

Assessing Sociograms' Role in Enhancing Engagement in Online Learning

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Abstract

This study examines the perceived value and impact of sociograms as instructional tools within online learning communities, analyzed through the Community of Inquiry framework. Using a convergent parallel mixed methods design, the research integrates quantitative data from Likert scale surveys and qualitative data from open-ended responses to gain a comprehensive understanding of students' perceptions. Quantitative analysis reveals moderate familiarity with sociograms and their perceived support in learning, sense of community, and course perspectives. Thematic analysis highlights five key themes: understanding barriers, perceived usefulness, engagement & interaction, community dynamics, and self-reflection. The findings suggest that while students recognize the conceptual benefits of sociograms for fostering connectedness and engagement, skepticism remains about their practical utility in significantly altering participation behaviors. The study underscores the importance of clear guidance and integration to maximize the benefits of sociograms in online education. Implications for theory and practice are discussed, emphasizing the need for balanced integration of innovative tools and robust support mechanisms to enhance student engagement and interaction in online learning environments.

Keywords: Online Learning, Sociograms, Community of Inquiry, Learner Engagement, Mixed-Methods.

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Introduction

Online discussions outside of class time are becoming increasingly prevalent in face-to-face higher education courses, providing dynamic spaces for learners to interact and learn. When built upon a community of inquiry (CoI) framework, courses foster cognitive, social, and teaching presences essential for a robust educational experience (Shea & Bidjerano, 2009). These presences align with the community of learning principles that posit learning as a social act occurring through shared activities and dialogue (Lave & Wenger, 1991), which is central to Asynchronous Online Discussions (AODs). The AODs have become integral to student engagement within digital learning environments. The interaction of the CoI model's presences can significantly enhance this engagement, leading to positive outcomes for distributed learners (Schellens et al., 2005). AODs facilitate sustained participation, strengthen social relationships, and promote knowledge construction (Koszalka et al., 2021; Jonassen & Kwon, 2001). In such communities, higher-order thinking and deeper understanding are achieved through continuous discourse and reflection.

However, despite the growth of asynchronous learning, challenges such as low participation, ineffective collaboration, and diminished learning performance persist (Daniel, 2020; Kreijns et al., 2013; McFarland et al., 2019). Particularly, the depth of engagement in AODs remains a concern. Students may contribute infrequently and superficially, focusing on individual ideas rather than meaningful dialogue and co-construction of knowledge (Aloni & Harrington, 2018). Such engagement often reflects a limited view of discussions, aimed at demonstrating understanding to instructors rather than fostering rich dialogue (Wise et al., 2013). Furthermore, there are doubts about whether asynchronous formats can support the social interaction necessary for effective group learning, as AODs often lack the social richness to build trust, community, and strong interpersonal relationships (Fehrman & Watson, 2021; Roseth et al., 2011; Saltfarelli & Roseth, 2014). To address these issues, this study explores the potential of discussion sociograms—a visual representation of dialogic relationships within a learning community—as an instructional tool to deepen engagement, encourage meaningful social interaction, and improve learning outcomes in AODs.

Literature Review

Online Collaborative Engagement

As previously discussed, a significant concern in AODs is the depth and quality of student engagement, especially in collaborative contexts (Kreijns et al., 2013; Miller et al., 2021). This Engagement should transcend mere interaction to encompass deep, substantive connections that enhance mutual understanding and knowledge construction within a shared responsibility framework (Stahl et al., 2009). The effectiveness of AODs in enabling dispersed learners to develop higher-order thinking skills (Anderson et al., 2008) highlights the importance of collaborative engagement. Within AODs environments, student-initiated interactions are crucial for advancing discussions past basic reactions, thereby promoting collaborative knowledge building and improving learning outcomes (Dillenbourg et al., 1996).

Technological platforms in online learning offer both opportunities and challenges. Key to learning, social interactions can be supported by computer-mediated tools such as discussion boards and virtual collaborative spaces (Stahl & Hakkarainen, 2021). These platforms, whether synchronous or asynchronous, enable knowledge assimilation, skill development, and attitude formation through cooperative tasks and feedback mechanisms (Dillenbourg, 1999; Scardamalia & Bereiter, 1994). They provide communication and representation tools that allow students to collectively engage in learning activities (Stahl & Hakkarainen, 2021). However, technology's dual role is clear: while innovative tools are developed to enhance collaboration (Anderson, 2008; Hernández-Sellés, 2019), issues such as technical problems and digital literacy gaps pose significant barriers (Hrastinski, 2009; Blau et al., 2020).

Community of Inquiry Framework

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In a systematic review of online teaching and learning by Martin et al. (2020), learner engagement was identified as a predominant theme, with seven sub-themes emerging: presence, interaction, community, participation, collaboration, involvement, and communication. Under engagement, the most researched theme was 'presence,' largely propelled by the CoI framework.

The CoI framework, developed for text-based and asynchronous computer conferencing in higher education by Garrison et al. (1999), has been a comprehensive model for understanding presence in various online educational contexts, including K-12 environments, blended learning, and synchronous course delivery (Shea et al., 2022). Extensively cited in online education research, the CoI framework conceptualizes an online learning community as a collective engaged in critical discourse and reflection to construct personal meaning and confirm mutual understanding (Garrison & Akyol, 2013). Within the CoI, the interrelated presences—social, cognitive, and teaching—are fundamental to educational experiences in online environments, with many studies highlighting that effective learning occurs within a community.

Teaching Presence (TP), typically seen as a singular factor, lays the foundation for community creation while supporting social and cognitive presence (Shea & Bidjerano, 2009; Garrison et al., 2010). TP encompasses instructors' actions, course materials, and direction, shaping and managing cognitive and social processes throughout the learning experience. TP manages the environment and facilitating learning experiences. Anderson et al. (2001) indicates that the design, facilitation, and direction of social and cognitive processes to achieve learning outcomes are TP's primary concerns, emphasizing the educator's interaction with students and course material.

