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ABSTRACT

This third annual publication contains ten articles written by college instructors who teach elementary science methods courses. Subjects considered include contract teaching, classroom techniques for isolating and culturing molds, science interests in the intermediate grades, a proposed program of science education for the elementary teacher, taped instruction in science methods courses, the status of the new elementary science programs in teacher-training institutions of Ohio, Kentucky, Pennsylvania, and West Virginia, a pre-school science project, reading groups in the science class, and undergraduate science teaching methodology. (PR)

Pennsylvania Clearinghouse On Methodology In Elementary Science

April, 1971

Vol. 3 No. 1

THE PENNSYLVANIA CLEARINGHOUSE ON METHODOLOGY IN ELEMENTARY SCIENCE

A Publication For

Methods Instructors in Higher Education

April, 1971

Edited, printed, and bound at Bloomsburg State College,
Bloomsburg, Pennsylvania, as a service to all educators

-EDITORIAL-

Donald A. Vannan
B.S., M.Ed., Ed.D.

As we move forward into this new year of hope, expectation, and change, a strong new pattern of educational endeavor--the individualization of instruction--appears to be emerging across the nation. Although inextricably intertwined with such terms as "individualized learning," or "informal education," or the "free or integrated day," or learning stations," or "individually guided education," or "individually prescribed instruction," or the "open space concept," or "self-paced learning," the general term "individualized instruction" is all-inclusive because it can be viewed from the teacher's position or from the pupil's position.

Now, you might ask, "What effect will this trend have on instruction in the area of elementary science?" The answer, to the best of my knowledge, involves the following directions:

(1) a movement away from one basal text to a multi-text, multi-level-text, teacher-constructed text, pupil-constructed-text approach

(2) an all-out sharing of science textbooks and materials among all teachers when they are not being used in the separate classrooms; new uses for the tape recorder

(3) a strictly-observed and well-defined policy of determining what science materials are available for use in the individual school districts[1]

[1]"The Science Equipment and Availability List," Science Activities, November, 1970.

(4) a cost-conscious administration and faculty will begin to shy away fron national programs in science and begin to concentrate on teacher-made and pupil-made self learning devices and literature, and "cut up books and workbooks"

(5) the complete changing of the "traditional" classroom into four learning areas which include "language arts," "mathematics," "social studies," and "science"--always set up and ready to be used; boxes, shelves, and curtains will divide the room into these interest zones.

(6) a restructuring of methods courses in elementary science on the college level to de-emphasize content in this course and concentrate on individualized approaches to methodology for the self-contained classroom and the departmentalized pattern, and building up (quantity) of required or prerequisite courses in content (some botany, some zoology, some physics, some chemistry, for example, or combinations of such courses.

(7) the movement of science from the classroom into the community to a greater extent (resource persons, science in the community, field trips where all children do not look at the same thing at the same time, ecology and pollution studies, etc.)

My best wishes are extended to all of you for a pleasant remainder of the academic year, a delightful and restful and learning summer, and a proud attack on the problems and challenges of the new year to come.

Donald A. Vannan

Editor

ACKNOWLEDGEMENTS

The Editor wishes to extend his thanks to:

(1) the administration of Bloomsburg State College for allowing this publication to go into its third year

(2) the Department of Education in Harrisburg for financial support at a time of financial uncertainty in the state

(3) the authors who have contributed their time, energies, and creative ideas so that others may share new ideas and philosophies

(4) Mrs. Shirley Walker for her typing of all of the articles contained herein

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(6) the Editor of <u>Science and Children</u>, Miss Phyllis Marcuccio, for advertising the availability of the publication on a monthly loan basis once each year in the "Ad-Vailables" column, and for permitting the publication of our first reprinted article

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PROSPECTIVE AUTHORS

If you are interested in submitting an article for consideration, the following points will be of interest:

(1) you must be a college instructor teaching a course generally titled "Methods and Materials In Elementary Science"

(2) the article must deal with elementary science as it applies to a methods course on the college level

(3) you should use the form at the end of this publication to submit your manuscript

(4) you will not be paid for the article; the publication is non-profit....you will receive, however, a free copy of the publication in which your article appears

(5) in addition to #4 above, your campus library will also receive a free copy of the publication in which your article appears; additional copies (as long as the supply lasts) will be available for $1.00 each with the check made payable to The Bloomsburg Foundation, payment required in advance and sent to the Editor

(6) contributors from out-of-state are encouraged to send in manuscripts for consideration; this volume contains several articles from states other then Pennsylvania

(7) articles usually deal with methods used in the methods course but may include specifics such as college-public school programs of a cooperative nature, consultant work, etc.

