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Improving Student Attitudes Regarding Their Science Experiences in Upper Elementary Grade Levels

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Abstract

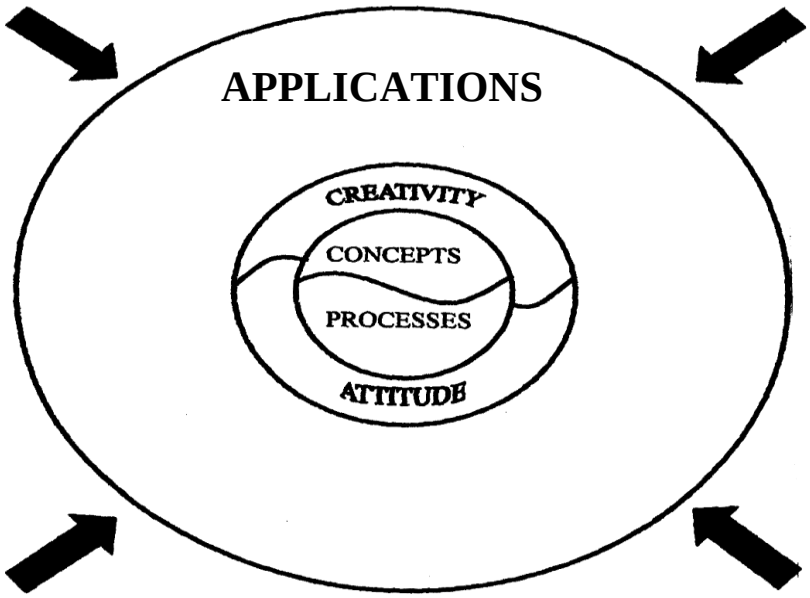
Chautauqua workshops have been hosted at the University of Iowa for over thirty years. One of the major efforts have been the use of *process skills* as a feature of a year-long effort. Successes with Chautauqua teachers have been extremely effective, especially for upper elementary and middle school students. As a year-long action, the Chautauqua efforts begin with Concepts and Process skills. This research illustrates the impact of Chautauqua teaching compared to typical classroom teaching. The data collected indicated a significantly higher percentage of students developing more Positive Attitudes towards science when taught by Chautauqua teachers. Science teaching was enhanced with a focus on Processes over one on Concepts.

Keywords: process skills, improving student attitudes, domains

McCormack and Yager (1989) proposed six domains for evaluating K-12 science teaching. The domains indicate varied goals and foci for science teaching that affect assessment of student learning. The "membrane" around the bull's eye in Figure 1 is where major efforts should be concentrated. The two enabling domains are developing more positive attitudes regarding science and increased personal creativity. However, the largest domain where most people live, work, and learn is the Application domain. This domain results in students actually using science Concepts and Process skills in their daily lives. The sixth domain is labeled Worldview which is defined as the philosophical, societal, and historical dimensions of the scientific (and technological) enterprises. Improving student attitudes in science in elementary schools was one of the enabling domains central to this research. Research showed that student attitudes decline for most students as they progress in school (Cho, 2002; Mbajiorgu & Ali, 2003).

Science C*oncepts* and P*rocess* skills are the "bulls-eye" where most start and stop when trying to improve science teaching. *Attitude* and C*reativit*y are the two enabling domains which

indicate what teachers need to do to encourage students to be curious, to be creative, and to understand the natural world.



WORLD VIEW

Concept Domain
Process Domain
The typical focus for traditional teaching (i.e., basic science concepts and skills)

Creativity Domain
Attitude Domain
The two enabling domains (i.e., questioning & personal engagement)

Application Domain → Using concepts and processes in new contexts (i.e. living in the whole world with use of science as defined by NSES; where most people live and operate when not engaged with science directly)

Worldview Domain → Examining the philosophy, history, and sociology of the whole science enterprise (i.e., observing science as it operates as a specialized human activity)

Figure 1. Display of the interactions of the six domains of science for teaching reform and assessment of student learning.

The Iowa Chautauqua program was unique in that it aimed to improve K-12 science learning by broadening teacher views concerning the nature of science and technology. It remains a program aimed at improving student learning and the actual "doing" of science instead of students merely remembering information included in textbooks, laboratory manuals, and teacher lectures. Such "doing" of science involves the Exploration of the natural world, seeking Explanations of objects and events encountered, and including Evidence for the explanations proposed (NSTA, 2013).

