Journal of University Teaching & Learning Practice

Volume 19
Issue 4 *Pedagogies of belonging in an anxious world*

Article 19

2022

Examining students' collaborative epistemic actions in a MOOC learning environment

Ammar Bahadur Singh
Østfold University College, Norway, ammar.b.singh@hiof.no

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Abstract

Human intellectual development is grounded in dialogue and collaboration. This study examined how students' collaborative epistemic actions and activities evolve and expand in interactive online learning meetings and how digital technology affords coordinated epistemic actions, enhancing students' agency in learning in an institutional massive open online course (MOOC). As data, recordings of students' online video meetings were analyzed using interaction analysis and interpreted using the cultural-historical theory of learning. The findings revealed that students engaged in four epistemic actions and several epistemic activities: (a) co-orientation (epistemic positioning and planning rules of engagement), (b) presentation (sharing ideas explicitly), (c) assessment (questioning, clarifying, and feedback giving), and (d) reflection (concluding and outlining further actions). These collaborative epistemic actions evolved when the students presented, explained, claimed, and vetted their epistemic claims related to creating the examination assignment in the online collaborative learning meetings. Digital technology can effectively mediate students' coordinated epistemic activities. Online interactive sessions will establish the relational zone of belonging, and foster students' emotional, cognitive, or intellectual becoming, enhancing their agency in online learning.

Practitioner Notes

1. Collaborative learning meetings may create premises for students' active learning in institutional MOOCs, where they remain remotely located.
2. Students can take different epistemic positions, and digital technology can help transform those positions during the collaborative learning process.
3. Digital technology can assist students in deepening interactions, fostering meaning-making processes, and thus invoking agency in learning.
4. Online collaborative learning meetings can create an intersubjective space of meaning-making and foster conceptual development for solving learning problems.
5. Developing and advancing the conceptual understanding of learning tasks or problems requires students to enact their epistemic agency.

Keywords

Collaborative learning, collaborative epistemic actions, epistemic activities, shared understanding, co-agency

Introduction

The first generation of massive open online courses (MOOCs), also called connectivist or cMOOCs, emphasized learner participation, peer-to-peer learning, interaction, and social networking, leading to collaboratively creating networks, content, and knowledge (Mohamed & Hammond, 2018; Siemens, 2013). Communication and interaction among participants leads to learning and understanding, not to consuming pre-mediated content from experts (Bates, 2020). On the other hand, the second generation of MOOCs, also called xMOOCs, focus on knowledge transmission, which primarily includes video lectures, automated quizzes, supporting reading materials, discussion spaces, and assignment tasks (Bates, 2020). They underpin a cognitive–behaviorist pedagogical model, where teachers remain experts and students as knowledge consumers (Anderson & Dron, 2011; Siemens, 2013).

However, this categorization does not represent the current trends and practices in MOOC development. MOOCs take hybrid formats that include content transmission, social networking, and online collaborative learning activities (Bayne & Ross, 2014; Mohamed & Hammond, 2018). Even xMOOCs differ in their pedagogy, content, and assessment, as some emphasize social interaction, encouraging learners to connect with fellow learners through social networking such as Facebook (Mohamed & Hammond, 2018). Social interaction (connection and idea exchanges) and collaboration primarily take place in and through course discussion forums in MOOCs (Qureshi et al., 2021; Wu, 2021), which enhances understanding of course content and develops social intelligence (Garreta-Domingo et al., 2018; Margaryan et al., 2015). Research studies show that discussion forum–driven collaborative learning promotes social engagement and higher-order thinking skills (Yadegaridehkordi et al., 2019). We argue that the online meetings examined in this study can deepen and foster collaborative learning. They can create a relational zone for belonging, emotional, social, and conceptual development in online learning environments where participants remain remotely located and unfamiliar with one another.

Online collaborative learning is a collective process of productively engaging in learning to develop a conceptual understanding of how to solve learning problems. Mutual engagement, interaction, and contribution are required for collaborative learning, creating spaces for intersubjectivity—a process of productively engaging in joint meaning-making discourse among participants (Stahl, 2021). Students change and improve ideas, build and innovate knowledge through collaboration (Harasim, 2017), and develop a shared understanding and higher-order thinking (Bali, 2014; Margaryan et al., 2015) in spaces for intersubjectivity. We build our capacity to learn together in the realm of intersubjectivity with the help of new technology. As Wegerif (2013) contends, this is expected to be the core complex competence required for future educational practices. Learning how to engage meaningfully in learning is the enactment of agency, which comes into play while engaging in collaborative learning activities (Engeness, 2021a; Stetsenko, 2020). Collaborative learning demands students' active engagement and contribution to joint learning processes, where each group member takes responsibility for their learning (Stetsenko, 2017). Students in small groups can decide how to proceed and engage in collaborative learning meetings to develop a shared understanding of learning problems. When students collectively decide how to conduct a learning process by revealing their epistemic positions, we call them collaborative epistemic actions (CEAs).

