Effectiveness of professional development program on a teacher' s learning to teach Science as inquiry

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Abstract

This is a study of a science teacher's beliefs concerning how a professional development program affect both the teaching strategies used and the beliefs professed influence classroom instruction after participating in the Iowa Chautauqua Professional Development program. The results of the study indicate that teachers often have problems with implementing new instructional strategies especially, inquiry teaching. The causes for the difficulty were found to include: (a) a major gap

between the teacher's common knowledge and their common practices, (b) more experience with the inquiry teaching and learning approaches is needed, (c) getting student participation as a partner in inquiry is new, (d) some students are resistant to working on their own inquiries, and (e) management issues. The Iowa Chautauqua Professional Development program helped the teacher to change her philosophy of teaching and learning and use of more constructivist learning environment practices.

Introduction

This study focuses on one teacher, Ms. Smith, and her thoughts, actions, and concerns about using inquiry teaching determined by constructivist perspective. Ms. Smith's reflections over the course of the year long Iowa Chautauqua Professional Development Program (ICPDP) were used to investigate the effectiveness of ICPD program on Ms. Smith's philosophy and perceptions of her actual classroom practices as well as to analyze why the teacher is resistant to using more inquiry strategies in their classrooms and. Such information may be used to overcome many of the problems teachers face when they contemplate such changes. The question for most teachers is: "how can we add inquiry teaching to an already full schedule?"

Since the late 1950s, inquiry teaching has been a major goal for science education (Haury, 1993). Inquiry-based teaching is central to the reforms recommended in the National Science Education Standards to facilitate the implementation of constructivist teaching learning practices (NRC, 1996) and the Benchmarks for Science Literacy (AAAS, 1993).

Designing a learning environment is connected with the whole process of learning, its transfer, and specific past experiences (Bransford, et al., 1999). According to Crawford et al (1999), authentic learning based on real-world projects involves creating environments related to students' own interests. This is an important responsibility for teachers who want to create learning environments in which students achieve even more. These environments engage students in complex problem solving where they explore ideas and issues. These classroom activities should draw on students' prior experiences and knowledge. However, creating this kind of environment is not easy (Crawford, 1999).

The National Science Education Standards state that "inquiry into authentic questions generated from student experiences is the central strategy for teaching science" (NRC, 1996, p.31). Because engaging students in inquiry helps them to develop

- Understanding of scientific concepts.
- An appreciation of "how we know" what we know in science.
- Understanding the nature of science.
- Skills necessary to become independent inquirers about the natural world.
- The dispositions to use the skills, abilities, and attitudes associated with science (NRC, 2001).

Many teachers have difficulty teaching science using an inquiry method because they were not taught in this way nor were they exposed to it in their teacher preparation programs (Kleine et al, 2002). Much research provides reasons given for many teachers not to use inquiry. These include: (1) it takes too much time and energy, (2) there is a risk that administrators will not understand new teaching methods, (3) student are too immature, (4) teachers lack desire to change their teaching habits, (5) the cost of materials is too high, (6) teachers are afraid of losing control, and (7) there is not enough time to cover all that is required in the existing curriculum (Costenson & Lawson, 1986, Lawson, 2000, Leonard & Chandler, 2003, Niemi, 2002, Windschitl & Buttemer, 2000).

The National Science Education Standards suggest that students in K-12 schools learn science by engaging in their own investigations, in order to answer their own questions. The test should not be based on standard science content knowledge, but on students' ability to understand the processes of science. However, many classroom teachers are hesitant to allow students to experience inquiry-based learning. Oftentimes, this is because teachers question their own science content knowledge and their own abilities to perform scientific investigations.

Teachers are essential parts of inquiry teaching because when the teacher understands the importance of inquiry, every situation can be turned into "hands-on minds on" activity (Windschitl & Buttemer, 2000). Teacher beliefs are very central components for inquiry teaching. Pajares (1992) argues that: "The beliefs teachers hold influence their perceptions and judgments, which, in turn, affect their behaviors in the classroom." (p.307). The Iowa Chautauqua Professional Development Program

(ICPDP) is specifically designed to target the emphases for needed beliefs regarding professional development as envision in the NSES (NRC, 1996) (see Table 1).

