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# Reflection on the Iowa Chautauqua Program as a Science Teacher Inservice Model

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**Abstract:** The Iowa Chautauqua Program has provided effective staff development for over 2,700 K-12 science teachers during the past two decades. This is a review of the features of the program, its instructional staff, and a description of the outcomes as disclosed from evaluative studies conducted by staff, teacher participants, doctoral students, and outside evaluators. Examples of outcomes are included as revealed from the qualitative studies reported in newsletters, published papers, dissertations, annual staff reports, and evidences of success reported to accrediting groups. The Chautauqua stresses student-centeredness, constructivist learning, and the visions of reform featured in the National Science Education Standards.

Keywords : professional development, Iowa Chautauqua Program, constructivist learning model, student-centeredness

## Needs for Reflection of the ICP Experiences

In consideration of teachers as central to science education, professional development is indispensable in determining the success of science education reform. It is obvious that science teachers need to be life-long learners because science and society have been rapidly changing and therefore students have been exposed to greater variety in their experiential world. Moreover, the focus of science learning in the new century shifts from passive acquisition of facts and routines to the active application of ideas in a real world context (Yager, 2000). Science teachers in such an environment must be active practitioners who develop knowledge and skills through the professional learning experiences and utilizing them in their own classrooms. Also, if classroom reform is to become a reality, teachers must be given ongoing feedback, encouragement, and support so that they can recognize their own changes as they implement new standards-based materials.

The *Iowa Chautauqua Program* (ICP) has been recognized as an excellent model for providing such professional development opportunities for inservice science teachers. Since its inception in 1983, the ICP has served over 2,700 K-12 science teachers and succeeded in reforming hundreds of science classrooms. A number of studies have revealed that the ICP has been successful in enhancing science teaching practices and improving student performance in important domains of science learning (Blunck, 1993; Iskandar, 1991; Liu, 1992; Lu, 1993; Mackinnu, 1991; Yager et al., 1992; Zehr, 1991). The ICP has also been introduced to over 300 Korean science teachers through adopting this model in the overseas training program executed by the Science Education Center at the University of Iowa with a sponsorship from the Korean Government. When it was attempted to develop the Korean program using the key features of the ICP, four-week long summer workshop and follow-up efforts were included: that is, the summer workshop has been followed by classroom-based research projects based upon teacher self-selction (for example, Lee, 2001; Shin, 2000). Although it can be hardly said that the summer workshop for Korean teachers represents the entire features of the ICP, the follow-up efforts with the teachers were considered a vital component of the Korean program.

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This article provides reflection of past experiences with the ICP as a basis of future efforts for inservice teacher programs. In what follows, the features of the ICP are explored before referring exemplary cases of teaching practices in the Chautauqua science classrooms. Then, some principles for science teacher professional development are proposed, which could be used to develop effective programs for inservice science teachers in Korea.

## Procedural Features of the ICP

The ICP consists of intense and continuing efforts over multiple years. The annual sequence of activities includes the following:

1. A two-week leadership workshop for lead teachers, curriculum developers, and area scientists, who become a part of the instructional team for a workshop involving teachers who are interested in current reform efforts
2. A three-week summer workshop, where the participants learn about the research on how people learn, innovative teaching methods, and new assessment procedure. After these considerations, the enrolled teachers plan a five-day module for use with their own students in the fall that illustrate the visions discussed and analyzed.
3. Teaching the five-day module soon after schools open in the fall
4. A three-day fall short course, which focuses on reviewing the experiences with the five-day module, while also developing a month-long module with extensive assessments planned
5. A series of interim communications, which include newsletters, special memoranda, monthly telephone contacts and school/classroom visits by lead teachers and regional staff
6. A three-day spring short course, where the participants report on their experiences and the results of the assessments concerning their month-long experiences with the new module

A vital part of the ICP is involvement of lead teachers as a part of the instructional team. When the program began, two experienced and enthusiastic teachers were chosen for the instructional staff. As the program was completed each year, those who were most successful in changing their own teaching practices and improving their science classrooms were invited to join the lead teacher group. It was their task to enroll for the leadership workshop and to prepare for handling the instruction with new teachers and to help their colleagues with continuous reform efforts. Thus, the Chautauqua lead teachers assume important roles for moving science education reform efforts to local teachers and establishing collaboration among science teachers. Often reports of the lead teachers concerning their successes with the ICP resulted in numerous calls for offering workshops and other forms for involving them in their own districts and beyond.