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We argue that CEAs influence students' roles and activities in learning. For example, orientation (planning a course of action and deciding on the rules of engagement) as a CEA determines what functions and activities each group member will conduct in the learning process. Learners can assume the roles of presenter, feedback provider, and active listener in a group learning process (e.g., online meetings). Therefore, we argue that CEAs influence epistemic activities in online collaborative learning meetings, and digital technology can promote and transform students' epistemic positions and activities.

However, existing studies on collaborative learning in MOOCs focus on examining students' text-based collaboration, log data, and student opinion surveys (Amarasinghe & Hernández-Leo, 2019; Zheng et al., 2015). MOOCs still lack community building, interpersonal communication mechanisms, and collaborative learning features (Gamage et al., 2020; Zheng et al., 2015). Intersubjectivity, or the social process of meaning-making, is an underexplored area in the field of computer-supported collaborative learning (Stahl, 2021) and MOOCs. Existing pedagogical practices in conventional MOOCs (e.g., MOOCs offered by big platforms such as Coursera and edX) emphasize content transmission rather than conversation and collaboration (Harasim, 2017). The Pedagogical Information and Communication Technology Massive Open Online Course (ICTPED MOOC), the focus of this study, is an institutional MOOC that includes the delivery of fine-tuned content, social networking (e.g., Facebook group discussions), and online collaborative learning activities (e.g., online meetings) (Engeness, 2021b).

The MOOC is a credit-bearing course aiming to develop teachers' professional digital competence. The online collaborative learning meetings in the ICTPED MOOC provide a fertile environment for developing and expanding intersubjectivity, as they promote interaction and collaboration among remotely located students, primarily through synchronous (e.g., Teams, Zoom) and asynchronous (e.g., course discussion forums). This study examines how students' CEAs evolve and expand in online collaborative learning meetings and how digital technology promotes such activities, enhancing students' agency in learning in the ICTPED MOOC. We addressed the following research questions:

- *RQ1: How did students engage in collaborative epistemic activities in online meetings?*
- *RQ2: How did digital technology facilitate students' learning during online meetings?*

Literature review

According to Mohamed and Hammond (2018), cMOOCs and xMOOCs promote distinct views on learning and knowledge acquisition. The cMOOCs promote open learning principles that allow collaborative knowledge-building. They are based on the principles of connectivism: learner autonomy—learners decide what to read and discuss; diversity—learners with diverse levels of knowledge and socio-cultural background can choose various tools for learning varied content; interactivity—communication and cooperation between participants leading to emergent knowledge; and openness—open access, content, activities, and assessment (Downes, 2012). They emphasize "human agency, user participation, and creativity through a dynamic network of connections afforded by online technology" (Ebben & Murphy, 2014, p. 333). Nevertheless, Harasim (2017) argues that current online courses, including MOOCs, "reduce human agency to consuming and reducing truths" (p. 127) because they provide little room for

idea generation and discussion through conversation. Interactive and collaborative learning activities are underprioritized (Gamage et al., 2020).

The current format of MOOCs (e.g., xMOOCs) follows a more cognitive–behaviorist approach and relies on content transmission(Harasim, 2017), which is dominated by video presentations, reading text, and automated assessments (Bates, 2020). They are offered on a single learning platform (e.g., Canvas) (Jacoby, 2014), but xMOOCs also provide a mix of media and spaces where students can create, share, interact, and transmit knowledge (Mohamed & Hammond, 2018). For example, students are encouraged to connect, share, and engage in learning on Facebook and Canvas discussion forums and online videoconferencing tools (e.g., Teams, Zoom) in the ICTPED MOOC. Unlike conventional MOOCs (e.g., those offered by FutureLearn, edX, and Coursera), instructors actively follow students' learning activities and address their learning needs in institutional MOOCs (the ICTPED MOOC). Students are encouraged to engage with fellow participants and course instructors to solve their learning problems.

However, the outdated methods in which current MOOCs are primarily based on information transmission can be resolved by what Soylev (2017) calls "the social MOOCs or MOOCs 2.0," emphasizing peer interactions, peer assessment, and online, face-to-face learning. Many studies indicate that social learning (e.g., connectivity and cooperation) can foster students' motivation to learn(Brinton et al., 2014) and alleviate feelings of isolation (Li et al., 2014). Social learners, especially those who engage in discussion forums, tend to complete the courses more than non-social learners (e.g., those who do not engage in discussion forums) (Crane & Comley, 2021). Forming small groups of students who engage in online interaction and social networking can address the barriers to social, collaborative learning in MOOCs. Such small groups focus on project-based learning (Li et al., 2014) and understanding course content (Krasny et al., 2018).

