

Facilitating online interaction and collaboration in a professional learning network

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Abstract: The Creating, Collaborating, and Computing in Mathematics (CCC-M) project is a collaborative research project based on a university-school board partnership to design and build a professional learning network (PLN) of teachers. This study describes the CCC-M project, examines online interaction and collaboration among the teachers within the PLN in Year 1 (2013-2014) of this project, and discusses the strategies emerging from these analyses for the following project year (2014-2015).

Introduction

The Creating, Collaborating, and Computing in Mathematics (CCC-M) project is a collaborative research project based on a university-school board partnership to design and build a professional learning network (PLN) of teachers. Along with a brief introduction of the CCC-M project, this study examines online interaction and collaboration among the teachers within the PLN in Year 1 (2013-2014) of this project, and discusses the strategies that were identified for the following project year (2014-2015) on the basis of these analyses.

Context of the Study

The main goal of the CCC-M project is to enhance the capacity of teachers and students for integrating technology into teaching and learning, and to improve student success in mathematics in elementary and secondary schools. For their ongoing professional development, teachers use technology within a PLN and also explore technology for integrating it into their mathematics classrooms. It is a three-year funded project and the objectives of CCC-M project in Year 1 (2013-2014) are as follows:

- (a) Foster a community of practice in mathematics teaching and digital tools
- (b) Develop collective understandings of the situation with regard to student success in mathematics.
- (c) Develop practice in terms of using digital tools for ourselves and for students
- (d) Engage in sustained sharing, reflection, and inquiry activities
- (e) Consolidate a long-term partnership between the school board and the University

The CCC-M project is a collaborative research project between a university and a school board. The overall approach is based on principles of design-based research, in particular the participatory aspect with distributed leadership among researchers, administrators and practitioners. The Leadership Team consists of university-based educational researchers, three consultants of the school board (i.e., one techno-pedagogy consultant, two math consultants from the elementary level and the secondary level), and one senior administrator from the school board. The school board consultants invited candidate teachers for this project and thirteen teachers, including six from secondary schools and seven from elementary schools, voluntarily participated in the project.

In Year 1 (2013-2014), the participating teachers attended five face-to-face (F2F) meetings. The Leadership Team planned each F2F meeting according to the objectives of the project and designed activities in accordance with the teachers' needs and feedback. At the F2F meetings, the teachers discussed some issues related to their practice in teaching and learning mathematics and hence developed mutual understanding and collective knowledge about the situation through these activities:

- Shared their own classroom practices (e.g., successful strategies for teaching math in the classroom)
- Discussed math concepts that are challenging for the students

- Identified three critical issues (i.e., transfer of knowledge; decoding application questions & situational problems; student engagement and motivation)

The F2F meetings also provided hands-on sessions with various digital tools (e.g., Educreation, instaGrok, iMovie, and Smart Math tools) to develop teachers' practice in integrating technology into their mathematics classrooms.

Between the F2F meetings, the teachers interacted and collaborated with each other in EdModo (<https://www.edmodo.com>), which is an online space for K-12 social learning communities. The online activities on EdModo enable the teachers to engage in ongoing interaction and collaboration with each other by sharing their experiences, thoughts, and information for their professional learning.

Conceptual Framework

The CCC-M project follows a design-based research approach (Brown, 1992; Collins, Joseph & Bielaczyc, 2004) as a conceptual and methodological framework along with notions of professional learning network (PLN) and teachers' capacity for integrating technology into classroom practice.

Design-based research: It is an emerging educational research paradigm to “create and extend knowledge about developing, enacting, and sustaining innovative learning environments” (Design-based research collective, 2003, p. 5). The design research approach is based on close collaboration between researchers and practitioners, in this project teachers and consultants from a school board. It fosters a better understanding of the needs, concerns and perspectives of a real situation.

Professional learning network: It is generally referred to as "a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way" (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006, p.223). For teacher professional development, the PLN is considered as an effective environment for enhancing teachers' capacity for teaching and learning in practice through collaborative learning processes rather than individual, isolated professional development. A rapid development of technology, such as social media and digital tools, allows teachers to engage in collaborative practice (e.g., sharing information and resources, reflection and inquiry) through online interaction and collaboration regardless of time and place.

Teachers' capacity for technology integration: The Technological, Pedagogical, and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) builds on Shulman's (1987) work on teacher knowledge. It has been increasingly applied to discuss the complex interdependencies between three primary forms of knowledge in terms of technology integration: Content (CK), Pedagogy (PK), and Technology (TK). Along with TPACK, many recent studies have focused on understanding more precisely what knowledge teachers need to develop for effective integration of technology into their classroom practice (Archambault & Barnett, 2010; Graham, 2011; Kabakci Yurdakul et al, 2012).

