

DEVELOPING LEADERSHIP IN A NATIONAL COHORT OF SECONDARY BIOLOGY TEACHERS: USES OF AN ON-LINE COURSE STRUCTURE TO DEVELOP A GEOGRAPHICALLY DISTANT PROFESSIONAL LEARNING COMMUNITY

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Abstract

This report is a descriptive study of the role that on-line courses might have on the development of Professional Learning Communities (PLC's) that support national leadership initiatives of participating high school biology teachers. The one hundred teachers involved in the Life Sciences for a Global Community (LSGC) Institute are expected not only to deepen their content knowledge, but also impact their district and state biology curricula. Additionally, the dispersion of Institute participants across the country presents a unique opportunity to develop, communicate, and implement a national coherent reform agenda. However, the geographic distance presents a barrier to collaborative design of leadership projects. Therefore, the LSGC Institute designed web-based, distance learning courses as a means for both the instruction and development of distant professional relationships.

This study is an initial investigation into the impact that three web-based courses had on the development of a national Professional Learning Community. We first report on themes and patterns that were derived from a conceptual analysis of the discourse generated in the first cohort of teachers during three on-line courses offered during the academic years 2007-2008. We then discuss the themes and patterns generated by this initial analysis as to the likelihood that they indicate movement toward a Professional Learning Community. Most of the comments across courses were characterized by individuals responding to instructional prompts. The second and third most common responses were interactions among the students, some related to teaching *biology while others covered matters of school context*. The emergent themes in the conceptual analysis were found to strongly align with three dimensions of Professional Learning Communities (PLC's) and weakly align with two dimensions. The results of this analysis will inform the Year Two on-line courses to include more structures to support the dimension of emerging leadership among the teachers.

Life Sciences for a Global Community: Description of Institute

Washington University in St. Louis, a leader in life sciences education and research, has developed the Life Sciences for a Global Community (LSGC) Institute, a high school biology teacher institute program leading to a master's degree in biology. The Institute offers an innovative approach to high school biology teaching and learning, centered around an interdisciplinary curriculum taught by world class researchers. Institute faculty are recognized leaders in all areas of biological research. They include sixteen faculty members, eight of whom are full professors. The program design includes two Summer Institutes at Washington University, work during the academic year with on-line support, and a leadership component. A mixed method research design will generate data regarding effectiveness, provide accountability, and inform dissemination.

Through the Institute, there is a commitment to preparing teachers to improve their students' biological content knowledge, and to help sustain change in teaching practice at their schools and districts. Project leaders envision a rigorous interdisciplinary approach, combining content knowledge and the broad implications for human impact. To this end, the project has the following goals:

- Develop a national cadre of master teachers of high school biology who demonstrate intellectual engagement with and mastery of global issues in life science, and who use related research-based pedagogy and challenging content in their courses;
- Improve interest, engagement, and achievement by affected students in secondary biology; and,
- Promote Institute partners' and participants' development as local and national educational leaders through participation in a national Professional Learning Community.

To assess teacher and student knowledge acquisition and achievement, the evaluation is built on a random-assignment control design of three cohorts of teachers who each begin the program in sequential years: 2007, 2008, and 2009. Of the teachers who applied and were accepted to the project, one hundred were assigned randomly to initial treatment and control groups. Teachers and students of Cohorts II and III serve as control groups for the programming presented to Cohort I. On-line administration of content pre-/post-tests and surveys of students' attitude toward learning biology were administered in Spring 2008. Results are currently being collected and analyzed.

Leadership Development: A National Professional Learning Community

Transfer of the content and enthusiasm for the discipline into the teachers' classrooms and the development of a national Professional Learning Community is another major component of the Institute program. However, the geographical dispersion of teachers within each of the three cohorts presented a unique challenge to the development of a leadership program that is based on collaborative models. Literature describing the dimensions of local Professional Learning Communities guided the design of the national model [1, 2]. The vehicle used to develop and maintain communication between teachers across the nation is a series of on-line courses during the academic year.

This study used the following courses: 1) *Chemistry for Biology Teachers*; 2) *Case Studies in Biology*; and, 3) *Program Capstone I*. It provides an initial look at the effectiveness of this tool in building and sustaining professional relationships that are likely to lead to collaborative leadership.

