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Perceptions of Secondary and Post-Secondary Interdisciplinary Faculty on CISIP Professional Development: A Teacher Learning Community Designing Scientific Classroom Discourse Communities

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PERCEPTIONS OF SECONDARY AND POST-SECONDARY INTERDISCIPLINARY FACULTY ON CISIP PROFESSIONAL DEVELOPMENT: A TEACHER LEARNING COMMUNITY DESIGNING SCIENTIFIC CLASSROOM DISCOURSE COMMUNITIES

ABSTRACT: This study summarizes semi-structured focus group exit interviews with Communication in Science Inquiry Project (CISIP) participants, experienced secondary and post-secondary science, English, and ELL faculty. CISIP is an NSF-funded initiative designed to meet the need for highly qualified teachers and science education reform. The main purpose of the larger study was to understand teachers' application, in teams, of the CISIP model during the three-week summer institute. The focus group interviews helped to triangulate researchers' observations with the participants' perceptions. Participants expressed favorable attitudes toward their extended CISIP experience, at least one year's participation before the summer institute. All acknowledged the value of a professional learning community. Science educators valued sharing ideas with other teachers and disciplinary area experts to incorporate academic and English language acquisition, oral and written discourse teaching strategies into their inquiry-based science lessons. By providing an adaptable curriculum model CISIP facilitators affected individual educators' beliefs, assisted them in learning new pedagogical strategies, and helped them design CISIP-aligned curriculum. However, full implementation of the CISIP model has been a challenge, perhaps due to so few teachers having a school-based CISIP team member, systemic school-based frame factors, or insufficient practice with the CISIP model.

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Purpose

The focus of this paper is to report on the evaluation of the Communication in Science Inquiry Project (CISIP) summer institute as conducted in focus groups that served as semi-structured exit interviews with participants. These interviews were conducted during the last two days of the second annual 3-week CISIP summer institute and provided valuable feedback for ongoing product development (i.e., the professional development itself) to fulfill the project's objectives. CISIP is an NSF-funded initiative designed to: a) meet the need for highly qualified teachers who are able to use academic language strategies, oral and written discourse, learning principles to support all students, but especially English language learners, to learn science; and b) science education reform. This study is part of a paper set that describes other significant aspects of CISIP including an evaluation of "signature lesson" modules developed by teachers at the summer institute, a summary of observations of small group dynamics at the summer workshop, and the continued development of a classroom observation instrument.

As Borko (2004) reports, "we have evidence that professional development can lead to improvements in instructional practices and student learning." The main purpose of the larger,

on-going research objective of this study was to understand teachers' application, ideally in teams, of the CISIP model during the professional development institute as they designed new curriculum to support the construction of scientific classroom discourse communities. The purpose of these focus group interviews was to generate a snapshot of teachers' self-perceptions of how CISIP had affected their practice as well as triangulate the university researchers' observations.

The main purpose of CISIP is to deliver professional development to in-service science and English/ELL teachers with the aim of improving student science achievement and this goal itself did not change, but the professional development product conceptualization underwent a philosophical shift in terms of what teachers were expected to design and use in their classrooms. The original model included the same areas of emphasis: a) inquiry; b) oral discourse; c) written discourse; d) academic language development; and e) learning principles (NRC, 2000; NRC, 2005). However, during the previous summer's institute content area (Earth science, biology, chemistry, and physics) committees had been formed and scripted modules of a 1-2 week set of lessons in each of these areas were fashioned without regard to the teachers and individual students who would be using them. The shift to "signature lessons" allowed for individual or teams of teachers to select an area of emphasis from the CISIP model that they were interested in developing throughout the following school year and then generate specific lessons that could be used as milestones to show increasing development of a scientific discourse community in their classrooms.

