

PERCEPTION OF AGRICULTURE AS A CONTEXT FOR ELEMENTARY SCIENCE TEACHING:
A CASE OF CHANGE IN SANILAC COUNTY, MICHIGAN

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Abstract

Agricultural educators advocate promotion of agricultural literacy among U.S. citizens. Many argue for the infusion of agricultural examples into the science curricula as a means to inform school children about agriculture and to bring a real-world context to science instruction. The W.K. Kellogg Foundation funded a three year county-wide program in Sanilac County, Michigan designed to improve both science and agriculture literacy. This study sought the perceptions of elementary school teachers and principals relative to the use of agriculture as a context for science instruction. Data were collected from all the county's kindergarten through sixth grade teachers and elementary school principals. Baseline data were gathered in May 1992. Three years later, after the educational intervention, program impact data were collected. May 1992 findings showed that principals held very positive perceptions with regard to teaching science through agricultural examples, while teachers held lower perceptions. In May 1995 teacher perceptions of agriculture were more favorable and their comfort with teaching science through agricultural themes increased. The study suggests that non-traditional programs should be developed at the elementary school level to educate students about food, agriculture and renewable resources.

For over a decade calls have sounded to educate a larger audience about agriculture and the human food system. Mawby (1985), one of the first, suggested that "few issues are of greater importance to the world than adequate food supplies, proper food use, and knowledge about the components of the agricultural industry" (p.7). Since the late 1980's, educators have advocated for the integration of agricultural concepts into the elementary school science curriculum (National Research Council, 1988; Trexler and Miller, 1992; Leising and Zilbert, 1994; Birkenholz, Frick Gardner, and Machtmes, 1994; Frick, Birkenholz, and Machtmes, 1995). The National Research Council (1988) coined the term "agricultural literacy" and suggested agriculture too important to be taught to only those in vocational education. It urged that more agriculture be taught in the country's schools. The Council suggested in many elementary schools "the most realistic way to teach science through agriculture is to introduce modules, or units of instruction that supplement

and eventually replace existing curricula and textbooks" (p. 13).

Concomitant to agricultural education's move toward re-defining its audience, the American Association for the Advancement of Science (AAAS) cried out for increased science literacy. The association argued that "the boundaries between traditional subjects should be softened and more emphasis placed on the connections among the science disciplines, and science, technology, and society" (AAAS, 1989, p. 5). Practitioners began to explore ways to broaden science's scope through curriculum integration with agricultural education.

In 1991 the Sanilac County Intermediate School District (SISD), and the seven local school districts it serves, embarked upon a county-wide program to improve both science and agriculture literacy by creating a process of capacity-building and curriculum development. Grant proposals

were written to carry out their plan . SISD submitted a proposal to the W. K. Kellogg Foundation and received three years funding beginning in February 1992.

Fishbein and Ajzen's (1975) work in determining intentions to participate set the study's theoretical framework. They argued that participant knowledge, observation, or other information about an issue could predict intention to participate. This suggested teachers' intent to participate in or principals' intent to facilitate an elementary agriscience program could be predicted by analyzing his/her beliefs about agriculture and science. Greenwald (1989) supported this theory, reporting that individuals with positive attitudes toward a subject or situation tend to evaluate them positively.

This research initially sought to identify areas where program leaders should direct resources to enhance adoption of a curricular change . The United States Department of Education (1994) identified teachers and principals as the primary change agents in science education and suggested that principals shape the organizational conditions necessary for success in the implementation of change. In agricultural education, (Terry,, Herring, and Larke, (1992); Humphrey, Stewart, and Linhardt, (1994) found preservice and inservice teachers in Texas and Missouri respectively, possessed low levels of agricultural content knowledge. This is particularly salient in light of Hashew's (1986) finding that prior teacher knowledge of subject matter contributed to the transformation of written curriculum into classroom use.