Cognitive Presence refers to the extent students can construct and confirm meaning through critical thinking and discourse (Garrison et al., 2000), a process that can vary throughout a course and its modality (Akyol & Garrison, 2008). Although fostering cognitive presence in online environments is challenging due to the difficulty in course design for diverse student needs, structured tasks such as term papers and asynchronous discussions with clear protocols can enhance it. Additionally, cognitive presence is promoted by externally facilitated regulation scaffolding, such as role assignments, rather than solely by extrinsic motivation through grades (Gasevic et al., 2015).

Social Presence, as defined by Garrison et al. (2010), is the ability to perceive others in an online environment, highlighting the human aspect of learning and relationship development. Social media platforms like Facebook and Twitter can augment social presence (Tang & Hew, 2017), which in turn can enhance perceptions of cognitive presence.

Together, these presences create a cohesive and supportive online learning environment. The CoI framework has been widely applied across various educational contexts, demonstrating its utility in online and blended learning environments (Shea et al., 2012). Despite its strengths, sustaining deep engagement within this framework poses challenges, highlighting the need for innovative tools like sociograms to enhance interaction and engagement.

Sociograms

Sociograms are vital visual tools for mapping and understanding engagement within student networks, representing the dialogic interactions in educational contexts. The educational value of visual aids is well-documented (Mayer, 2005), with sociograms recognized for their ability to reveal interaction patterns in online learning communities (Marbouti et al., 2016). By integrating qualitative and quantitative data, sociograms provide educators and learners with a new perspective on the dynamics of online discussions and collaborations. They pinpoint active participants, dominant discussion themes, and isolated community members.

Social Network Analysis (SNA), a methodology for capturing learner interaction and relationships affecting learning outcomes, has been widely applied in educational settings. It examines the interaction and collaboration degree essential for academic success (Froehlich et al., 2020). Saqr et al. (2018) demonstrated SNA's utility in collaborative learning, using sociograms to clarify relational positions within group discussions. Further, SNA can visualize group dynamics in Problem-Based Learning (PBL), measure engagement, and track participation within Learning Management System (LMS) discussions. High-performing students usually maintain denser ego networks with higher centralities, while low-performing students have more fragmented networks that fluctuate significantly

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(Ghadirian et al., 2018). High centrality, indicative of frequent interaction, is a strong predictor of student performance (Dawson, 2010; Saqr et al., 2018).

As a component of SNA, sociograms graphically map social links within a group, delineating relationships and interactions among its members (Katz, 2004). Created with nodes (individuals) and edges (interactions), these visual representations clarify the social structures within a learning environment, both at macro and micro levels (Borgatti et al., 2009). This duality in analysis offers a comprehensive view of interaction patterns, peer relationships, and engagement levels, functioning as a diagnostic tool for student behavior and overall network health (Bakharia & Dawson, 2011; Crossley et al., 2015; Author_2, 2023).

Innovative applications of SNA include pedagogical design and student feedback. Tools like SNAPP provide real-time visualizations of social interactions in forums, fostering environments conducive to peer support and knowledge exchange (Dawson et al., 2010). Wong et al. (2021) visualize interactions, linking analysis with practical educational applications. Tools like Starburst (Marbouti & Wise, 2015) and Nebula (Ng, Iravani, & contractor, n.d.) display discussion posts in formats that emphasize interaction hierarchies, aiding content popularity comprehension and idea dispersion. These interfaces help educators promptly identify less active or isolated students, enabling interventions that encourage collaborative dialogue (Romero et al., 2013).

The instructional benefits of sociograms are evident; however, there is a lack of comprehensive insight into how learners perceive and utilize these tools within educational settings. Addressing this shortfall, this study investigates students' perceptions of discussion sociograms in the context of the CoI, underscoring the necessity for foundational network literacy to accurately interpret these visual data maps (Lockyer et al., 2013). By examining the students' perspectives, which are pivotal yet often overlooked, this research contributes to both reinforcing the educational value of sociograms and highlighting the need for enhancing network literacy to improve online teaching and learning practices through better utilization of conversation trajectories and instructor participation analysis.

Purpose of the study

The purpose of this study is to explore the perceived value and impact of sociograms as instructional tools within online learning communities, utilizing the CoI framework. Specifically, the study examines how sociograms influence students' engagement, interaction, and perceptions in AODs, integrating both quantitative and qualitative data to provide a comprehensive analysis of their benefits and challenges in online education.

The study addresses the following research questions:

1. How do students perceive their online learning community, and what are the key themes that emerge from their descriptions of these communities?
2. How do students' perceptions of sociograms relate to the elements of the CoI framework (SP, CP and TP), and to what extent can these perceptions predict the CoI elements?
3. How do sociograms influence student engagement and participation in online discussions, and what are students' opinions on incorporating sociograms in their future courses?

Methods

Participants

Participants were 134 students from three undergraduate and two graduate online courses at a large public university in the eastern United States. These courses, ranging from 100-level to 500-level, required bi-weekly participation in asynchronous discussions designed to promote critical thinking. Students were exposed to sociograms as part of their course design, which visually represented their interactions within online discussion forums to enhance peer understanding and foster a sense of community. Following the exclusion of incomplete surveys, the final sample included 106 students. Participation was voluntary, and no incentives were provided. All participants gave informed consent according to approved IRB guidelines.

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Instruments

The primary instrument was a Qualtrics survey featuring both Likert scale and open-ended questions designed to capture different aspects of the students' perceptions (Appendix 1). The survey consisted of three main sections: The students' Sense of Learning Community, Students' Perception of Sociograms (SPS), and the Community of Inquiry (CoI).

Students' Perceptions of Sociograms (SPS): This scale was designed to measure students' general understanding and specific impressions of sociograms within educational contexts. Cronbach's alpha for this scale was .89, indicating high internal consistency. Principal component analysis confirmed that the scale items collectively form a robust component, explaining 66.771% of the variance. The items with a 10-point Likert scale are measured (see table 3).