Literature Review

Lave and Wenger (1991) developed a learning theory out of situated learning called legitimate peripheral participation in communities of practice. Their study of a wide range of apprenticeships led them to construct a more widely-encompassing structure that is useful as an "analysis perspective." Situated learning bridges cognitive processes and social practices. As Lave and Wenger (1991) state "learning is not merely situated in practice…learning is an integral part of generative social practice in the lived-in world." The CISIP learning community includes veteran teachers as well as less experienced practicing teachers and secondary (and post-secondary) science teachers along side with English and ELL faculty. This range of teacher knowledge (both content area and pedagogical content) and skills makes all participant teachers experts and novices at the same time. For example, a 20-year veteran of the science classroom may have extensive knowledge of how to teach science, but very little awareness of how to use academic language strategies. All teachers have something to learn from each other in the professional development activities because the CISIP model integrates the critical elements of both disciplines. Teacher participants also have their own experiences to share, which benefits the novice as well as the master teacher. Lave and Wenger's concept of legitimate peripheral participation and generative growth has been successfully applied to other professional development programs by Franke, Kazemi, Carpenter, Battey, and Deneroff (2002), with mathematics educators. In sum, legitimate peripheral participation is "an analytical viewpoint on learning, a way of understanding learning" (Lave and Wenger, 1991) and in this case we are concerned with teacher learning.

The CISIP participants are part of a teacher learning community as defined by Cochran-Smith and Lytle (2003):

> "social groupings of new and/or experienced educators who come together over time for the purpose of gaining new information, reconsidering previous knowledge and beliefs, and building on their own and others' ideas and experiences in order to work on a specific agenda intended to improve practice and enhance students' learning."

All of these activities have been observed during CISIP workshops during the school year and at the summer institute.

Kunzman (2003) identified five themes central to the learning of experienced teachers: a) a greater awareness of their struggling students; b) a broader and more complex understanding of curriculum planning; c) the importance of collegiality and collaboration in professional life; d) the value of feedback and structured reflection; and e) the development of a theoretical framework to inform and guide practice. Many of the teachers in Kunzman's study recognized how curriculum-planning literature could improve their practice, more so than pre-service teachers who lacked teaching experience and awareness of how theory can translate to classroom practice.

Jeanpierre, Oberhauser, and Freeman's (2005) study of a similarly constructed professional development program reported that the key characteristics of shifting secondary science teachers to a more inquiry-based practice included: "deep science content and process knowledge with numerous opportunities for practice; the requirement that teachers demonstrate competence in a tangible and assessable way; and providers with high expectations for learning and the capability to facilitate multi-faceted inquiry experiences." Again the opportunity for practice supports Lave and Wenger's learning theory and legitimate peripheral participation that acquisition of new knowledge must include access to such opportunities; without practice participants are more likely to revert to their old methods.

Methodology

Program

The purpose of CISIP is to provide its science, language arts, and ELL participants with the opportunity to develop the skills needed to integrate a palette of academic language development strategies, oral and written discourse teaching strategies into inquiry-based science lessons. The CISIP project also draws on numerous learning principles, including the three outlined in "How Students Learn" (NRC, 2005): a) engaging prior knowledge; b) the role of factual knowledge and conceptual frameworks; c) metacognition; d) feedback; and e) assessment.

This second summer institute reflected a shift from the original project design that occurred halfway through the intervening school year. Originally, the goal was to produce modules of scripted science lessons to be widely disseminated after field-testing. The revised vision of the project was based on participant belief surveys (about the barriers they perceive in implementing the CISIP model and how often they used core CISIP strategies and employed modes of inquiry-based science instruction), an evaluation of the modules, and many classroom observations,

which led to the conclusion that the scripted module lessons did not meet CISIP goals. Typically these lessons reflected a trend toward embedding too many concepts into a lesson and rushing through lessons so that most students lacked the time to reflect upon their learning and make meaningful connections. The lessons also did not allow teachers to behave as reflective professionals and use their formative assessment of students' understandings to customize instruction to meet the wide range of student abilities, and prior knowledge. Consequently, the revised CISIP initiative is intended to be more adaptable and responsive to students' learning needs, as determined by their teachers. Models of effective lessons will still be produced and used with participants throughout the professional development workshops, but are now viewed more as exemplars rather than the central products of the grant. Empowering teachers to use the CISIP principles and building professional development materials to facilitate teacher learning has placed teacher and student learning at the center of emphasis rather than the curriculum itself.