The Iowa Chautauqua Professional Development Program (ICPDP) is a multi-state professional development project designed to enhance instructional processes for K-12 science teachers by using inquiry teaching as a model for constructivist learning for leader. One of the goals of the ICPDP is to improve teachers' confidence in teaching science. The project began in Iowa in 1983 and was funded later as a part of the National Science Teachers Association (NSTA) Scope, Sequence, and Coordination Project. During the 2004-2005, the State of Iowa provides grants for Title II A funding for ICPDP to provide professional development at the state.

Table 1: Features of the Iowa Chautauqua Professional Development Program as Envisioned by the NSES

Less Emphasis On	More Emphasis On
Transmission of teaching knowledge and skills by lectures	Inquiry into teaching and learning
Learning science by lecture and reading	Learning science through investigation and inquiry
Separation of science and teaching knowledge	Integration of science and teaching knowledge
Separation of theory and practice	Integration of theory and practice in school settings
Individual learning	Collegial and collaborative learning
Fragmented, one shot sessions	Long-term coherent plans
Courses and workshops	A variety of professional development activities
Reliance on external expertise	Mix of internal and external expertise
Staff developers as educators	Staff developers as facilitators, consultants and planners
Teacher as technician	Teacher as intellectual, reflective practitioner
Teacher as consumer of knowledge about teaching	Teacher as producer of knowledge about teaching
Teacher as follower	Teacher as leader
Teacher as an individual based in a classroom	Teacher as a member of a collegial professional community
Teacher as a target change	Teacher as source and facilitator of change
	(NRC, 1996)

The staff development model employed by the ICPDP includes a three-week summer institute. In this training, the teachers assume the role of students to explore issue-based questions. They look for key science concepts and study different constructivist pathways for learning. The summer institute is a prelude to an academic year-long experience involving two three-day short courses, one in the fall and another in the spring. These short courses are designed to help teachers to incorporate constructivist teaching practices through use of inquiry. The features of ICPDP are shown at Table 2.

Table 2: Iowa Chautauqua Professional Development Program Features

One year project
A two-week leadership conference for 25 of the most successful teachers from previous years who want to become a part of the instructional team for future workshops
A three to four-week summer workshop at each new site for 30 new teachers electing to try inquiry teaching and learning strategies; the workshop provides experience with inquiry (teachers as students) and time to plan a five-day inquiry unit to be used with students in the fall
A three day fall short course for 30-50 teachers (including the 30 enrolled during the summer); the focus is upon developing a month long inquiry module and an extensive assessment plan
Interim communication with central staff, lead teachers, and fellow participant, including a newsletter, special memoranda, monthly telephone contacts, and school/classroom visits
A three day spring short course for the same 30-50 teachers who participated in the fall; this session focuses upon reports by participants on their inquiry experience and the results of the assessment program

Research question

There are many studies undertaken to evaluate effectiveness of ICPD on teachers' teaching strategies. However, none of the studies specifically focused on one teacher to investigate effectiveness of ICPD and the difficulties that teacher face during the actual implementation. Table 3 shows how various data sources combined to fit the following research question.

The specific research question guided this investigation is:

How does the Mrs. Smith change her philosophy and perceptions of her actual classroom practices over the course of a calendar year during the yearlong Iowa Chautauqua Professional Development program?

a. Changes in philosophies as evidenced by pre-post test administration of the PTL
b. Changes in perceptions of classroom practices as evidenced by pre-post test administration of the CLES-T and videotape observations using ESTEEM
c. Mrs. Smith's students' perceptions of her practice as evidenced by administration of CLES-S

Table 3: Cycle of the Study

Instrument	Day one of the summer workshop	After implementation of the Fall mini course	After implementation of the Spring mini course
PTL	X		X
CLES-T	X		X
CLES-S			X
ESTEEM		X	X

Methodology

Subject

Participant in this project were drawn from the Area Education Agency 267 (AEA 267) in north-central Iowa.

At the beginning, the Constructivist Learning Environment Survey Teacher form (CLES-T) (Fraser & Taylor, 1990) was given to the teachers to find out their beliefs concerning constructivist teaching science in the classroom. This study focuses on one teacher, Ms. Smith, for the following reasons:

- She had the lowest score on the CLES-T (Fraser & Taylor, 1990) pretest.
- During the interview with the workshop leader, she was the only teacher who accepted her weak background initially concerning teaching inquiry in pre-workshop interviews.

- On her written reflections, she explained her frustrations concerning use of inquiry methods and her own more traditional teaching experiences more openly than did all the other teachers who attended the summer workshop.