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CONTRACT TEACHING AT THE COLLEGE LEVEL
IN TEACHER EDUCATION

Miles Esget

About one year ago, the writer decided to attempt contract teaching in a course in the preparation of elementary school teachers at Humboldt State College in Arcata, California. The course carries the title of "Curriculum and Instructional Materials in the Elementary School." There are three parts to the course. One part deals with teaching methodology in mathematics, one in science, and other in social science. The author is responsible in the course blocking for the science and social science sections. The first task was to write the contracts. It was decided that about thirty contracts would suffice, at least as a beginning. The philosophical concept which became the cornerstone of the contracts was developed over a number of years during which much student evaluation of the classes had been solicited. The evaluations continuously elicited a desire for students to demonstrate that they already possessed a number of teaching techniques that were at least of average or above merit. The contracts then were written so that a student or groups of students could demonstrate such skills as they may possess. If the classes were small enough, there would be time for individual presentations; otherwise, to economize class time, groups would be asked to present one or more contracts. The writer decided that it would enhance the student's preparation to discover information from a wide variety of professional materials. Therefore, no single college text was chosen as a guide to the course. The student would be asked instead to examine various texts as a resource for gathering ideas, in addition to his own, in readiness for class presentation.

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contracts is included in this article for the reader's clarification.

A Contract on the Use of Inquiry Training Techniques in Science in the Elementary School Classroom

Material: A wide variety of techniques can be used here:

1. Map problems
2. Picture interpretation problems
3. Prediction and checking against
4. S.R.A. - yes and no techniques
5. Laboratory approach
6. Project approach
7. Combination of these and many others

The materials needed will vary with the technique. See some of the following material as furnished by the instructor:

1. Simulation Games in Social Studies
2. S.R.A. materials -- The Idea Book, The Resource Book
3. Laboratory materials as suggested by Inquiry Techniques for Teaching Science, Romey, pp. 206-219
4. 8mm cartridge film loops and projector
5. Laboratory equipment as needed and provided in the science laboratory
6. Interpretative pictures (ask instructor where these are stored)
7. Handout by the instructor on inquiry (ask instructor for these)

Readiness: The group may wish to read, Readings on Teaching Children Science, Kuslan and Stone, or one of the other references. pp. 262-270. They may wish to try out various techniques on each other.

Presentations: Present material much as suggested in Kuslan and Stone or one of the other references--show both methods.

Follow-up: Leave plenty of time, at least a half an hour, for college class questions and general discussion. You may wish to ask:

1. How did the two demonstrations differ? Why this difference?

2. How does inquiry and problem solving (in its usual sense) differ?

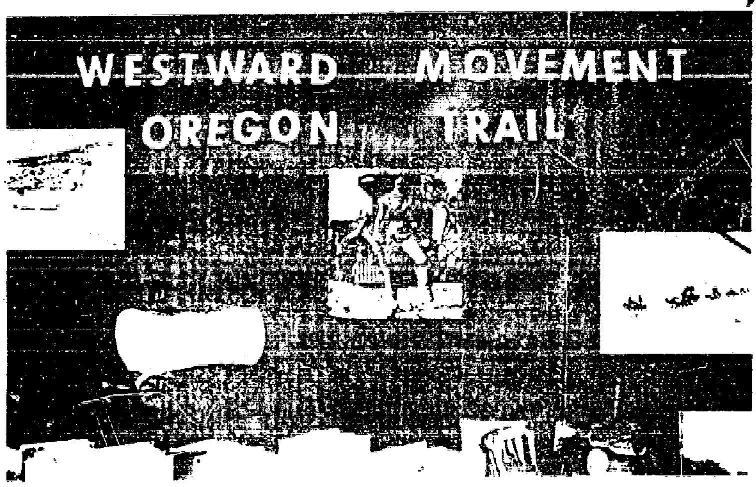
3. Should science activity be both structured and unstructured? Why?

Four contracts are always demonstrated by the instructor to each incoming college class. The four contracts differ somewhat between the science and social science methods courses. In science the following are presented: (1) demonstrating, promotive, and informative types; (2) experimenting; (3) correlated techniques; (4) project stations approach. In social science the instructor demonstrated for the student the following: (1) simulation game; (2) inquiry development; and (3) correlated technique. The demonstrations capitalized on the use of bulletin boards, overhead projectiles, filmstrips, films, slides, pictures, and science laboratory equipment.

