Applying the Community of Inquiry e-Learning Model to Improve the Learning Design of an Online Course for In-service Teachers in Norway

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Abstract: Education authorities in Norway endorse online courses for in-service teachers to raise education standards and to promote digital competence. Naturally, these offerings present teachers with opportunities to integrate new theoretical perspectives and their professional experience in an online learning community. The inquiry into one's professional practice, enhanced by critical reflection in a group of fellow professionals, is considered essential for a lifelong learning practitioner, however, the emerging examples of instructional design tend to prioritise content delivery rather than professional discourse. In this paper, we demonstrate how the Community of Inquiry (CoI) framework could be adopted to transform learning design, which prioritises the delivery of individual assignments, into a more collaborative learning experience. Using the CoI instructional design principles and the associated questionnaire, we have investigated student perceptions of learning via an online course and formulated recommendations about how the course design can be refined to promote learning in the community. Despite the modest evidence, this investigation can serve as an example of how a concrete learning design can be improved based on this validated e-learning model.

Keywords: Community of Inquiry, continuing education, distance education, deep learning design, constructivist learning

1. Introduction

The first online courses in continuing education in Norway were designed as part of the government's initiative to raise the quality of teaching practice in primary education (Norge Kunnskapsdepartementet, 2011; 2014). The authorities endorsed the design of MOOC-based courses (Norway Ministry of Education and Research, 2014) to meet the demand for educators trained to the updated standards, including digital competence (Krumsvik, 2014). One of the first offerings for in-service teachers, Matematikk MOOC (n.d.), provides flexible and cost-effective education at scale (Tømte et al., 2016), however, the quality of online learning in terms of promoting twenty-first century skills such as dialogic communication, critical thinking, and innovation essential for lifelong learning, is yet to be explored (Kareluik et al., 2013). According to experts in the field (Aditomo et al., 2013; Damşa et al., 2015; Fossland and Ramberg, 2016; Koh, Herring, and Hew, 2010; Spronken-Smith et al., 2012), the quality of online learning can be improved by employing inquiry or project-based learning, where participants explore alternative solutions. Despite this, the emerging instances of online learning design concentrate primarily on technology-enabled content delivery and an individual's interaction with it.

A viable path to facilitate a shift from the learning design based on content acquisition to learning in the community is offered by the Community of Inquiry (CoI) framework. This is a socio-constructivist model for e-learning research and practice, which focuses on the inquiry and the examination of alternative perspectives by a group of learners. In this model, learning involves the construction of a shared understanding to which group members contribute their experience and critical reflection. The model includes principles of practice and a validated questionnaire, which can be applied to investigate aspects of learning in the community (Garrison, 2016; 2017). This article reports on a study which attempted to use this framework to align the Matematikk Mooc 1 online course (UiA, n.d.) with CoI learning design principles. The investigation is structured in three stages, guided by the answers to the following questions:

- What are the students` perceptions of the social, teaching and cognitive aspects of learning in the community in Matematikk Mooc 1?
- How did the current learning design impact the students` perceptions of collaborative learning in Matematikk Mooc 1?

- Which CoI design principles could be reinforced to enhance learning in the community in Matematikk Mooc 1?

In the first step, we collected participant perceptions of collaborative learning to verify the status of the learning community on the online course. We then examined how the current learning design affected those perceptions. Lastly, we related the findings to the CoI instruction principles to find improvements to the course design.

We introduce the theoretical concepts related to the Community of Inquiry model followed by the significant body of research which applies the framework to concrete examples of learning design. We present the mixed-methods approach employed in the study of Matematikk Mooc 1, and a summary of findings. In conclusion, we offer suggestions on how the learning design of Matematikk Mooc 1 could be refined to boost collaborative learning.

2. Community of Inquiry – a model to guide learning design

The concept of the Community of Inquiry (CoI) was formulated by Garrison, Anderson, and Archer (1999) in their study tracing professional discourse in a text-based computer-mediated discussion forum. It is grounded in the socio-constructivist perspective on learning, according to which knowledge is constructed socially through the integration of alternative viewpoints in the course of inquiry, enhanced by reflection. In the context of instructional design, the CoI model indicates that a meaningful learning experience can be created through the interplay of three key elements: social, teaching and cognitive presence. These components represent different aspects of learning in the community.

Social presence involves the expression of a participant's socio-emotional identity in the online environment. It is concerned with how well course participants identify themselves with other members of the group, and can align their learning objectives and activities with those of the group. At the group level, it relates to group cohesion by setting a socio-emotional environment where trust, openness and a focus on the study are vital factors (Garrison, 2016; 2017).

Teaching presence involves the design of a learning experience as well as the facilitation and the direct instruction taking place during the course. It is responsible for setting and sustaining collaborative learning, primarily through managing both the socio-emotional climate and the inquiry process (Anderson et al., 2001). Strong leadership and a distinct learning design structure have been shown to increase student engagement in the collaborative environment (Garrison, Clevaland-Innes, and Fung, 2010; Shea and Bidjerano, 2009). It is not direct instruction that stimulates learning, however, but the design and the facilitation of activities promoting discussion and reflection (Garrison and Clevaland-Innes, 2005; Kupczynski, Wiesenmayer, and McCluskey, 2010; Vaughan and Garrison, 2006;). The quality of discourse and thinking shaped by the teaching presence distinguishes the learning community from any other social community that is typically dominated by casual interaction. The teaching presence also includes feedback and assessment to correct student misconceptions and to evaluate the progress of the inquiry process.