Ms. Smith had 11 years of teaching experience at the same middle school. She stated that she loved teaching, and was eager to improve her teaching practices. She was volunteered to join the ICPDP because she wished to learn how to use inquiry effectively in the classroom. She was enthusiastic and eager to change her science teaching and strategies. She was willing to share her teaching performances via video recordings with the other participants.

Data Collection

Five types of data were used to analyze Ms. Smith's teaching practices:

1. The Classroom Learning Environment Survey (CLES): CLES has two versions. The Constructivist Environment Surveys Teacher Form (CLES-T) (Fraser & Taylor, 1990) and the Constructivist Learning Environment Survey Student Form (CLES-S) (Aldridge, Fraser, & Taylor, 2000) were used to assess teacher's and students' perceptions of constructivist teaching practices occurred in the classroom.
   Both the CLES-T and CLES-S consists of 42 statements about the classroom-learning environment. A five-point Likert-type scale is used to determine perceptions of a five features of constructivist classroom: Personal Relevance (PR), Scientific Uncertainty (SU), Critical Voice (CV), Shared Control (SC), and Student Negotiation (SN) (Table 4).

Table 4: Subcategories of CLES

CLES Subcategories	Example Questions from the CLES
Personal Relevance: Relevance of learning to students' lives	(1) Students learn about the world outside of school.
Critical Voice: Legitimacy of expressing a critical opinion.	(3) It's OK for students to ask "why do we have to learn this?"
Shared Control: Participation in planning, conduct and assessment of learning.	(4) Students help me to plan what they are going to learn
Uncertainty: Provisional status of scientific knowledge.	(8) Students learn that the views of science have changed over time.
Student Negotiation: Involvement with other students in assessing viability of new ideas.	(23) Students ask each other to explain their ideas

CLES-T was completed to day one of the summer workshop and after implementation of the spring short course based on her perceptions of her teaching in terms of constructivist teaching practices whereas CLES-S was completed after implementation of the spring short course based on students' perceptions of their teacher' (Mrs. Smith) constructivist teaching practices. The reliability of CLES-T (Abd Hamid, 2006) and CLES-S (Taylor et al., 1994) showed in Table 5.

Table 5: Reliability of CLES-T and CLES-S Subcategories

Subscales of CLES	**CLES-TAlpha Reliability (N=31) (Abd Hamid, 2006).**	**CLES-SAlpha Reliability (N=34) (Taylor at al., 1994)**
Personal Relevance (PR)	0.70	0.81
Scientific Uncertainty (SU)	0.56	0.54
Critical Voice (CV)	0.76	0.79
Shared Control (SC)	0.90	0.85
Student Negotiation (SN)	0.71	0.68

2. Philosophy of Teaching and Learning (PTL) (Lew, 2001): The instrument consists of eight open-ended questions and provides evidence of what teachers believe about their teaching and learning philosophy. Data were obtained from day one of the summer workshop and after implementation of the spring short course. It has three subcategories: (1) what students should be doing in class, (2) what teachers should be doing in class, (3) the teacher understanding of process and content.

3. Written Reflections: These data were collected from Ms. Smith's class journals entries collected over a seven days period through short courses during the 2003-2004 academic year. In these entries, she evaluated her own beliefs concerning teaching and learning after every class period. Additionally, she recorded the problems she faced during her move to more inquiry teaching.

4. Videos: The goal was to find the teacher's constructivist behaviors using video-tapes of her classroom performance. Two videotapes were collected during the study. First one was after implementation of the fall shout course and the second one after implementation of the spring shout course. The videos were used to assess the level of constructivist practices implemented during the lesson in different categories of teacher's attempts to: (1) share responsibility of learning

with students, (2) engage students in activities and experiences, (3) focus on activities relating to student understanding of concepts, (4) adapt her teaching activities based on students' level of understanding, (5) teach higher order thinking skills, (6) integrate content and process skills, (7) facilitate students connecting major concepts, (8) demonstrate interpersonal relations with her students, (9) use examples, and (10) integrate concepts and skills.

5. Expert Science Teaching Educational Evaluation Model (ESTEEM) (Burry-Stock, 1995). ESTEEM was used to assess the actual classroom practices of the participants from the videotapes. The reliability of the ESTEEM is r (14) = .37 (Campbell, 2004). The ESTEEM consists of four subcategories: (1) facilitating the learning process from a constructivist perspective, (2) content specific pedagogy (Pedagogy related to students understanding), (3) contextual knowledge (Adjustments in strategies based on interactions with the students), and (4) content knowledge (Teacher knowledge of subject matter). It is based on five point Likert type scale, five being highest level and the one is the lowest level (Dreyfus & Dreyfus, 1986). These categories were as follows: (1) novice, (2) advanced beginner, (3) competent, (4) proficient, and (5) expert (Table 6) (Berliner, D.C., 1988).