The Iowa Chautauqua Professional Development Programs were originally developed and implemented for college science teachers. They were funded by the National Science

Foundation (NSF) and offered by the American Association for the Advancement of Science (AAAS, 1963, 1965). It provided a model for updating science content as well as learning achieved by college science teachers. The model continues to indicate the needed changes in teaching in K-16 situations in Iowa and beyond while also assessing success with student learning.

The Chautauqua experiences were unique and consisted of year-long efforts to replace the typical professional development programs often meeting for two or three weeks or as many as four during the summer. The Iowa Chautauqua efforts often occurred as a single experience for two or three weeks in the summer followed by fall and spring short courses to discuss changes planned at the summer workshops. The staff included experienced Lead Teachers for given sites across the State. As a rule with Professional Development Programs there are no follow-up efforts done to learn what changes actually occur in classrooms following workshop efforts. Activities were planned for use with teachers and students when classes began in the fall of the year. Research results indicated the specific features of the most successful changes in terms of both teacher preparation and ways of continuing the work with enrolled in-service teachers.

The Iowa Chautauqua Programs were successful because of major NSF funding over a period of many years. Funds were used to support staff members and teacher enrollees involved with the Chautauqua Program. The staff members were dedicated to improving science teaching and student learning involving all six domains. Just as the Iowa Chautauqua programs were funded by NSF, another program called Science: A Process Approach (SAPA) was also funded by NSF (1963-83). SAPA provided a way of defining successes (as well as failures) with evidence for improving student learning. The science process skills identified by SAPA for elementary schools were Observing, Classifying, Measuring, Communicating, Inferring, and Predicting. They were the tools that both scientists and students could use to investigate the world around them and to evaluate the actual personal “doing” of science.

A major uniqueness of the Iowa Chautauqua programs were that they consisted of a year-long series developed and approved by the National Diffusion Network (NDN, 1993). A year-long Chautauqua sequence included three major features: 1) Two or Three Week Summer Workshops in each of the Area Education Agencies (AEA), 2) Three Day Fall Short Courses, and 3) Three Day Spring Short Courses. All three meetings included personal communications among participating teachers. Continuation of communication among teachers was encouraged throughout the whole calendar year and beyond.

The research efforts for this study involved comparing Chautauqua and Control teaching efforts and their impact on student learning. This research involved the same teachers and students over the same academic year at two Chautauqua Sites. The Control teachers were typical teachers who used textbooks, laboratory manuals, and lectures for teaching. They were invited to assist with this research by local AEA staff in Iowa, and were from nearby schools. The original AEAs in Iowa numbered fifteen – but now consist of only nine. The Chautauqua and Control teachers were the same with regard to age, gender, and having at least four years of teaching experience (but no more than ten years). Some years there were as many as five summer workshops at five locations. This research was a study of student differences concerning positive attitudes observed regarding their experiences and involved upper elementary grade level students.

Research Question One

The first research focus for this study dealt with differences in positive attitudes of students in science classrooms. The question proposed was: How do attitudes concerning science in upper elementary grade level students differ?

A Research Panel involving AEA staff members across Iowa was formed to collect and evaluate information concerning science attitudes in student classrooms each year. Each Research Panel consisted of one AEA team leader and at least two other staff members. One of the major responsibilities of this Research Panel was to locate and identify Control teachers who were interested in being a part of this research effort to evaluate student attitudes towards science.

Members of the Research Panel interviewed teachers at each Chautauqua site to locate Control teachers. The Panel members asked teachers to rate student attitudes concerning science using four categories (positive attitudes, some positive attitudes, marginal positive attitudes, and no positive attitudes) to indicate student degrees of positive attitudes about "doing" science. These observations were undertaken soon after the opening of the new academic year (October).

Research Results

Figure 2 reveals responses collected from a random number of upper elementary level teachers at the Chautauqua sites. The teachers were questioned about their perceptions of positive student attitudes concerning science in their classrooms at the end of the first semester (mid-December) using the four categories listed above. The information collected in the fall by the Research Panel was tabulated to indicate positive student attitudes about science in their classrooms. Figure 2 illustrates these findings.