Several studies emphasize improving MOOC design to integrate social, collaborative learning (e.g., peer-to-peer interaction, assessment, and online, face-to-face learning). They stated that students establish trust, social cohesion, and a community of learners and learn more in groups of people with different perspectives, leading to knowledge co-creation through in-depth online interaction. Peer interaction in MOOCs motivates students to complete courses (Ma et al., 2022) and promotes student engagement (Wu, 2021). Learning is developed and promoted when students build a learning community, collaborate, and contribute to collective knowledge-building (Conole, 2015; Jeong et al., 2017; Margaryan et al., 2015), which leads to nurturing collective intelligence (Garreta-Domingo et al., 2018). Students learn more and contribute to the co-creation of knowledge in groups of students with diverse perspectives(Krasny et al., 2018). Diversity in small group discussions in online video calls in MOOCs can enhance students' performance in final exams (Kulkarni et al., 2015). Therefore, many studies have shown that teachers can effectively develop their professional development by actively engaging in social interaction and collaborative learning in MOOCs (Brevik et al., 2019; Ma et al., 2022). Teachers can make pedagogical innovations through collaborative learning and sharing (Laurillard, 2016).

Learning is a mediated process. Various socio-cultural and digital resources mediate learning. For example, text, videos, and audio resources in MOOC platforms can mediate students' learning and promote their agency in online learning (Engeness, 2021b). According to Riofrío-Calderón and Ramírez-Montoya (2022), literature tends to conceive mediation from a

technological perspective rather than a pedagogical perspective, which is underexplored in MOOCs. Mediation, the pedagogical process of supporting one another to solve problems and develop products through continuous feedback, must be further explored in the context of online learning, including MOOCs.

The literature discussed above has documented that collaborative and social learning activities in MOOCs are crucial to promoting learning and knowledge co-construction. Diversity in interaction and collaboration can enhance social knowledge-building processes and lead to innovation. Therefore, scholars emphasize integrating communication, interaction, and collaboration as essential design elements of MOOCs. However, online social and collaborative learning activities in MOOCs, primarily through online video conferencing, are underprioritized. This study explores the underdeveloped research area by examining how students in online collaborative learning meetings engage in learning and what role digital technology plays in enhancing students' agency in learning in the ICTPED MOOC.

Theoretical framework

The cultural-historical theory of psychological development (Vygotsky, 2012) emphasizes that an interactive learning environment promotes collaboration, interaction, and mediational learning. Communication, interaction, and dialogue are inherent to collaborative practices (Stetsenko, 2017). Using a Bakhtinian perspective, Wegerif (2019) argued that learning to think involves engaging students in dialogic processes, leading to expanded understanding. Technologies may support new kinds of educational dialogue among students. Technology-mediated discussion may allow many voices to interact from within or come forth (Wegerif, 2013, 2019). Conversations lead to increased self-insight and taking the initiative to co-author meaning in conversation increases epistemic responsibility (Wegerif, 2019).

Voloshinov (1986) further emphasizes such a meta-perspective of dialogue when he states, "consciousness becomes consciousness…only in the process of social interaction. Individual consciousness is…a tenant lodging in the social edifice of ideological signs" (p. 86). For Vygotsky, the social dimension of consciousness is primary in time, and the individual dimension is derivative and secondary (Rommetveit, 2014). Proper understanding is created in dialogic interaction (Voloshinov, 1986). However, the notion of collaboration is not only limited to dialogicality; it goes beyond it and includes "the realm of practical doings and activities" (Stetsenko, 2008, p. 524). Stetsenko further contends that to be in dialogue with others is to belong and share approaches, ideas, and concepts. Stetsenko (2017) argued that collaborative practices:

> …constitute the primary relations connecting individuals to their world and give rise to psychological processes (cognition, self, self-regulation, and emotion), with individuals acting as agents involved in collaborative practices that issue in psychological processes and knowledge construction. (p. 159)

According to Stetsenko (2017), individuals as social actors of collaborative practices contribute to these practices "from their unique positions, stances, and commitments;" change themselves, the methods they employ, and their world; and bring these changes into realization in and through collaborative practices grounded in collaboration (p. 171). Collaborative practices enhance the conceptual understanding of learning tasks or problems. Conceptual development does not accumulate bits of information in an individual logical conceptual system. Instead, it

is about how learners' "ways of being-knowing-doing are organized and conducted within their meaningful life projects" (p. 337).