Based on this context, this study focuses on the online activities and investigates the uses of Edmodo in Year 1 of the CCC-M project along the following research questions:

- (a) How did the teachers interact and collaborate with each other in EdModo?
- (b) What are the strategies for facilitating their interaction and collaboration in EdModo in the following year?
- (c) What are the main considerations for promoting online activities in this kind of PLN?

Methods

The CCC-M project applies a design-based research approach following iterative cycles of design, evaluation, and revision of an innovative learning environment (van den Akker et al., 2006). To investigate the online interaction and collaboration of teachers, in this study, we mainly focused on how their online activities were occurring in Edmodo.

Data collection and analysis

The three school board consultants and the thirteen participating teachers engaged in online activities through Edmodo. We collected data from transcripts posted on the Edmodo between September 2013 and June 2014. A total of 85 threads with 65 replies were collected and analyzed quantitatively and qualitatively. The discourse of the transcripts was analyzed by using coding schemes developed through a combination of top-down and the bottom-up approaches (Lampert and Ervin-Tripp, 1993) (See Table 1). Coding was based in part on conceptions of teacher knowledge and integration of technology (e.g., TPACK, Mishra & Koehler, 2006) as discussed in the conceptual framework.

Units of analysis	Topics	Categories
The initial message of a thread	Membership	Leadership team Participating teachers
	Themes	Technological knowledge (TK) Pedagogical knowledge (PK) Content knowledge (CK) Administration (A) General information (GI) Social cues (S)
	Types of discussion	Asking questions Sharing information and resources Reflecting practice
Each message in a thread	Kinds of responses	Direct response References Personal practice and experiences Alternative concerns of the issues Insights on the issue
A thread	Interaction patterns: Types of talk	Exploratory talk Cumulative talk Disputational talk

Table 1: Framework for coding systems to analyze Edmodo transcripts.

The initial messages of the threads were coded in terms of *Membership* (*who*), *Themes* (*what*), and *Types of discussion* (*how*) and the following responses to the initial messages within the threads were identified according to the *Kinds of responses*. A whole thread, including an initial message and the responses, was categorized in terms of *Types of talk* by applying the interactive dialogical framework for peer talk (Wegerif & Mercer, 1997) – Exploratory (i.e., “partners engage critically but constructively with each other's ideas”), Cumulative (i.e., “speakers build positively but uncritically on what the other has said”), and Disputational (i.e., “disagreement and individualised decision making”) talks.

In addition, we interviewed ten teachers, either face-to-face (six teachers) or through written interviews (four teachers) depending on the interviewees' availabilities, in terms of their perceptions of using Edmodo (e.g., benefits, challenges, and suggestions).

Results and Discussion

In this section, we present the overview and types of online activities and patterns of online interaction.

Overview of online activities

Eighty-five initial messages with 65 replies were posted between September 2013 and June 2014 in Year 1. Fifty initial messages (58.8 %) had no reply. The average number of replies to the remaining initial messages was 1.86 replies. It implies that active interactions among the participants did not occur as much as expected.

The consultants as facilitators initiated 19 messages (22 %) and the participating teachers did 66 messages. It means that the average number of initiated messages per teacher was five messages. The teachers' levels of engagement in online activities vary depending on their familiarity and proficiency with social network tools. Five teachers as active members posted more than five initial messages while two teachers did zero and only one message that was posted at the first F2F meeting for self-introduction.

Types of online activities

The initial messages were initially analyzed by using the TPACK framework (Mishra & Koehler, 2006) and finally categorized in terms of *Themes* (i.e., technology, pedagogy, content, administration, general information, and social cues) and *Kinds of discussion* (i.e., asking questions, sharing information and resources, and reflecting practice) that emerged in the review of the transcripts.

1. Asking questions

The teachers asked some questions in relation to the Themes, such as requests for information and resources and help for challenges in classroom practice. Most messages were about technology-related questions (e.g., technology knowledge and technology and pedagogy knowledge).

1) Technological knowledge (TK)

Question for all of you more tech-savvy than I (which covers just about everyone!). I downloaded an App called "Net that Solid" onto my own ipad. It's a game that asks multiple-choice questions about nets of solids, faces, vertices... I went to then download it onto all the school ipads and it is non-existent. When I "google" it and try to down load through there, it tells me it is unavailable in the U.S. store, Canada store... but it had worked just the night before???