Research design

These case and cross-case studies are based in interpretative research (Erickson, 1986) and each case is defined as a summer institute team of CISIP participants. Six semi-structured focus group interviews were conducted with middle school, high school, and mixed group participant teams during the final two days of a three-week summer institute. The teams often included some post-secondary faculty (both community college and university faculty) who were also part of the professional development and many of whom were on the leadership team helping to design the professional development itself. The interviews explored all participants' mid-project experience with CISIP professional development activities, materials, and resources. All except one team had both science and language arts members. Groups were instructed to select a major learning outcome from the CISIP model to focus on implementing for the following school year. For example, teachers might focus on oral discourse, but were also required to choose specific learning principles and academic language development strategies. A summary of group composition and their selected area(s) of emphasis are presented in Table 1.

Table 1. Focus group interview compositions and selected area(s) of emphasis to focus on for the following school year.

CISIP Team composition	**Area(s) of emphasis selected**
1) MS Team #1. All from the same school. 2 science, 1 LA	Oral (1) and written discourse (2)
2) HS Team #1: All from different schools. 2 science, 1 LA/ELL	Oral and written discourse; scientific explanation and argumentation
3) HS Team #2. All from same school with 1 CC member (acted as a consultant). All 4 LA/ELL/ English.	Oral discourse (2) and written discourse (1)
4) Mixed Group #1. MS: 2 science, 1 language arts; HS: 1 ELL; Univ.: 1 science	Argumentation. Science content: toxicology, antibiotics. LA: oral discourse, prior knowledge, use of science articles for claims and evidence.
5) Mixed Group #2. MS: 1 language arts; HS: 1 science; CC: 3 science.	Oral discourse (1), argumentation (3), feedback (1). Selected areas of perceived weakness to use CISIP principles to improve teaching.
6) HS Team 3#. All but one from same school. 3 science, 2 English/ELL.	Metacognition (2), oral discourse (2), written discourse (1).

MS = Middle School, HS = High School, LA = Language Arts, ELL = English Language Learner

Many interview questions were generated by the university research group to probe specifically for participants' views of their use of the CISIP professional development and then combined into fewer categories to allow for a range of responses and remove questions that might be leading. The interviews were conducted during the workshop setting and spaced throughout the last two days so that they did not take the participants away from their time together designing their lessons. The pre-set interview questions were asked in the following order: a) How was the area of emphasis decided upon [in your group]? b) What was your biggest challenge in the development of your lesson plan? c) How did you use the CISIP resources in your lesson plan? d) How are your signature CISIP lessons different from non-CISIP lessons? e) Has the team activity affected how you think about teaching and learning? If so, in what way? Interview data reflects group consensus in these focus group settings.

Data Analysis

Each CISIP team was interviewed by 1-2 university researchers and their responses were digitally recorded while the researchers took notes. The interviews lasted 19 to 38 minutes each and were supported by informal observations by the research team of the groups in their work sessions leading up to the focus group interviews. One researcher listened to the interview tapes and summarized the direct responses using a spreadsheet to compare responses from one group to another. Erickson's (1986) qualitative data analysis method was used and the data were searched for patterns. Interviews with key informants were transcribed and coded for ancillary professional development issues to capture more of the finer-grained details. Key informants were selected based on their position as mentors to other teachers and their extensive involvement, insights, and understanding of the project.

Findings

The data were analyzed to investigate teachers' challenges, their use of resources to overcome these challenges, how their CISIP lessons differed from their regular curriculum, and the effect of working as a team on how they think about teaching and learning. Each group worked together either as sounding boards and intellectual resources and provided feedback for each other's individual "signature lesson" ideas or worked tightly as a team to develop a series of lessons that they would all teach with some modifications for individual groups of students. As seen in Table 1, all teams selected an aspect of oral discourse and four out of six teams also identified a complimentary written discourse objective. Two teams wanted to work specifically with scientific explanation and argumentation. A scientific explanation was defined by the project, and constructed through the previous spring's professional development, as students using evidence to support scientific claims.