Table 6: The Stages of Teacher Practicing Constructivist Teaching

Stage 1. Novice: The elements of the tasks to be performed need to be labeled and learned, and one learns a set of context-free rules to guide behavior…The behavior of the novice is rational, relatively inflexible, and tends to conform to whatever rules and procedures and they were told to follow.
Stage 2. Advanced Beginner: Here experiences can become melded with verbal knowledge, similarities across context are recognized, and episode knowledge is built…The novice and beginner, though intensely involved in the learning process, may also lack a certain responsibility for their actions. This occurs because they are following rules,…but not actively determining through personal action what is happening.
Stage 3. Competent: Competent performers of a skill have two distinguishing characteristics.
First they make conscious choices about what they are going to do. They set priorities and decide on plans. They have rational goals and choose reasonable means for reaching them. In addition, while enacting their skill, they can determine what is and what is not important. From their experience they know what to attend to and what to ignore … teachers at this stage begin to feel responsible for what happens….However competent performers are not

yet fast, fluid, or flexible in their behavior.

Stage 4. Proficient: This is the stage at which intuition or know-how becomes prominent.

Nothing mysterious is meant in these terms…At some point in learning to ride a bike you no longer think about it…..From the wealth of experience that the proficient individual has accumulated comes a holistic recognition of similarities…which allows proficient individuals to predict events more precisely…The proficient performer, however, while intuitive in pattern recognition and in ways of knowing, is still analytical and deliberate in deciding what to do.

Stage 5. Expert: If novices, advanced beginners, and competent performers are rational, and proficient performers are intuitive, we might categorize experts as "arational". They have an intuitive grasp of situations and seem to sense in non-analytic, non-deliberate ways the appropriate response to make. They show fluid performance, as we all do when we no longer have to choose our words when speaking or think about where to place our feet when walking…They are not consciously choosing what to attend to and what to do. They are acting effortlessly and fluidity, behaving in ways that are not easily described as deductive or analytical … the behavior of the expert is certainly not irrational.

Data Analysis

This study employed qualitative and quantitative methods to obtain data for respond to the research question. The qualitative data were gathered from the teacher's written reflections and her responses on the PTL survey. These data were used to assess Ms. Smith's own ideas about inquiry teaching. Quantitative data were obtained from two videotapes, the CLES-S and CLES-T surveys.

Results

Changes in Philosophy of Teaching

At the start of the fall 2003 meetings of the Iowa Chautauqua Workshop, Ms. Smith answered the question as to how she would define and explain the concept of inquiry in the following way:

"To me pure inquiry would be to let the kids study whatever they want in whatever way they want. In the real world of 3 sections of science I can't see myself doing that. I feel that I will always choose the topic based on the standards and benchmarks. I am ordered to teach. If I were a private teacher with a class of 1 or 2, it would be

wonderful to say, 'what do you want to learn today?' and then to help them do just that."

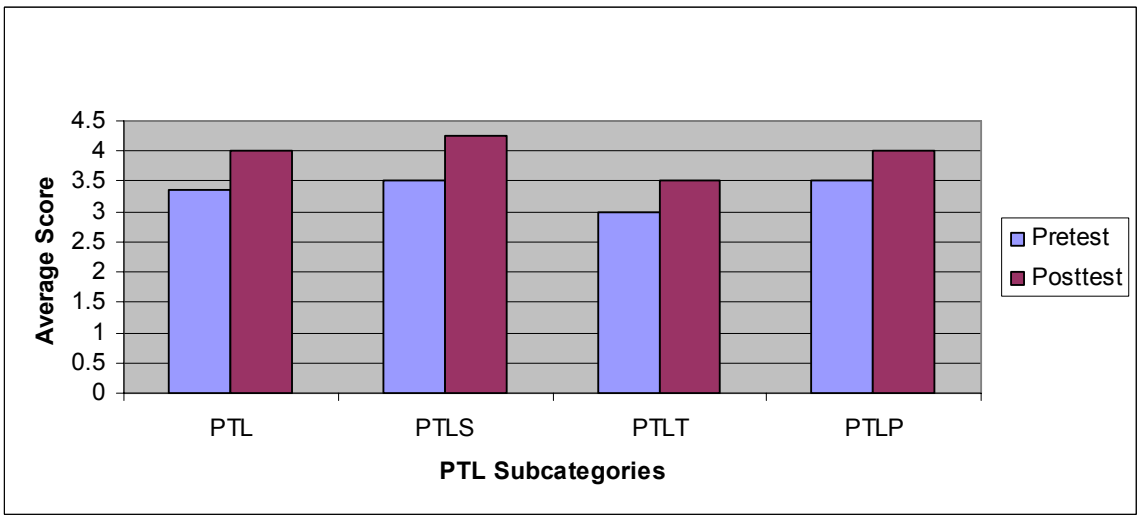
From her statement it is clear that even though she believed inquiry means letting her students search for their own questions, she could not see herself actively practicing such an action in the classroom.

