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**A COMPARATIVE SUMMARY OF INSTRUCTIONAL
SCIENCE MATERIALS AND OUTDOOR EXPERIENCES
FOR STUDENTS IN IOWA ELEMENTARY SCHOOLS
FROM 1980 TO 1987**

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Following the development of the "new science programs" in the late 1960's, Iowa became a leading state in the adoption and implementation of activity-based science in elementary classrooms. A survey conducted by Anderson in 1980 indicated that approximately 40 percent of the school districts in Iowa were using NSF developed programs in their elementary buildings.

Research on the NSF curricula indicate that the programs were more effective in raising student performance and attitudes than the traditional reading-based programs. Shymansky (1989) indicates that students using the NSF curricula showed significant gains in achievement, process skills, perceptions and analytic skills.¹ They generally performed better on standardized tests as well, with only one performance area significantly lower (that being related skills).

In an investigation of exemplary elementary science programs by NSTA's Search for Excellence in Science Education, a number of features were noted. Yager and Penick (1989) indicate exemplary programs provide students with direct experiences with ideas, materi-

¹Shymansky, et al. (1983) reported a mean effect size of .29 on the composite performance favoring students using the NSF developed curricula. Bredderman (1983) also reported results favoring students in hands-on programs with a mean effect size of .35. Effect size is a quantitative procedure used in meta-analysis. Mean effect size procedures are used when a number of comparison samples are pooled. This method gives greater stability to an estimate of the treatment effect (Borg 1987). The positive values indicate that the hands-on programs are more effective than the traditional based reading programs in generating higher academic performance and more positive student attitudes.

als, use of information and making decisions. Furthermore, they report considerable differences in attitudes between students enrolled in standard programs and those in exemplary programs. Students in exemplary programs perceive their classes as being more fun.

In the past decade, textbook series were adopted in most school districts. In many cases, according to teachers, the decision was made because NSF materials had been in use for a number of years and the revisions were only minimal. New materials, such as the Delta Modules, are considered as supplements rather than core programs. Those concerned about science education in Iowa are asking two important questions: What materials are currently being used in Iowa elementary classrooms? And, how has the adoption of textbook programs affected the time allocated to hands-on science in elementary classrooms?

The Research Investigation

A survey of elementary classroom teachers was conducted in February 1987 to ascertain the dominant elementary science programs in Iowa schools, the age of the materials used, supplemental resources, percentage of time in the dominant program, percentage of time allocated to hands-on science and the percentage of classrooms in which time is spent on outdoor exploratory experiences.

A sample of 302 elementary schools was drawn from the 926 elementary schools listed in the 1986-87 *Iowa Educational Directory*. One teacher from each grade level, grades 1 through 6, was surveyed in the selected schools. Responses were received from 164 schools, a response of 54.3 percent.

The data in this study was compared to a similar survey conducted by Jan Anderson in the spring of 1980. Her sample included 300 randomly selected schools from 1,182 elementary schools listed in the 1979-80 *Iowa Educational Directory*. Responses were received from 190 of the 300 selected schools, a return of 63.3 percent.

The forms were reviewed by Dr. Jack Gerlovich, Iowa Science Supervisor; Duane Toomsen, Iowa Environmental Education Consultant and Dr. Greg Stefanich, Professor of Science Education at the University of Northern Iowa. Because most school buildings have a building-wide science text adoption, this grade percentage tabulation should present an accurate report. An overall "no text" percentage of 7.93 percent was reported, with 22.67 percent of first grade teachers reporting "no text," grades 2 through 4 having 4-5 percent with "no text" adoptions and grades 5 and 6 at about 6 percent. Grade level data is shown in Table 1.

Table 2 represents the data from Anderson in 1980. A comparison of the two tables indicates a considerable change in the dominant science programs used by schools.

Table 1
Percentage Distribution and Rank Order of Science Programs
Used in Iowa Elementary Classrooms in 1987

Textbook Rank Order by Publisher	Grade						All Grades
	1	2	3	4	5	6	
1. Merrill	15.33	18.99	25.85	27.03	25.74	31.40	24.05
2. Silver Burdett	16.00	20.89	14.97	14.19	19.85	17.44	17.22
3. Heath	16.00	19.62	12.93	14.19	16.91	13.95	15.72
4. Holt	8.67	10.13	12.54	11.49	6.62	8.14	9.59
5. McGraw Hill	6.00	8.23	6.12	7.43	8.82	6.98	7.26
ESS	5.11	8.52	3.00	6.74	8.46	6.69	6.40
6. Ginn	4.11	3.80	5.44	4.73	3.68	2.33	4.01
7. Scott Foresman	2.67	5.06	3.40	4.05	2.21	5.81	3.86
8. Harcourt, Brace	4.00	3.16	2.72	2.70	4.41	2.33	3.22
SCIS	2.25	3.79	2.55	2.28	2.75	1.79	2.56
9. Addison-Wesley	2.67	1.90	4.08	3.38	1.47	0.00	2.25
10. Laidlaw	.67	.63	2.72	2.70	1.47	2.33	1.75
11. Houghton, Mifflin	1.33	1.27	1.36	1.35	1.47	1.16	1.32
SAPA	.91	2.09	1.33	1.18	.43	.45	1.06
12. Modern Curriculum Press	0.00	.63	.68	.68	1.47	1.16	.80

*"No text usage" received a 7.93 total grade percentage and would rank fifth if listed on this table.

