A Role for Professional Development in Sustainability: Linking the Written Curriculum to Enactment

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Abstract: Learning Sciences researchers have a tradition of developing inquiry-oriented and technology-rich curriculum materials, often in the context of design-based research on learning. But what becomes of the materials developed after the research is completed? A key challenge for the Learning Sciences is to address the issue of sustainability for the materials we develop. Professional development (PD) can help teachers make adaptations to the written curriculum while maintaining its integrity. We examine empirical data from a study of PD in the context of inquiry-oriented curricular reform to show how PD aligned with written curriculum and informed by enacted curriculum can influence teachers’ practice in ways that are consistent with the goals of the curriculum designers. We conclude with a model for PD design informed both by the written and enacted curriculum to facilitate teacher planning that allows for adaptations that maintain fidelity to the curriculum design.

Learning Sciences researchers have a long tradition of developing inquiry-oriented and technology-rich curriculum materials, often in the context of design-based research on learning (Singer, Marx, Krajcik, & Clay-Chambers, 2000). But what becomes of the materials developed in this research after the research is completed? A key challenge for the Learning Sciences is to address the issue of sustainability for the materials we develop. One challenge is to foster the flexible adaptation of materials by teachers in ways that facilitate adoption but preserve the key commitments of the designers (Squire, MaKinster, Barnett, Leuhmann, & Barab, 2003). This is a long-standing problem for curriculum designers, who have come to recognize differences between the written curriculum, the planned curriculum, and the enacted curriculum (Remillard, 2005). Surely one answer to this challenge lies in the development of “educative” materials that are constructed in a way that facilitates their implementation (Ball & Cohen, 1996; Davis & Krajcik, 2005). Another answer is to design of professional development in ways that help teachers make connections to the written curriculum, and also to provide tools that allow them to reflect on their enactment of curriculum in ways that bring acceptable variations into focus for examination. In this paper, we examine empirical data from a study of teacher professional development in the context of inquiry-oriented curricular reform to show how professional development aligned with a written curriculum and informed by the enacted curriculum can influence teachers’ practice in ways that are consistent with the goals of the curriculum designers.

Background

Early research on curriculum focused on “implementation fidelity,” or efforts to get enactment to be as close to the intention of designers as possible, but eventually moved to a stance that valued the adaptations made by teachers in local contexts (Snyder, Bolin, & Zumwalt, 1996). More recently, and in the learning sciences, there has been a focus on how to support teachers in the process of adaptation in ways that maintains connections to the written curriculum (Lin & Fishman, 2004; Squire et al., 2003). This is coupled with an increasing interest in focusing on the outcomes of instruction (i.e., student learning), especially in light of the demands placed upon schools in an era of standards and high-stakes accountability (Goertz, 2001). This focus on student learning enhances the value of what Remillard (2005) called the “planned curriculum,” or the adaptations teachers make to help curriculum materials better fit their contexts, including the needs of their students. We are interested in understanding how professional development can help teachers with that planning. In particular we explicitly focus on how linking student learning outcomes and the written curriculum through professional development can help to shape teacher planning and therefore affect enactment.

What is the “real” curriculum? Is it what was written or what was enacted? Some would argue that we must measure the success of curriculum adoption in terms of alignment with the written curriculum (Snyder et al., 1996), while others define the enacted curriculum as “the curriculum” - a manifestation of the relationship between the teacher
and the text of the written curriculum informed by past experience, with student learning as an outcome informing the “living” curriculum (Clandinin & Connelly, 1992). Focusing on student outcomes as what matters most in standards-based reform (Fishman, Marx, Best, & Tal, 2003), we take a neutral stance on this question. The written curriculum represents an instructional philosophy informed by research, designed to teach specific subject matter dictated by local, state and national mandates. As part of engaging in the reform called for in the standards, teachers need to adopt the given philosophy and teach the mandated subject matter. However, we do not believe that teachers must teach the curriculum verbatim in order to accomplish this. The written curriculum provides the skeleton for instruction, but the teacher fleshes it out. However, to maintain the integrity of the written curriculum, teachers’ classroom adaptations need to align with the basic tenets of the written curriculum. We propose teacher professional development provides the mediating factor that can privilege both the written and enacted curricula to inform the planned curriculum and future enactments.