Sense of Learning Community: This scale was designed to understand the perceptions of the online courses as their learning community (see table 1). A principal component analysis confirmed the scale's uni-dimensionality, with both items showing high communalities (.882) and loadings (.939) on a single component explaining 88.189% of the variance. Cronbach's alpha was .85. This scale included two Likert scale items: An open-ended question, "Tell me about your perception of the learning community," was included to provide qualitative insights.

Community of Inquiry (CoI) Presences: This scale measured students' perceptions of Teaching Presence (4 items), Social Presence (7 items), and Cognitive Presence (7 items), adapted from Albaugh et al. (2008) and modified by Authors_1 & Author_2 (2021). Cronbach's alpha values were .95, .93, and .97, respectively.

Procedure

Students participated in bi-weekly discussion forums within their courses. After each discussion, sociograms were generated, visually depicting the frequency and nature of student interactions. These sociograms, which used pseudonyms to protect student identity, were integrated into the course platform to help students visualize their position within the learning community and potentially enhance their engagement. Upon course completion, instructors emailed students a survey link to gather insights on their perceptions of the sociograms and the CoI elements. The sociogram included in the survey used pseudonyms instead of real names to abide by IRB requirement (Figure 1).

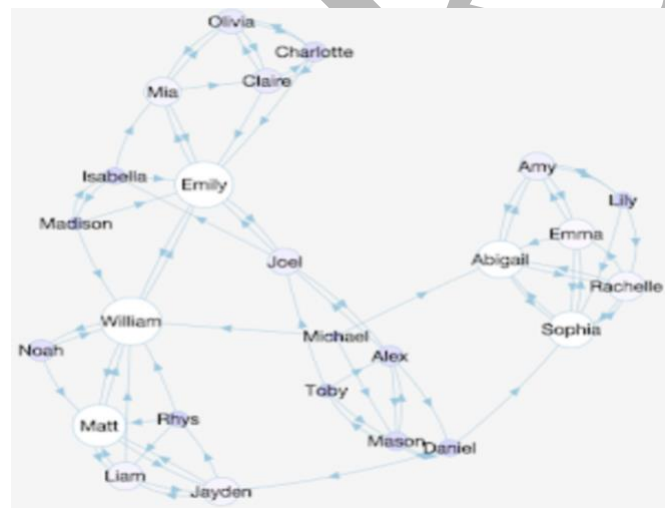


Figure 1. Sociogram used in the Qualtrics survey

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Data Analysis

For this study, the Convergent Parallel Mixed Methods design as outlined by Creswell (2014) was adopted. This approach entailed the concurrent collection and analysis of both quantitative and qualitative data. In the initial phase, quantitative data were analyzed using descriptive statistics, correlation analyses, and regression techniques to assess the impacts of sociograms on various elements of the CoI framework. The qualitative component involved thematic analysis of responses to open-ended questions, guided by the procedures recommended by Braun and Clarke (2006).

The analysis began with three researchers independently coding the qualitative responses to ensure a comprehensive grasp of the material. Initial thematic categories were developed during these individual reviews. Coders then paired up to compare and discuss their interpretations, refining the initial codes to more accurately capture the essence of the participant responses. This collaborative review was crucial in maintaining consistency across coders and minimizing individual biases. Following the paired coding, the researchers engaged in an iterative process to further refine the themes. This involved multiple rounds of discussion and re-examination of the data. Discrepancies were resolved through consensus, underscoring the collaborative nature of the analysis. The effectiveness of our thematic analysis was quantitatively assessed using Cohen's Kappa, which measures inter-rater reliability. The initial kappa scores indicated substantial agreement across several thematic categories, specifically: "General insights from the network on discussion dynamics" ($\kappa = .74$), "Influence of sociograms on discussion participation" ($\kappa = .74$), and "Preferences for Sociogram use in future courses" ($\kappa = .87$). Subsequent discussions among coders led to enhanced consensus, eventually achieving full agreement ($\kappa = 1.00$) across all categories.

The final stage of analysis was conducted by the lead researcher, who meticulously reviewed all themes for consistency with the study's objectives and theoretical framework. This rigorous review process affirmed the reliability of the thematic outcomes, providing a robust narrative that addressed the research questions comprehensively.

Results

This section presents the findings from the investigation into the perceived value of sociograms as instructional tools within online learning communities, analyzed through the CoI framework. The study aimed to address three key research questions: students' perceptions of their online learning communities, the relationship between these perceptions and the CoI framework's elements, and the impact of sociograms on student engagement and participation in AODs.

The analysis combined quantitative data from Likert scale survey responses, which provided a broad understanding of students' perceptions, with qualitative insights from open-ended survey questions that offered a deeper contextual understanding. Descriptive statistics and correlational analyses were used to examine the relationships between students' perceptions of sociograms and the three CoI presences—Social, Cognitive, and Teaching. Additionally, regression analyses were conducted to predict the influence of sociogram perceptions on these elements. The qualitative data were analyzed thematically to uncover the nuanced experiences of students regarding their engagement and interaction dynamics within the online learning environment.

Students' Perceived Learning Community (RQ1)

To address the first research question, the study analyzed both quantitative and qualitative responses regarding students' perceptions of online learning communities. Descriptive statistics for students' perceived learning community are presented in Table 1, while Table 2 summarizes key themes identified from the qualitative data.

Table 1 Descriptive statistics for students' perceived learning community

Item	Mean	SD
I see the value of online learning communities	8.64	2.08
I see my course as a learning community	8.27	2.14

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Students reported a high perceived value for online learning communities ($M = 8.64$, $SD = 2.08$) and similarly rated their courses as effective learning communities ($M = 8.27$, $SD = 2.14$). A strong positive correlation ($\rho = .704$, $p < .001$) indicates that students who value online learning communities are more likely to perceive their courses as successful learning environments. Complementing these quantitative findings, qualitative data gathered from 70 open-ended responses revealed six key themes that provide deeper insights into how students perceive their online learning communities (Table 2).

