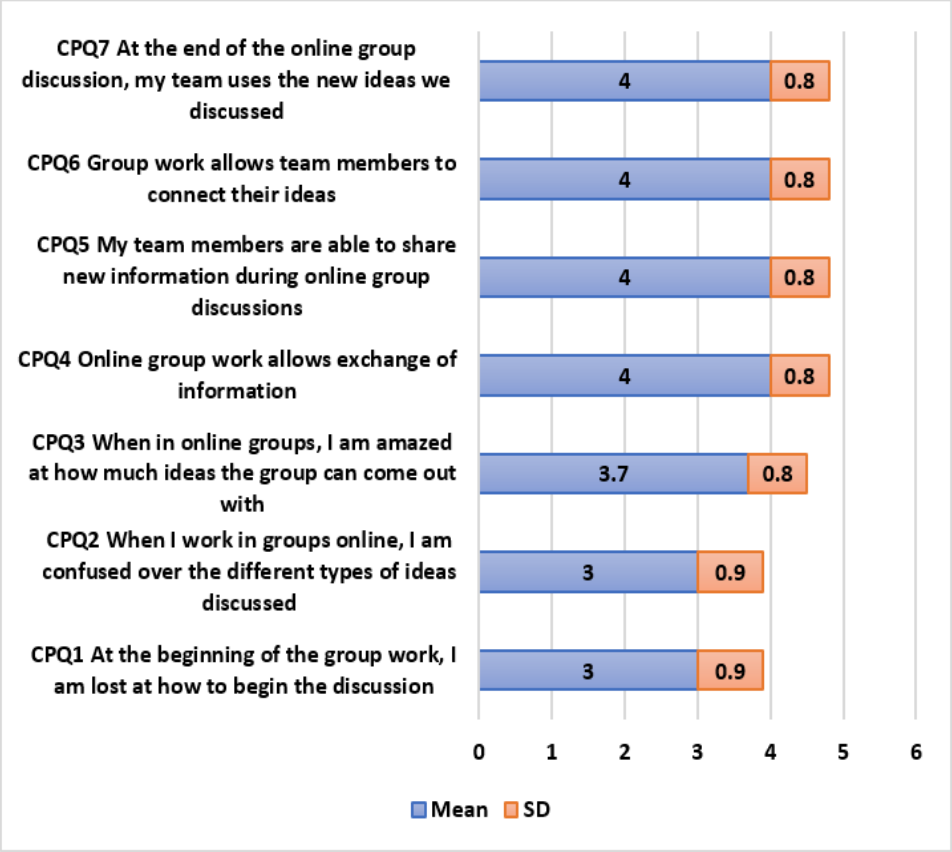


Fig. 2 presents the data analysis of learners' perceived autonomy in online group work. The highest mean scores (mean = 4.0, SD = 0.8) were observed for CPQ4, CPQ5, CPQ6, and CPQ7, indicating strong agreement among respondents that information exchange frequently occurs during online group discussions. The results further suggest that participants recognize online group discussions as effective platforms for generating new information and ideas. Additionally, respondents expressed enthusiasm toward the ideas produced in these discussions, as reflected in the high mean score for CPQ3 (mean = 3.7, SD = 0.8). However, some challenges were noted: learners occasionally struggled to initiate discussions (CPQ1, mean = 3.0, SD = 0.9) and felt confused due to the diversity of ideas presented (CPQ2, mean = 3.0, SD = 0.9).

Findings for Connectedness

This section presents data to answer research question 2- How do learners perceive their connectedness in group work online? In the context of this study, this is measured by social presence.