The most frequently quoted challenges by the teachers were: a) acquiring a clear understanding of the CISIP model principles, b) not having time to design lessons; and c) integrating the science concepts into the language arts curriculum. Newer participants to the CISIP professional development, as well as some of the more veteran participants commented on the need for better definitions of various items from the model, even though during the course of the summer institute these definitions were generated by expert groups and distributed to the teams. Nearly every group wanted to have more time to design their signature lessons and receive feedback on their ideas. English and language arts educators indicated that they were most challenged to integrate scientific inquiry into their curriculum. One solution they used to address this issue was

to use relevant scientific articles as text for student analysis as a means to deconstruct scientific explanations using claims and evidence.

All groups identified teamwork as the most significant activity for problem solving curriculum development, followed by CISIP materials and training. A community college member of Mixed Group #1 supported this by saying that having regular access to the various perspectives of CISIP participants and their areas of expertise was the strongest part of the project. The more experienced members of this same group, who were also on the CISIP leadership team, one a middle school science teachers and the other a university science faculty member, stated that through their involvement with CISIP its principles have become second nature; "as we grow with CISIP, we use more and more of the components." Others in this group, without team members from their own institutions, commented that when they attend CISIP workshops they still feel as if they belong to a team of professionals. There were also the long-term benefits of teamwork. Two middle school group members (one science and one LA teacher) who were identified by a 30-year veteran science teacher on the leadership team as exemplifying the project's interdisciplinary goals commented on the positive synergistic effect of sharing curriculum over the past two years. One said "it's amazing to see the reaction of the kids…when you [both] speak the same language… [they] get to see how it all integrates together."

One interview question asked participants how their CISIP lessons differed from the rest of their curriculum to learn how teachers perceived changes in their own curriculum and pedagogy since they became involved in CISIP. Participants in Mixed Group #2 commented that it was difficult **not** to use the CISIP principles once they were familiar with them. Middle School Team #1 stated that their CISIP "lessons are more connected and intertwined" and that "CISIP will help us meet state standards and assessments." A high school team reported that "CISIP lessons force a teacher to do what they ought to be doing anyway" with more documentation and teaching less material, in more depth.

We finally inquired about the effect of team activity on teaching and learning. Five of six teams emphasized the benefits of sharing ideas and clarifying content as part of a collaborative relationship with other teachers. Quoting a high school biology teacher, "collaborating generates a synergy." A language arts community college member stated that sharing ideas and receiving feedback from their team allowed for constant revision: "I love the fact that we're always growing as a team…it's always positive to see how much better it can get…you never have time during the year to collaborate." Additionally four of six teams commented directly on the learning benefits for their students. For example, a member of a high school team, composed of two science teachers and one language arts teacher, stated that "CISIP looks at learning as a whole instead of…in academic isolation [where] students receive a disjointed education." Another high school team of language arts teachers reported that the collaborative nature of the project allowed them to internalize CISIP principles and while it was a slow process, it is one that "resulted in more explicit classroom instruction." A member of this group commented that he preferred the new model of CISIP because he was developing his own lessons, as opposed to teaching a single scripted science lesson, and this "serves my purposes much more clearly."

The relationship between the reported use of CISIP principles and participant-designed lessons was also analyzed and found that the alignment of lesson with CISIP principles was higher

among science educators than language arts specialists (see an associated paper in this set). Feedback was provided to the teachers on these lessons for revision before field-testing occurred in the beginning of the 2006-2007 school year.

Like the teachers in Kunzman's (2003) study, the CISIP teachers are in-service experienced teachers and during their professional development experiences they frequently commented on how much they valued the time to discuss teaching with other professionals who were motivated to improve their practice. Even though many teachers taught in diverse classrooms they gained a greater awareness of English language learners through various activities designed to broaden their cultural perspectives.