Table 2 Themes in students' perceptions of online learning communities

Theme	Definition	Example
Value of Collaboration and Discussion	Highlights the importance of collaboration and interaction among students.	<i>"The discussions connect the community of students to the learning material each week."</i>
Sense of Community and Belonging	Indicates a sense of community, belonging, and interpersonal relationships.	<i>"There is value in the relationships with my fellow learners. I consider them part of my learning community."</i>
Challenges and Limitations	Describes the challenges and negative aspects of online learning communities.	<i>"I honestly dislike the online learning community. This is my first semester, and it has many flaws for someone like me."</i>
Flexibility and Accessibility	Emphasizes the flexibility and convenience of online learning.	<i>"It allows people from all over, who can't attend face-to-face classes, to participate."</i>
Knowledge Sharing and Learning	Focuses on the sharing of knowledge and the benefits of online learning communities.	<i>"Online learning communities offer knowledge sharing among participants."</i>
Role of Instructors	Mentions the role, involvement, and impact of instructors.	<i>"Helpful but not as dynamic as I'd like. Instructors could engage more to enhance exchanges."</i>

These themes provide valuable insights into students' experiences and perceptions of their courses within these communities. The most frequently mentioned theme was the "Value of Collaboration and Discussion," highlighting the critical role of interaction among students. Other significant themes included a "Sense of Community and Belonging," "Challenges and Limitations," "Flexibility and Accessibility," "Knowledge Sharing and Learning," and the "Role of Instructors."

Overall, students perceive online learning communities as beneficial for collaboration, discussion, and knowledge sharing. They feel a sense of community and belonging but also face challenges related to connectivity and interaction. The flexibility and accessibility of online learning are highly appreciated, and the role of instructors is crucial for fostering an engaging and supportive learning environment. The strong correlation between students' perceptions of the value of online learning communities and their view of their courses as learning communities underscores the importance of these factors in shaping a positive online learning experience.

The relationship between the Students' Perceived Sociogram (SPS) and CoI Elements (RQ2)

To address how perceived sociograms relate to the CoI framework's elements, this study examined the relationship between SPS and the three CoI presences: SP, CP, and TP. The analysis included descriptive statistics, correlation coefficients, and regression models.

Descriptive statistics. Students reported moderate familiarity with sociograms ($M = 5.04$, $SD = 3.56$), and perceived them as somewhat supportive of their learning ($M = 5.70$, $SD = 2.89$). Sociograms also contributed to their sense of

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belonging ($M = 6.04$, $SD = 2.95$) and influenced their overall thoughts about the course ($M = 5.38$, $SD = 3.31$). Additionally, sociograms were seen as potential influencers of participation in discussions ($M = 5.24$, $SD = 3.16$), with a preference expressed for incorporating them in future courses ($M = 6.26$, $SD = 3.37$).

Table 3 Descriptive Statistics for SPS items (10 point scale)

Items	N	Mean	Median	Std
SPS1. I am familiar with this kind of social network map.	105	5.04	5	3.56
SPS2. I feel this social network map would support my learning.	105	5.70	5	2.89
SPS3. A social network map makes me feel more like a member of a learning community.	106	6.04	6	2.95
SPS4. A social network map like this will influence my overall thoughts about this course.	106	5.38	5	3.31
SPS5. If given a social network map, my participation in the discussion would change.	104	5.24	5	3.16
SPS6. I would like to have a social network map in your other course discussions.	106	6.26	7	3.37

Correlation Analysis. A correlation analysis between SPS items and CoI elements showed strong relationships, particularly between SPS2 ("I feel this social network map would support my learning") and SP indicators (Appendix 2). Similarly, SPS3 ("A social network map makes me feel more like a member of a learning community") correlated strongly with SP, indicating that sociograms significantly contribute to fostering a sense of community and interaction among students. The correlations between SPS items and CP were also robust, suggesting that sociograms can enhance cognitive engagement by helping students feel more connected to the learning community. The correlations with TP were weaker, though still significant, indicating that while sociograms influence instructional dynamics, their primary impact may be on social and cognitive aspects of learning rather than direct teaching practices.

Regression Analysis. The regression analysis provided further insights into these relationships. For SP, the first model, which included only SPS3 ("A social network map makes me feel more like a member of a learning community"), explained 33.1% of the variance ($R^2 = .331$). The inclusion of SPS6 ("I would like to have a social network map in other course discussions") increased the explained variance to 38.0% ($R^2 = .380$), and adding SPS5 ("If given a social network map, my participation in the discussion would change") further improved the model, accounting for 40.4% of the variance ($R^2 = .404$) (Table 5).

Table 4 Model Summary for SP Predicted by SPS

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	.576a	.331	.325	1.785
2	.616b	.380	.368	1.728
3	.635c	.404	.386	1.703

Note. a. Predictors: (Constant), SNAP3. b. Predictors: (Constant), SPS3, SPS6. c. Predictors: (Constant), SPS3, SPS6, SPS5.

For CP, the model began with SPS2 ("I feel this social network map would support my learning"), explaining 35.5% of the variance ($R^2 = .355$). Including SPS6 increased the explained variance to 38.4% ($R^2 = .384$) (Table 6). Finally, in predicting TP, the model with SPS3 alone explained 28.5% of the variance ($R^2 = .285$) (Table 7).

Table 5 Model Summary for CP Predicted by SPS

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	.595a	.355	.348	1.872
2	.620b	.384	.372	1.838

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Note. a. Predictors: (Constant), SPS2. b. Predictors: (Constant), SPS2, SPS6.

Table 6 Model Summary for TP Predicted by SPS

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	.534a	.285	.278	1.44

Note. a. Predictors: (Constant), SPS3.

These findings suggest that sociograms are effective tools for enhancing Social and Cognitive Presence in online learning environments. The strong correlations and significant variance explained by SPS items for SP and CP indicate that sociograms play a crucial role in fostering interaction and engagement, which are central to meaningful online learning experiences. Although the relationship between sociograms and Teaching Presence is weaker, the results still suggest that sociograms contribute to the instructional process, albeit indirectly. These insights emphasize the importance of integrating sociograms into online course designs to cultivate more engaging and community-oriented learning environments.