The ICP is an example where new curriculum modules serve as a powerful professional development opportunity for teachers. The three-week summer workshop is a time when incoming teachers experience the new approaches to science curriculum and the instructional strategies that they are expected to try during the academic year. Modules, which are templates and suggestions that are completed during the actual teaching and learning, are the major products of the summer workshop. The teachers develop five-day modules and try them in the fall before returning for the three-day short course. The fall short course provides teachers with opportunities to discuss successes and failures with the five-day modules and to develop improved modules and assessment plans for long-term applications. The spring short course is a time for sharing experiences with long-term application of modules, analyzing the assessment results, and planning for even more extensive changes as a result of future workshop series.

It should be noted that the ICP is a multiple-year project and operates on a continuing basis. The annual sequence of events is recycled every year as more science teachers are involved. This continuing nature of the ICP allows for ongoing support for teachers so that their classroom reform efforts can bear fruits. Few other inservice models have been developed to the extent that the ICP has. The majority of inservice programs are structured as one-shot or short-lived experiences that do not support the specific needs of the teachers. While providing motivation, constructive criticism, exemplars of science teaching and learning, and new curriculum materials, the ICP addresses science teachers concerns about classroom improvements which usually occur slowly and unevenly. The ongoing support from the ICP for science teachers also encourages collaboration with action research projects, involving central staff, lead teachers, and fellow participants. Actually much of the data supporting the ICP comes from the action research projects conducted within the classrooms of Chautauqua teachers.

## Changes in Chautauqua Classrooms: Key Features of the ICP

At the core of the ICP is the STS/Constructivist approach to science teaching and learning. STS has been defined as "the teaching and learning of science and technology in the context of human experience" (National Science Teachers Association, 1993, p.3). Among others in this definition, the centrality of *learning* and the focus on *context* are the most important concepts (Yager, 1995a). These two concepts lead to consideration of STS as an instructional approach that facilitates student learning in line with constructivism, which in turn emphasizes learning as driven by learners active participation and as situated in an authentic context (Lutz, 1996; Yager, 1995a).

It was evident that STS/Constructivist approach was employed in the Chautauqua classrooms when both formal and informal documents produced during the ICP sequences were examined. These documents included the official newsletter called *Chautauqua Notes*, Chautauqua assessment handbooks and evaluative reports, Ph. D. dissertations focusing on the impact of the ICP, videotapes illustrating the impact of the Chautauqua program on teachers, and anecdotal reports from the Chautauqua teachers. The characteristics of the STS/Constructivist approach and qualitative descriptions of what happened in the Chautauqua classrooms can be used as sources to learn what aspects of the Chautauqua classroom contributed to science teaching/learning improvements.

Several researches have identified the features of Chautauqua classrooms where STS/Constructivist approach are employed. Tweed (1987) found characteristics that applied to most Chautauqua classrooms by comparing classrooms before and after using an STS/Constructivist approach for science teaching and learning. As a part of his research on the effectiveness of the ICP, Liu (1992) examined practices observed in STS/Constructivist classrooms and characterized the teaching behaviors of Chautauqua teachers. Yutakom (1997) produced a set of STS/Constructivist teaching behaviors through the study of the congruence between teacher perceptions about STS/Constructivist and the associated teaching behaviors exhibited in their science classrooms. More recently, Kimble (1999) conducted an observation of STS/Constructivists classrooms taught by eight exemplary teachers who were leaders in the ICP over a five-year period.