Fig. 3 Mean for Connectedness / Social Presence

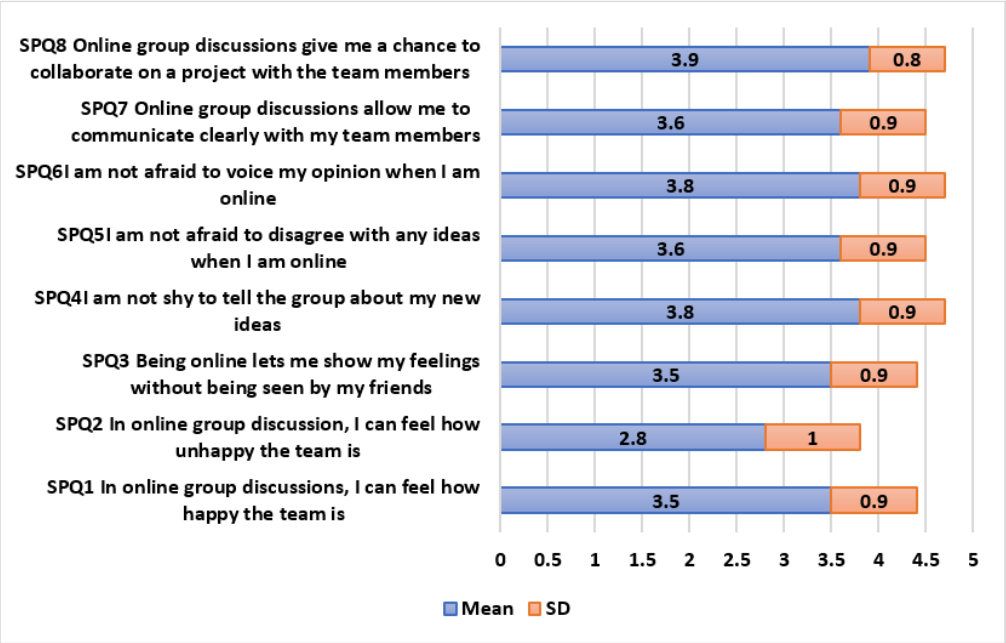
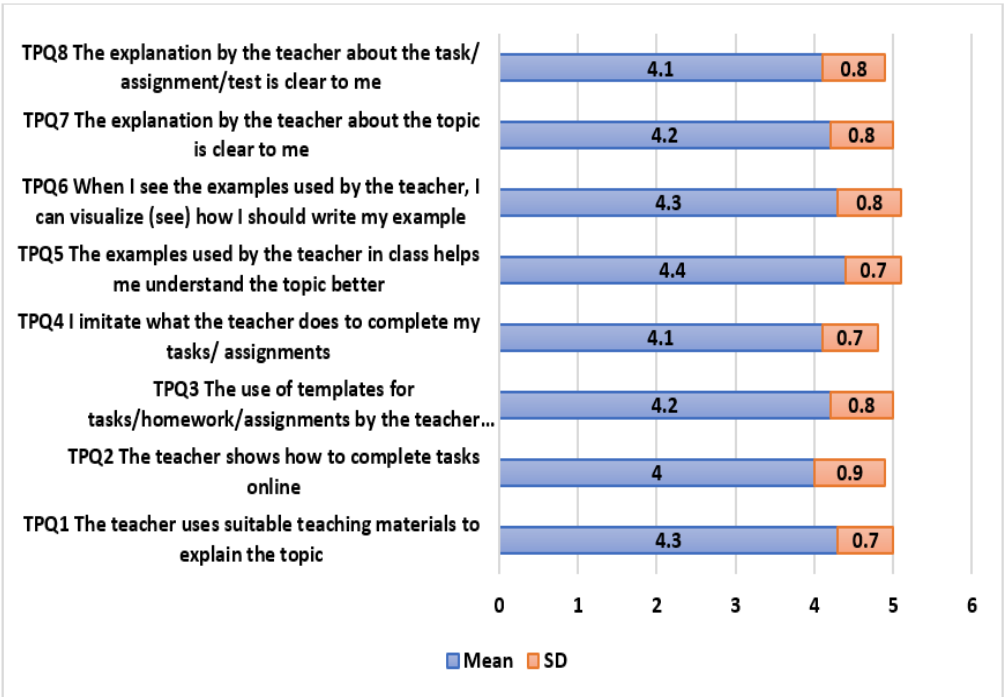


Fig. 3 shows the mean for connectedness/social presence. The highest mean is item 9 (mean=3.9,SD=0.8) which states that online group discussions gave the learners a chance to collaborate with their team members. Next, two items share the same mean of 3.8. The first is item 4 (mean=3.8,SD=0.9) which reveals that the learners were not shy to tell their peers about their new ideas. Next, item 6 (mean=3.8, SD=0.9) shows that the students were not afraid to voice their opinion when they were online. The lowest mean is item 2 (mean=2.8, SD=1) that states that in online group discussions, they could feel how unhappy the team was.

Findings for Diversity & Openness

This section presents data to answer research question 3- How do learners perceive their diversity & openness in group work online? In the context of this study, this is measured by teaching presence.

Fig. 4 Mean for Diversity & Openness / Teaching Presence



The mean scores for diversity and openness or teaching presence are presented in Fig. 4. The highest average item is TPQ5, with a mean score of 4.4 and a standard deviation of 0.7. It shows that the students strongly agree that the examples used by the teacher in class helps them understand the topic better. This is closely followed by TPQ1 and TPQ6 with a mean score of 4.3. Other items include TPQ3 and TPQ7 with a mean score of 4.2, while TPQ4 and TPQ8 have a mean score of 4.1. The lowest mean score is TPQ2 with 4, and the standard deviation is 0.9. It shows that the students agree that the teacher shows how to complete tasks online. However, all mean scores are above 4, indicating a consistent and strong presence of teaching support across all levels.

Exploratory Statistics (correlation)

This section presents data to answer research question 4- Is there a relationship between all components in group work online?

To determine if there is a significant association in the mean scores between all components in group work online, data is anlaysed using SPSS for correlations. Results are presented separately in table 4,5 and 6 below.

Table 4 Correlation between Autonomy and Connectedness teaching presence.