Ms. Smith's answer for what inquiry should look like in the science classrooms is as follows:

"At its best it is interested students working individually and in groups to accomplish a goal. At its worst it is chaos, bored, off task, students getting in trouble for misbehavior, with little if any learning taking place. I think most teachers who want to try inquiry wish for the first situation but are afraid it will turn out to be the second. Consequently we tend to control, boss, and hover and in so doing squelch the essence of inquiry. **Teaching inquiry is scary, risky business**!"

According to PTL analyses, her practice improved after the spring short course compared the summer workshop in all categories including what students should be doing in class, what teachers should be doing in class, and the teacher understanding of process and content (Figure 1).

Figure 1: Changes on PTL and Subcategories of PTL over the ICPD



In the graph:

- PTL= Philosophy of Learning and Teaching Survey
- PTLS= What Students Should be Doing in Class Subcategory of PTL
- PTLT= What Teachers Should be Doing in Class Subcategory of PTL
- PTLP= The Teachers Understanding of Process and Content Subcategory of PTL

The teacher's Philosophy of Teaching and Learning (PTL) indicates a change in her beliefs about what the teacher should be doing in the classroom. Before the workshop, her beliefs about modeling the best teaching and learning in her classroom was noted with the following statement: ".... I hope my students feel that I am knowledgeable about the topic and that I care about them and want them to be successful." Her answer for this question after the workshop was: "I'm not afraid to say that I don't have the answer, because they need to know how to go about finding their own answers." Her focus became more on her students instead of concern for her own competence. Because she let students construct their own understandings, she had moved toward use of more constructivist strategies.

Potential Problem for Ms. Smith to Teach Inquiry

Ms. Smith's written reflections showed that she faced some problems while using an inquiry method. For example, some students did not participate enough; more importantly some students did not know how to get the inquiry started. In the second day reflection, Ms. Smith states: "..the groups that met were a little bit aimless today…". The third day reflection indicated:

"Some groups are still struggling to develop a realistic plan. Many are very interested in doing a video but have no idea how they will show measurable data with a video. Some are spending all of their time working to assemble large numbers of pictures of themselves growing up. I had to rain on their parades by insisting that I was not interested in a photo album. I wanted scientific data".

From the teacher's reflection on day four:

"…some students are getting lazy about completing the log. Today I had to insist that they couldn't leave the room until they had shown me a reasonable complete log entry."

When asked how she manipulates the educational environment to maximize student understanding, her first answer was:

"I try to manipulate the educational environment in several ways. I have students work alone, in small groups, and as a whole class. I have them write, read, listen, and speak. I let them move to different areas of the room at different times. I let them change-learning partners frequently. I let them help each other as well as getting help from me. We review and preview what we are going to learn. We use a variety of materials. We talk about things in their lives that relate to what we are learning. I give feed back about how they are doing. I give praise and encouragement for hard work and cooperation."