Cognitive presence is the essence of the CoI framework, in which the actual learning takes place. It is represented by the Practical Inquiry model (Garrison, Anderson, and Archer, 2001) which demonstrates how experience interplays with reflection during the dynamic inquiry stages: the triggering event, exploration, integration, and resolution.

The three components of the Community of Inquiry reflect the dynamic nature of learning in the community. They can be realised as shared responsibilities rather than fixed roles among the community participants. As learners gradually develop their metacognitive abilities, they can assume more control over the progress of an inquiry, with the tutor acting as a guide and a more experienced colleague. The three components described above are essential, interdependent, and provide a holistic representation of an educational experience.

The correlation between social, the teaching and the cognitive aspects in a learning community has been validated by numerous studies using the CoI questionnaire and factor analysis of the student perceptions of collaborative learning (Arbaugh et al., 2008; Yusuf, Mustafa, and Uğur, 2016). While the questionnaire can be used to evaluate the status of a learning community (Richardson et al., 2012), seven principles of practice and

the associated implementation techniques highlight the most salient responsibilities of the teaching presence (Vaughan, Garrison, and Cleveland-Innes, 2013). These principles can guide a tutor in forming and sustaining a learning community in which the facilitation of learning goes beyond the presentation of content and the assessment.
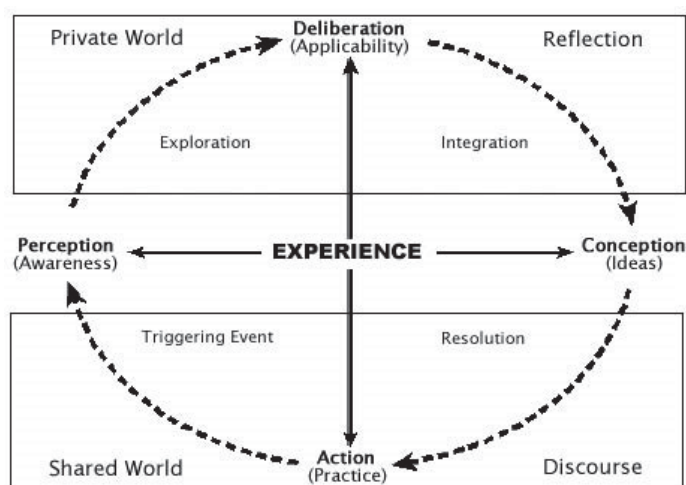

Figure 1: Model of Practical Inquiry (PI) by Garrison, Anderson, and Archer (2001)

The CoI model has been applied in several instructional design studies, either on its own or in combination with other e-learning design models such as Learning By Design, TPACK or the Quality Matters rubric (Makri et al., 2014; Swan et al., 2014; Szeto, 2015; Wisneski, Ozogul, and Bichelmeyer, 2015). It has typically been employed to validate and guide the design of online and blended courses in an academic context, where the objective was to develop higher-order thinking. From a broader perspective, the CoI model represents "epistemic engagement" in opposition to the presentational or performance-tutoring alternatives (Larreamendy-Joerns and Leinhardt, 2006). The latter approaches tend to rely on technology affordances to facilitate the acquisition of discrete, declarative or procedural knowledge. By contrast, the CoI model emphasises the social and the autonomous aspects of learning, oriented towards the holistic intellectual development essential for the professional practitioner in the twenty-first century.

3.   The methodology

The investigation into the collaborative learning in the Matematikk Mooc 1 was intended as an example of a pragmatic approach based on the mixed-methods design (Creswell and Plano Clark, 2011; Griffin and Museus, 2011; Ivankova, Creswell, and Stick, 2006; Lund, 2012; Onwuegbuzie and Leech, 2005). In particular, the goal was to refine practice by aligning an existing learning design with the CoI model. The use of the questionnaire followed by interviews allowed for the triangulation of results and gave an insight into causal relations. The CoI questionnaire was used to collect student evaluations of collaborative learning during the course. Analysis of the responses revealed those aspects of instruction which diverted most from the CoI model. These were further explored in semi-structured interviews to establish how the course design affected student learning. Finally, by comparing the findings with the CoI design principles, we could indicate the potential for revision to enhance collaborative learning (Richardson et al., 2012; Vaughan, Garrison, and Cleveland-Innes, 2013).

Developed by Arbaugh et al. (2008), the CoI questionnaire elicits student perceptions of learning in the online community. It consists of 34 statements, including 13, 9 and 12 on teaching, social and cognitive presence, respectively. Students could mark their level of agreement using the Likert scale from 1 (strongly disagree) to 5 (strongly agree), with an additional "I don't know" option to capture a lack of opinion. It was translated into Norwegian and agreed on by two native speaking teachers. Numerous validation studies confirmed good construct validity and the high internal consistency of the scale (Arbaugh et al., 2008; Shea and Bidjerano, 2009; Yusuf, Mustafa, and Uğur, 2016). The dataset was collected and coded with the aid of the Questback online survey tool following informed consent, with optional participation and the privacy of respondents ensured.