		AUTONOMY	CONNECTEDNESS
AUTONOMY	Pearson (Correlation	1	.394**
	Sig (2-tailed)		.000
	N	286	286
CONNECTEDNESS	Pearson (Correlation	.394**	1
	Sig (2-tailed)	.000	
	N	286	286

**Correlation is significant at 0.01 (2-tailed)

Table 4 shows there is an association between autonomy and connectedness. Correlation analysis shows that there is a moderate significant association between autonomy and connectedness (r=.394**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a moderate positive relationship between autonomy and connectedness.

Table 5 Correlation between Connectedness and Diversity & Openness

		CONNECTEDNESS	DIVERSITY & OPENNESS
CONNECTEDNESS	Pearson (Correlation	1	.438**
	Sig (2-tailed)		.000
	N	286	286
DIVERSITY & OPENNESS	Pearson (Correlation	.438**	1
	Sig (2-tailed)	.000	
	N	286	286

**Correlation is significant at 0.01 (2-tailed)

Table 5 shows there is an association between connectedness and diversity & openness. Correlation analysis shows that there is a moderate significant association between connectedness and diversity & openness (r=.438**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a moderate positive relationship between connectedness and diversity & openness.

Table 6 Correlation between Diversity & Openness and Autonomy

		DIVERSITY & OPENNESS	AUTONOMY
DIVERSITY & OPENNESS	Pearson (Correlation	1	.408**
	Sig (2-tailed)		.000
	N	286	286
AUTONOMY	Pearson (Correlation	.408**	1
	Sig (2-tailed)	.000	
	N	286	286

**Correlation is significant at 0.01 (2-tailed)

Table 6 shows there is an association between diversity & openness and autonomy. Correlation analysis shows that there is a moderate significant association between diversity & openness and autonomy (r=.408**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a moderate positive relationship between diversity & openness and autonomy.

CONCLUSION

Summary of Findings and Discussions

This research explored students' perception of autonomy, connectedness, diversity, and openness in online group work, guided by Connectivism (Bozkurt et al., 2023). The results indicated teaching presence (diversity & openness) as the most robust factor (mean=4.4), highlighting the essential role of instructor facilitation in enabling transparent collaboration, aligning with Shea & Bidjerano (2023). Yet, whereas students manifested high participation in autonomy-driven activities (mean=4.0 for idea exchange), confusion in initiating discussions (mean=3.0) confirms Howard et al. (2023) on the requirement for structured self-regulation. Connectedness (social presence) revealed successful collaboration (mean=3.9) but weaker emotional perception (mean=2.8), reinforcing Lowenthal et al. (2022) on difficulties in maintaining belongingness in virtual environments. The moderate correlations (r=0.39–0.44) among all facets confirm Bozkurt et al. (2023)'s thesis on learning in digital spaces flourishing on networked nodes, further affirmed by Zheng er al. (2023) research on cognitive-social presence dynamics. These findings cumulatively underscore the dual nature of autonomy (empowering yet in need of scaffolding) and the imperative of purposeful design in engendering emotional connectedness, adding empirical support to the literature on networked learning.

Implications and Suggestions for Future Research

Theoretical and Conceptual Implications

The findings of this study offer significant theoretical contributions by empirically validating key principles of Connectivism (Bozkurt et al., 2023) in the context of online group work. The demonstrated interconnections between autonomy, connectedness, and diversity components (with correlations ranging r = 0.39-0.44) provide quantitative support for the theory's fundamental premise of learning as a networked process. These results extend our understanding of Jarvela et al. (2023) collaborative learning framework by specifically quantifying how teaching presence operates in digital environments. The study challenges conventional pedagogical models by presenting compelling evidence that learning in digital spaces must be conceptualized as a dynamic, technology-mediated process rather than a linear transmission of knowledge.

Pedagogical Implications

The practical applications of these results indicate several key considerations for instructors developing online collaborative learning experiences. The noted difficulties in early discussion stages (mean=3.0) suggest the need

for more structured support of independent learning, possibly through carefully crafted discussion questions and clearer task initiation procedures. The comparatively lower marks for emotional perception (mean=2.8) among social presence aspects imply that existing online collaboration tools might require augmentation through more regular synchronous interactions or the incorporation of affective computing technologies. The strong showing of teaching presence facets (mean=4.4) emphasizes the ongoing need for instructor leadership in online contexts, specifically through the offering of clear examples and open communication procedures. These findings support and extend Shea & Bidjerano (2023) Community of Inquiry framework by offering specific, evidence-based suggestions for implementation.

Suggestions for Future Research

Extending these results, a number of fruitful avenues for further research become apparent. The design and experimentation with AI-facilitated support mechanisms could offer interesting insights into the dynamic preservation of ideal balance between learner autonomy and group cohesion in real-time collaborative settings. Comparative analyses across various cultural and institutional settings would assist in determining the generalizability of the present findings with respect to diversity and openness in online collaboration. Longitudinal study designs may render crucial information on the sustainability of Connectivism-based interventions over longer durations, especially given Rasheed et al (2024) appeal for greater adaptability in digital pedagogies. Research into the intersection of emerging technologies such as affective computing with traditional collaborative learning models may also create new possibilities for the improvement of emotional connectedness in virtual teams.

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