Contribution to Teaching and Learning Science

This study supports the critical role of teacher learning communities and shows that even experienced teachers may struggle with learning new concepts. Returning to the theoretical framework of legitimate peripheral participation as an analytical tool for teacher learning we can group these CISIP teachers' experiences into some common themes. First, like the CISIP model itself the members of the CISIP community have demonstrated that "learning is not merely a condition for membership, but is itself an evolving form of membership" (Lave & Wenger, 1991). Teachers enter into CISIP professional development and must pass through a period of acquiring an (oral and written discourse) understanding of how to: a) teach inquiry; b) create a science classroom discourse community with the support science notebooks as a learning tool (for themselves and their students); c) employ academic language development strategies that also support ELL's; and d) implement learning principles. This is an ambitious project that carried a high cognitive load for teacher learners. Second, Lave and Wenger emphasize that there must be transparency to the apprenticeship and at this time of the professional development stage there was an added challenge in that there were few models of teacher participants implementing CISIP in their classrooms. At the summer institute there was a session during which some participants shared their experiences of using selected CISIP strategies. They brought student work in to share with their CISIP colleagues and told their stories of the curriculum design and decisions and how that made a difference in their students' level of engagement and understanding of science concepts. These examples were cited as having been very helpful in building teachers' understanding of how to apply the CISIP model.

It will be important for the professional development of the CISIP project to show models of how the theoretical can be transformed into practice as it is difficult to reproduce and transform a community of practice inside a black box. In addition, in order to mentor new CISIP teachers there must be master CISIP teachers who by their very participation in CISIP are in the process of re-shaping their own professional identities in the context of teaching and learning.

Even experienced CISIP teachers have acknowledged the critical role of connecting student learning with curriculum and instruction. As Kunzman (2003) reports, "teacher education fosters vital learning that classroom experience alone is unlikely to provide." The CISIP model is based on the concept of teacher learning communities as a means for affecting positive change for student learning within inquiry-based science instruction. The focus group interviews reveal participants' appreciation of purposeful and professional experiences that gives them the time

and skills to revise their own curriculum, especially with their colleagues. By participating in the CISIP teacher learning community, individuals have increased their awareness of many different types of teaching strategies, and how to better employ oral and written discourse.

We would like to predict that these professional development experiences will result in more authentic inquiry-based science instruction and higher student achievement. We believe this will be borne out by future classroom studies because CISIP deliberately promotes planning lessons for student learning and teachers saw CISIP principles as a natural means for effective classroom instruction. However, as seen more clearly in the lessons that participants generated (see other paper in set), full implementation of the CISIP model has been a challenge for most participants. These difficulties are perhaps due to so few teachers having a school-based team member, systemic school-based frame factors, or insufficient practice with the CISIP model. Teachers' beliefs may have shifted, but it remains to be seen how well CISIP is implemented in the classroom. A key informant, a veteran 30-year middle school science teacher commented that:

> they exemplify the… concepts that CISIP stands for because they work together. Conversely the newest member of the [school] …team doesn't have that corresponding team member so her life is going to be much more difficult unless she can establish a relationship with somebody; otherwise she's going to have to do it all. So, I've always taught in that kind of situation whenever possible because a team member to work with closely in language arts, it's very important, it's critical. I don't know, either you need to have those individual team memberships like that or full-school buy-in where it's taught by department and I've never seen that; nor do I expect to live long enough to see [it].

This teacher understands that there is another layer to affecting change in schools, which are the schools themselves. He knows that it is even more difficult to persuade an entire institution to transform its identity than to indoctrinate just one teacher or a team of teachers.

Some additional questions relating to legitimate peripheral participation that this research group should consider during the next phase of CISIP with a new cohort of teachers include: a) Are there developmental cycles in CISIP professional development? If so, what are they? b) How transparent was CISIP to newcomers? c) Is CISIP accessible to new participants so that they can gain membership into the CISIP teacher learning community? If not, what needs to change?

Future professional development efforts for science educators may be more successful if facilitators consider the situational variety and diverse needs of modern educators by using the lens of legitimate peripheral participation. By providing an explicitly adaptable transparent model, facilitators may be better able to empower educators to assess, design, and enact effective pedagogy and curriculum to meet the needs of their own diverse students in learning science.