This study's conceptual model emphasized the need to provide teachers and principals with support in both agricultural and science education simultaneously, as comfort in both areas influence adoption of a curriculum innovation in agriscience. Change within a system, such as the adoption of an agriscience curriculum innovation, causes discomfort in individuals as traditional curriculum

and teaching practices are replaced (Marris, 1974). Hart and Rottom (1990) suggest curriculum and professional development need to be regarded as interactive elements of the same reform process. Tobin (1995) suggests helping teachers foster ownership for a curricular change through a needs study that involves self-reflection on current practice.

Purpose and Objectives

The study's purpose was twofold. First, it sought the perceptions of teachers and principals relative to agriculture as a context for science instruction. And second, the study attempted to determine how an elementary agriscience curriculum development program affects perceptions about teaching State-mandated science competencies through the context of food, agriculture, and the environment. Initially, data were collected to assist program leaders set priorities for the teacher and principal capacity-building activities. After three years of intervention, teachers and principals were again surveyed to determine the program's impact. The specific research objectives were to:

1. determine elementary teachers' and principals' perceptions relative to agriculture and science as topics for instruction and, more generally, their perceptions about these fields on a broader level prior the inception of the program.
2. describe differences, prior to the program, between teachers and principals perceptions about agriculture and teaching science through agricultural examples.
3. determine the perceived level of teacher comfort with teaching the science of agriculture.
4. determine the needs to implement an agriculturally-based science curriculum.

5. describe the elementary program's affects on teacher and principal perceptions about teaching science through an agricultural context.

Methodology

Population

This study was conducted in Sanilac County, Michigan. The population for this study included all Sanilac County kindergarten-sixth grade teachers (N=161) and principals (N=15).

Instrumentation

This study utilized a one-group pretest-posttest design (Cook and Campbell, 1979). Data were collected via survey questionnaires. The data collection instruments consisted of self-administered questionnaires with both closed and open-ended questions. Staff members in the Department of Agricultural and Extension Education at Michigan State University and SISD staff validated the instruments. Questionnaires took no more than 10 minutes to complete; their relative simplicity was intentional given that a similar instrument was administered to fifth grade students in the program. A five-point Likert-type scale, with 1=never, 2=rarely, 3=sometimes, 4=usually, and 5=always, was used to measure perceptions and attitudes. To ensure usability and reliability, the instruments were field-tested in an adjoining county's schools by twelve teachers and twelve principals. A Cronbach's alpha of (.88) and (.85) was determined for scales pertaining to perceptions about agriculture and science, respectively.

Data Collection

In April 1992, prior to the program's onset, principals were contacted to assist with survey distribution. Project staff hand delivered the questionnaires to principals. Principals then dispersed the surveys to teachers along with a

cover letter explaining the importance of the survey, guaranteeing confidentiality, and appealing for prompt response. Teachers and principals returned their surveys via inter-county school mail to the researchers. By May 1992 survey from 147 teachers (91% response rate) and 12 principals (80% response rate) were received.

In April 1995, after three years of treatment, the researchers followed a similar protocol to collect data and to determine the program's impact, 146 teachers (91%) and 15 principals (100%) responded to the survey. It should be noted that only six (6) teachers (or less than 4%) retired between 1992 and 1995. Therefore, the study's population remained reasonably constant, allowing for comparison between the 1992 and 1995 groups.

Educational Intervention

The intervention's goal was to create a process for agriscience curriculum development that integrally involved the county's seven school district's elementary teachers. All teachers met in grade level meetings to agree upon core science subjects for infusion into agricultural themes. After these meetings, the program's curriculum writer aligned agricultural themes with Michigan's science curriculum standards, ensuring inclusion of essential science concepts. With this framework, lead teachers and the program's curriculum writer found agriculture and science literacy materials for inclusion into the new curriculum. Eight-week's worth of materials and lessons were modified, combined into a unit of instruction, and integrated into the context of an agricultural theme. To enhance curriculum use, make adoption less problematic, and promote hands-on learning, the program's aide purchased materials and combined these into kits supporting the curriculum for each teacher in the county. Teachers were then introduced to the curriculum and kits at half-day inservices led by the program's coordinator. After the inservices, the kits were delivered to teachers. Once taught, kits were picked up for

refurbishment and new ones delivered. During the summers, teachers met to revise the curriculum. Forty percent (40%) of the county's teachers met in weeklong summer sessions during the funding period. By project's end, each teacher had four (4) eight-week units and kits of supporting materials for use.