The characteristics of the STS/Constructivist approach that the former researchers have identified can be grouped into three categories, which are: (1) student-centeredness, (2) relevancy, and (3) variety. These three categorizations will be considered in the following sections. They are offered as models for teachers to adopt or adapt in their own classrooms as reforms are sought.

### Student-centeredness

One of the interesting findings in Tweeds study, *Classroom Characteristics Before/After* (Tweed, 1987) is a change in the teachers verbal behavior: In the before-Chautauqua classroom the teachers felt uncomfortable when saying, "I dont know." Usually the teacher was regarded as an expert and engaged in "spoon-feeding" information to students. But in the after-Chautauqua classroom the teacher often stated, "I dont know!" or "Lets find out," which allowed students to design and carry out their own research.

Such a change in the teachers verbal behavior is strong evidence for the student-centered nature of the Chautauqua classroom. Other student-centered characteristics of Chautauqua classrooms were also identified in follow-up studies (Kimble, 1999; Liu, 1992; Yutakom, 1997). Those characteristics and some examples are:

- Students are encouraged to identify their problems and use their ideas to drive lesson. For example, an eighth-grader came to science class with a problem that his family was unable to drink their tap water. This problem caused the class to start a study on water quality (for detail, see Yager, 1995b).
- The teacher changes the curriculum to utilize students present understanding. In a Chautauqua classroom, a short interview, pre-concept map and five topic-related questions were used for the teacher to learn about what the students did or did not know, what they would like to know, or just things on which they need more information (for detail, see Stuekerjuergen, 1995).
- Students are allowed adequate time for their expressions and the teacher accepts a variety of student responses. One of the lead teachers waited 3.8 seconds per question before proceeding to other materials. And he frequently acknowledged and clarified students ideas, and gave feedback without judging whether and who were right or wrong (Yutakom, 1997).
- Students are encouraged to engage in student-student verbal interactions and the teacher also works with students about the processes used/needed for their activities. As students are involved in their own investigations on many occasions, the amount of time the teacher spent at the front of the classroom providing information decreased (Liu, 1992).

The ICP with STS/Constructivist approach at its core seeks to increase student ownership in their own learning to satisfy this condition. As a consequence of taking ownership for science learning, students are expected to attain more positive learning outcomes.

### Relevancy

In the Chautauqua classrooms new learning starts with a real issue in everyday life. In other words, the Chautauqua classroom starts with issues and concerns which means establishing relevancy for science lessons to student everyday living. Here is a teachers story about relevancy of the Chautauqua science class to students as well as about its student-centered nature:

I began the year sure that I could interest most of the students in an issue dealing with water quality. We decided to take a small group of students to a cold water stream to do some measurements that coincided with an ongoing DNR study. ... As we traveled to the study site we passed several farms that gave off the pungent odor of Iowas number one livestock product: pork. The students immediately asked the questions that had been in the news all summer.

"Cant something be done to stop the smell?", "What does the feedlot run-off do to the environment?", "My relatives ... are worried about the smell and about the water pollution. Should they be?", "Is anybody trying to figure out how to solve some of these problems?"

... The students were, as usual, verbally exploring several issues related to farm waste management, any one of which would make a good investigation. ... In order to begin our investigations we had to refine our ideas to a set of questions that could be addressed through information searches, interviews, or experiments (Crandall and Lutz, 1994).

After that, the students proceeded to conduct several investigations, including library searches, field surveys, personal interviews, water testing experiments, and community visits. These activities led students to discovery of one important aspect of science: every question generates new questions, and every issue has more than one solution. The class ended with the students multi-media presentations of their research and with other useful products such as a video slide show, a resource list, and charts and graphs of data.