Assessing the Impact of Sociograms on Student Engagement and Preferences for Future Course Integration (RQ3)

This section explores how sociograms influence student engagement in online discussions and examines students' perspectives on incorporating sociograms in their future courses. The analysis combines quantitative data from Likert scale responses with qualitative insights to assess the effectiveness of sociograms as tools for enhancing participation and fostering a sense of community within online learning environments. The findings provide a comprehensive understanding of the potential benefits and challenges associated with the use of sociograms in educational settings.

General insights from the network on discussion. In the Qualtrics survey, students were presented with an artificial network visualization to remind them of the networks they encountered during their courses. This was done in compliance with IRB requirements to ensure the confidentiality and integrity of the data, thus actual networks were not included. The visualization served as a prompt for students to reflect on their general insights regarding the network.

A total of 64 responses were analyzed, revealing five key themes that encapsulate students' perceptions and interactions within the network. These themes are presented in Table 8.

Table 7 General insights from the network on discussion dynamics

Themes	Definition	Quotes
Understanding barriers	Responses that represent difficulties in interpreting sociograms.	"I have no idea how to read this map."
Perceived usefulness	Responses skeptical of the practical application of sociograms.	"It can show which members are participating the most. What it doesn't show is the content or whether the participation is relevant or insightful."
Engagement & Interaction	Responses discussing the level and nature of engagement facilitated by sociograms and the dynamics of interaction among participants.	"It shows the interactions that are taking place and lets me see discussions that I would like to participate in that I otherwise may not have seen."

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Community dynamics	Responses highlighting perceptions of community structure, inclusivity, and the social connections that emerge within the learning environment as shown by sociograms.	<i>"That everyone branched off and had their own conversations while still all being intertwined."</i>
Visualization & Awareness	Responses focusing on how sociograms serve as a tool for visualizing discussion structures and enhancing awareness of one's own and others' roles within discussions.	<i>"The layout of the network map makes it easy to see the flow of conversation."</i>
Self-reflection	Responses using network insights as a tool for personal reflection to identify and implement changes in engagement strategies, aiming for more effective and broader interaction in future discussions.	<i>"Seeing how others engaged in the discussions makes me want to be more active and contribute more thoughtfully to conversations."</i>

Students frequently highlighted the importance of *"Engagement & Interaction"* and *"Community Dynamics,"* with these themes appearing most often. These responses reflect how students perceive sociograms as tools that can enhance the level of engagement and reveal the underlying dynamics of interaction among participants. Conversely, the theme of *"Understanding Barriers,"* though mentioned less frequently, indicates that some students struggled with interpreting sociograms. This suggests a need for clearer instructions or support to maximize the benefits of these tools. The themes of *"Perceived Usefulness"* and *"Visualization & Awareness"* provide a mixed perspective. While some students recognize the potential of sociograms to improve awareness and visualize discussion flows, others remain skeptical about their practical utility, questioning whether these tools genuinely enhance the learning experience.

Finally, the theme of *"Self-Reflection"* underscores the potential of sociograms to encourage students to reconsider and refine their participation strategies, suggesting that sociograms may serve as valuable reflective tools in online discussions. Overall, the insights gathered from this analysis provide a nuanced understanding of how sociograms are perceived by students. These findings emphasize the need for thoughtful integration of sociograms into online learning environments to enhance engagement and community dynamics, while also addressing the challenges some students face in interpreting these tools.

Navigating the divide: sociograms' influence on student participation. Descriptive statistics from the Likert scale questions in the SPS, particularly items SP4 and SP5, revealed moderate mean scores of 5.38 (SD = 3.31) and 5.24 (SD = 3.16), respectively, indicating that while students recognize the potential impact of sociograms on their course perspectives, they remain uncertain about these tools' ability to influence their participation behaviors. The qualitative analysis supports this, showing that although students acknowledge the conceptual benefits of sociograms for fostering connectedness, there is no clear consensus on their effectiveness in significantly changing participation patterns. In essence, students seem to appreciate sociograms for their theoretical advantages but are skeptical about whether these will translate into more active engagement in discussions.

The quantitative data suggesting mixed opinions about sociograms was reinforced by the open-ended responses from 59 students, who were asked how their participation might change if sociograms were integrated into their courses. The responses were categorized into three main sentiments: positive, negative, and neutral, with several themes emerging to illustrate how students believe their participation would be affected by this tool.

Among the 28 students who felt that sociograms would change their behaviors, many believed that these tools would enhance their engagement in discussions. They anticipated that visualizing their interactions would motivate them to participate more actively and engage with a broader range of peers. For example, one student noted, *"It would motivate me to branch out more in conversation,"* reflecting the perceived potential of sociograms to stimulate interaction and collaboration. Additionally, some students indicated that sociograms could guide their participation

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by highlighting individuals they had not interacted with before. One participant mentioned, *"I could go to a student that I was unaware of,"* suggesting that sociograms could help diversify interactions and ensure they connect with a wider array of classmates.

On the other hand, 27 students expressed that sociograms would not alter their participation habits. These students believed that their engagement levels were influenced by factors other than visual aids like sociograms. As one student stated, *"I don't believe my participation would change based on a social network map. I would participate the same,"* indicating a perception that sociograms would not impact their behavior in discussions. While these students did not feel the need to elaborate further, some did express skepticism about the practical utility of sociograms, doubting whether these tools would provide meaningful benefits to their learning experience. One student articulated this skepticism by saying, *"I don't see how it would be relevant. Join discussions that weren't well represented by the map?"* highlighting concerns about the relevance and effectiveness of sociograms in enhancing engagement.

Finally, four students expressed uncertainty about how to use sociograms effectively. These students emphasized the need for more guidance and instruction on how to incorporate sociograms into their participation strategies. As one participant remarked, *"I'm not 100% sure how I'm supposed to use the map to increase my participation,"* suggesting that better support and explanations might be necessary for students to fully leverage the benefits of sociograms.