The qualitative component was designed as a semi-structured interview to explore reasons for the low perception of the CoI components that emerged from the survey results (Kvale, 2007; Rowley, 2012). Five informants were selected through convenience sampling, and the interviews were conducted over the Skype VoIP communicator with an eCamm Call recorder to help transcription and verification (Deakin and Wakefield, 2014; Lo Iacono, Symonds, and Brown, 2016). The participants were informed about the purpose and the steps involved in the study before being asked for their consent. Since the interviews were to be held remotely, test calls were made to check the connection and the shared understanding of the interview questions.

4. The study findings, analysis and discussion

The CoI questionnaire elicited 46 responses from 320 enrolled participants within three weeks in the spring semester. The modest size of the sample determined the use of descriptive statistics (Muijs, 2011). The central tendency, the standard deviation and the skewness were calculated for each of the survey items. The dataset was structured into grouped variables representing the categories of cognitive (C), social (S) and teaching presence (T). By summarising the statistical indicators for each category of the CoI presence, we could obtain an indication of how the respondents perceived a specific aspect of learning in the community in relation to the other two elements.
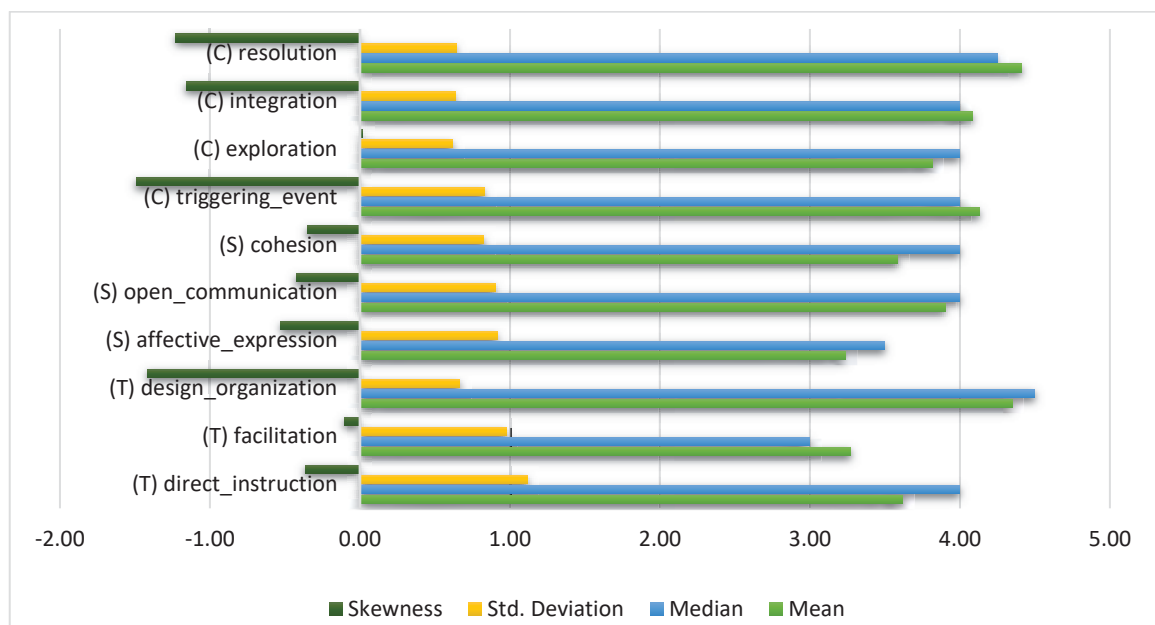

Figure 2: Statistical indicators for categories of cognitive (C), social (S) and teaching (T) presence

The findings related to the categories of cognitive presence (C) indicated that students appreciated the subject matter as being relevant to their professional interests and practice. The cognitive trigger score suggests that the topics raised in the forum most likely sparked curiosity. The cognitive resolution score also seems to highlight an appreciation for developing practical knowledge and skills. The exploration and the integration scores, however, suggest that the participants may have relied on activities other than discussions or brainstorming in the forum to develop this knowledge. While the Practical Inquiry model initially situated the inquiry in the context of online asynchronous conferencing (Garrison, Anderson, and Archer, 1999, 2001), the completion of the inquiry stages may continue beyond the forum, in an alternative activity form (Archer, 2010; Akyol and Garrison, 2011). The exploration may be undertaken during face-to-face dialogue, while the integration may be pursued through individual assignments (Archer, 2010). Notably, the exploration and the integration stages, which according to the Practical Inquiry model take place in the private world of reflection, were perceived as slightly less important than the triggering event and the resolution, both originating in the external world of experience (Garrison, Anderson, and Archer, 2001).