Thus, the Chautauqua classroom activities are often initiated by the issues relevant to the out-of-school lives of students. The classroom also addresses current societal issues related to science and technology. It was evident when examining the long lists of topics for the modules completed in the classrooms. Interesting topics compromising the Chautauqua modules included: "Seat Belt Science" (force and dynamics), "Plants Pass Acid Test" (acid rain and water pollution), "Garbage Party" (conservation of resources), "Toilet Paper" (the effects of commercial toilet tissues on water flow and pollution), and "Water, Water Everywhere". The relevancy of the Chautauqua science class, when it is associated with its student-centered features, is believed to have a synergistic effect in changing student perceptions concerning academic achievement in more positive directions.

Furthermore, the Chautauqua classroom pursues a long-term relevancy. When interviewed, the teachers proposed that students, after leaving school, would be able to apply their knowledge and skills in their daily lives. They wanted their students to be life-long learners and responsible citizens. To achieve these long-term goals, they provided students with opportunities to apply what they learned with everyday challenges; they created situations to increase career awareness related to science and technology; they motivated students to take actions that illustrated exemplary citizenship roles (Kimble, 1999; Yutakom, 1997). They often involved students from previous years with new students and their questions and activities. Learning becomes more collaborative and extends to people and situations beyond the single classroom.

### Variety

The student-centeredness and relevancy of the Chautauqua classroom dictates a variety of teaching and learning methods, including authentic assessments. First of all, "the text becomes less of a crutch and more of a resource" (Tweed, 1987). It means that in the Chautauqua classroom the teachers became less dependent on textbooks and often followed student-oriented ideas with supplemental use of printed materials. Consequently, various teaching and learning methods replaced the role traditionally occupied by science textbooks. Kimble (1999) reported that teacher questioning, student writing and drawing, student oral presentations, small group work, and whole class discussions are among the most frequently employed methods used by the Chautauqua teachers. Concerning curriculum resources, outside the school resources such as parents, scientists, and other experts in the local community as well as science-related institutions were used extensively. The Chautauqua teachers also provided opportunities for students to gain information through various techniques, including interviews, surveys, media, and technology.

One of the Chautauqua lead teachers described the merit of the variety of teaching and learning methods as follows:

Variety in teaching strategies may offer the low-ability students a better means of understanding, or communicating concepts in the classroom. It also provides opportunities for students who are gifted/talented or highly-motivated in specific areas to come closer to reaching their potential, not only in science, but in other discipline as well. ... Variety in teaching strategies also creates a more positive and active atmosphere in the classroom. ... we are always searching for the best and most effective methods of helping students learn (Masters, 1988).

The ICP encourages the teachers to assess student competence and performance in many areas that include extension of the curriculum in concept, process, creativity, attitude, application, and world-view domains. This illustrates another aspect of variety of assessment that the Chautauqua teachers pursue. Such extension demands variation in assessment strategies and assessment tends to be more integrated into daily instruction. Yutakom (1997) reported that approximately 75 to 80 percent of the teachers used student designed assessment tools as well as journals and anecdotal records in STS/Constructivist classroom. Other assessment tools used in Chautauqua classrooms include daily-based observations and weekly records of student presentations, projects, rubrics, and concept maps to show relationships and connections. The Chautauqua teachers also use self-evaluation to improve their teaching, including audio and video taping of lessons and peer evaluation of such records (Yager and Liu, 1995).

Another aspect of the variety of assessments in the Chautauqua classrooms lies in the way teachers use assessment results. Here is an example of how one Chautauqua teacher used assessment for science teaching and learning.

My sixth grade students ... are trying to view assessment as a celebration. Rather than focusing on what we dont know, we are using pretest and posttest information to find out how much we have grown. ... Pre-assessment will tell us what a student can or cannot do and allow the teacher to set goals for the instruction. The post assessment is a celebration for both teachers and students as they note growth in student understanding. Recognizing how a students idea have changed and improved is exciting. Students get excited when they realize their successes, and teachers get excited when they realize their goals have been achieved. (Dunkel, 1993)

Thus, assessment in the Chautauqua classroom is used to provide the basis for improvement of science teaching and learning, and also provides evidence that students have learned more than is observed or measured in traditional classrooms.

