Understanding the Teacher's Role in a Knowledge Community and Inquiry Curriculum

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Abstract: This study examined teacher's role in a Knowledge Community and Inquiry (KCI) curriculum. Three science teachers and their students in a climate change curriculum unit involved in this design-based research. Curriculum design documents and video recordings of teacher-students interactions were the sources of data. Grounded theory coding techniques and a video coding scheme were applied to the analysis of data. Analysis examined the roles that teachers played in the KCI curriculum as well as the teacher-students interactions. Teachers played a predominantly logistical role in the beginning of the enactment of this KCI curriculum, followed by increasingly pedagogical practices.

Teachers are critical to the success of any reform-based curricula that often require them to substantially change their perspectives of teaching and learning to adopt an innovative pedagogy (Blumenfeld et al., 1991; Fishman et al., 2004). Prior research has advanced one promising approach to teaching and learning (Bielaczyc & Collins, 1999; Slotta & Najafi, 2010) that transforms classrooms into knowledge communities with the support of technology where students can acquire the 21st century skills (Brown & Campione, 1996; Scardamalia & Bereiter, 1992). This knowledge community method requires that teachers transform their classroom into a community of learners. Teachers are often suggested to play a role of "coach" or facilitator of knowledge construction, supporting students to construct their own knowledge within a complex range of activities (Blumenfeld et al., 1991; Brown et al. 1993; Brown & Campione, 1994; Hewitt & Scarmadalia, 1998; Hmelo-Silver & Barrows, 2008; Scarmadalia, 2002). However, it is challenging to describe how such pedagogical practices can be achieved in the classroom by teachers. Indeed, the research literature has very little to say about the specific role of teachers (Putnam & Borko, 2000). There is no research has specifically addressed what teachers are actual doing and what they should be doing in a knowledge community approach.

The knowledge community approach has not enjoyed much success at the secondary level (Staples, 2007), partly because of the heavy content expectations teachers must address, the traditional assessments students must perform, and the challenging forms of teaching practice (Slotta & Peters, 2008). In order to make this method more accessible to teachers, Slotta and his colleagues (Slotta, 2007; Slotta, & Peters, 2008) have introduced the Knowledge Community and Inquiry (KCI) model that integrates a dimension of scaffolded inquiry within a knowledge community approach. In the KCI model, students first engage in collective knowledge construction activities to explore and examine their own ideas, which are then aggregated into community knowledge base. Next, students work collaboratively in scaffolded inquiry activities, drawing on knowledge elements from the community knowledge base to produce new elements to that knowledge base and specific outcomes that serve as assessments of individual understanding.

Early implementations of the KCI model have been successful (Slotta & Peters, 2008). Nevertheless, their approach has ignored any specific description of the teacher's role within the model. To inform such a description, the present study has recorded large amount of videos of teachers' enactment of KCI curriculum for the purpose of examining the detail of teachers' interactions, and to analyse the role they play at various points in a KCI curriculum. The objective of this study is to create a fine-grained description of the teacher's role by analysing the curriculum design documents and the teacher-students interactions in the practical enactment of a technology-infused science curriculum unit. The following research questions have guided this study:

1. What roles does the teacher play in the classroom during a KCI curriculum?
2. What kinds of interactions with students does the teacher implement during different phases of KCI?
3. How does the teacher scaffold students' inquiry and collaboration in a KCI curriculum?

The study

This study was conducted to understand the teacher's role in a global climate change curriculum unit that was designed according to the KCI model. The overall research program employs a design-based methodology (Brown, 1992; Collins, 1992) where the investigations are embedded within a deeply contextualized curriculum. Because teacher's understanding of the theoretical position and faithful enactment of the curriculum are critical, a co-design process (Shrader et al., 2001; Roschelle & Penuel, 2006) was employed where researchers and teachers worked in close collaboration in the development of research materials and instructional designs. The research site of the study is a private secondary school in Toronto. Three teachers and their students from five class sessions at grade eight participated in this study. In this paper, we present two analyses that we conducted.

Curriculum Design Analysis. The goal of this analysis is to identify the teacher's role as it was designed (explicitly and implicitly) within the curriculum. In this analysis, we examined the curriculum design documents, teacher's lesson plans, and emails between the teachers and the researchers. We used open coding and axial coding techniques in the grounded theory method (Strauss & Corbin, 1998).

Teacher-student Interaction Analysis. The purposes of this analysis are: 1) to describe the roles that the teachers played in their practical enactment of the designed KCI curriculum; 2) to identify teacher-student interaction patterns. By reviewing literature, we developed a two-level coding scheme (Table 1) to analyse video recordings of teachers' classroom enactment. At present, we have analysed the video from the first class period only, across all five sections of the class, although this analysis will be scaled to 20 or more class periods.