Most importantly, collaborative learning activities create a zone of proximal development (ZPD). We conceptualize the ZPD as a socio-pedagogical space where collaborative teaching and learning activities occur. Learners and instructors are interconnected in "a holistic process of interaction, intellectual development, and upbringing" (Kostogriz & Veresov, 2021), as well as a diagnostic tool by which instructors assess students' learning activities and devise strategies to address their learning needs. The socio-pedagogical space is created through three distinct and interrelated domains of practice—"the material-semiotic, the cultural-historical, and the lived" (Kostogriz & Veresov, 2021). The first domain is the arrangement and availability of organized material-semiotic resources or historically produced signs, tools, and means for learning and development, such as various multimodal resources (texts, audios, videos, tutorials, or reference materials) in the MOOC. The second domain encompasses "cultural-historical practices that create social environments," that is, "an intellectual space" for education and development where we form relational practices using material-semiotic tools for accomplishing joint activities. The third domain is the space of lived experiences, or an intersubjectivity space where we engage in dialogical communication, meaning-making, and learning. A new meaning is produced when interaction occurs between "individual-social, everyday-scientific, and self-other" (Kostogriz & Veresov, 2021). Technology can create a rich socio-pedagogical space for intellectual development. Research studies on computer-supported collaborative learning show that technology can offer learners opportunities to engage productively in collaborative learning (Jeong et al., 2017; Stahl, 2021).

Thus, we conceptualize online collaborative learning meetings as socio-pedagogical spaces of intellectual development, where semiotic tools (something students share or wish to discuss) mediate students' collaborative learning. More competent students can assist less capable students in learning. They also develop their agency in learning, conceptualized as the capacity to know and learn how to engage meaningfully in collaborative learning (Edwards, 2022; Engeness, 2021a). Such abilities are enacted and expanded when students position themselves in collaborative learning practices to solve their problems (Stetsenko, 2020). Engaging in online collaboration can become demanding for students if they do not know how to share epistemic responsibility. Galperin's pedagogical theory offers a systematic approach to how students can engage in learning, leading to transformation (enhanced capability or problem-solving capability of actors involved) (Arievitch, 2017; Engeness, 2021a). Galperin specifies six dialectically evolving pedagogical phases: motivation, orientation, materialized action, communicated thinking, dialogical thinking, and acting mentally. Agentic learners who know how to engage meaningfully in learning can create rules of engagement or orient their learning processes (Engeness, 2021a). These pedagogical phases can be applied to understand how students collaboratively develop their understanding of their tasks or problems in online meetings in the ICTPED MOOC. We argue that understanding learning tasks or other problems demands a systematically organized approach or specifically designed learning activities in MOOCs. We use Galperin's pedagogical phases as an analytical tool to understand how students engage in learning during their online collaborative meetings. The following table presents a simplified version of Galperin's pedagogical theory. More detailed information about the theory can be found in Engeness (2021a).

Table 1.
Galperin's Pedagogical Phases

Galperin's Pedagogical Phases	Activities
Motivation	Forming attitudes and relationships to learning outcomes
Orientation	Charting a plan of action (how to proceed to accomplish a task)
Materialized action	Presenting resources that encapsulate characteristic features of the target scientific concepts. These resources can directly mediate a discussion and visualize the ideas (e.g., presentation of the draft of a task)
Communicated thinking	Questioning, explicating, assessing, and verifying ideas or claims
Dialogical thinking	Reflecting, concluding, and structuring
Acting mentally	Developing a mental image of the understanding (enhanced capability)

Method

Setting and participants

The ICTPED MOOC is a credit-bearing course that aims to develop pre-service and in-service teachers' professional digital competence. The ICTPED MOOC is an institutional xMOOC; it consists of seven modules and includes video lectures, information texts, automated quizzes, assignment tasks, and discussion forums. Teachers in the MOOC have an opportunity to interact with course instructors and their fellow teachers via discussion forums and online video conferencing platforms (e.g., Teams, Zoom).

Teachers had to complete an obligatory examination assignment in Module 7 (flipped classroom). They were encouraged to engage in voluntary online synchronous collaborative learning (i.e., online meetings) with their peers to discuss how they could better create examination assignment tasks. Teachers had to develop a pedagogical task for the flipped classroom that they could use for teaching and learning in their professional practices. They were provided with basic information about collaborative learning meetings. For example, the researcher created a Google document to help teachers develop their groups and schedule meetings. Teachers were suggested to work in groups of 2–4. The researcher created an informative video to encourage the teachers to participate in online collaborative learning meetings and to guide them in forming a group. The video was embedded in the module and sent to all teachers (N = 165). In total, 31 teachers consented to film recordings of their meetings, 23 of which participated in collaborative discussions and shared their recordings.

Data materials and tools

As the primary data materials, teachers' online collaborative learning meetings were used to examine teachers' CEAs. Eighteen teachers in five sessions allowed the researcher to participate in, observe, and film their meetings; five teachers in two meetings did not allow the researcher to observe their meetings, but they did share recordings of their sessions with the researcher. A meeting (00:49:25 minutes long) in which the researcher participated as an observer was selected for analysis in this study.