3

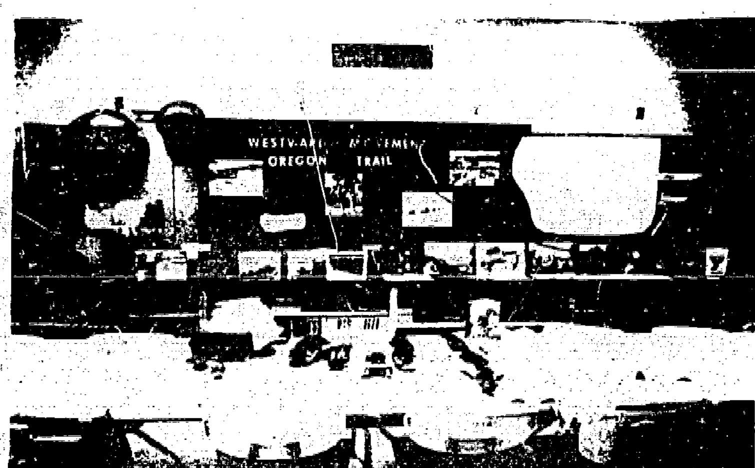
One of the student demonstrations is illustrated by pictures A through C. Picture A depicts the nature of a display that might be used by a fifth grade teacher as a motivation device in introducing a unit on the Westward Movement. The student group planned the nature of the display, gathered the necessary materials, and presented it in class. In the presentation, they noted that time would be provided to discuss the pictures and give a short description of the content of many of the books in the exhibit. Since this was a teacher training class, the instructor called attention to the manner in which the materials for the display were obtained and pointed out that many other articles of this nature were obtainable through the same sources. These articles represented a wide variety of subject areas.

A



Picture B shows the same interest center, but it exemplifies at this point the contribution that students might make to the center from materials available in their homes and in the community. These items are to be shared with the whole class of pupils in the fifth grade. It is to be noted that many of these items are of the manipulated type thus arousing the curiosity of the child. This will cause him to ask many questions about them. The child responsible for adding the materials to the exhibit would act as a resource for information about each article in question.

B



Picture C is another case of student participation in the interest center. Yarn was used to show the general location of the Oregon Trail. The inserts in this picture might bring a lively discussion about the Conestoga wagons.

C

PATCHWORK PROGRESS AND A CALL FOR A NEW PROFESSION

J. Wesley Bahorik

Elementary School Science curriculum designs which place students in groups have the inherent problem of meeting the needs of all students. This is a problem because, if for no other reason, not all individuals will proceed at the same rate. This can incite a desire within a conscientious teacher to try to change the design. In conjunction with this inherent feature, Shirley Brehm in, "The Impact of Experimental Programs in Elementary School Science,"[1] cites new programs in high schools, the explosion of knowledge, the concerns and findings of the "cognitive psychologists", and pressures from the scientific communities as additional forces moving for change in science programs.

Decisions for change have been the responsibility of educators working with the products of researchers. Unfortunately the products and decisions have not been conclusive. Neither group can be blamed for not doing their job. The fact is that the job is formidable. For example, in an attempt to analyze which teaching method is best by using four variables, audio-visual aids, texts, laboratory exercise, and lecture, at least sixty-five research treatments can be set up (not to mention all the variations within each of the four). Fragmentary evidence and unsatisfactory decisions are obviously the bedfellows of such complexity.

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A typical example of this patchwork progress is the current status of individualized instruction. I. L. Ramsey and S. L. Wiandt present support for this type of instruction. The article, "Individualizing Elementary School Science,"[5] is a report of a project undertaken in Columbus Ohio, by a five-member team consisting of the school principal, three teachers (one each in fourth, fifth, and sixth grades), and a college professor.

The following outcomes from the study involving several groups with differing degrees of individualization were reported: (1) teachers felt the greatest asset of the project was the enthusiastic response of the students, (2) the teachers noted an increase in the students ability to pursue their individual projects, (3) there was a more complete coverage of science topics studied, (4) a greater variety of areas was covered in the classroom, (5) the students were afforded more contact with the materials of the laboratory, and (6) as they became more accustomed to individual work, they became more creative. Some disadvantages of individualization were reported: (1) greater time was spent by the teacher in organizing classroom activities (also, conferences and guidance were time consuming), (2) it was hard for the teacher to feel acquainted with the work of each pupil since twenty to thirty projects were simultaneously in progress, (3) it was hard for the teacher to help all the students at the same time, (4) more material and equipment is needed for individualized study, and (5) housekeeping and storage were a problem.