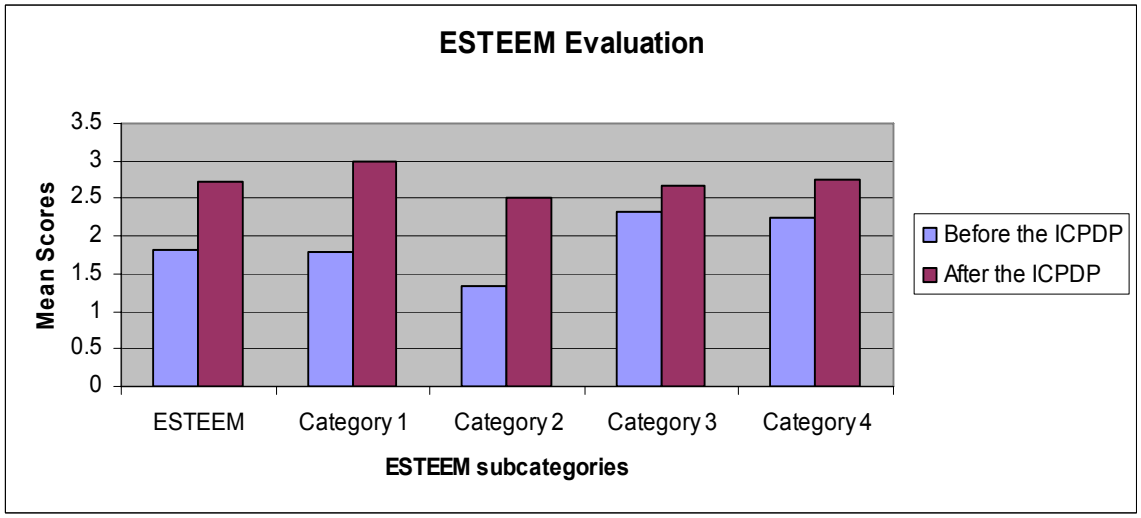
She was worried about classroom management and the environment more than students' needs and questions. After the spring short course, she realized that students better understand when they have an opportunity to explain their ideas in the classroom. She stated: "I try to require students to explain their thinking, predict, and reflect before and after activities." (Last day of the spring short course)

Changes in Perception of Classroom Practice

According to the ESTEEM evaluation of the traditional teaching video cassette, Ms. Smith could be classified as an advanced beginner. The evaluation of her inquiry teaching video showed her teaching practices improved to a "competent" level using Dreyfus and Dreyfus (1986) subscales. Even though she had extensive teaching experience, she still held part of her traditional views concerning teaching. She was a strict teacher who was more concerned about timing and discipline than student participation. She had her vision about what she wanted from students for assignments. She had a plan that was related to her goals or the textbook. At the beginning of the inquiry class period, only one student asked a question. Most of the time she was the one asking questions and giving ideas about what was to be searched and precisely how to conduct an experiment. On the other hand, to drive a discussion, she asked more questions or used students' questions.

The evaluation of videocassettes which were collected after the fall short course and spring short course showed that Mrs. Smith's practices of teaching were improved in all categories (Figure 2). Especially, in facilitating the learning process from a constructivist perspective and pedagogy related to student understanding as well as adjustments in strategies based on interactions with the students, and content knowledge were improved.

Figure 2: Changes on the ESTEEM and its four Subcategories over the One-Year Project

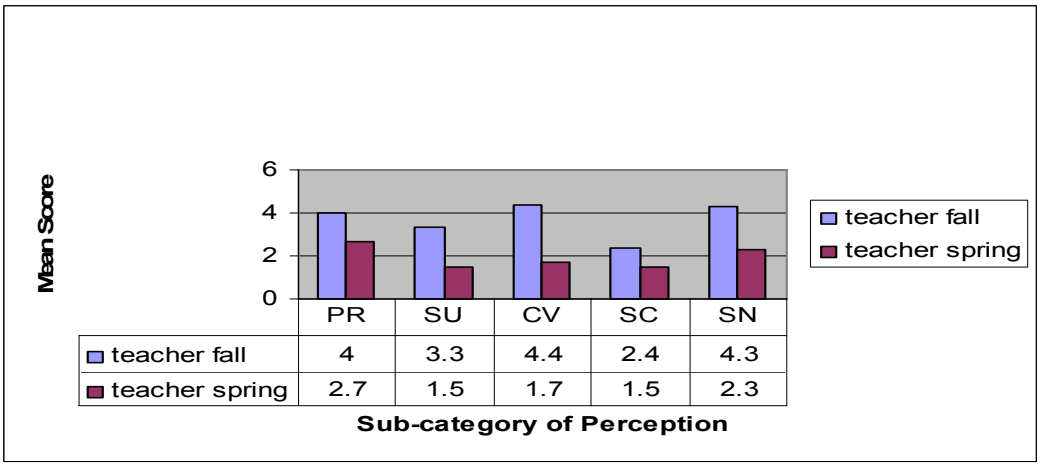


The Teacher's and Students' Perceptions of the teacher's use of Constructivist Teaching Practices

Ms. Smith's responses on the Constructivist Learning Environment Survey (CLES-T) and her students' responses on the CLES-S indicated that there were a difference between the teacher's and the students' perceptions concerning the use of constructivist practices. Figure 4 shows the comparison of CLES-T and CLES-S which shows the patterns of differences between teacher and students in their perceptions of Personal Relevance (PR), Student Uncertainty (SU), Critical Voice (CV), Shared Control (SC) and Student Negotiation (SN) based on total mean scores.