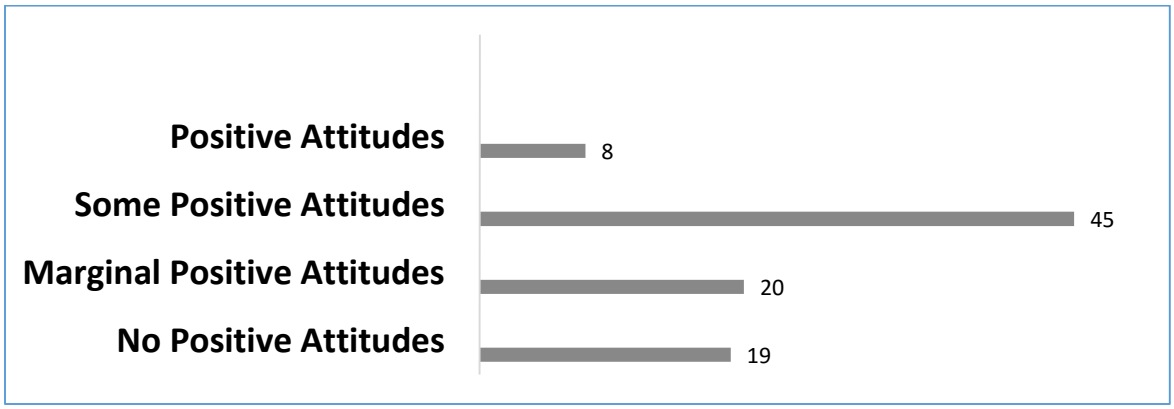


Figure 2. Attitudes of students concerning process skills.

Research Question Two

The second question for this research was: How do student attitudes differ when taught by Chautauqua teachers compared to students taught by Control teachers. The question was designed to indicate differences in student attitudes in upper elementary grade level science classes.

Another larger Research Panel was established to collect data throughout the academic year. This larger Panel consisted of at least four members but sometimes up to ten or twelve. This year-long Panel included the Institute Director, a PhD student with research expertise who assisted with all MS students (for their MS Theses), successful past Teacher Leaders, new Teacher Leaders, and school administrators.

Observations of upper elementary grade level students were conducted by this Research Panel for each Chautauqua site at the end of the academic year (mid-May). The Panel was asked to indicate the differences in student attitudes toward science in terms of science classes, usefulness of science, and how science was taught in Chautauqua classrooms compared with those in Control classrooms. The percentages in Table 1 were calculated from information collected from students at each Chautauqua site during the Spring Short Courses.

Research Results

Table 1 reveals that overall percentages of Chautauqua taught students indicated more positive attitudes towards science, science teachers, and the usefulness of science when compared to Control taught students. Chautauqua students displayed significantly more positive attitudes toward science indicated by the Control taught students at the 0.001 level. As indicated in Table 1, 84% of 165 students enrolled in the Chautauqua classrooms described “science classes as being fun”. This percentage dropped to 38% in Control classrooms involving 83 students. A similar observation was shown for “Science is my favorite course”, 23% in Chautauqua classes, but only 10% in Control classes. A steady decline was observed for the question “science is my least favorite course” with 21% in Control classes and dropping to 7% in Chautauqua classes. The question concerning “science classes are boring” indicated 31% of students in Control classes felt science was boring, but again only 12% in Chautauqua classes indicated science as being boring.

Percentages of student attitudes concerning perceptions of the “usefulness of science” were higher with Chautauqua students when compared to Control students. The data indicated that 80% of Chautauqua students described “science classes as useful” while only 71% of students in Control classes indicated science classes being useful. Percentages of students in Chautauqua classes concerning “science classes makes me more curious” were about three times higher with Chautauqua students at 74% as compared to 25% with Control students. The percentages in terms of “science classes dealt with personal questions” and “science classes help me make decisions” were about twice as high with Chautauqua students at 80% and 63%. However the percentages were 42% and 30% consecutively with Control taught students. Our results with “science teachers admit to not knowing” were three times higher in Chautauqua classes (72%) vs Control classes (25%). When comparing Chautauqua students with Control students concerning “science teacher likes my questions” it was nearly twice as many in the Chautauqua classes at 90% than Control classes at 47%. The overall comparison of Chautauqua teaching and Control teaching indicated that more positive attitudes are found in Chautauqua classrooms.