Table 2
Percentage Distribution and Rank Order of Science Programs
Used in Iowa Elementary Classrooms in 1980
(programs with greater than 5 percent usage)

Textbook Rank Order by Publisher	Grade						All Grades
	1	2	3	4	5	6	
1. ESS	9.86	8.61	11.38	15.88	16.88	16.67	13.21
2. Harcourt Brace	11.97	11.26	12.57	12.35	13.64	13.64	12.55
3. Silver Burdett	14.08	12.07	11.38	11.76	13.64	10.61	12.34
4. SAPA	10.56	11.92	10.78	10.00	9.09	11.36	10.59
5. Heath	13.38	12.58	8.98	0.00	6.49	6.08	9.72
6. Laidlaw	7.75	7.28	9.58	10.59	9.74	9.09	9.06
7. SCIS	12.68	9.93	8.38	5.88	8.08	9.09	8.62
8. Teacher Developed	10.56	5.96	7.19	8.82	0.00	0.00	6.88
9. Addison-Wesley	5.63	0.00	0.00	8.24	8.44	8.33	6.77
10. Other or no direct text	3.53	19.81	19.96	16.48	14.00	15.13	10.26

Using the results of a national survey, Weiss (1978) stated that the top three science textbooks were published by (1) Harcourt-Brace, with a 12 percent usage from K through grade 3 and a 16 percent usage in grades 4 through 6; (2) Silver Burdette, with 5 percent usage from K through grade 3 and 10 percent usage for grades 4 through 6; and (3) Laidlaw, with 5 percent usage from K through grade 3 and 7 percent usage for grades 4 through 6.

Silver Burdette and Heath ranked in the top five in all three surveys. Harcourt-Brace and Laidlaw were widely used in the 1978 and 1980 surveys, but dropped to eighth and tenth places respectively in the 1987 survey. Merrill, although not used enough to be ranked in the 1978 and 1980 surveys, was reported to have distribution of 24.05 percent in 1987, 10 percent higher than any science textbook had received in previous survey studies. Silver Burdette also showed a 5 percent gain in usage over the 1980 Iowa survey. Heath increased by 6 percent from 1980 usage. Holt, in fourth place in the current survey, was not reported in the 1978 and 1980 surveys as having significant usage.

Use of NSF-sponsored materials was relatively high in Iowa in 1980. Anderson (1980) found that 30.46 to 37.12 percent of the classrooms in grades 1-6 used these materials. Weiss (1978) reported 5 percent of teachers in K-3 used ESS and 9 percent in grades 4-6. Those using SAPA were listed at 4 percent in K-3 and 9 percent in grades 4-6. SCIS was used by 11 percent in grades K-3 and 12 percent in grades 4-6. Guillickson (1978) found percentages to be 14.6 for ESS, 5.4 for SCIS and 8.0 for SAPA.

The current survey indicates that the dominant usage of an NSF curriculum has declined significantly in Iowa. ESS is the dominant program in only 6.4 percent of the classrooms, with SCIS in 2.56 percent and SAPA in 1.06 percent. This is about a 75 percent decline since 1980. However, many NSF materials are still fairly widespread as supplemental sources.

Overall adoptions were about 11-20 percent fewer in 1987 than in 1980. For grades 3-6, fewer than 5 percent of the textbook adoptions were made before 1978 and fewer than 7 percent for grades 1 and 2. The Weiss (1978) survey reported 19 percent of the textbooks for K-3 had copyright dates over ten years old and 24 percent for grades 3-6. Anderson's (1980) Iowa survey reported 20 percent of textbooks for grades 1-3 at over 10 years old and 15 percent for grades 4-6 over 10 years old. The data appear to indicate that school districts are more likely to change programs, but the adoption cycle is somewhat longer than it was 10 years ago. (See Table 3.)

Table 3**Frequency of Classrooms Adopting New Textbooks
1980 Survey vs. 1987 Survey**

Grade	1980	1987
1	56%	36.0%
2	59%	45.0%
3	60%	43.5%
4	56%	41.9%
5	60%	48.5%
6	54%	43.0%

**Supplemental Programs and Materials Used
in the Elementary Schools of Iowa**

The survey gathered information regarding programs and materials used to supplement or augment the primary program. These survey results are recorded in Table 4. Sixteen programs and materials (including "locally developed" and "other") were listed in the survey. SCIS, ESS, SAPA and MINNEMAST are considered "programs"; all other listed items are "materials."