Context
The research informing this paper took place in the context of the Center for Learning Technologies in Urban Schools (LeTUS), a collaboration between Detroit Public Schools, Chicago Public Schools, the University of Michigan and Northwestern University. This paper examines the impact of Saturday workshops supporting a unit on Communicable Diseases (Hug and The Center for Learning Technologies in Urban Schools, 2002), taught in the 7th grade during the 2003-2004 academic year, the fourth it has been enacted in the district (including an initial pilot enactment). This represents the first year “lead teachers” from the school district (experience teachers with past exemplary practice) took over the responsibilities of the workshops, supported by university personnel (Fogleman, Fishman, & Krajcik, in press).

One component of the Communicable Disease Unit is the use of concept maps as a way of fostering understanding by having students organize their ideas in a structured manner, facilitating thinking in terms of concepts and their relationships rather than simple examples. We selected the teachers’ use of concept maps as a tracer of teacher learning from professional development and its subsequent impact on practice and student learning. The curriculum adopted Novak’s (Novak & Gowin, 1984) model of concept maps, with characteristics of clear concepts, hierarchy, linking words and cross-links. Prior observations suggested that teachers were not incorporating concept maps as written in the curriculum. Pre-unit interviews, as well as comments at the first workshop, supported this observation. In order to assist teachers in their use of concept map as intended by the authors of the unit, lead teachers, working together with the curriculum designers and researchers, designed workshops to focus on this area prior to teachers’ anticipated use of concept maps. Teachers then had an opportunity to incorporate concept maps into their instruction, and to comment and reflect on their use(s) of concept maps at a follow-up professional development session.

Methods
Participants
Thirty-one Detroit Public School 7th grade science teachers adopted the Communicable Disease Unit in 2004. Eighteen teachers participated in the concept mapping portion of the first workshop. Of these, one had a student teacher and did not primarily teach the unit herself, three were participants in other studies, one did not want to be studied, and two were unavailable for the knowledge and belief interviews. The remaining 11 teachers, who represent a cross-section of experience with the unit, are the focus of this study.

Data
Prior to the workshop, we interviewed the teachers about their beliefs and knowledge on the subject of concept maps (pre-unit interview). We observed each of the two workshops dealing with concept maps, recording a running record of the activities covered and the strategy used to teach them. We interviewed those who attended the workshops about what they learned (post-workshop interview). We observed the teachers enacting concept maps, some on multiple occasions, recording a running record of the teachers’ instruction and students’ response. We collected concept maps created by the students. Finally, at the end of the unit, we repeated the belief interview with the teachers (post-unit interview).
Analysis

We employed a mixed methods approach. First we quantified the shift in teachers’ knowledge and beliefs prior to the professional development and after enactment to identify episodes of teacher learning, coding. We coded the pre- and post-unit interviews for content knowledge of concept maps and beliefs about past success using concept maps. We then employed cross-case analysis (Yin, 1994) to study the impact of professional development on teachers’ planning and enactment of the written curriculum to identify to what teachers attribute their shift in knowledge and beliefs. We examined the interviews and observations for each teacher looking for emerging themes within and across teachers. We then traced change in teachers’ knowledge about concept maps and their beliefs about their usefulness. We compared their enactment with the resulting student work, as well as the teachers’ beliefs about the student work.