Student perceptions of social presence (S) were distinctly lower than those of the remaining two elements. The distribution of scores for group cohesion, open communication and affective expression suggests that the awareness of the social and the emotional dimensions may have varied considerably among students. The overall picture, however, suggests inadequate affective expression and group cohesion. This could be

translated into the reduced ability of students "to identify with a group, communicate openly in a trusting environment, and develop personal and affective relationships progressively by way of projecting their individual personalities" (Garrison, 2009b cited in Garrison, 2017). While instrumental to the collaborative inquiry, social presence has been shown to correlate with teaching presence tasked with setting a climate to support open communication and designing interactions focused on the shared academic purpose (Akyol and Garrison, 2011; Gutierrez-Santiuste, Rodriguez-Sabiote, and Gallego-Arrufat, 2015; Shea and Bidjerano, 2009). The comparison of findings on teaching and social presence in our study is likely to provide a more detailed indication of how those two aspects were interrelated during the course.
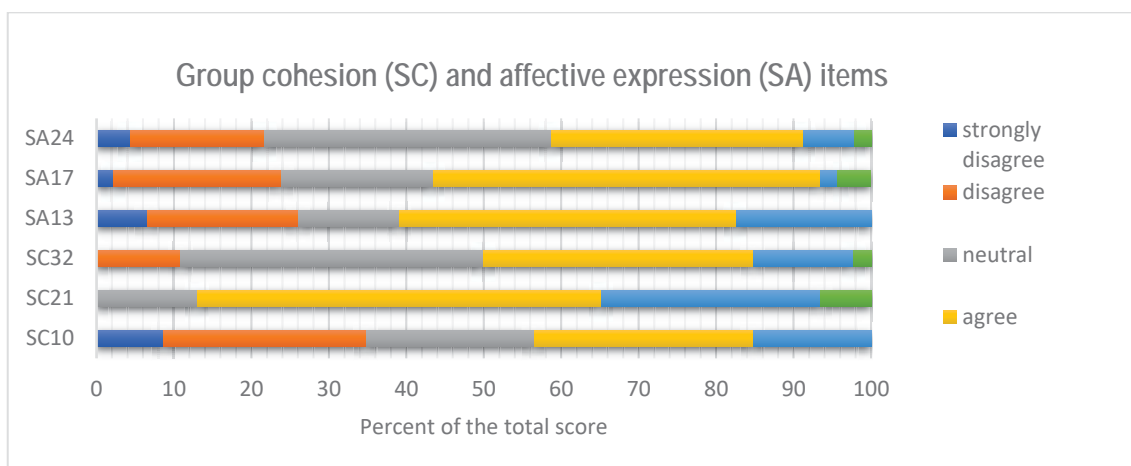

Figure 3: Populated group cohesion (SC) and affective expression variables (SA) with the corresponding survey statements below

SA24   Getting to know other course participants gave me a sense of belonging in the course.
SA17   I was able to form distinct impressions of some course participants.
SA13   Online or web-based communication is an excellent medium for social interaction.
SC32   I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.
SC21   I felt that my point of view was acknowledged by other course participants.
SC10   Online discussions help me to develop a sense of collaboration.

The teaching presence results suggest that design and organisation is valued significantly higher than facilitation and direct instruction. Here, "design and organisation" refers to the procedures, the course content and the scheduled events predefined in the LMS. In contrast, facilitation and direct instruction describe the dynamic processes taking place during the course.
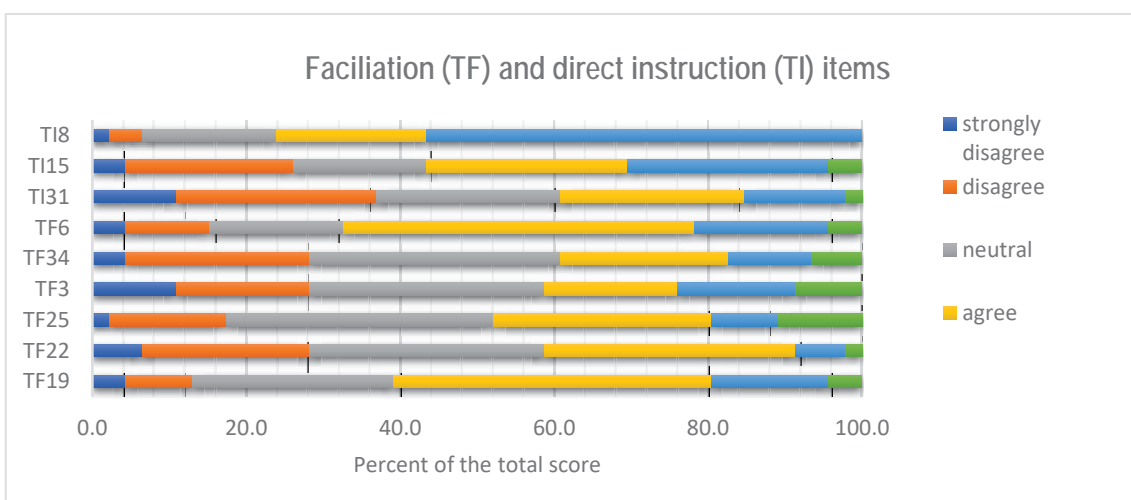

Figure 4: Populated facilitation and direct instruction variables with the corresponding survey statements below

TI8 The instructor provided feedback in a timely fashion.

TI15 The instructor helped to focus discussion on relevant issues in a way that helped me to learn.

TI31 The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.

TF6 The instructor encouraged course participants to explore new concepts in this course.

TF34 The instructor helped keep the course participants on task in a way that helped me to learn.

TF3 Instructor actions reinforced the development of a sense of community among course participants.

TF25 The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.

TF22 The instructor helped to keep course participants engaged and participating in productive dialogue.

TF19 The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.