2) Technological and Pedagogical knowledge (TPK)

I have created my group for students and I went to see the steps they would need to follow to join my group. When they log on as student, it asks them to check off a box about their parents being ok with the terms and conditions... am I having them just check it off, or should I have them sign up at home?? Does it really matter in terms of permission?

2. Sharing information and resources

The teachers shared information and resources with other teachers.

1) Technological and Pedagogical knowledge (TPK): Math game websites

The following are the math game websites I was talking to you about. I have not had the time to check them out in great detail and for some you need to instruct your students to choose the right grade level. All I can say is, I assigned it as homework to find websites and it paid off. This is the first year that I get good websites. It took time afterwards to verify them all but worth it:)

- *<http://www.ixl.math> (this site is limited to 20 questions a day but practices multiple choice by subject level. There is a cost if you want to remove the 20-question limit:)*
- *<http://www.coolmath.com> (older grades ages 13-100- site is busy so you may want to check it out yourself first)*
- *<http://www.funbrain.com> (can choose grade level and need to sign in as new player. Then they return to a board game each time and can pick up where they left off. Could use some management with the younger grades to write down their codes)*
- *<http://www.buzzmath.com> (there is a free version and a \$\$ version. Free version allows up to 60 students and never expires. Seems really good- best of the bunch I think. Set yourself up as a teacher, then you get your kids to create an account as a student, within your classroom. You'll be given a code to give to them. You can assign work and they choose topics out of a "textbook"*

by grade level. Each topic has activities ex: placing numbers on a number line. Seems to go up to grade 8. Will take more time to explore this weekend!)

2) Technological and Pedagogical knowledge (TPK): Apps

Found a free App called YourTeacher. Has videos covering different topics in Math, and by grade level. Gives good examples on how to explain a topic through video and visuals. Might be using ideas to film my first flipped classroom!

3. Reflecting on practice

Teachers reflected on their own practice regarding planning, implementing, and updating classroom activities and their levels of reflection varied from brief description to reflection with evaluation and planning.

1) Technological and Pedagogical knowledge (TPK): Smartboard

We are in review mode for their term 1 math summative. So as review I used the multiple choice option on the smart board and did review questions. Each student took a piece of scrap paper and folded it in 4, and labeled each square A,B,C and D. When they thought they had the answer they would hold it up. It helped with the calling out.

2) Technological, Pedagogical and Content knowledge (TPACK): Educreations

This week we moved along in our Educreations projects. We had already previewed and postviewed 2 videos on youtube about How To... so I felt them ready to move on.

On Tuesday, we brainstormed the various topics we have been looking at in Geometry and listed them on Chart Paper in a "How to" list. The students then found a partner and signed up for a topic. The consultant came in as a guest and went over how Educreations works and the kids then got started on brainstorming.

I would suggest a graphic organizer for this part. Something as simple as boxes representing each page with lines beside each box to write the script. I did not do this, but I would the next time I will.

On Friday during Math centers, one of the centers working on their Educreations on the ipad. This was a good way to integrate time to work on it while only having 2 ipads in the class. Also, this week we were looking at ordered pairs, so two of the other centers were Chess, Battleship. Of course there was a Math Reflex center, and two other polygon based games. The kids really look forward to center day. It is the one time that I don't hear a peep out of them :) except for, comments like "wow Miss, I used to hate math, now it is my favorite subject!"....pretty rewarding!

Patterns of online interaction

Each thread including an initial message and the replies was analyzed in terms of *Kinds of responses* and the interaction patterns were categorized according to three *Types of talk* (Wegerif & Mercer, 1997), that is exploratory (e.g., joint consideration through justification and reasoning), cumulative (e.g., repetitions, confirmations and elaborations), or disputational (e.g., assertions and challenges or counter assertions) interactions. Most threads were identified as the cumulative interaction, like sharing uncontroversial knowledge (e.g., resources and experiences) and elaborating the previous talk.