Table 1: Coding scheme for video analysis

<table>
<tr><th colspan="2">Code</th><th>Meaning</th></tr>
<tr><td colspan="2">Logistical: WCI, SGI</td><td>Teacher provides procedural or logistical information to students in the whole class (WCI) or in small groups (SGI), such as managing students' behaviour, helping students solve technical difficulties, giving instructions on how to use software, etc.</td></tr>
<tr><td colspan="2">Conceptual: WCI, SGI</td><td>Teacher talks about science concepts to students in the whole class or in a group.</td></tr>
<tr><td rowspan="8">Pedagogical: WCI, SGI</td><td>Connection</td><td>Teach helps students to recall or connect to prior knowledge, experience, or personal relevance.</td></tr>
<tr><td>Context</td><td>Teacher sets the context for following instruction or activities, such as introducing learning activities, talking about the content that will be learned and agenda, etc.</td></tr>
<tr><td>Elaboration</td><td>Teacher elicits students' thinking; asks or helps students to elaborate their thinking, explain their own idea clearly, or think beyond what they are learning.</td></tr>
<tr><td>Evaluation</td><td>Teacher evaluates, assesses, or monitors students' progress, their understanding of concepts, their learning outcome, and praise them.</td></tr>
<tr><td>Guidance</td><td>Teacher guides, explains, or engages student in inquiry activities or process; give directions or suggestions on how and what to do next in order to continue their learning process, how to find learning resources, etc.</td></tr>
<tr><td>Modelling</td><td>Modelling of reflective thinking, connecting of knowledge, collaborative working, and building on other's ideas, etc.</td></tr>
<tr><td>Question</td><td>Quick responses to student's questions</td></tr>
<tr><td>Reflection</td><td>Encourage or request students to reflect on their learning activities, learning process</td></tr>
</table>

Results

Curriculum Design Analysis

The following categories of teacher's role were identified from the coding of the designed curriculum: content lecturing, evaluating students, introducing learning activities, making connections, explanation or elaboration, and classroom management role. These reflect the intention of the design team, with regard to what activities we felt the teacher should be engaged with, and when. It is important to conduct this analysis, so that it can be compared with observations of the enactment, to inform the more abstract or general model (i.e., KCI).

Content lecturing is the most frequent role identified for the teacher within our design. Content lecturing happens mostly during the collective knowledge construction stage of KCI where the teacher would lecture about various science concepts and principles relating to climate change: carbon dioxide and greenhouse effects, carbon sinks and carbon sources, heat transfer, ocean circulation, weather patterns, and many others.

Evaluating students is an important role articulated for the teacher within our design. Teacher evaluates students in two ways: first, to give students periodic quizzes during the implementation of the curriculum and a final examination at the end of this unit; second, to evaluate students' contribution to the advancement of community knowledge. In our design, the teacher should examine individual student's editing history of the regional pages, issue pages and remediation pages and give marks based on the quality of each student's editing. To implement this second type of evaluation properly, teacher needs to introduce students the rubric that will be used in evaluating their editing contributions to the wiki pages.

Introducing the learning activities and explain in detail how they will be enacted was another important element of our design, since the particular learning activities within this curriculum unit were quite novel (e.g., editing wikis). This includes the demonstration of any technologies used in the curriculum unit.

Making connections refers to that teacher should help students to connect the climate change issues they are investigating to the science content they are learning and to connect climate change science concepts to climate models. In our design, this connection role happens when students collectively construct community knowledge base.

Elaboration refers to a role that the teachers play to help students gain deeper understanding of content. The teachers may highlight or clarify science concepts and principles; follow-up on things that the teacher thinks the students have difficulty in understanding; explain the role of a science model. Facilitating and leading student discussion on climate science content or remediation plans are also considered as elaboration role.

Coordination was a final role described for teachers: grouping students, assigning students to peer review groups, giving students class time to complete their reflections, assigning reference topics, etc.

Teacher-student Interaction Analysis

Table 2 shows the frequency, the total time, and the average time (in seconds) teachers spent on each type of interaction. Table 2 indicates that logistical interaction, happened 166 times in small group and in whole class, is the most frequent form of interaction between the teacher and the students. This means that the teachers interacted with students more often provide logistical or procedural assistances to students. The emphasis on logistics and pedagogy is due to the fact that the video data we analysed so far are only from the very first class period of the curriculum, where teachers needed to introduce the technology that used, help students solve technical difficulties, and explain the activities.