Table 2.
Overview of Online Collaborative Learning Meetings

Number of meetings	Number of participants	Duration of meetings	Type of observation
1.	3	49:25:00	Researcher participated
2.	4	53:29:00	
3.	4	01:02:06	
4.	4	45:06:00	
5.	3	47:32:00	
6.	3	44:14:00	Researcher did not participate
7.	2	33:40:00	
Total (N = 7)	(N = 23)	Minutes = 274:28:06	

Analytical procedures

Interaction analysis (IA) was used for the data analysis (Jordan & Henderson, 1995). Erickson (2012) suggested three procedures for identifying and analyzing videotape data. Erickson's Type I procedures treat the entire interaction as a meaning-making event and emphasize inductive approaches to meaning construction. We treated each recorded meeting as a meeting-making event in which participants actively engaged in learning.

In the initial data analysis phase, we went through the first five recordings (5 meetings, 196 minutes) where the researcher participated as an observer. We selected a meeting to examine how the participants who had developed some understanding of how to solve their examination assignment assisted the participants who were wondering how to solve the assignment and how digital technology assisted the students in developing their understanding of solving the task and transforming their epistemic positions. We observed how students initiated their meetings, framed rules of engagement, enacted them while engaging in discussion, and concluded their learning.

The recordings of the online meetings were transcribed in Norwegian using Jefferson's transcription notation (Appendix 1) (Jefferson, 2004). Four extracts were selected from the meeting for the IA. The chosen extracts represented the patterns of interaction between the students in the interaction trajectories and were analyzed using IA (Derry et al., 2010; Jordan & Henderson, 1995). The primary units of analysis were sequences and turn-takings in student interactions (Linell, 2009). Each utterance was analyzed in relation to the previous one in the ongoing learning trajectories.

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The IA was conducted in three steps (Linell, 1998): first, the interaction sequences were described by referring to the numbered lines; second, interactions were analyzed from the perspective of the research questions; and third, the findings were presented. Finally, after completing the IA, the extracts were examined via the analytical lens offered by Galperin's pedagogical phases. In this way, we examined students' collaborative epistemic activities during different segments of the online meeting to develop their understanding of the examination assignment task.

Findings

Co-orientation

In the following extract, the students are at the beginning of their online collaborative meetings. From the Galperin perspective, they are in the orientation phase.

Table 3.
Co-orientation

1.	S1	I am not well prepared today for the presentation.
2.	S2	Okay. That is fine.
3.	S1	However, I can be with you all and provide my feedback on your presentations.
4.	S3	…I will also listen to you and ask some questions.
5.	S2	Yes, you can provide us with feedback. We can also help you decide how to work on the examination assignment.
6.	S1	That is great. I am really looking for that.
7.	S2	Before I present, I would like to say something about my profession. I teach social studies to 10th-grade students. I have selected WWII as a topic for my flipped classroom, and students will have to prepare Padlet notes about what might have prevented WWII.

S1 states that she is not well prepared for the presentation but will actively listen to others and provide her comments (lines 1, 3). S3 is also willing to listen to and engage with the presentation of S2 (line 4). S2 agreed with their proposals and stated that the discussion might help others to understand how to create the examination assignment. S1 expects to gain insights into how she can create the examination assignment during the discussion (line 6). S2 briefly presents his professional background, topic of his examination assignment, and digital tool (Padlet) used before sharing what he has done so far (line 7).

The students jointly plan how they can engage in the meetings, explain their understanding of the examination assignment, and specify what roles they take during the session. S3 wants to listen to fellow students and raise questions about the assignment, while S1 wishes to offer his feedback on S2's presentation and ideas. S2 takes the presenter role, as he has already developed some ideas about solving assignments. He assures fellow participants to assist them in developing a conceptual understanding of solving the problem during the meeting. Digital technology functions as tool for connecting participating students at this stage.

The extract shows that students can jointly plan how to engage in learning. They can independently reveal their knowledge about the topic of discussion, specify their epistemic positions, and take responsibility for contributing to collaborative learning. Thus, planning, presenting epistemic positions, and taking initiatives are the main co-orienting activities. In doing so, the students demonstrate their agency in how to engage in learning, which influences subsequent learning activities. Digital technology (as a resource) does not come into play at this stage of learning.

Presentation

The students share and present their examination assignment tasks-in-progress. From the Galperian perspective, they are in the materialized action phase.

Table 4.
Presentation

1.	S2	(*Sharing his OneNote presentation).* Now, you see here what I am working on. I have selected WWII as a topic of discussion, and students will prepare Padlet notes about what might have prevented WWII. This is the learning goal. Then, they will present in a group and discuss how to produce something.
2.	S1	It is fascinating. Why are you using Padlet?
3.	S2	Well…I think Padlet allows students to collect their ideas, which will promote active student learning. It will also enhance their digital and writing skills, as they should find reliable resources and note important points in Padlet. I am also working on specifying assessment criteria to assess students' learning activities.
4.	S3	Can you share the assessment criteria you are working on?
5.	S1	(*Pointing to listed assessment criteria).* These are the assessment criteria. I initially prepared them to assess students' learning about the Cold War and Vietnam War. I will modify them to assess students' learning about the current topic. For example, students should use reliable sources and cite some direct quotes from authors.
6.	S3	Okay, will students make a talking head presentation in small groups?
7.	S2	I think students will only prepare Padlet notes, but I will create a talking head tutorial video to explain the task to the students.