Specifically, the facilitation and direct instruction to support cohesion and collaborative dialogue tend to be seen as insufficient, with a relatively high rate of missing responses. The low perception of formative feedback also indicates inadequacy in this area. The positive evaluation of a structured course design may reflect student preferences for the content-centred organisation of the study. A clear learning path in the LMS, with access to digital resources, provides flexibility yet constrains the interaction "to neglect the process and fixate upon the product" as noted by Dewey (Lipman, 2003 cited in Garrison, 2017, p.24). The facilitation and formative feedback, on the other hand, represent responsibilities related to the study, understood as "the process of actively searching for personal meaning and shared understanding" (Garrison, 2017, p.24), which may have been discounted at the design stage.

4.1 The key themes identified in the qualitative inquiry.

The CoI categories appreciated least were the group cohesion and affective expression, attributes of social presence, followed by the facilitation and direct instruction, associated with teaching presence. These categories became the focus of the interview questions and, subsequently, the key themes for the presentation of findings from interviews.

4.1.1 Affective expression

Preference for video-conferencing

Becoming acquainted with fellow students appears to have taken place mainly through peer assessment and posting commentaries to the discussion forum. Students suggest that video-conferencing could have been used to facilitate introductions and to help establish an online identity. Some informants also indicated their preference for synchronous communication as more expressive and practical, and less demanding: "And this is also challenging... When we are not talking directly but use writing… so we had to learn to be direct when writing, to be more specific. This might be better when you can use chat, where you can see each other, the body language" (Respondent C).

Using asynchronous text exchanges may pose a challenge to inexperienced online learners who need to "project themselves socially and emotionally and, as real people" (Gutierrez-Santiuste, Rodriguez-Sabiote, and Gallego-Arrufat, 2015, p.350). "Written communication lacks a sense of immediacy that builds interpersonal relationships. Immediacy is important to a supportive and learning environment as it reduces personal risk and increases acceptance, particularly during critical discourse that purposefully questions ideas and understanding" (Garrison, 2017, p. 26). The preference for synchronous video-conferencing is likely to address the need to establish social presence, including relationships with other members in the group. Its immediacy can support instant feedback and spontaneous interaction, which can sustain extempore dialogue. In the context of higher-order learning, however, text-based communication seems more appropriate to encourage reflection, explicit expression and revision (Garrison, 2017).

Connectedness

All the informants indicated the need to bond with others for learning. Some course participants had the benefit of studying together with their teacher colleagues from the same school or district. The geographical proximity helped them form a natural partnership practised through regular face-to-face meetings where they "stretched each other to be better." Others, who enrolled on the course alone in their district, may have perceived it as a challenge "not to have someone to discuss things with on a daily basis". "I have been alone in my district. I've communicated with fellow students in connection with peer assessment, and discussions, but

we had no contact via Facebook or Hangout. I have been working alone a lot. I call myself a kitchen table student. I talk to myself in my mind" (Respondent E).

In addition to geographical separation, some course participants experienced a distance in their relationship with the tutor, especially in the initial stage of the course. During the introduction, students were advised to seek peer assistance before approaching the tutor for help. As the course progressed, the facilitator invited students to make contact if they needed additional guidance. Some, however, might have felt too inhibited to take the initiative: "She encouraged us to make contact if we got stuck either concerning mathematical problems or some of the graded assignments related to teaching practice. If we couldn't grasp it either together or on our own, we should not be afraid to make contact with her" (Respondent B).

The existing course design appears to have overlooked the significance of a sense of belonging and the connectedness among the course participants. With no explicit steps to build a community, the design seemed to favour the students who had already formed a professional affinity with the students coming from the same workplace. Moreover, using asynchronous communication may have raised an additional barrier between those course participants who already had a community they could identify with, and those who needed one (Palloff and Pratt, 2007). Another type of distance identified was the perceived hierarchical relationship between the facilitator and the student. To some students, requesting additional explanations from the facilitator may have been the equivalent of admitting one's intellectual incapacity. Both types of distance are likely to be perceived as a communication barrier when trying to establish a climate of trust and respect as a foundation for learning in the Community of Inquiry (Gutierrez-Santiuste, Rodriguez-Sabiote, and Gallego-Arrufat, 2015; Haynes, 2016).

4.1.2   Group cohesion

Individual progression path
In addition to peer assessment, a discussion forum was intended as the main platform for student interaction during the course, however, participation in the forum may have been affected by attending an individual progression path, which involved scheduled graded assignments. Solving problem-based tasks uploaded by the instructor to the forum was an extra activity which was not graded, but had to be completed.

> *And this feeling that after you've completed one assignment, there is a new one waiting, and when you're through with it, so you have to go over to the next one. That's why you wouldn't necessarily go back and throw yourself into a discussion.* (Respondent A).

> *If someone is working with geometry, and I am already working with statistics, it would take me a lot of time to refocus again to engage with the topic* (Respondent D).

Posting messages to the forum tended to depend on each individual student's schedule, which meant that periods of activity varied in the forum. Participation in the discussion was likely to be seen as a lower priority than individual graded assignments with fixed deadlines. The lack of assessment of contributions to the discussion forum may also have undermined cohesion (Rovai, 2003). The considerable amount of workload associated with the individual written assignments may have prompted a casual attitude to engagement in the forum, which could have further eroded group cohesion (Lombardi, 2008).