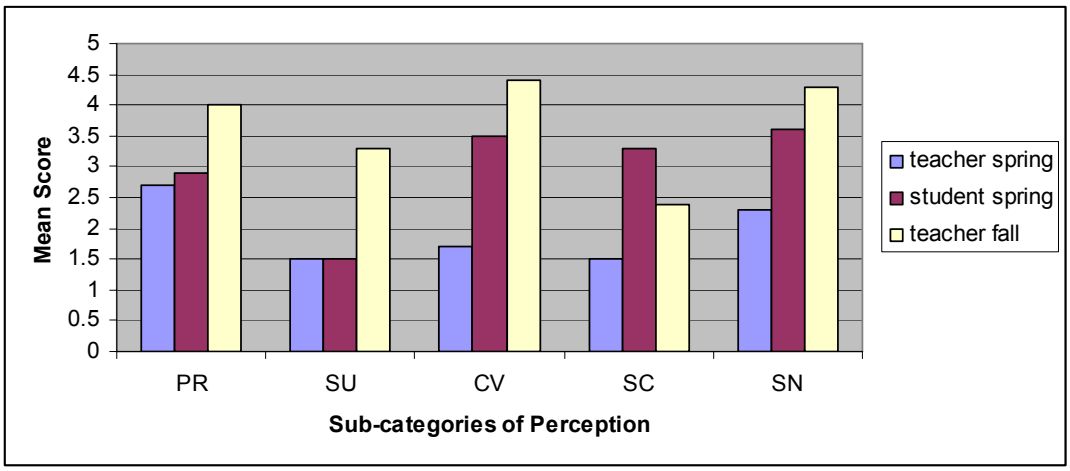
Figure 3 shows the CLES-T analyses. It indicates very interesting results in terms of Ms. Smith's opinions about her use of constructivist practices which considerably changed over time. She started to see herself more clearly than she did six months earlier. Even though she had an idea what constructivist practices should be, the workshop led her to become more knowledgeable about how to use inquiry in the classroom. She became more unbiased about her classroom practices.

Figure 3: Comparing Fall 2003 and Spring 2004 Teacher's Perceptions of Teacher Use of Constructivist Practices



Students are good data sources for professional development programs because they are directly affected by the instruction. During fall 2003, Ms. Smith believed that the teacher needs to have control. After the spring short course her perception of student control is improved which means during fall semester her belief about teaching was teacher-centered however in spring her teaching approach become more student-centered which led students to have control over their own learning. However, in the spring of 2004 the CLES-S and CLES-T scores on Shared Control subcategory was conflicting because while students think they have more control on the learning environment, the teacher think the just opposite (figure 4).

Figure 4: Comparison between Teacher and Student Perceptions of the Teacher's Use of Constructivist Practices



The comparison of CLES-T spring and fall scores with CLES-S spring score (figure 4) indicate that students' perception of teacher's use of constructivist practices is more positive than the teacher's perception of her use of constructivist practices in terms of Personal Relevance (PR) which teaching practices focused on the connectedness of the school to students' out of school experiences, Critical Voice (CV) which teacher practices facilitated student explaining and justifying their newly developing ideas and Student Negotiation (SN) which allowed students to interact verbally with the purpose of building scientific knowledge. Neither teacher nor the students perceived a change in the extent to which teacher practices allowed students to experience the tentativeness of science differed as measured by Scientific Uncertainty (SC) subscale.

On the PTL posttest she responded: "Where possible, I try to allow students choice and opportunity to show creativity and to work in groups."

Before the summer workshop, she tended to rely on the textbook rather than engaging students with questions. However, she wanted her students to go beyond the "cookbook experiments" and to experience to the joy of learning. Ms. Smith's belief on the PTL pretest about the best learning situation for her students was: "I try to have relaxed setting in my classroom. I try to have the students work together, help and support each other….. I try to downplay competitiveness in most situations and to help the students see how it can be win/win instead."