Student views on using sociograms in their future courses. The Likert scale data indicated a generally positive inclination toward incorporating sociograms in future courses, with a mean score of 6.26 for SPS6, *"I would like to have a social network map in other course discussions."* To further explore this, 72 students provided their opinions on whether they would like to have sociograms in their future classes, along with their reasons.

Table 8 Student views on using sociograms in their future courses

	Theme	Definition	Example
Positive	Encouraging Broader Interaction & Inclusion	Responses indicating that sociograms might encourage students to engage with a wider range of peers, including those on the periphery of the network.	<i>"It would help people who do not interact as much see where they can improve in future discussions."</i>
	Enhancing Communication Awareness & Improvement	Responses suggesting that sociograms could help students become more aware of their communication patterns and identify areas for improvement.	<i>"It would tell me how much more I would need to communicate."</i>
	Fostering Competitive & Motivational Engagement	Responses reflecting that sociograms might serve as a motivational tool, encouraging students to participate more actively due to competitive or data-driven feedback.	<i>"I love the availability of data. It is the best feedback for me, even if it is negative for me. That can motivate me more."</i>
Negative	Perceived Lack of Utility	Responses expressing doubt about the usefulness or relevance of sociograms in enhancing participation or learning.	<i>"No thanks. I am not a fan of online discussion boards and feel adding a social network map would be a waste of time."</i>
	Concerns About Personal	Responses indicating discomfort with the idea of being observed or	<i>"The sociogram would make me feel uncomfortable and more observed."</i>

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	Comfort & Privacy	tracked, or concerns about personal privacy.	
	Doubts About Practical Impact	Responses expressing skepticism about whether sociograms would effectively change participation behaviors or enhance discussions.	<i>"Sometimes, the constraints of the discussion are out of my control, such as when other classmates wait until late in the week to post and I don't have as much opportunity to engage in a true discussion... I'm not sure if this map would be able to change my behavior if other classmates continue to post close to discussion deadlines."</i>
	Preference for Autonomy & Existing Interaction Styles	Responses preferring existing methods of interaction and communication over using sociograms.	<i>"My decisions on who to interact with are based on the post, not on how to 'expand my network'."</i> <i>"I made my decisions on who to interact with based on the post, not on how to 'expand my network'. Which is just good life advice."</i>
Neutral	Indifference or Uncertainty	Responses showing a lack of strong opinion or interest in using sociograms, or uncertainty about their impact.	<i>"I don't really mind either way."</i>
	Conditional Support	Responses indicating potential support for sociograms if more information or guidance is provided.	<i>"I think if I knew more about social mapping I would gain additional insight into class discussions."</i>

Qualitative feedback aligns with these quantitative trends, indicating that many students believe sociograms improve self-awareness and communication during discussions. Comments such as *"It helps in understanding our role and how we can communicate better"* reflect positive views toward sociograms' role in fostering broader interactions beyond basic discussion requirements. The visual clarity provided by sociograms, which eases the interpretation of discussion dynamics, is also valued, as seen in statements like *"The diagram is easier to read than trying to see who interacted with whom in the discussion thread or on a Google doc."*

However, alongside this willingness to use sociograms, concerns were also voiced regarding privacy, potential competitive behavior, and the actual impact on participation. For example, some students remarked, *"The sociogram would make me feel uncomfortable and more observed,"* reflecting worries about sociograms fostering a sense of being watched. Furthermore, 32% of students expressed reluctance to use sociograms in future discussions, primarily citing a lack of perceived benefits or necessity. This skepticism is captured in comments like *"I'm not sure how it would help me"* and *"I do not need a map of who communicated where."* Additionally, a significant aversion to group discussions was noted, with sentiments such as *"Having course discussions as the main grades was absolutely horrible... discussion groups give me anxiety and make me extremely self-conscious about the things I post."*

Lastly, 7% of participants displayed neutrality or indifference, summarizing their stance with *"I don't really mind either way"* and *"I'm indifferent."* These neutral responses suggest that while some students see potential in sociograms, others may need more information or a clearer understanding of how these tools can enhance their learning experience. While data suggests that sociograms could positively correlate with enhanced discussion engagement, their full integration into future courses warrants careful consideration, especially given the concerns about privacy and the potential for inducing competitive dynamics.

Discussion

This study explored the perceived value and impact of sociograms as instructional tools within online learning communities, guided by the CoI framework. The findings provide insights into how sociograms influence students' engagement, interaction, and perceptions in AODs.

Regarding perceptions of online learning communities (RQ1), the quantitative analysis showed that students generally view online communities positively, with high mean scores indicating a strong recognition of their value. This aligns with prior research highlighting the benefits of online communities for fostering collaboration, support, and knowledge sharing (Shea, 2006; Singh et al., 2022). Qualitative data enriched this understanding, with themes like *"Value of Collaboration and Discussion"* and *"Sense of Community and Belonging"* underscoring the importance of interaction and SP in online learning. These findings resonate with the CoI framework's emphasis on SP as a critical component of effective online education.

For the relationship between sociograms and CoI Elements (RQ2), correlation analyses revealed significant relationships between SPS and the CoI elements. Strong correlations between SPS and both SP and CP suggest that sociograms enhance social and cognitive engagement—key components of meaningful learning experiences. By visually mapping interactions, sociograms appear to facilitate SP by helping students better understand and engage with their learning community, echoing research by Akyol & Garrison (2008). Regression analyses further supported these findings, showing that SPS items could explain a substantial portion of variance in SP, CP, and TP, with the strongest predictive relationships for SP and CP. These results highlight sociograms' potential in promoting both engagement and cognitive presence, aligning with findings by Bakharia & Dawson (2011).