S2 is presenting his examination assignment (line 1). The other two students were curious about various aspects of his presentation, such as assessment criteria and talking head videos (lines 4 and 6). S3 asks S2 to show the assessment criteria for assessing students' learning about the topic (line 4). S2 shares his previously created assessment criteria, which he plans to modify and use for assessment (line 5). S1 is curious to know why S2 uses Padlet (line 2). S2 argues that Padlet can promote students' active learning because students can record essential points in Padlet while navigating and consulting resources. S3 wants to know whether S2 allows his students to create talking head videos for presenting their tasks (line 6). S2 clarifies that students will only prepare notes in Padlet, but he will create talking head videos explaining the learning tasks to the students.

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S2 shares his ideas and approaches to creating the examination assignment, and fellow participants attempts to making sense of them. Digital technology (the draft of examination assignment shared on the screen) functions an important role in assisting S2 to present his ideas explicitly and fellow participants in visualizing S2's ideas. S2 also presents his approaches to turning the examination into a learning task that can promote students' active engagement in learning, including task giving, jointly preparing Padlet notes, and presenting and discussing the notes in a group. He explains the assessment criteria to be used to assess students' learning. Fellow students question S2's ideas and approaches and give their suggestions for improving ideas.

The extract indicates that students' epistemic activities develop when they jointly attempt to present and make sense of ideas and approaches to creating the examination assignment. Digital technology assists them in sharing, visualizing and making sense of the developed ideas (OneNote presentation). Materialized ideas (the draft of assignment) can be well presented, discussed and questioned with the help of digital technology. Thus, digital technology helps remotely located students share and present ideas in detail, which leads to visualizing ideas and fostering sense-making. In doing so, it assists students in developing their agency.

Assessment

The students were engaged in developing a more detailed understanding of the draft. From the Galperian perspective, they are in the communicated thinking phase.

Table 5.
Assessment

1.	S1	Maybe, I have not fully understood your task. Are you going to give your students a video to watch at home? Flipped classroom, right?
2.	S2	Yes. I will provide a self-created video tutorial (10–12 minutes) for students to watch at home. Then, they will continue the discussion in the classroom.
3.	S1	*(Referring to S2's assignment shared on the screen)* I see your assessment criteria, and you have numbered them 1–2, 3–4, and 5–6. Are those characters?
4.	S2	Yes, the number will indicate students' achievement in the task.
5.	S1	Mm…that is right.
6.	S3	Do you think students should be engaged in developing assessment criteria?
7.	S2	I think it is a good idea, and they can engage in developing assessment criteria in advance, but I am not sure to what degree they can be involved because of the time limit. Perhaps, they can assess their tasks based on the given assessment criteria.
8.	S3	Will students present their tasks in the classroom?
9.	S2	Not sure yet, as we keep going digital now. Perhaps, they will present in breakout rooms.
10.	S3	Yes, you are right. Due to the pandemic, teaching will be fully digital.

The students are engaged in understanding S2's draft of the examination assignment. S1 wants to know whether S2 will create video tutorials for the flipped classroom (lines 1 and 11). S2 explained that he will self-create video tutorials that students will watch at home and then discuss in class. S1 also wants to know why S2 has numbered assessment criteria (line 3). S2 clarifies that students will receive numerical grades according to their performance (line 4). S3 wonders whether S2 involves students in developing assessment criteria (line 6). S2 acknowledges that involving students in developing assessment criteria is a good idea, but he is unsure of how students can contribute to creating the standards (line 7). However, S2 believes that students can assess their tasks using the given assessment criteria (line 7). S3 wondered whether students could present their tasks in the classroom (line 8). Given the pandemic situation, S2 states that students will make the presentation in breakout rooms (line 9), and S3 is also aware of the existing situation and mode of teaching and learning (line 10).

The students were actively engaged in the discussion. S1 and S3 raise questions about various aspects of S2's assignment task. For example, video tutorials, assessment criteria, and students' involvement in developing assessment criteria. S1 explained the questions and attempted to justify his approaches to solving the problems. The students contribute to expanding their understanding of S2's ideas and approaches. Thus, students' collaborative epistemic activities evolve as they attempt expand and advance their understanding of the assignment. Digital technology helps students keep track of presented ideas and deepens the discussion of the problems as it allows them to frequently revisit the shared ideas.