Table 2: The frequency, average time, and total time teachers spent on each typo of interaction

Code	Frequency	Time	Average
SGI_Conceptual	1	33.92	33.92
SGI_Logistical	89	2002.01	22.49
SGI_Pedagogical	18	392.93	21.83
WCI_Conceptual	6	289.72	48.29
WCI_Logistical	77	2765.11	35.91
WCI_Pedagogical	68	3249.11	47.78

A more detailed coding of the pedagogical content of student-teacher interactions will reveal more information about the teacher's role within a KCI curriculum or a knowledge community approach, more generally. Figure 1 displays a finer grain coding of the pedagogical interactions (WCI_Pedagocial and SGI_Pedagogical, from Table 1 above) from the three teachers in this first class period. While all three teachers clearly performed many "Whole class" Context and Guidance interactions, this is reasonable because at the beginning of a new unit the teachers need to set the learning context and provide students with guidance about the activities. Figure 1 also suggests differences among the three teachers in terms of their interaction patterns. For example, Teacher 3 shifted his interactions with student very often, 40 times for Teacher 3 vs. 31 for Teacher 1 or 15 for Teacher 2. While these differences are not statistically significant, the coding is in the early stages, and these patterns will be a focus of future analysis. These preliminary results suggest that in the first activity the teachers interacted with students more often for the purposes of 1) providing logistical or procedural assistances, and 2) setting the learning context and guiding students. Also, teachers perform pedagogical interactions differently. We believe that as more data are analysed, they will reveal important relationships between the nature of the KCI model, the specific curriculum topics and interventions, and the kinds of interactions that occur in the classroom.

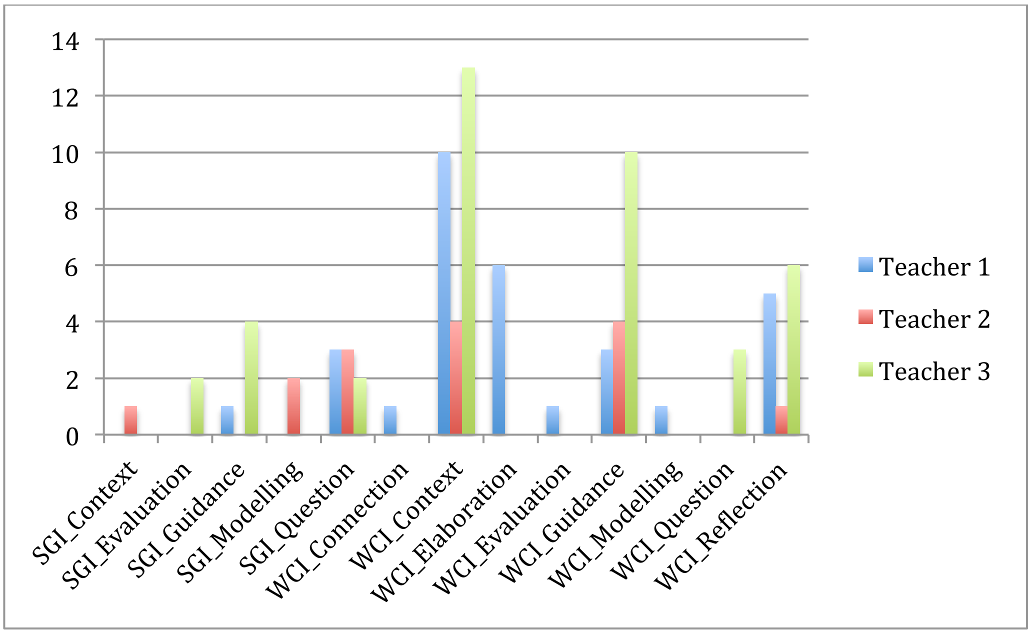

Figure 1. Frequency distribution of each type of interaction among the three teachers

Discussion

Understanding the dependencies of innovations on dynamics within the classroom is an important goal in learning sciences research. Even if the classroom teacher is deeply involved in the design of the innovation (i.e., in co-design), the true nature of our interventions only takes shape during enactment. Hence must address these dependencies. This study is creating a fine-grained description of the teacher's role in the KCI model by examining three teachers' enactment of a climate change curriculum unit. Results so far indicate that the roles played by teachers during curriculum enactment differ, at certain degrees, from what the design had specified. They played more roles than we had designed during the curriculum design stage, with a lot of logistical and procedural interactions, which were not anticipated in the design. Ideally (in subsequent activities), teachers who enact a knowledge community approach should spend more time on pedagogical interactions to set the learning context, guide students, elaborate students' thinking, connect students with previous experiences, evaluate and monitor students, and encourage reflection about learning activities.

Our future analysis will extend the teacher-student interaction analysis to 20 class periods. As we code the more substantive activities (i.e., in the middle and end of the curriculum) we anticipate that the pattern of interactions will vary. We are also analyzing the teachers' background knowledge and see how this variable affects their interactions with students.

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