Presentational style
The course participants were expected to upload to the forum solutions to the problem-based tasks presented by the tutor. By sharing their answers with fellow students, they could gain access to other solutions. The facilitator reportedly encouraged the students to share their strategies and discussed the best answers in the discussion forum.

> *There has been little discussion in which I can disagree with you. It has been more like sharing experiences. (..) Discussion? I am not sure I can call it a discussion. (..) And I have learnt a lot that things can be done in different ways. (..) There's always been such a polite tone that you can hardly call it a discussion. But we have shared experiences.*

> *Were many questions asked to fellow students in the forum?*
> *No, there weren't* (Respondent A).

Reportedly, the interaction on the forum involved presentations of views and solutions, which others would learn about and comment, however, there does not seem to have been further probing or exploration. The overall tone of the forum "would be more on a supportive note" or "very reassuring."

Students indicated that sharing professional experiences was considered the most enriching part of the course, however, the discussion in the forum seems to have been replaced by "serial monologues" backed by reassurance. Becoming aware of the diversity of practice or perspectives is the first stage of critical inquiry. To promote a more in-depth understanding, students need to examine a presented viewpoint against alternative ideas and probing questions which enhance critical evaluation of the subject of an investigation. "This inherent human bias to confirm widely held ideas creates a cognitive straightjacket if we do not engage in critical discourse that considers alternative perspectives. (..) Learners need to be challenged if they are to move out of their intellectual comfort zone" (Garrison, 2017, p.13). Another concern emerging from the interviews was the climate of reassurance and support which seemed to have had a disengaging effect on the discussion participants. The participants seemed to readily agree, and a discussion involving different views seemed implicitly "impolite". This "groupthink represents the negative side of group safety and is a chief inhibitor of inquiry" (Kennedy and Kennedy, 2010, cited in Garrison, 2016, p.73).

4.1.3   Facilitation

Passive instructor
The facilitator's main activity involved publishing and explaining problem-based tasks in the discussion forum. All the respondents observed that the instructor's interventions were rare and may have been prompted by the spread of misconceptions in the discussion of a mathematical problem. "Do you think that the facilitator could have done more to encourage collaboration? (..) if the facilitator had been a model in a way and actively participated in discussions from the very beginning, not just uploaded the solution, but evaluated discussion as it developed" (Respondent D).

Students tended to perceive the facilitator's role as passive. The facilitator appeared to focus on direct instruction in the form of individual guiding or explanatory messages sent to the group. Facilitating discussion in the forum and providing acknowledgement was assumed to be participants` responsibility. This responsibility involves maintaining focus on the progression of the discourse through stages of critical inquiry (Garrison and Cleveland-Innes, 2005; Garrison, Cleveland-Innes, and Fung, 2010; Shea, Sau, and Pickett, 2006). While the student "must accept responsibility for constructing personal meaning (..) control must be commensurate with the abilities of the learner" (Garrison, 2017, p.15). The control, here, concerns the degree of shared metacognition involving the ability to co-monitor and co-regulate the collaborative discourse (Garrison and Akyol, 2015a; 2015b). By relinquishing facilitation to students, who may not have been prepared to exercise this responsibility, the facilitator might have inadvertently inhibited collaborative thinking, which could have further fostered their dependence on direct instruction.

Individual guidance on request
The students were advised to seek help from peers before sending an email to the facilitator. Some respondents felt uncomfortable about taking an initiative to contact the tutor for assistance. Others may have learnt to rely on the tutor's guidance as the course progressed. "I think it took me a while before I began making contact with the teacher, but it has become frequent in recent months. I have discussed the assignments all the way (..) I should have used the tutor much more. Then I would have benefited from the course even more" (Respondent D).

All the respondents emphasised that their facilitator offered individual guidance related to the study topics on many occasions. While this aspect of the facilitator's activity could be categorised as direct instruction, it has been described by the informants as guiding an individual inquiry. "She didn't give me direct answers but would ask a question which made me reflect and continue to work with the assignment, which I could use in practice with my pupils" (Respondent E).

Students reportedly approached the tutor for individual assistance, typically in connection with graded assignments. While one-to-one guidance may have helped students to obtain a passing score or even stimulate reflection, it is likely to have fostered a passive attitude and acceptance of a suggested point of view. To pursue critical understanding requires that students take an active stance "to view problems and questions from a number of perspectives, including perspectives of the other learners involved in the process (Garrison,

2017; Palloff and Pratt, 2007). Students are expected to question the assumptions presented by the instructor and those of the other students, as well as their own assumptions and ideas" (Palloff and Pratt, 2007: Chapter 6). From this perspective, individual guidance, which leads the student to the solution chosen by the tutor, seems to hinder the development of a critical understanding.

Peer and external facilitation

Facilitation could also be provided by fellow students or colleagues in the workplace. Some respondents reported they would often turn to their closest, more experienced, fellow students for explanation and guidance.

> *How important was the facilitator, their role in the course, for your learning?*
> *Not much, I think. Because if I struggled with something I would turn to people in my group, those closest to me in my district. I would take it up on Friday and ask if someone could explain it to me. Then I had four other educators who could show me and explain it to me, my fellow students* (Respondent A).
>
> *The most significant benefit came from studying, investigating, reading and discussing assignments together. This had the most considerable effect on my learning* (Respondent D).