The extract shows that students could expand their initial epistemic roles during the learning process. For example, S1 chose to be a listener in the orientation phase, but she was actively engaged in questioning during this assessment phase. The more clearly students understand ideas, the more vigorously they can contribute to collaborative learning processes. Digital technology can play a vital role in deepening discussion and assisting students to actively contribute to the learning process, as it provokes a shared inquiry. Thus, technology can augment collaborative learning activities, enhancing students' agency in learning.

Reflection

In the following extract, the students are in the phases of summarizing and concluding their meetings. From the Galperin perspective, they are in the dialogical thinking phase. The students reflected on their understanding of the examination assignment. S1 realizes that she has obtained some insight into how to create the examination assignment, but she still finds the concepts discussed challenging (line 1). S3 acknowledged the challenges in creating the examination and suggested that S1 read some reference materials before working on the examination assignment (line 2). S1 is willing to have another meeting to discuss the examination assignment (line 3). S2 stated that he would be glad to share his revised draft (line 4) but was uncertain about the next meeting (line 6). S1 wants to schedule another session (line 5) to discuss the draft of her assignment (line 8), but other students remain uncertain about follow-up meetings (lines 7 and 9).

Table 6.
Reflection

1.	S1	I got some insight into how to create the examination assignment now, but I still find it challenging.
2.	S3	Yes, it is not easy. It takes a while. However, simply speaking, it is just like creating a lesson plan and carrying it out in the classroom. Here are two excellent articles that you better read before working on the examination assignment.
3.	S1	How do you think we can continue working in groups?
4.	S2	I will be happy to discuss this further. I will revise and prepare a new draft also.
5.	S1	Okay. Can we fix our next meeting?
6.	S2	I am not sure yet, but we can try next Monday or Friday.
7.	S3	I am not sure if we are going to have one more meeting.
8.	S1	My suggestion is that we should have one more meeting. I will start working on my task, and we will discuss it.
9.	S2	Okay. We will try.

S1 and S3 reflected on their understanding of how to create the examination assignment. S1 still finds solving the examination assignment challenging and wants a follow-up meeting with fellow participants. S3 has developed some understanding of completing the assignment and suggests to S1 some readings to solve it. S2 wanted to discuss his revised draft in the would-be follow-up meeting, but he remained uncertain about the follow-up meeting.S3 was also uncertain.

By engaging in collaborative learning, students can reflect on their understanding of the target concepts. They can reveal the ideas they have developed and the challenges they see in solving the task and outline further steps in developing their knowledge to solve the problems. In doing so, they can enact their agency in learning. The role of technology in this stage of learning is not visible when it comes to assisting students' reflection on their education.

Discussion

The findings revealed that students could collaboratively plan, conduct, and conclude their meetings effectively by taking four epistemic actions (epistemic moves taken to discuss and develop an understanding of the examination assignment). Students also engaged in several epistemic activities (such as posing questions, clarifying, and validating) to develop, expand, and advance their conceptual understanding of the examination assignment task-in-progress. The epistemic actions and activities are summarized in Table 7.

Table 7.
Summarization of Students' Epistemic Actions and Activities

Epistemic actions	Epistemic activities
Co-orientation	Introducing
	Planning activities
	Revealing epistemic positions
	Initiation taking
Presentation	Presenting draft of the examination assignment
	Sharing ideas related to the draft
	Visualizing and detailing the ideas
Assessment	Questioning ideas
	Explicating and expanding ideas
	Assessing ideas
	Verifying ideas
Reflection	Reflecting upon key understanding
	Concluding
	Outlining further steps

The students started the meeting by revealing their epistemic positions (one's knowledge status about the task to be discussed). They specified how they would engage in learning during the session. These activities can be considered taking epistemic responsibility according to one's epistemic positions (listener, learner, feedback giver, and presenter). We refer to these activities as *co-orientation* (the first epistemic action), which is required to plan rules of engagement based on epistemic positions in online collaborative learning. Epistemic positioning helped map out the epistemic resources (more/less knowledgeable) that would come into play and be activated in the subsequent phases of collaborative learning. Epistemic positioning can change during the learning process. For example, S1 wants to be a listener while positioning herself in the learning, but she turns out to be an active questioner during the learning process. Thus, it can be argued that epistemic positioning may change as students enact their agency in learning. Agentic students who are aware of their learning goals and have developed the capability to engage in learning activities meaningfully can orient their learning process reciprocally (Engeness, 2021a). Previous studies also indicate that agentic students can initiate learning processes independently (Singh & Engeness, 2021). Digital technology (as a resource for learning) does not come into play at this stage of learning. Still, technology as a digital space can generally keep connecting and building a community of learners.