Analysis of Data

All data were analyzed using the SPSS/PC+ computer software program. Frequency counts, percentages, t-tests, means and standard deviations were used to describe findings. Findings from t-tests were used as a decision rule for declaring differences in perceptions between teachers and principals and changes in perceptions between pre and post-test scores. As this study was a census, these statistical tests assisted only in decision making and examining in detail, not for inferential purposes. Qualitative analysis was performed for open-ended questions. Whenever questionnaires contained incomplete items, they were treated as "missing values" and were not counted toward the sample statistics.

Results

Objective One

Objective one sought to determine elementary teachers' and principals' perceptions relative to agriculture and science as topics for instruction and, more generally, their perceptions about these fields on a broader level prior the inception of the program. Teachers and principals believed agricultural jobs "usually" require much education, and that agriculture "usually" includes more than farming (Table 1). They believed that many agricultural jobs "usually" require an understanding of science and that research in science has improved agriculture. School principals indicated a strong support with a mean of 4.17 on a 1 to 5 scale to the statement "science can be taught through agricultural examples", while teachers "sometimes" 2.92 agreed with the

statement. In addition, principals felt that "students 'usually' can solve science-related problems", although teachers thought students only "sometimes" can.

Teachers and principals thought teaching science was "usually" fun and useful in life (Table 2). They believed that scientific activities help people test ideas. Both groups felt that science helps student's develop questioning skills. Respondents thought science is "rarely" boring. They also indicated that science was "usually" one of their favorite subjects to teach. Teachers and principals believed that scientists "sometimes" discover information that is difficult to understand. Teachers stated students can solve science problems "sometimes", while principals thought they "usually" can.

Objective Two

This objective sought to describe differences, prior to the program, between teachers' and principals' perceptions about agriculture and teaching science through agricultural examples. For analysis of these perceptions a composite score was created. The agriculture composite score was calculated based on items a., b., c., and d., while teaching science through agriculture included items e. and f. Findings indicate that principals' mean composite score for agriculture, 4.10 (SD=0.94), was slightly greater than teachers, 4.02 (SD=0.79), while the principals' teaching science through agricultural examples composite was nearly a full point higher 4.0 (SD = 0.59) compared to 3.06 (SD=0.64) for teachers.

Objective Three

The third objective sought to determine perceived level of teacher comfort with teaching the science of agriculture. Teachers perceived themselves as being "usually" comfortable with conducting hands-on science activities and using real-world examples to teach science, with mean

Table 1. Perceptions about Agriculture and Teaching Science through Agriculture

STATEMENTS	Teacher (N=161/147) ^a		Principal (N=15/12)	
	M	SD	M	SD
<u>Agriculture items</u>				
a) Many agricultural jobs require an understanding of science	4.10	0.85	4.25	0.87
b) Research in science has improved agriculture	4.02	1.09	4.33	1.16
c) Agricultural jobs require much education	3.90	1.15	3.75	1.14
d) Agriculture is more than farming	3.90	1.18	4.10	1.17
<u>Teaching science through agriculture</u>				
e) Students can solve science-related problems	3.20	0.89	3.82	0.75
f) I/teachers like to teach science through agricultural examples	2.92	0.88	4.17	0.84