Table 1

Percentage of Students in Chautauqua and Control Classrooms Regarding Positive Attitudes about Science

	Chautauqua *n*=165	Non-Chautauqua *n*=83	Ƶ	P
Science is my least favorite course	7	21	3.238	0.0006
Science classes deal with personal questions	80	42	6.019	0.0001
Science is my favorite course	23	10	2.480	0.0068
Information from science classes is generally useful	80	71	1.589	0.0559
My science teacher admits to not knowing	72	25	7.041	0.0001
My science teacher likes my questions	90	47	7.441	0.0001
Science classes help me make decisions	63	30	4.908	0.0001
Science classes make me even more curious	74	25	7.368	0.0001
Science classes are boring	12	31	3.647	0.0002
Science classes are fun	84	38	7.366	0.0001

Implications

Chautauqua programs were successful because they were more student-centered and involved observations over a full academic year. Chautauqua teachers encouraged students to initiate something that was personal to them for studying and investigating. When students study personal issues, they become more involved in the “actual doing” of science by Exploring the natural world and seeking Explanations of objects and events encountered. They also offer evidence for their explanations. Students in Chautauqua classrooms challenge each other, as well as themselves, to answer their own questions through their own “exploring.” Students learn to work together. They ask more questions, express personal ideas, and respect ideas of other students. Students become more involved with the “doing” of science. They indicate their liking science more if they focus on actions involving their own interests and problems.

Saturday afternoon sessions were often hosted for students to demonstrate and showcase their use and understanding of the science process skills which they investigated throughout the academic year. The students often demonstrated how science teaching in classrooms taught by Chautauqua teachers were conducted and how such meaning of science could make a difference in student learning. The students were excited to show what they had done in their science classes throughout the academic year. Parents, teachers, school administrators, school board members, community leaders, as well as local media were all invited to attend the sessions and to see first-hand what the students had achieved. The local media representatives were invited to

publicize the accomplishments and learning experiences indicated by students by including photos and student stories.

More positive attitudes were expressed by students concerning science and their interest in exploring other features of the other science domains. All six "domains" of science represent facets which can also be used to reform science teaching, student assessment, and science content. Concepts and Process Skills are what most scientists know and do. They represent a very small fraction of the human population (0.000059%) of the whole world (Hurd, 1991). Very few teachers have ever experienced real "doing" of science themselves. If we are to achieve real student learning, we need to consider all six science domains. It is obvious that when the science process skills indicated student successes the other science domains are also successful. The concept and process domains are seen as traditional teaching while creativity and attitude domains are the two enabling domains. The application domain allows using concepts and processes in new contexts and the worldview domain involves the examining of philosophy, history, and sociology of the whole science enterprise. We need science teaching to focus on all six science domains not just skills developing more positive attitudes. But, it is important for all to be involved in science learning.

Conclusions

This research indicated that there were significant differences regarding positive attitudes between Chautauqua taught students when compared to those taught with traditional methods. This research indicated that Chautauqua teachers improve their students attitudes toward science by providing more minds-on activities, providing more student-relevant topics that encourage student involvement, using more cooperative learning activities to promote student-to-student interactions, focusing on positive and supportive communication with students, providing an organized classroom setting, and diversifying their teaching strategies. This type of teaching encourages students to become more interested and more motivated in their study of science. Chautauqua taught students are more inclined to ask more unique questions frequently involving their personal interests which help them make decisions in their lives. Students taught in Chautauqua classrooms express personal feelings in constructive ways and are encouraged to make decisions about personal values involving social and environmental issues. Further evidence suggests that student attitudes toward science are shaped at schools which are influenced by classroom factors such as a "given" curriculum, peer influences, and teachers being in charge of the classrooms. A focus on process skills increases successes in other domains – including Concepts, Processes, Creativity, Attitude, Applications, and Worldview.

References

American Association for the Advancement of Science (AAAS). (1963). AAAS *science: A process approach records*. Washington, DC: AAAS Archives and Records Center. Retrieved from archives@aaas.org

American Association for the Advancement of Science (AAAS). (1965). *The psychological bases of Science—A Process Approach (SAPA)*. This document is available as AAAS Miscellaneous Publication 65-8, Washington, DC.

Cho, J. (2002). The development of an alternative in-service programme for Korean science teachers with an emphasis on science-technology-society. *International Journal of Science Education, 24*(10), 1021-1035.

Hurd, P. DeH. (1991). Why we must transform science education. *Educational Leadership, 49*(2), 33-35.

Mbajiorgu, N. M., & Ali, A. (2003). Relationship between STS approach, scientific literacy, and achievement in biology. *Science Education, 87*(1), 31-39.

McCormack, A. J., & Yager, R. E. (1989). A new taxonomy of science education. *The Science Teacher, 56*(2), 47-48.

National Diffusion Network (NDN). (1993). *Developer demonstration program. The Iowa Chautauqua program* (Unpublished final report). U.S. Department of Education, Science Education Center, University of Iowa, Iowa City, IA.

National Science Teachers Association (2013-14). NSTA position statement. *NSTA Handbook* (pp. 227-229). Arlington, VA: NSTA Press.