The second epistemic action was the *presentation* of ideas and approaches for creating the examination assignment. S2 shared his draft of the examination assignment task on the screen, which functioned as a mediational tool for detailed presentation and meaning-making. We argue that the draft as a mediational tool had double functions in the learning process: first, it functioned as a tool to visualize ideas and approaches that stimulated interaction among students, and second, it became a semiotic tool for understanding concepts. Co-interlocutors need to understand the task to deepen their understanding. As stated by Galperin, the draft of the examination assignment as a materialized object carried and visualized ideas and meaning to the interlocutors (Engeness, 2021a; Podolskiy, 2014). The draft as a digital resource allowed S2 to systematically present and clarify his ideas about how he would solve the problems, help

other participants understand the concepts, and stimulate them to raise further questions and comments. These activities deepened students' interaction to understand S2's task. The less-prepared students understood how to create or solve the examination. Thus, we argued that digital technology (e.g., the draft shared on the screen) expanded students' collaborative epistemic activities, allowing them to enact and develop their agency in learning (Engeness, 2021a).

The third epistemic action was the *assessment* of ideas, in which students engaged in asking questions, illustrating ideas, and providing feedback on fellow students' ideas and approaches. Posing questions, answering questions, and expanding and vetting ideas are characteristics of higher-order and critical thinking, which could contribute to a profound understanding of the examination assignment. Students became deeply engaged in dialogue at this discussion stage, which could foster co-agency—a mutual process of understanding by elaborating and vetting ideas (Glăveanu, 2015; Leadbeater, 2017) or intersubjectivity in learning (Stahl, 2021). Digital technology, such as a shared draft of an examination assignment, can promote students' collaborative contributions to learning and transform students' epistemic positions. In doing so, technology can assist students in realizing and enhancing their agency in learning.

The final epistemic action was *reflection*, which involved reflecting, structuring, completing the concepts discussed and outlining further steps to complete the examination assignment. They concluded that creating the examination tasks was demanding, as it required conceptual clarity to solve them. Students who were not well prepared might need a follow-up session to deepen their understanding. They thought of a follow-up meeting to discuss their currently underdeveloped ideas, but remained uncertain about it. Agentic students can reflect on what they have done and learned and determine further actions to deepen their understanding of how to solve problems (Engeness, 2021a; Stetsenko, 2017). Reflecting on knowledge in groups can also mediate self-reflection, leading to enhanced problem-solving capability (Arievitch, 2017).

To conclude, students can productively engage in and jointly develop CEAs and activities in online learning meetings. They can volitionally take epistemic responsibility by revealing their epistemic positions in learning. Digital technology can change and transform students' epistemic positions, as less willing students can become active contributors to the learning process. It can expand students' collaborative epistemic activities and allow them to enact and develop their agency in learning as it assists students in presenting their ideas and discussing them. Thus, online learning meetings foster students' sense of belonging, and emotional, cognitive, or conceptual development, enhancing intersubjectivity and epistemic transformation (e.g., developing scientific understanding of learning problems).

Pedagogical implications

There are several pedagogical implications. First, students in online collaborative learning meetings can systematically engage in a learning process. They can reveal their epistemic positioning (e.g., assuming the roles of presenter, listener, and feedback giver) and develop CEAs, such as co-orientation, presentation, assessment, and reflection. However, students' epistemic positioning changes as they immerse themselves in the learning process, and digital technology (the shared draft on the screen) can assist in this process as it stimulates less knowledgeable or less-prepared students to engage in inquiry and interaction. It may help more knowledgeable students to clarify debatable issues (students' involvement in developing assessment criteria) and thus expand their knowledge. Thus, digital technology (resource) may

deepen students' understanding of learning problems and transform their epistemic positioning in the online learning environment.

Second, digital technology plays a vital role during the presentation and assessment stages of online collaborative learning. It has double mediational functions: it can develop and expand students' interaction and foster a meaning-making process as students can quickly point out the conflicting issues, which provokes discussion. Thus, digital technology can profoundly influence students' engagement, interaction, and meaning-making processes in learning. Digital technology (as a space) also allows students to present their drafts to each other and discuss them together, enhancing their understanding of the problems to be solved.

Third, online collaborative meetings may enable students to be responsible for their own learning. Students can enact, realize, and expand their agency in online collaborative learning. For example, they can reveal their epistemic positions, identify their learning needs, take the initiative in planning an action to engage with fellow students, share epistemic responsibility fairly, and assist one another in making sense of the ideas presented and discussed. Online meetings can create an authentic learning environment in which students have equal opportunities to contribute to learning processes by sharing their unique practice-oriented epistemic claims.

Finally, online collaborative learning meetings can develop a relational zone for social, emotional, and intellectual becoming among remotely located students, who often fail to engage in learning due to a lack of belonging and a community of learning. Online collaborative learning meetings can become instrumental in developing and expanding social learning and creating spaces for intellectual development in MOOC learning environments.

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Appendix 1

Transcription notations

Symbol	Description
[ ]	Speech overlapping
( )	Unclear section
Underlining	Denotes a raise in volume or emphasis
CAPITALS	Louder or shouted words
[…]	Utterances removed from original dialogue
…	Incomplete sentences