Note. Scale: 1 = Never, 5 = Always

^aPopulation, followed by number responding

Table 2. perceptions about Science and Teaching Science

STATEMENTS	Teacher (N=161/147)		Principal (N=15/12) ^a	
	M	SD	M	SD
Things taught in science are useful in life	3.90	0.80	3.83	0.72
Teaching science is fun	3.86	0.79	3.58	0.79
Teaching science helps develop questioning skills	3.77	0.92	3.83	0.84
Science is one of my favorite subjects to teach	3.56	1.05	4.08	1.08
Scientific activities help people test ideas	3.51	0.87	3.67	0.99
Scientists discover information that is difficult to understand	3.30	0.65	3.33	0.49
Students can solve science problems	3.18	0.71	3.82	0.75
Teaching science is boring for students	2.10	1.02	2.08	0.90

Note. Scale: 1 = Never, 5 = Always

^aPopulation, followed by number responding

scores of 4.05 and 4.07 on a 1 to 5 scale respectively (Table 3). Similarly, teachers were “usually” comfortable using the problem solving method of teaching, connecting science teaching to community problems, and teaching life science, physical science, and earth and space science.

They were “sometimes” comfortable with using agriculture as a context for science and implementing Michigan’s new science objectives.

Principals were asked to rate the comfort level of their teachers in using various scientific

methods (Table 3). In general, principals felt less confident of their teachers' comfort than the teachers themselves. Principals felt teachers were "usually" comfortable conducting hands-on activities, using real-world examples to teach science, and teaching life sciences. They perceived teachers being "sometimes" comfortable using the

problem solving method, connecting science teaching to community problems, using agriculture as a context for science, and implementing Michigan's new science objectives. In addition, they believed teachers were "sometimes" comfortable with physical and earth and space science.

Table 3. Perceived Level of Teacher Comfort with Teaching Science

How comfortable do you/your teachers feel with:	Teacher (N=161/147) ^a		Principal (N=15/12)	
	M	SD	M	SD
Using real-world examples to teach science	4.07	0.85	3.67	0.89
Conducting hands-on science activities	4.05	0.89	3.75	0.97
Teaching life science	3.78	1.00	3.67	0.65
Using the problem solving method of teaching	3.71	0.88	3.33	1.07
Teaching earth and space science	3.70	0.93	3.42	0.79
Connecting science teaching to community problems	3.57	0.96	2.83	0.72
Teaching physical science	3.54	0.97	3.25	0.73
Implementing Michigan's new science objectives	3.37	0.98	3.25	0.75
Using agriculture as a context for science	3.13	0.97	2.92	0.90

Note. Scale: 1 = Never, 5 = Always

^aN=population, followed by number of responding

Objective Four

Objective four pursued the needs to implement an agriculturally based science curriculum. Teachers and principals were asked an open-ended question related to their needs from program staff. Representative statements included the following:

Teachers

"Show me new ways to teach scientific concepts."

"Give me areas to work on and ideas to use at this grade level."

"Gathering and organizing material isn't such a time consuming task"

"Showing how to integrate science into other subjects."

"By designing lesson plans for my students, then gathering materials (no district money for this) showing methods to motivate students whose parents have not valued education."

"A specialist could come in and give students real-life situations."

Principals

"Lesson ideas appropriate for students that will turn them on to learning, problem solving, critical thinking and in doing a good job."

“Putting usable ideas together in units where materials and research has already been done.”

“Gather and organize materials, show how to integrate science in other subject areas.”

“To bring current curriculum to our staff. Support person and provide in-services.”

Objective Five

This objective sought to describe the program’s effect on teachers’ and principals’ perception about teaching science through an agricultural context. Teacher perception changed in two areas related to agriculture and teaching science through agriculture. In 1992, the mean score for “agriculture is more than farming” was 2.85 (SD=1.18), while in 1995 it rose to 3.19 (SD=1.0). Similarly, in 1992 the mean score for “I like to teach science through agricultural examples” was 2.92 (SD=.99), by 1995 agreement

with this statement increased to 3.3 (SD=.80). Teacher comfort with science changed from 1992 to 1995 in four categories (Table 4). These areas included their confidence with implementing Michigan’s new science objectives; using the problem solving method of teaching; using agriculture as a context for science and teaching science.