General Interest to the NARST Membership

These findings should provide the NARST membership with insights into the evolution of successful professional development by highlighting the challenges faced by in-service educators and the resources they used to solve these issues to create scientific classroom discourse communities situated in inquiry-based science instruction.

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Appendix A: Data Summary from Focus Group Interviews

Group composition	**Area(s) of emphasis selected**	**Area(s) of challenge**	**Use of CISIP resources**	**Signature CISIP lesson characteristics**	**Effect of team activity on teaching & learning**
(MS Team) MS: 2 science, 1 language arts	**Oral (1) and written discourse (2)**	How to fit lessons into regular curriculum.	CISIP definitions (workshop handouts) and "Tips for Teachers" book. Collaborating with other CISIP teachers.	"Lessons are more connected and intertwined." CISIP will help us meet state standards and assessment.	Building better lessons so that the science and the writing will compliment each other. Figuring out what is best for students.
(HS Team from different schools) 2 science and 1 language arts /ELL	**Oral and written discourse** as related to scientific explanation and argumentation	LA teacher had to wait to design lessons; she must coordinate with her colleagues at school. Concerned with how to teach students the strategies at the beginning of the year.	CISIP teacher participants were "excellent colleagues"; [we] learned a lot from them.	ALD has a high priority and bridging between English and science disciplines.	Helped to focus on common threads (use of notebooks, scientific explanation, writing characteristics). CISIP looks at learning as a whole.
(HS Team from same school with 1 CC member) All 4 language arts/ELL/ English	**Oral discourse (2) and written discourse (1)**; CC member acted more as a consultant	Integrating science into LA, specifically the use of inquiry. Learning the CISIP concept definitions.	ALD and writing palettes were used the most. The other CISIP teachers were great; would feel contacting them between professional development meetings.	"CISIP lessons force a teacher to do what they ought to be doing anyway." More documentation, teach less material in more depth.	Value of project over time, seeing the same people and develop relationships during collaboration.
(Mixed Group #1) MS: 2 science, 1 language arts HS: 1 ELL Univ.: 1 science	**Argumentation** Science content: toxicology, antibiotics LA: oral discourse, prior knowledge, use of science articles for claim and evidence.	Understanding the definition of a unit and the year-long design of CISIP. Having enough time to develop lessons.	Handouts, networking with one another, membership on various CISIP leadership committees, workshop experiences.	Difficult not to incorporate CISIP principles into the rest of the year once familiar with them and how they benefit students.	Two MS members had a 5-year history of collaboration; reported that students benefit from a less fragmented curriculum. Working in a team is "ideal for establishing connections."

Appendix A (con't)

Group composition	**Area(s) of emphasis selected**	**Area(s) of challenge**	**Use of CISIP resources**	**Signature CISIP lesson characteristics**	**Effect of team activity on teaching & learning**
(Mixed group #2) MS: 1 language arts HS: 1 science CC: 3 science	**Oral discourse** (1) **Argumentation** (3) **Feedback** (1) Selected areas of perceived weakness to use CISIP principles to improve teaching.	Lack of common definition of terms was difficult until they were clarified. More time was needed to develop lessons. Everyone has a different teaching situation.	Revised definitions, sample lessons, other participant's ideas, ALD strategies, use of notebooks with students.	CISIP lessons are more detailed and formalized, less random, better planned; more inquiry-based and more emphasis on ALD. Difficult not to use the CISIP principles once familiar with them.	Sharing ideas for lessons, insights, and perspectives from different grade levels. Help with other discipline content knowledge. Gained more confidence with teaching strategies.
(High School Team, all but one from same school) 3 science, 2 English/ELL	**Metacognition (2), Oral discourse (2), Written discourse (1)**	Using the CISIP lesson plan framework was challenging. Fitting the science into the LA class objectives.	ALD strategies and the LPs as a checklist for lessons.	More documentation for CISIP lessons, but shouldn't be a big difference [now]. Being more explicit with lesson plans.	Experiencing the "CISIP ideals in the professional development that we want for our students" has improved understanding. Collaborating generates a synergy that teachers rarely have the time for.