Turning to fellow students and work colleagues in the search for help to scaffold comprehension suggests insufficient interaction in the discussion forum. Research studies indicate that peer facilitation can engage participants more than facilitation performed by the tutor, who might be associated with authority and assessment (Lim et al., 2011, Mazzolini and Maddison, 2007 cited in deNoyelles, Zydney, and Chen, 2014). The participants` teaching experience in exercising leadership may be both a valuable contribution to collaborative learning as well as the skill they would like to develop (Rourke and Anderson, 2002). On the other hand, there is a concern about insufficient content knowledge, focus or direction in the cognitive presence (Garrison, 2017). As shown by Stein et al. (2013), students who have been coached in facilitation techniques over time are more likely to develop higher-order knowledge than those who did not receive similar coaching.

4.1.4   Feedback

Peer assessment

The informants appear to have relied on peer assessment for their formative feedback. Based on an evaluation of their assignment by two fellow students, they could revise their work before submitting it to the portfolio for the summative assessment. Respondents valued the peer assessment as an opportunity to gain an insight into alternative views which might lead to a revision of their own ideas: "This made me work thoroughly with the problem posed in the assignment. At the same time, I could see how others approached the same problem. This, I think, has been very instructive" (Respondent B).

In the introduction module, the participants were instructed to provide a constructive response when evaluating input from fellow students. Despite the support of rubrics, assessment comments appear to vary considerably in quality: "We were very cautious at the start when we evaluated each other's assignments. I would approach my own work in a more stringent way than others did" (Respondent D).

Feedback by inviting students to "diagnose their misconceptions" is the core of the social constructivist learning experience. Garrison posits that "all presences need to be considered when offering constructive feedback" (Garrison, 2016, p.98). He proposes that feedback, being part of the teaching presence, should be seen as a distributed responsibility for which the participants should be prepared. Similarly, Lynch, McNamara, and Seery (2012) report that peer assessment can be a valuable tool to promote reflection and learning, provided that students have been introduced to the evaluation procedure and the hallmarks of a quality response.
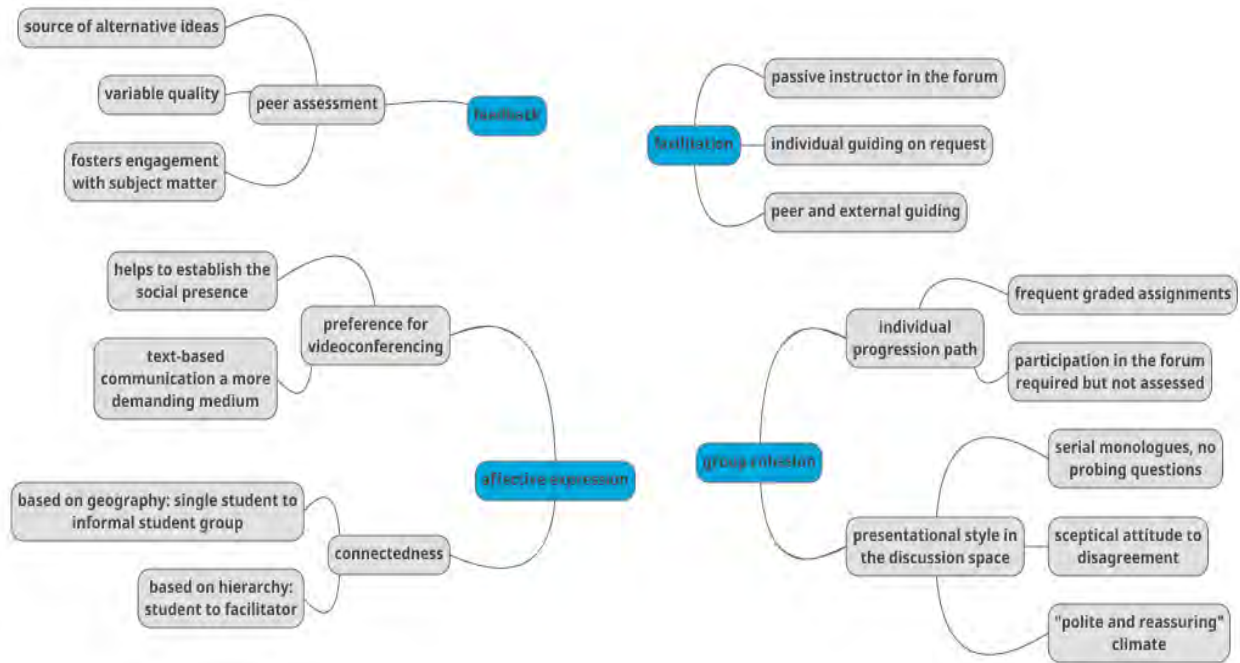
Figure 5: The key themes identified in the qualitative inquiry

The above analysis of the themes emerging from the interviews has highlighted those areas of the learning design which diverge most from the Community of Inquiry model. Based on the CoI design principles, we would like to propose measures to refine those elements to enhance collaborative learning during the course. These recommendations constitute an answer to the third research question.