Regarding the impact of sociograms on student engagement (RQ3), the thematic analysis provided a nuanced understanding. Themes like *"Engagement & Interaction"* and *"Community Dynamics"* were frequently mentioned, reflecting students' observations on how sociograms facilitate and visualize engagement within the learning community. Students appreciated how sociograms made interaction patterns visible, helping them understand participation dynamics and encouraging broader engagement. However, challenges such as *"Understanding Barriers"* and *"Perceived Usefulness"* were noted. Some students expressed difficulties interpreting sociograms and skepticism about their practical application. These concerns highlight the need for better guidance in using sociograms effectively. Educational institutions should consider offering training to help students and instructors fully utilize these tools. The mixed sentiments regarding sociograms' impact on participation behaviors suggest that while many students recognize their theoretical benefits, there is variability in how these tools influence actual engagement. This indicates that the effectiveness of sociograms may depend on individual differences and course design contexts.

Implications

This study's exploration of sociograms within online learning environments, particularly through the CoI framework, reveals significant theoretical implications. The positive correlations between sociograms and CoI elements indicate that these visual tools enhance SP, CP, and TP in online classrooms. The findings suggest that sociograms foster a more engaging and connected learning experience by visualizing interaction patterns and helping students recognize their roles within the learning community. This supports the CoI framework's emphasis on the interconnectedness of SP, CP, and TP in creating effective online learning environments. The study reinforces sociograms' value as conceptual tools that can enrich theoretical understanding of online engagement and community dynamics.

The study also highlights practical implications for educators. Positive mean scores for SPS items indicate that students see potential benefits in sociograms. However, the effectiveness of sociograms in changing participation behavior may be limited without clear guidance and instructional integration. Educators should consider incorporating sociograms into online courses with training sessions or tutorials to help students and instructors become proficient in interpreting sociogram data. By visualizing interaction patterns, educators can identify isolated learners or those less engaged, allowing for timely interventions to foster inclusivity and prevent dropout. Sociograms can also serve as diagnostic tools to guide the development of strategies aimed at enhancing inclusivity within the learning community. The qualitative data highlights diverse student opinions, reinforcing the need for

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educators to facilitate understanding and address potential concerns about privacy and competitiveness associated with sociograms.

Conclusion

This study explored sociograms' potential to enhance online learning environments within the CoI framework. The moderate mean scores for SP4 and SP5, coupled with qualitative findings, reflect some hesitancy among students to fully support sociograms as transformative tools for participation. While correlations between sociogram perceptions and CoI elements are positive, they do not necessarily indicate strong conviction among students that sociograms would drastically change their engagement levels.

Several limitations should be acknowledged. The reliance on self-reported data may introduce biases, as students' perceptions may not fully capture their actual engagement or learning outcomes. The cross-sectional nature of the study also limits the ability to infer causality between sociogram usage and improved learning experiences. The sample size, while sufficient for initial insights, may not be large enough to generalize findings across different educational contexts. Further research is needed to explore sociograms' long-term impact on student participation and engagement. Longitudinal studies could assess how sociograms' benefits evolve over time and across different courses, providing deeper insights into their sustained impact on learning and community building. Experimental designs could also rigorously assess causality between sociograms and learning outcomes. By introducing these tools in controlled settings, researchers can measure their impact on student engagement and cognitive processing.

The study highlights sociograms' theoretical and practical potential to enrich online learning environments. However, successful integration requires a balanced approach. Educators must introduce these tools while providing the necessary framework for students to engage with them meaningfully. This includes addressing privacy concerns, fostering inclusivity, and ensuring students are equipped to leverage sociograms effectively. By doing so, sociograms can become valuable assets in creating more connected, engaging, and inclusive online learning communities.

References

- Akyol, Z., & Garrison, D. R. (2008). The development of a community of inquiry over time in an online course: Understanding the progression and integration of social, cognitive, and teaching presence. *Journal of Asynchronous Learning Networks*, 12(3-4), 3-22.
- Aloni, M., & Harrington, C. (2018). Research based practices for improving the effectiveness of asynchronous online discussion boards. *Scholarship of Teaching and Learning in Psychology*, 4(4), 271.
- Anderson, T. (2008). The theory and practice of online learning. Athabasca University.
- Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, 5(2), 1-17.
- Bakharia, A., & Dawson, S. (2011, February). SNAPP: a bird's-eye view of temporal participant interaction. In *Proceedings of the 1st international conference on learning analytics and knowledge*.
- Blau, I., Shamir-Inbal, T., & Avdiel, O. (2020). How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacies, self regulation, and perceived learning of students? *The Internet and Higher Education*, 45, 100722.
- Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *science*, 323(5916), 892-895

Assessing Sociograms' Role in Enhancing Engagement

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Crossley, S. A., Salsbury, T., & Mcnamara, D. S. (2015). Assessing lexical proficiency using analytic ratings: A case for collocation accuracy. *Applied Linguistics*, 36(5), 570-590.
- Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, 49(1-2), 91-96.
- Dawson, S. (2010). 'Seeing' the learning community: An exploration of the development of a resource for monitoring online student networking. *British Journal of Educational Technology*, 41(5), 736-752.
- Dillenbourg, P. (1999). What do you mean by collaborative learning? Collaborative-learning: Cognitive and computational approaches., 1-19.
- Fehrman, S., & Watson, S. L. (2021). A systematic review of asynchronous online discussions in online higher education. *American Journal of Distance Education*, 35(3), 200-213.
- Froehlich, D. E., Rehm, M., & Rienties, B. C. (2020). Mixed methods social network analysis. *Mixed methods social network analysis: Theories and methodologies in learning and education*, 1-10.
- Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87-105.
- Garrison, D. R., & Akyol, Z. (2013). The community of inquiry theoretical framework. In M. G. Moore (Ed.), *Handbook of distance education* (pp. 104-119). Routledge.
- Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and Higher Education*, 10(3), 157-172.
- Garrison, D. R., Cleveland-Innes, M., & Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. *The Internet and Higher Education*, 13(1-2), 31-36.
- Gašević, D., Dawson, S., & Siemens, G. (2015). Let's not forget: Learning analytics are about learning. *TechTrends*, 59, 64-71.
- Ghadirian, H., Salehi, K., & Ayub, A. F. M. (2018). Analyzing the social networks of high-and low-performing students in online discussion forums. *American Journal of Distance Education*, 32(1), 27-42.
- Hernández-Sellés, N., Muñoz-Carril, P. C., & González-Sanmamed, M. (2019). Computer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers & Education*, 138, 1-12.
- Hrastinski, S. (2009). A theory of online learning as online participation. *Computers & Education*, 52(1), 78-82.
- Jonassen, D. H., & Kwon, H. (2001). Communication patterns in computer mediated versus face-to-face group problem solving. *Educational technology research and development*, 49(1), 35-51.
- Kreijns, K., Kirschner, P. A., & Jochems, W. (2013). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, 19(3), 335-353.