Findings

We coded each of the pre- and post-unit interviews of the teachers from 0-5 (see Table 1 below). Because of the small data set we conducted a Wilcoxon Signed Ranks test to determine whether the teachers demonstrated a significant shift in content knowledge from concept maps. The teachers’ mean content knowledge was 2.00 (SD = 1.48) (elaborated on below). Most teachers saw concept maps as webs with linking words, even those experiences with the unit. After the workshop the teachers’ mean content knowledge of concept maps improved to 4.5 (SD = .68), most teachers having a definition of concept maps that aligned with the unit. This represented a significant shift in teacher knowledge (p < .01). We also coded the teachers’ beliefs about their past success using concept maps as instructional tools from 1-5 (see Table 1). Most teachers were not satisfied with their instruction, with a mean value of 2.55 (SD = 1.37) from the pre-unit interview. On the post unit interview there was a positive shift, with all but one teacher showing improved beliefs in their success using concept maps with a mean score of 4.27 (SD = 1.10). This represented a significant shift in teachers’ beliefs (p < .05). In order to determine what attributed to these shifts in knowledge and beliefs, we turn to the cross-case analysis. Below we describe the educative components of the written curriculum, the workshops and the findings from the teacher interviews, classroom observation and student artifacts.

Table 1: Description of ratings for quantitative analysis for teachers’ knowledge and beliefs

<table>
<thead>
<tr>
<th>Teacher content knowledge of concept maps</th>
<th>Teacher beliefs about success using concept maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>0</td>
<td>No knowledge of concept maps</td>
</tr>
<tr>
<td>1</td>
<td>Web</td>
</tr>
<tr>
<td>2</td>
<td>Web with linking words</td>
</tr>
<tr>
<td>3</td>
<td>Hierarchy and 1 of the remaining 3.</td>
</tr>
<tr>
<td>4</td>
<td>Hierarchy and 2 of the 3 remaining.</td>
</tr>
<tr>
<td>5</td>
<td>Concepts, linking words, hierarchy, and cross-links.</td>
</tr>
</tbody>
</table>

The written curriculum included a detailed description of how teachers should introduce concept mapping to their students. In particular, the use of concept maps was designed to have students organize ideas about “what is a disease”, a sub-question of the curriculum. Teachers were to have students revisit the map as their understanding grew. The written lesson contained a “teaching strategy” that described how to model concept mapping using a well-known term (“dog”), pointing out that the teachers should explain to students that concepts are placed in hierarchical order, with the most complex items at the top and the least complex at the bottom. Bulleted notes in the written curriculum were intended to draw teachers’ attention to (1) returning to concept maps during the course of the unit, (2) getting as many students involved in creating concept maps as possible, (3) the importance of using a rubric to evaluate the concept maps and (4) where the teachers can find examples of rubrics elsewhere in the unit. In addition, the text directed teachers to the teacher resource section towards the back of the unit to find a sample disease concept map. The written curriculum specifically instructed the teachers when to revisit the maps during particular lessons.

Based on interviews, most teachers had prior beliefs and knowledge of concept maps as web-like, with the main concept in the center and related concepts coming out (8/11) or had no previous knowledge of concept maps.
(1/11). Some teachers included linking words placed on the lines connecting the concepts (6/11). Two teachers working on advanced degrees in education had a broader description of concept maps that included both the website-like structure and the hierarchical model, but when pressed reported that they primarily had their students create the website-like models. Most teachers reported not being satisfied with their previous instruction (7/9) for various reasons, including that the maps were too complicated to create, the teacher failed to show the students how to create quality maps, and the teacher was not able to make sense of what the students put down on paper. Five of the eleven teachers had experience teaching the Communicable Disease Unit, and although 2 were the teachers who were familiar with hierarchy, all reported using the website-like structure in the past despite the written curriculum.

Two workshops supported teachers’ implementation of concept maps in the Communicable Disease Unit. Researchers helped the lead teachers plan the concept mapping portion of the workshops by supplying teachers with information about Novak’s (1984) idea of concept mapping. The lead teachers, too, initially defined concept maps as webs with linking words. The researchers supplied the lead teachers with the theoretical rationale for why the unit included the hierarchical structure of concept maps with linking words. During this discussion, the researcher supplied the lead teachers with the theoretical understanding as the lead teachers interjected their own experience supporting some of the assertions made by the researcher. One lead teacher specifically said at the beginning of the discussion that she had to think about the all the information before developing an opinion one way or another about the changes we were suggesting. This discussion both informed the lead teachers’ content knowledge and well as providing compelling evidence for sharing this information with the other teachers. Convinced of the advantage of the hierarchical approach to concept mapping, the lead teacher included this information in the workshops. The lead teachers designed the workshops to teach teachers about concept maps as used in the curriculum, using theoretically sound professional development instructional strategies, including peer exchange and model teaching (Garet, Porter, Desimone, Birman, & Yoon, 2001; Kubitskey & Fishman, 2005; Kubitskey, Fishman, & Marx, 2004) The lead teachers had the teachers create hierarchical maps in groups and the teachers shared what they perceived the advantages to such an approach might be and how they planned on using them in the classroom. In addition, teachers shared their past instructional approaches with the group, discussing how their approaches could be used in this new context. For instance once teacher talked about having students “read” down the concept map, placing the concepts and linking words into sentences.