5. The Community of Inquiry design recommendations

5.1 Plan for the creation of open communication and trust: establish community and cohesion

To improve the existing design, the facilitator should take leadership in establishing inclusiveness and trust by modelling behaviour and discussing engagement rules and expectations with students (Palloff and Pratt, 2007; Vaughan, Garrison, and Cleveland-Innes, 2013). It is essential to provide plentiful opportunities for dialogue and interaction to reduce the perceived distance between the participants, including the facilitator. The real-time communication may be particularly useful for that purpose. However, "we must be careful not to emphasise personal identity (interrelationships) at the expense of group identity (academic purpose)" (Garrison, 2017, p.48). Social presence must be built around the common purpose and the direction of the group interaction. In addition to the icebreaking and cohesive protocols and strategies (McDonald, 2012; Vaughan, Garrison, and Cleveland-Innes, 2013), it seems vital to distinguish between a course discussion forum as the platform for critical inquiry and a Facebook group as an informal arena where the participants can address their social and support needs. Finally, to refocus the course design on higher-order learning, contributions to the discussion forum must be recognised as essential to promoting cognitive presence. Consequently, the course participants should be allowed time for reflection, participation in shared activities, and peer feedback.

5.2 Plan for critical reflection and discourse, establish inquiry dynamics: sustain respect and responsibility; sustain inquiry that moves to resolution

To strengthen the cognitive presence during the course, a dialogic approach, which stimulates reflection, should replace a one-way presentational style of communication in the discussion forum (Swann, 2010). The measures undertaken by the facilitator to encourage collaborative discourse may involve scaffolding a discussion using selected strategies (Darabi et al., 2011; deNoyelles, Zydney, and Chen, 2014) or coaching and feedback (Stein et al., 2013). The CoI model also proposes that facilitation should be dynamically balanced, with the tutor assuming a more active role, especially in the early stages of the course when the cohesion is relatively low. The study by Arend (2009) indicates that effective facilitation is likely to be modest in quantity yet directed to stimulate purposeful student-to-student dialogue. The facilitator's leadership can take the form of implementing explicit discussion protocols or coaching which may help students to co-direct the discourse

(deNoyelles, Zydney, and Chen, 2014; Stein et al., 2013; Zydney, deNoyelles, and Kyeong-Ju Seo, 2012). As the level of group cohesion and metacognition increases with the course progression, facilitation may gradually be exercised by the other participants of the discourse (Garrison, 2017; Palloff and Pratt, 2007;). Given time for reflection, boosted by the formative feedback and facilitation, the discussion in the forum may become a vehicle for the epistemic growth of the group members.

5.3 Ensure assessment is congruent with intended processes and outcomes.

Assessment tends to send a signal to students the type of knowledge they are expected to develop and how they can approach learning. Formative feedback seems indispensable to a critical understanding of the subject. It is instrumental in the development of the metacognitive skills necessary for participation in the online discourse (Garrison, 2017). Palloff and Pratt (2007) recommend the use of rubrics to assess the quality of contributions in the discussion forum and their weight in the total grade for the course. The discussion rubrics proposed by Vaughan, Garrison, and Cleveland-Innes (2013) can be used proactively to shape student metacognition, and as a reference when providing formative feedback.

6. Limitations

This study was based on a modest sample and was conducted while the course was still in progress. The author is a proponent of collaborative learning, and this might have affected the qualitative stage of the inquiry (Creswell, 2012). At the same time, the choice of a mixed-methods design may render a more balanced picture of the student perceptions. Hopefully, the descriptions of research procedures lend transparency to the study.

7. Conclusion

The Matematikk Mooc 1 in its present design has arguably been conceived as cooperative, in opposition to collaborative, learning (Panitz, 1999). Students could interact to some degree by providing and receiving peer assessment, but nonetheless, their efforts were concentrated on submitting the papers necessary to complete the progression path laid out in the LMS. The acquisition of essential content knowledge appears indispensable to teaching practitioners who want to continue their professional development in the field, however, it may reduce a learning experience to "product delivery" if the completion of tasks overrides the process of learning. It seems that professional reflection enhanced by collaborative inquiry offers the preferable path to develop a more profound understanding. "Interpersonal relationships are the greatest influence on our thinking and learning. This is in contrast to the fallacy of the isolated creative thinker. Thinking and learning is not a private experience. It is dependent upon open communication. We don't know what we don't know until we are confronted with conflicting facts and arguments" (Garrison, 2017, p.12). This perspective in the context of online academic endeavour presents affordances which, transcending the benefit of flexible access to content, create conditions for a transformative, transaction-based educational experience. For this to happen, the discussion forum must become a platform for critical discourse where participants, with the facilitator's active support, can scrutinise alternative perspectives through their critical reflection as professional practitioners.
The goal of the present study was to propose the Community of Inquiry model as an instructional approach to improve the learning design of Matematikk Mooc 1. To this end, we have presented the framework from the pragmatic, instructional point of view, and we have applied the survey instrument followed by interviews to gain an insight into collaborative learning during the 2017 edition of the course. Despite the modest evidence, the study identified areas of learning design which could benefit from the Community of Inquiry model.

Specific CoI design principles were called upon to recommend concrete measures to promote collaborative learning within the existing design. Finally, the study hopefully directed attention to the advantages of grounding course learning design in the research-based conceptual model and practice. While no blueprint for online courses in continuing education has yet emerged, the Community of Inquiry framework, with its validated survey instrument, can provide a consistent reference for aligning course design with the socio-constructivist approach.

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