Principals’ agreement with the statement “teaching science is fun for teachers” changed from 3.58 (SD=.79) in 1992 to 4.13 (SD=.52) in 1995. Principals’ perceptions of teacher comfort changed in two statements. The 1995 mean perception score was higher than in 1992. In 1995, they agreed more strongly with the statement that teachers were comfortable “using agriculture as a context for science,” 3.67 (SD=.90) compared to 2.92 (SD=.90) in 1992. Similarly, in 1995 principals ranked teachers more comfortable with “connecting science teaching to community problems” 3.67 (SD=.72) compared to 2.83 (SD=.72) in 1992.

Table 4. Change in Teachers’ Level of Comfort with Teaching Science

STATEMENTS	1992 (N=161/147)		1995 (N=161/146)	
	M	SD	M	SD
Teaching life science	3.78	1.00	4.11	0.91
Using the problem solving method of teaching	3.71	0.88	3.95	0.91
Implementing Michigan’s new science objectives	3.37	0.98	3.67	0.91
Using agriculture as a context for science	3.13	0.97	3.59	0.93

Note. Scale: 1 = Never, 5 = Always

Conclusions

1. Capacity-building activities to help teachers become comfortable with agriculture are critical in the development of a successful elementary agriscience curriculum.
2. Teachers are aware of the opportunity to

use agriculture as a context for science instruction, but lack understanding of and comfort with agricultural concepts.

3. Teacher comfort with science concepts tends to enhance the use of agriculture as a context for science instruction.
4. Principals and teachers require and request

assistance to model the use of agriculture as a context for science teaching and in the development of materials.

5. A sustained, multi-year capacity-building program, with accompanying support services, enhances teachers' perceptions about agriculture, while decreasing their reluctance to use agricultural themes as a context for teaching at the elementary level.

Recommendations and Implications

Prior to program implementation

Since teaching science through an agricultural context is new to Sanilac County, support systems for teachers and principals are needed as they traverse the path to adoption of curriculum changes. Senge (1990) stresses "resistance to change is neither capricious nor mysterious. It almost always arises from threats to traditional norms and ways of doing things" (p.88). Therefore, efforts to involve principals and teachers in changes concerning programmatic thrusts may reduce resistance to a non-traditional way of teaching. In addition, could be facilitated by employing a resource person(s) with experience in agricultural and elementary science education to serve as a link between the SISD and teachers and principals "ownership".

Given teachers expressed only moderate interest in teaching science through agricultural examples and that principals perceived teachers as being only somewhat comfortable with agriculture as a context for science instruction, it is prudent to heed the observation of Fullan (1982) "educational change depends on what teachers do and think" (p. 107). Provided the lack of teacher knowledge of and comfort with agriculture, it is recommended that a systematic capacity-building process be established. Its goal should be twofold:

- 1) improving teachers' perceptions and 2) increasing their knowledge of agricultural and science concepts. To accomplish this goal, a variety of approaches can be drawn upon: summer institutes in local community settings, guest speakers, quarterly inservices, newsletters, teacher mentoring, teacher curriculum development activities, etc.

End of program funding

Given that the program continues even after the initial funding from the W. K. Kellogg Foundation ended, further qualitative research could shed light on the processes that institutionalized the program. It could also bring to the fore teachers' and principals' motivation for becoming involved in the program. In addition, further quantitative research could determine the program's impact on student knowledge and perceptions of agricultural and science concepts.

This case study paints only a single portrait of one rural county's teachers and principals as they worked to implement K-6 agriculturally based science curricula. Further research in other contexts can add to the body of knowledge related to merging agricultural and science education in elementary school settings and to the assistance needed by practitioners.

To educate more people about food, agriculture, and renewable resources, non-traditional programs can be developed in the formalized elementary school curricula. For this to happen, elementary educators will need understanding of the agri-food system and curriculum integration theory. Agricultural educators that prepare preservice teachers may consider expanding their audience by including elementary education majors or by networking with teacher educators who traditionally prepare elementary teachers.

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