To sum up, the characteristics of the Chautauqua classrooms which have been described are interrelated: Student-centeredness brings relevancy, both of which entail use of varied strategies in teaching, learning, and assessment. Such related features of the most successful Chautauqua classrooms are offered as evidence for positive gains for the students in the Chautauqua classrooms.

## Platform for Future Science Teacher Inservice Program

We have discussed the feature of the ICP and the exemplary models of STS/Constructivist practices. Through this reflection on past experiences with the ICP, four major points with concerns of successful inservice model may be of interest to other science educators.

First, leadership development is essential to diffuse science education reform efforts to many local and individual classrooms. The training workshop for the lead teachers and their identification as significant partners in the instruction enabled the ICP to promote the formation of a growing network among teachers who are interested in science classroom reforms. Recently peer coaching and mentoring processes are receiving more attention as promising ways to promote teacher development and classroom improvement. Such teachers as the Chautauqua lead teachers are those who developed the unique knowledge and skills of science teaching throughout their careers. Therefore, playing the roles of peer teacher, role model, counselor, and sponsor, they develop successful mentorship programs in their communities and schools. Such leadership is especially beneficial for beginning science teachers, who usually begin their teaching career with the feeling of being unprepared and alone.

Second, science teachers can best learn through actual examples from practice. Teacher inservice programs must honor the knowledge of the practicing teacher as well as draw on research and other sources of expertise outside of schools and classrooms (Loucks-Horsley *et al.*, 1998). Consistent with this notion, the ICP has collected examples of actual practices in the format with both videotapes and written documents which can be used for teacher reflection. Some examples of these materials were used in the preparation of previous sections of this report. Such examples illustrate how the STS/Constructivist approach can be achieved in real science classrooms and provide vivid information for teachers to translate and use in their own classrooms. The curriculum modules developed by the Chautauqua teachers can also serve as exemplary models of STS/Constructivist instruction.

Third, professional development programs for teachers should ultimately affect student learning. In most cases evaluation of inservice is accomplished by questionnaires at the end of instruction. Therefore, any changes are self-reported ones provided by the teachers enrolled at the close of a single instructional sequence. Although most of these evaluations are positive, there is no information concerning the longevity of change in teaching and the ultimate affect on student learning. There is no doubt that educational reform aims ultimately for improvement of student achievement. Thus, teacher inservice programs should be developed to bring positive gains not only to teachers but also to students.

Lastly, the experiences with the Chautauqua teachers revealed that teacher development and classroom improvement are slow processes and that collaborative action research as well as continuous communication is needed if real progress is to be made. Action research is regarded as a major form of professional development and is now seen as central to the restructuring of schools (Holly, 1991). Of course, the types of action research, the problems to be solved, and the strategies to be employed may vary depending on individual classroom situations. However, the nature of action research cannot undermine the necessity of implementing it. Rather it is important that teacher and students actually do something to improve their classrooms in a mutually supportive environment.

At the same time with provision of these key principles of science teacher education program, the ICP is stepping forward to the next step. It includes international application of the Chautauqua inservice model. The Iowa workshops for Korean science teachers, which have been held for the last eight years, have further proven the effectiveness of the Chautauqua model. Similar classroom changes as described in this report have been found in Korean earth science classrooms of five teachers who participated in Shins research (for example, see Yager, 2001 and Shin, 2000). It is now apparent that future inservice program needs to focus on active preparation of a group of mentor teachers to assist preservice and new teachers in collaborative efforts in a long term period rather than one short event. The ICP provides a vision for needed directions. Now it is time to get it underway. Achieving a future that characterizes current reforms will be closer to reality if more Chautauqua-like efforts are initiated.

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