1) Collective resources

Teacher A:	<i>The following are the math game websites I was talking to you about. I have not had the time to check them out in great detail and for some you need to instruct your students to choose the right grade level. All I can say is, I assigned it as homework to find websites and it paid off.</i>	Sharing resources
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	<i>This is the first year that I get good websites. It took time afterwards to verify them all but worth it:) (Nine websites with brief comments)</i>	
Teacher B:	<i>Thanks Teacher A! I can't wait to add these to my centers!!</i>	Social cue (appreciation)
Consultant A:	<i>Great, thanks! I also like to use http://www.multiplication.com with my daughter (cycle 2 elementary). She finds the games lots of fun.</i>	Adding another resource

2) Collective practice

Teacher A:	<i>I have been implementing a few different technologies in my classes. I have set up each group with an edmodo.com page. -My gr. 8s love it. They use it as a community where they can help each other and get clarifications for classes other than my own because they follow each other for most subjects. -Oppositely, my gr. 9s (regular group) never check, and if they do they won't admit it in class. I see a big difference in how the tool is perceived between groups.</i>	Sharing experiences of using Edmodo with two different groups
Teacher B:	<i>I have experienced similar results with Edmodo, my sec one's LOVE it, meanwhile my sec five's maybe use it to retrieve powerpoint presentations I post but won't admit it or use it as an extension of the classroom to ask questions and help each other.</i>	Sharing experiences with similar issues

3) Elaboration of the practice

Teacher A:	<i>I just wanted to share how things were going thus far: 1) I have done warm ups at the end of class as a way to gauge whether students really understand the material. It's been quick, easy and very informative. 2) I'm working on trying to ask students to create videos explaining math concepts like we did at the meeting. Does anyone remember which app/ program we used to make the videos? please help :)</i>	Sharing experiences Asking a question
Facilitator A:	<i>The free app is called Educreations. Glad to hear that the warm ups at the end of class are working for you. Can you share an example of the type of question you've been asking?</i>	Answering the question Requesting elaboration on "warm ups"
Teacher B:	<i>Yes, please share some examples! For some reason I don't recall the "warm up" suggestion- can you explain please?</i>	Requesting elaboration on "warm ups"
Teacher A:	<i>Sure I can explain what I'm doing. After teaching a lesson, I usually have one or two short questions that I ask the class about that concept. - They write their responses on cue cards and the goal is to show me they understood the lesson. - It's a great way for me to verify if they grasped the concept or not. - So they can either answer by writing an explanation in words, use examples, draw diagrams. - Examples of what I used so far: what does an exponent tell us to do? (example: it's telling us how many times to perform repeated multiplication) OR - what are the different strategies to solve a problem?</i>	Responding to the request - More details on the practice

<i>I hope this helps :)</i> <i>Thank you so much for letting me know about educreations :)</i>

Summary of the results and suggestions

In sum, the results of this study indicate, first, that the number of messages including initial messages and the replies showed that online participation and interaction occurred in Edmodo at a lesser level than we expected in comparison with the F2F activities. However, as we explain in the next section, one positive outcome is that some of the active participants have agreed to play an active role as core members in the PLN to model and stimulate reflection, sharing, and inquiry. Second, the teachers' postings mainly dealt with technology-related themes (e.g., TK, TPK, and TPACK). Third, the reflection and interaction patterns still remained at superficial levels (e.g., cumulative talk).

From the interviews with individual teachers, we found that the teachers need some time (an enduring challenge) to familiarize themselves with Edmodo and develop the habit of accessing the online community space regularly to read and post messages. Due to the scarce time and busy schedule, the teachers require more structured guidelines indicating specific deadlines and regular reminders.

Conclusions and Implications

Based on the results in Year 1, we revised the objectives for Year 2 (2014-2015) to further engage the participating teachers in activities of sharing, reflection, and inquiry. We plan these activities not only at F2F meetings but also in online community spaces (e.g., Edmodo, Vialogue, etc). The way we choose to further this engagement is by expanding the Leadership Team, adding six teachers taking responsibility for one of these activities.

A central activity will be to initiate a process of sharing lessons through classroom visits and also video capture. One group of lead teachers will explore the production of video-based lesson study. They have agreed to allow videotaping of their classroom activities and engage actively in the iterative process of lesson study - (a) identifying a lesson topic; (b) implementing the lesson; (c) sharing and discussing the video clip of the lesson with other teachers; and (d) re-designing the lesson.

A second group of lead teachers has agreed to model and stimulate reflection: their main roles will be (a) to keep writing their own reflective journal; (b) to share parts of the reflections with other teachers on Edmodo; and (c) to play an active role in online reflective activities on Edmodo (e.g., posting questions and replying to other teachers' messages).

A third group of lead teachers will act similarly to model and stimulate inquiry. They will develop their competence in action research that is a strategy to identify a problem in teaching and learning, implement change, and reflect and document their professional practice throughout the self-inquiry process.

This study contributes to a better understanding of PLNs in this context. It offers an example of designing and developing the PLN, in particular based on a partnership between a university and a school board for ensuring the situated and contextualized professional learning for teachers and the sustainability of the PLN along with the capacity building at the level of school board for ongoing professional learning.

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