The data recorded in Table 4 show CLASS to rank first, used by 21.65 percent of teachers surveyed in Iowa elementary classrooms. ESS was second with a reported usage of 20.1 percent. Learning Tree had an overall average of 14.79 percent. Locally developed materials rank fourth at 14.48 percent, and "other" programs and materials rank fifth at 14.37 percent. When "other" materials were identified, approximately 50 percent listed the use of *My Weekly Reader's* science section. OUTLOOK is sixth with overall usage at 13.22 percent. SCIS had 6.83 percent usage and ranked tenth. SAPA ranks twelfth (listed at 5.47 percent), having a higher percentage of usage in the first through fourth grades.

The number of class periods reported spent on selected programs and materials is shown in Table 5. ESS and SCIS lessons are used most often from 1 to 11 class periods a year. However, approximately one-third of the 147 schools using ESS and slightly over one-third of the 64 schools using SCIS reported usage more often than 28 class periods a year. In all other selected programs and materials surveyed, usage is most frequent from one to five class periods a year.

The results of the time spent on a dominant text are recorded in Table 6. First and second grade teachers spend the least time using a dominant text. In these two grades, about 25 percent of the classrooms

Table 4
Percentage Distribution of Supplemental Programs and Materials
Used in Iowa Elementary Classrooms in 1987 by Rank Order

Programs and Materials (Rank Order)	Grade						All Grades
	1	2	3	4	5	6	
1. CLASS	12.00	15.19	19.04	27.70	19.85	18.60	21.65
2. ESS	16.00	26.66	9.52	21.08	26.47	20.93	20.11
3. Learning Tree	11.33	8.86	14.28	20.27	15.44	18.60	14.79
4. Local	20.00	13.92	8.84	18.24	15.44	10.46	14.48
5. Other	10.66	8.23	10.20	8.10	17.64	31.39	14.37
6. OUTLOOK	8.00	6.96	10.88	17.56	16.17	19.76	13.22
7. Wild	6.66	6.33	12.92	9.45	11.76	17.44	10.76
8. IDEAS	3.33	15.52	4.76	14.86	11.76	11.62	10.30
9. ECAPS	3.33	9.49	7.48	12.16	11.02	15.11	9.76
10. SCIS	6.00	10.11	6.80	6.08	7.35	4.65	6.83
11. Ding Darling	.66	1.90	.68	8.10	10.29	17.44	6.51
12. S-APA	4.66	10.76	6.80	6.08	2.20	2.32	5.47
13. Sharing Nature	2.66	8.62	2.04	7.43	1.11	8.13	4.99
14. OBIS	1.33	1.90	6.12	4.05	8.08	8.13	4.93
15. Examining Your Environment	3.33	3.80	6.12	6.08	2.20	2.32	3.97
16. MINNEMAST	3.33	3.16	.68	0.00	1.11	2.46	1.79
No Programs	0.00	0.00	0.00	0.00	0.00	0.00	17.33

Note: 1) "Other" is explained as the use of *Weekly Reader* science section at about 50 percent of "other"

Table 5
Percentage Distribution of Class Periods that Selected Programs
and Materials are Used in Iowa Elementary Classrooms in 1987

Materials	N	1-5	6-11	12-15	16-21	22-27	28+
ESS	147	34.69	18.37	6.80	7.48	1.36	31.97
SCIS	64	31.25	10.93	7.81	10.93	1.56	37.50
SAPA	41	60.97	7.31	0.00	12.20	0.00	19.51
MINNEMAST	11	90.90	0.00	9.09	0.00	0.00	0.00
Learning Tree	121	83.47	10.74	4.96	0.00	0.00	.83
OUTLOOK	111	58.56	24.32	9.91	4.50	0.00	2.70
Wild	78	64.10	19.23	7.69	2.56	1.28	5.12
IDEAS	90	77.77	12.22	2.22	4.44	0.00	3.33
ECAPS	70	78.57	10.00	7.14	1.43	1.43	1.43
Ding Darling	52	84.62	11.54	3.85	0.00	0.00	0.00
Sharing Nature	36	83.33	16.66	0.00	0.00	0.00	0.00
Examining Your Environment	37	89.19	5.41	0.00	2.70	0.00	2.70
CLASS	156	85.90	7.69	3.85	0.00	0.00	2.56
OBIS	47	93.62	4.26	0.00	2.13	0.00	0.00
Local	145	68.28	7.59	4.14	3.45	1.38	15.17
Other	99	58.59	20.20	5.05	5.05	1.01	10.10
Total	285						

Table 6
Percentage Distribution of Iowa Classrooms in Which Time is Spent
on a Dominant Science Text for a Certain Percentage of Science Time Per Week