After the workshops, 8 of the teachers specifically acknowledged that the view of concept maps was new to them, and that they anticipated using concept maps with greater success. One teacher, who said students called her the “queen of concept maps” in the pre-unit interview, noted that the workshop “reminded” her of that approach to concept maps, and thought it useful to those who were new to concept mapping. The two teachers who included hierarchy in their description of concept mapping in the pre-unit interview each shared during the workshop that they had used the website-like maps in their instruction. One teacher specifically said she was could now see how concept maps might be valuable instructional and assessment tools, whereas before she thought they were basically useless. The workshop, thus, influences teachers’ content knowledge by either (a) giving the teachers new knowledge, (b) giving the teachers information that allowed them to adapt their pre-existing knowledge, or (c) convincing teachers to use knowledge they already had. All teachers reported that they would use this information in their instruction. The workshop acted as a mediating factor in the teachers’ planning for the enactment of the written curriculum. Teachers planned to use concept maps incorporating hierarchy, as written in the curriculum, and were better informed about the structure intended by the curriculum designers. But the degree of success in the enactment varied amongst the teachers.

Eleven teachers who attended the workshop were observed during their introductory concept mapping lesson with students. In addition, one teacher was observed who did not attend the workshop, as a point of comparison for understanding how the workshop might have led to changes in practice. All teachers modeled the creation of a concept map on the board using a familiar term, had the students brainstorm terms, group the terms, and then create a map as instructed in the unit. All teachers instructed their students to create hierarchical concept maps, and nine included linking words. None of the teachers included cross-links, which was not surprising since during the workshop the lead teacher suggested holding off on cross links until later in the unit. Students then created concept maps about communicable disease. A teacher with experience using concept maps and a strong belief that linking words were too confusing for the students did not adopt linking words. The teacher whose students called her the “queen of concept maps” still had her students create giant posters with colored markers, since she saw this creative outlet as one of the major advantages of doing concept maps. In these two cases, teachers adopted the “new” structure of concept maps clarified during the professional development, but did not compromise
their fundamental beliefs. A third teacher attempted to adapt a concept mapping technique she had used with her students in the past that was more appropriate for web-like maps. When her students failed to make the adaptation, this teacher scrapped the old approach to encourage hierarchical maps. With the exception of this teacher, the structure of the concept maps created by the students strongly aligned with the structure taught in the class. The enacted curriculum was influenced by both the workshop and the written curriculum and the student work was influenced by the enactment.

Lead teachers incorporated teachers’ practice into the second workshop. Nine of the eleven teachers attended the second workshop. Teachers reported various degrees of satisfaction with their students’ work. During the workshop all reported with a “thumbs up” that they were happy with the concept mapping lesson, but when pressed, most teachers acknowledged that they were not completely satisfied with their students’ work. This workshop provided an opportunity for teachers to talk about the issues that emerged in their practice. To facilitate the discussion, a lead teacher brought in examples of her own students’ work and asked other teachers to do the same. She used this work to provoke a discussion about what represents quality concept maps, how to assess these maps, and how to assist students in creating quality concept maps, particularly through the assessment process. Here, too, teachers shared their experiences, although these sharing opportunities did not always align with the intent of the unit. One teacher, the “queen of concept maps” suggested that hierarchy was not that important as long as the teacher could “see” the logic of the students. The lead teacher interjected that hierarchy was very important in this unit not only for assessment, but also in helping the students organize their thinking. In the post-workshop interviews teachers shared how the workshop gave them ideas about how to plan for their next iteration of concept maps. In particular, how to continue with what they perceived as positive changes in the students work and learning, as well as address some of the issues problems that arose during their own practice.