Methods of Analysis

The following is an analysis of the use of an on-line course structure as an instrument supporting the development of the national Professional Learning Community (PLC). We analyzed the written discourse of the teachers during the on-line courses by conducting a conceptual analysis [3]. The unit of transcript analysis for this study was the message level, which allowed multiple coders to agree on the total number of messages [4]. We then ranked the themes and patterns generated by this analysis according to those supported by the most evidence to those supported by the least. Evidence in this case was considered to be the quantity and quality of the statements made by each of the participants in the on-line system during each of the courses. The themes and patterns emerging from the analysis of the transcripts were then coded and discussed according to the alignment of each with the dimensions of a published framework *characterizing Professional Learning Communities* [1].

Results of Analysis

Each course had between 500 and 700 entries on the on-line discussion board over a fifteen-week period of time. The conceptual analysis identified five major themes and patterns evident across courses (see Table 1). For the purposes of this study, a theme/pattern is discussed if more than five participants indicated evidence, multiple times, within each course. The predominant theme, occurring on average in 48.3% of the messages, was derived from the

discussion among individuals sharing thoughts that were within the parameters of the course assignment. Two types of messages characterized these participant comments, one relating to instructors and the other to anyone in the cybercommunity.

Table 1
Percent of Total Themes and Patterns Generated by Analysis of On-Line Discourse among Teachers Participating in Distance Learning Courses in the Washington University LSGC Institute for High School Biology Teachers, 2007-08

Themes and Patterns	<i>Chemistry for Biology Teachers</i>	<i>Program Capstone I</i>	<i>Case Studies in Biology</i>
	N=510	N=513	N=648
Participant sharing of content within course parameters	60%	35%	50%
Participants interacting with other participants about course content	20%	25%	31%
Participants seeing selves and others as resources for participants	5%	20%	10%
Participants sharing the context of their teaching	10%	15%	5%
Participants sharing personal information about their professional and personal lives	5%	5%	4%

For example, in the course entitled, *Chemistry for Biology Teachers*, this comment was posted (11-21-07) by the course instructor in consultation with a research scientist, responding to several questions about the fate of the carbon dioxide that plants produce during respiration:

The carbon dioxide is released through the stomata like other gases and is then available for use during photosynthesis just as any other CO₂ in the atmosphere. However, some plants perform CAM photosynthesis where CO₂ is banked or stored for later use. In these plants, stomata open at night and remain closed during the day. The CO₂ is converted to an acid and stored during the night. During the day, the acid is broken down and the CO₂ is released to RUBISCO (an initial enzyme) for photosynthesis. The CAM plants include many succulents, such as cacti and agaves, and also some orchids and bromeliads.

The comment above shows an example of individual student-to-instructor interaction, as well as illustrating the depth of content that can be discussed in a distance learning environment. The following comments (posted on 9-22-07) show how several individuals respond to course design prompts in sequence without interacting with each other:

- The first post—“Animation on chemical bonding was excellent. It was very easy to understand, the explanations were clear. I am sure that my tenth grade biology and *Intro. to Chemistry in Anatomy* class would very easily understand the whole process of bonding.”
- The next post—“The enzyme connection is great. We just finished enzymes in *Anat[omy]*. For some reason it seems to be one of the topics that students struggle with the most. I’m going to use this with them as a review of enzymes and an intro into cellular respiration, which is our next topic.”
- Next post—“It was another good animation. The collection of short videos, animated and otherwise, will be helpful next week as I start the basic biochemistry stuff in biology class.”

These were prompted by the assignments and formed the fundamental structure of the interactions between members of the cohort and between individuals and the instructors.

The next strongest theme, evident in 25.3% of the responses, was that of *professional interactions* about the course content. These were initially prompted by the assignments, but were attempting a connection to other course participants, as well as the instructors. For example, in a posting on 1-28-08 from the *Case Studies in Biology* course, one participant wrote: “I agree with Jane, in that the Dilemma category is more effective for higher-level thinking. It requires the student to synthesize information from the case and then actually take action based on what they know.” Comments were placed in this category if they referenced a prior comment or asked a question of another teacher because of a prior position that he or she stated.

The third theme/pattern, occurring in 12 % of the total messages, contained comments in which teachers were sharing information about the context of their teaching. These were

sometimes about district politics, sometimes about school-based barriers to good teaching, and sometimes about environmental resources, such as those available for field trips.

One example of this type of comment was posted on 1-29-08 from the *Case Studies in Biology* course: “I’m so sorry that you consider twenty-six to be a small class. In our regular bio class, we limit it to twenty-four, and in the basic classes, they try to keep them to about twenty.” Or, as this teacher from an under-resourced district in the *Program Capstone I* course stated on 9-16-07, “My Commodore-644 won’t load these classroom pics, but I get some idea from your descriptions.”