Textbooks can be a good source to start student inquiry, but letting students ask engaging questions encourages them to take ownership of the problem (Hollenbeck, 2003). As the Standards indicate, "when a textbook does not engage students with a question, but begins by assessing an experiment, an essential element of inquiry is missing" (NRC 2000, p.28).

Discussion

During the course of this study, Ms. Smith achieved a deeper understanding of inquiry. It is evident from her final reflection that all facets of the professional development improved in her abilities to teach science as inquiry. Her teaching became more inquiry-focused. She stated:

"I was able to include guided inquiry experiences like the one above throughout the module. In the beginning of the year, I don't think I would have included as many

inquiry experiences that I did without being held accountable through this class. I get so caught up in the everyday rush, especially in the beginning of the year, that even though I thought inquiry was a good idea, I probably wouldn't have followed through because it does take some different planning. As the year progressed, I found that not only was I including the inquiry for the two modules required, but also infusing it in places I had never thought of before.

In conclusion, I probably only made baby steps in infusing inquiry into my classes, but I feel they were necessary for me to grow more comfortable. I have a ways to go: I need to learn how to better give up control and to be more concerned on how the students are assessed. That is an area that I'm still conflicted over because I feel the pull of the standards-based curriculum that I'm held accountable for versus giving more choice to the students. This year has definitely had an impact on my teaching and the students' learning."

Qualitative and quantitative assessments were applied to data from the ICPDP workshop to determine whether or not significant change took place in this one teacher's understanding of inquiry. After the two workshops, there were highly positive changes concerning her beliefs about inquiry. Positive changes to beliefs were supported data from CLES and ESTEEM. Looking into the classroom through a new lens, helped this teacher to recognize her traditional views of teaching practices which were largely driven by wanting to make a difference for her students.

The researcher of this study believes that teachers have an essential role in making inquiry teaching successful. When teachers know what they want students to demonstrate, they can better help them learn real science. Teachers can encourage students to think about possible explanations of their own ideas. Teachers should be a guide for students. There is often a positive correlation between an inquiry method and teacher philosophy. This means that when teachers are highly qualified in terms of understanding the basic science, the inquiry method can be used successfully. As teachers become more confident with inquiry, they are able to share their teaching and learning experiences with our students.

The study provide a change in a teacher view and practices after experiencing the ICPD program as well as assessing the value of inquiry teaching methods based on constructivist teaching method based on constructivist learning theory. As indicated by Anderson (2002)"Even though teachers need to learn how to teach constructively,

acquire new assessment competencies, learn new teaching roles, learn how to put students in new roles and foster new forms of student work, the task of preparing teachers for inquiry teaching includes much more." (p.8)

Conclusions

Many teachers have difficulty teaching science by inquiry because they were not taught this way nor were exposed to it in their preparation to become teachers (Kleine et al, 2002).

Ms. Smith's goal was to create a classroom environment that helped students to have ownership of the problem and develop their skills to conduct scientific inquiry. This was directly opposite of her traditional classroom model in which she presented information and expected her students to memorize the information and do cookbook experiments. After the ICPDP she succeeded in needing her goals.

The results of the study show that the teacher often has problems with implementing more inquiry teaching. Major ones include:

1. There is a great gap between the teacher's common knowledge and their common practices.
2. There is a need for more experience with inquiry teaching and learning approaches.
3. Seeking students' participation.
4. Problems on engaging students.
5. Management issues.
6. Time constraints and lack of teaching practice made inquiry teaching difficult to implement for this teacher regardless of her previous experiences

To achieve inquiry teaching, teachers need to feel secure enough about their own knowledge to help their students learn. The Iowa Chautauqua Science Program offered this teacher an opportunity to achieve and to learn how she can work with her students with an inquiry approach.

Ms. Smith's main problem was a gap between her common perception of teaching and learning and her common practices. Lawson (2000) argues that, "Developing the needed teaching skills takes considerable practice and commitment. But once those

skills have been acquired, the inquiry classroom becomes a very exciting and rewarding place and the thinking skills that students acquire can be used far beyond the confines of that classroom." (p.7)

Ms. Smith needs more experience in using inquiry methods in her classroom. The Iowa Chautauqua Program helped her to increase her confidence in teaching science, and her understanding and use of the basic features of inquiry. She's on her way!

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