During the post-second workshop and post-unit interviews teachers reported their plans to incorporate some of the techniques taught at the workshop into their practice. Three teachers said they would use the examples of students work in their own practice, to have the students evaluate others as a way of getting a better understanding of the structure. One of these teachers, who was disappointed after she expected to see improvement in her students’ work, had the students critique the concept maps supplied by the lead teacher as a group and then had the students critique each others’ maps. A second teacher, after having the students’ critique others’ maps on an overhead, supplied the students with the rubric and had them work in groups, critiquing their own work as they went along. Both teachers reported being more satisfied by their student work. In addition, a teacher who had not used linking words during their first instruction mentioned they planned to incorporate linking words because linking words seemed to lend themselves in making sense of the hierarchical map. The teachers reported that she had an opportunity to include the linking words on revisions of the map, and she was much more satisfied with the result. What was particularly interesting about the data from these later interviews was how it revealed that teachers had incomplete understandings of concept mapping after the initial workshop, and that it was only after being able to reflect on their practice in the second workshop that they were able to form an understanding of concept mapping that was more closely aligned with the written curriculum. Even some of those with the initial understanding of the fundamental structure of the concept maps failed to anticipate some of the issues that would arise when assisting the children in creating such maps. Interestingly, supplied with the information from the second workshop, even teachers who were not satisfied with the results intended to continue to adopt the “new” hierarchical approach, while adapting their instruction, rather than returning to the more familiar web-like structures.

Discussion

Instruction is a living manifestation of curriculum enacted by the teacher and experienced by the students. In order to facilitate the sustainability of long-term systemic change, fidelity between the written curriculum and enacted curriculum needs to be maintained, while allowing for adaptive flexibility in instruction. Our data indicates that professional development can serve as a mediating factor between the two. Professional development designed to inform teachers’ planning and practice followed up by professional development that gives teachers an opportunity to reflect, informed by student learning, assists teachers in their adaptations and helps maintain the original goals of the curriculum. We present a model for professional development that incorporates these findings. This model assumes long-term professional development supporting teachers’ enactment. The professional development needs to be looked at in context and as a continuum, rather than distinct instances. The first professional development prior to teacher enactment informs teacher of the specifics of the unit, including both the practical, as well as the philosophical tenets underlying the instructional design. The next professional development, after the teachers have had an opportunity to enact the curriculum, should include a formal mechanism
for incorporate knowledge gained through those enactments, as well as reinforce the essence of the written curriculum. (See Figure 1). Although the model appears to be linear, it is intended to be iterative, with each successive professional development instance including both a reflective component as well as an introduction to component of various portions of the written curriculum. As long as the essential components of the written curriculum remain the backbone of the professional development design, this model allows for flexibility and adaptability that informs the enacted curriculum over time, sustaining the reform initiative.

![Diagram](image)

**Figure 1:** Professional development design plan incorporating the written curriculum, enacted curriculum, and student learning.

**Future Work**

The findings from this research suggest that professional development should be informed by both the written as well as the enacted curricula. We realize that the example of concept mapping represents a relatively small piece of the larger problem of supporting flexible adaptation, but hope that it provides a window into the process and a methodology for studying it. More work with other, and broader, examples of curricular goals need to be examined. As responsibilities for the reform shift from the university curriculum developers to the school district, research focus might also shift to how professional development facilitators become informed of the key goals and concepts of reform-oriented curriculum materials. In order to increase the chances of successful systemic change using such materials, curriculum designers need to better understand how to create professional development support materials that can be used by lead teachers or other school personnel. These materials should make the guiding principals and basic tenets of the unit explicit and supply professional development strategies that allow for professional development design informed by written and enacted curricula.

**References**


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