The fourth theme/pattern was derived from comments that referenced each other as professional resources or experts and comprised 10% of the messages. These were sometimes aligned with course assignments and sometimes not. These comments were most often about matters of pedagogy or pedagogical content knowledge. An example of this type of interaction was posted on 2-09-08 and came from a student in *Case Studies in Biology*:

But to recap, I feel that class discussions in the form of the Socratic Seminar would be an effective method for underperforming students. I actually just went to a small seminar on the Socratic process. If anyone wants more information, here is a website...

This is an example of a comment that occurred on 10-21-07 during a discussion of course-related material in the *Chemistry for Biology Teachers*, but was more about sharing resources related generally to teaching:

Abby, thanks for the post. I too am a member of the *AP Biology* listserv and even though you get quite a bit of junk, there is a great deal that is very informative. I would suggest [that] anyone [teaching] AP or is considering teaching it in the future get on the list.

And finally, a fifth theme or pattern, occurring in 9.3 % of messages, encompassed comments that were made to share information about oneself. These appear to be attempts to relate to others on a more holistic level than course ideas alone would allow:

- “This past week, I was in charge of presenting a professional development [activity] for the entire staff on Monday, was out of town at a school improvement workshop on Monday night and all day Tuesday, had a swim meet out of town on Thursday, and still had to teach my classes, prepare two labs, and write a lab practical test. But, that is just me. As teachers, we are ‘living the dream!’” (*Case Studies in Biology*, 1-26-08)
- “[S]tay warm, it was a balmy -3°F here this past Saturday...wooooooeeeeee!!!”
- “I went for a 12-mile run right before the Super Bowl, had dinner, then fell asleep at kick-off only to wake with 45 seconds to go in the game. Saw all I needed to see.” (*Case Studies in Biology*, 1-05-08)

Discussion

The primary goal of the on-line courses was the delivery of content in a way that would help teachers integrate new content and instructional practices into their classrooms. The success of this goal was assessed by a baseline of participation in the on-line discussion forum and the quality of student work produced in response to assignments. The secondary goal and the purpose of this study was to assess the ability of the on-line course environment to promote the establishment of a PLC comprised of teachers who are geographically dispersed across the country.

As we assess the Institute’s progress in the development of a national Professional Learning Community, we have drawn on the literature describing the dimensions of local PLC’s in school district organizations [1]. According to Hall and Hord, these PLC dimensions are:

- 1) Shared Values and Vision—Commitment to student learning;
- 2) Collective Learning and Application—Apply learning to better attend to students’ needs;
- 3) Supportive and Shared Leadership—Jointly held power and authority that involve teachers in decision-making processes;
- 4) Supportive Conditions—Physical and human capacities that promote collaborative organizational arrangements and relationships; and,
- 5) Shared Personal Practice—Feedback and assistance from peers that support individuals and community improvement.

The evidence from the teacher discourse during the on-line courses indicated that all three of the on-line courses, to varying degrees, were effective at supporting the development of all but one of the dimensions of these PLC indicators. The course structures provided supportive

conditions for the promotion of collaborative organizational arrangements (PLC#4). Teachers were given the time, space, and encouragement to share information about teaching. A reading of the discourse provides one with a picture of the similarities and differences in high school teachers' classrooms across the nation. The on-line discussion forum also provided a space for teachers to share values and vision for student learning (PLC#1). This was most often the result of a direct question or prompt, but was sometimes a conversation that resulted from a spontaneous question initiated by teachers.

The dimensions of PLC's supported by the strongest evidence from the cross-course conceptual analysis were those indicating the sharing of personal practices (PLC#5) and those that illustrate the teachers' collective learning and its application to better teach their students (PLC#2).

Not surprisingly, the dimension of PLC's not supported by the distance learning structure was that of supportive and shared leadership (PLC#3). Incorporating leadership goals into the distance learning environment will occur in the academic Year Two of the program, 2008-09.

Conclusion

In summary, the on-line courses, as taught during the first year, seemed to encourage participants to interact with each other around the specific content of the course and the more general context of teaching. There is also evidence, although less predominant, that they used the forum to begin to forge more personal relationships with one another. If electronic relationship formation in both professional and personal domains builds learning communities in the same way as local PLC's, then these findings would suggest that on-line coursework can support the development, at least initially, of collaborative leadership teams. These findings will inform the development and implementation of Year Two of the on-line courses, assuring that the designs reinforce the impact of the first year, and extend this into a peer leadership environment that would allow teachers to establish their work around shared values of educational reform.

References

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