Assessing Sociograms' Role in Enhancing Engagement

- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.
- Lee, M.K., Sharma, P. (2023, April). Applying community detection algorithms to examine group formation in online discussions, accepted as a presentation, AERA, Chicago.
<https://www.aera.net/Publications/Online-Paper-Repository/AERA-Online-Paper-Repository-Viewer/ID/2107692>
- Lee, M.K., Clariana, R. (2021, November). Students' Perceptions in Online Courses with the Community of Inquiry Framework, accepted as a presentation, Association for Educational Communications & Technology.
- Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing pedagogical action: Aligning learning analytics with learning design. *American Behavioral Scientist*, 57(10), 1439-1459.
- Katz, N., Lazer, D., Arrow, H., & Contractor, N. (2004). Network theory and small groups. *Small group research*, 35(3), 307-332.
- Koszalka, T. A., Pavlov, Y., & Wu, Y. (2021). The informed use of pre-work activities in collaborative asynchronous online discussions: The exploration of idea exchange, content focus, and deep learning. *Computers & Education*, 161, 104067.
- McFarland, J., Hussar, B., Zhang, J., Wang, X., Wang, K., Hein, S., ... & Barmer, A. (2019). *The Condition of Education 2019*. NCES 2019-144. National Center for Education Statistics.
- Marbouti, F., & Wise, A. F. (2016). Starburst: A new graphical interface to support purposeful attention to others' posts in online discussions. *Educational Technology Research and Development*, 64(1), 89-111.
- Martin, F., Sun, T., & Westine, C. D. (2020). A systematic review of research on online teaching and learning from 2009 to 2018. *Computers & education*, 159, 104009.
- Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.
- Miller, H., Witherow, D. S., & Carson, S. (2021). The effects of self-regulated learning interventions on student academic performance in online courses. *Journal of Educational Technology Systems*, 49(2), 187-202.
- Romero, C., López, M. I., Luna, J. M., & Ventura, S. (2013). Predicting students' final performance from participation in on-line discussion forums. *Computers & Education*, 68, 458-472.
- Roseth, C. J., Saltarelli, A. J., & Glass, C. R. (2011). Effects of face-to-face and computer-mediated constructive controversy on social interdependence, motivation, and achievement. *Journal of educational psychology*, 103(4), 804.
- Rovai, A. P. (2002). Sense of community, perceived cognitive learning, and persistence in asynchronous learning networks. *The Internet and Higher Education*, 5(4), 319-332.
- Saltarelli, A. J., & Roseth, C. J. (2014). Effects of synchronicity and belongingness on face-to-face and computer-mediated constructive controversy. *Journal of Educational Psychology*, 106(4), 946.
- Saqr, M., Fors, U., Tedre, M., & Nouri, J. (2018). How social network analysis can be used to monitor online collaborative learning and guide an informed intervention. *PloS one*, 13(3), e0194777.
- Saqr, M., Nouri, J., & Vartiainen, H. (2020). Robustness and rich clubs in collaborative learning groups: A learning analytics study using network science. *Scientific Reports*, 10(1), 14445.

Assessing Sociograms' Role in Enhancing Engagement

- Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The journal of the learning sciences*, 3(3), 265-283.
- Schellens, T., & Valcke, M. (2005). Collaborative learning in asynchronous discussion groups: What about the impact on cognitive processing?. *Computers in Human behavior*, 21(6), 957-975.
- Scott, J. (2017). *Social network analysis* (4th ed.). SAGE Publications.
- Shea, P., & Bidjerano, T. (2009). Community of inquiry as a theoretical framework to foster “epistemic engagement” and “cognitive presence” in online education. *Computers & Education*, 52(3), 543-553.
- Shea, P., Hayes, S., Smith, S. U., Vickers, J., Bidjerano, T., Pickett, A. & Jian, S. (2012). Learning presence: Additional research on a new conceptual element within the Community of Inquiry (CoI) framework. *The internet and higher education*, 15(2), 89-95.
- Shea, P., Li, C. S., & Pickett, A. (2006). A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *The Internet and higher education*, 9(3), 175-190.
- Shea, P., Richardson, J., & Swan, K. (2022). Building bridges to advance the community of inquiry framework for online learning. *Educational Psychologist*, 57(3), 148-161.
- Singh, J., Singh, L., & Matthees, B. (2022). Establishing social, cognitive, and teaching presence in online learning—A panacea in COVID-19 pandemic, post vaccine and post pandemic times. *Journal of Educational Technology Systems*, 51(1), 28-45.
- Tang, Y., & Hew, K. F. (2017). Using Twitter for education: Beneficial or simply a waste of time?. *Computers & education*, 106, 97-118.
- Wise, A. F., Hausknecht, S. N., & Zhao, Y. (2014). Attending to others' posts in asynchronous discussions: Learners' online “listening” and its relationship to speaking. *International Journal of Computer-Supported Collaborative Learning*, 9(2), 185–209.
- Wise, A. F., & Paulus, T. M. (2016). Analyzing learning in online discussions. In M. G. Moore & W. C. Diehl (Eds.), *Handbook of distance education* (4th ed., pp. 390-409). Routledge.
- Wong, G. K., Li, Y. K., & Lai, X. (2021). Visualizing the learning patterns of topic-based social interaction in online discussion forums: An exploratory study. *Educational Technology Research and Development*, 69(5), 2813-2843.