Grade	N	0	1-20	21-50	51-80	81-99	100
1	150	25.33	19.33	18.00	21.33	10.00	6.00
2	158	22.15	17.09	15.82	20.25	17.72	6.96
3	147	14.92	11.56	14.29	17.69	24.49	17.69
4	148	12.16	8.78	15.54	20.27	27.03	16.22
5	136	10.29	13.97	13.24	26.47	30.15	5.88
6	86	11.63	5.81	18.60	19.77	29.07	15.12
Total	825						

spent no time using a dominant text. Ten to 15 percent of the third through sixth-grade teachers reported spending zero time in a dominant science text. Although fifth and sixth graders spend more time studying science, about 40 percent of the teachers surveyed spend 80 to 100 percent of that time using a dominant science text. Over 15 percent of sixth grade teachers reported using a dominant text 100 percent of their allotted science time. Over 40 percent of teachers in grades 3 and 4 reported using a dominant texts 80 to 100 percent of the time.

Hands-on Process Time

Science time spent in "hands-on" process is listed in Table 7. When compared with Anderson's (1980) Iowa survey, the data indicates more teachers devoted a greater percentage of time to "hands-on" science in 1980 than in 1987.

In a 1975 national survey, Helgeson (1977) indicated 7 percent of grades K through 3 used "hands-on" activities daily, and 11 percent used them daily in grades 4 through 6. Anderson's 1980 Iowa study indicated about 12 percent of the teachers in grades 1 through 3 and 14 percent in grades 4 through 6 allocated 81-100 percent of the time to hands-on science. However, the current Iowa survey shows lower figures in the 81-100 percent category: grades 1 through 3 averaged about 5 percent and grades 4 through 6 about 4 percent. The 1987 survey "0-21 percent" category reflects an increase from about 20 percent to over 50 percent. Anderson (1980) reported the most frequent response to hands-on science was 21-40 percent at every grade level. We appear to have experienced a significant decline in hands-on science over the past eight years.

Table 7
Comparison of "Hands-On" Percentage of Science
Time Allotments Using Iowa 1979-80 and 1987 Surveys

Grades	0-21	21-50	51-80	81-100
1 Anderson (1980)	25.52	27.66	21.28	12.77
Current (1987)	55.34	26.67	12.00	6.00
2 Anderson	25.17	33.11	15.89	10.60
Current	56.32	28.48	12.65	2.52
3 Anderson	23.35	38.92	15.57	10.18
Current	48.68	36.73	7.48	6.80
4 Anderson	18.24	34.71	20.00	13.53
Current	63.52	26.35	5.41	4.73
5 Anderson	21.94	29.68	20.00	12.26
Current	52.94	27.21	13.24	6.62
6 Anderson	20.45	25.76	23.48	12.12
Current	52.31	34.88	11.62	1.16

Outdoor Exploration Time and Teacher Preparation

Table 8 indicates the percent of students receiving outdoor instruction in science. Third graders were least likely to spend time outdoors (with 53.07 percent reporting no outdoor activity) while sixth graders were most likely to spend time outdoors with only 24.42 percent not going outside.

Comparison of the Anderson (1980) survey with this 1987 study shows that about 20 percent more teachers are now involving students in outdoor science experiences at the first and second grade level. Increased outdoor experiences, 5-10 percent, are also reported for grades 3-6. Overall, about 50-60 percent of the elementary school students in Iowa receive some form of outdoor education each year.

Table 8
Percentage of Iowa Classrooms in Which Time is Spent on Outdoor Exploration Experiences

Grade	Anderson 1980	Norton 1987
1	45.86	62.00
2	37.84	52.33
3	40.25	46.93
4	52.69	58.78
5	46.36	52.92
6	66.15	75.58

Discussion

The 1987 survey data indicates that the NSF curricula are still being used as dominant programs in about 10 percent of the elementary classrooms responding to the survey. About 35 percent of Iowa classrooms are using investigations from ESS, SCIS or SAPA. However, in about 40 percent of the cases, usage is fewer than 5 class periods each year.

During the past eight years, science study based on textbooks appears to have increased in the elementary classrooms in Iowa. Although the NSF programs and a wide variety of supplemental science materials are being used, teachers have reduced the amount of time devoted to hands-on classroom instruction for students. New textbooks are being provided, but adoptions do not appear to be as frequent as in the past.

A challenge for the next decade appears to be to apply the research base in science education to classroom instruction. Strong evidence supports hands-on science as the most effective way to deliver science to elementary-age students. Many classroom teachers, however, are utilizing only a basal textbook to teach elementary school science. More in-service programs are needed to enrich teacher background and encourage the use of frequent hands-on investigations. We must convey the importance and relevance of hands-on science to help children develop an understanding and appreciation of science.

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