J. V. Derose provides additional support for individualized study in his paper, "The Independent Study Science Program at Marple Newtown High School."[3] In a program open to grades nine through twelve, he found by using final examination scores as a measure that: (1) these scores were higher in accelerated and independent study groups than in regular groups, and (2) the student in independent study builds a bank of strategies and grows in confidence, self-direction, skills, motivation, initiative, and tenacity.

Unfortunately, neither of the previous studies can be considered conclusive. R. J. O'Toole,[4] using three groups of fifth grade students and rigorous pre and post test analysis, found that: (1) there is no significant difference between groups in the achievement of science content, (2) there is no significant difference between groups in problem solving abilities, (3) there is no significant difference between groups in increased science interest, (4) there is no significant difference between groups in attainment of a more positive self-concept, and (5) there is no significant difference between groups in selected problem solving abilities.

In view of the above contradictory information it would appear that neither side can conclude an argument. This is not the fault of the researchers on either side. The true test of a device is its actual use. Here is where the problem of indecision is perpetuated. Not enough schools have tried to individualize at least some aspects of their programs.

Some schools have tried, others have not. R. Cunningham in, "Implementing Nongraded Advancement with Laboratory Activities as a Vehicle - An Experiment in Elementary School Science,"[2] reports the successful use since 1963 of a "Dual Progress Plan" which includes nongraded individualized work in the areas of science and mathematics. D. Smith in, "A Study of the Use of Various Techniques in Teaching Science in the Elementary School,"[6] concludes that reading and discussion of the text are used more frequently than other techniques in teaching science in e elementary school.

These reports are discouraging because they indicate that although the technique of independent study in connection with laboratory work holds promise as a useful teaching method it is not given a chance. The obvious implication from this is that more research is required in the area of individualized instruction before teachers, who largely have been trained in other techniques, are asked to use this method.

Research along will not solve the problem. In this argument, as well as any other controversy in science education, there is a polar spectrum with researchers at a peak on one end and practitioners on a peak at the other. The area between, the "disseminators," appear as a dull glow. After all, who wants to be called a "disseminator"? It sounds pathologic. In reality it may be extremely vital. There seems to be an almost tautological emphasis on cultivating master skills as a teacher or attaining world renown as a researcher. These are futile emphases since both of these groups will continue to function inefficiently without the essential flow of information between them. Perhaps the time has come to develop a class or a profession of "disseminators."

BIBLIOGRAPHY

1. Brehm, S. A. Impact of Experimental Programs on Elementary School Science. Science Education 52: 293-8, Ap. 1968.

2. Cunningham, R. Implementing Nongraded Advancement With Laboratory Activities as a Vehicle: An Experiment in Elementary School Science. School Science and Mathematics 67: 175-81, F. 1967.

3. Derose, J. V. Independent Study Science Project at Marple Newtown High School. Science Teacher, 35: 48-9, My. 1968.

4. O'Toole, R. J. Effectiveness of Individualized Elementary School Science. Science Education 52: 381-4, O. 1968.

5. Ramsey, I. J. and S. L. Wiandt. Individualizing Elementary School Science. School Science and Mathematics 67: 524-32, N. 1967.

6. Smith, D. M. Study of the Use of Various Techniques in Teaching Science in the Elementary School. School Science and Mathematics.67:559-66, Je. 1967.

MOLD CULTURE

Thomas D. Johnsten

The molds are common inhabitants of the environment and are particularly interesting to children. They can be found growing on almost anything and almost anywhere--from left over chip dip to leather. The following simple techniques can be mastered easily by children to isolate and culture molds in the classroom.

Preparing a Culture Media

A good general media for the most common molds is soil-gelatin media. Once the media has been prepared it can be stored in the refrigerator for future use. The petri dish is the common laboratory container used in mold culturing; however, any small Pyrex dish which is adequately covered and is transparent can be used. The following are the steps in preparing the media:

1. Fill four containers about one-quarter full of fertile soil. (Baby bottles are very useful for this purpose.) Add enough distilled water (from drug store or supermarket) to fill the containers. Do not screw the caps on tightly.

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2. Sterilize the soil-water containers in a pressure cooker at 15 pounds for 15 minutes. If a pressure cooker is not available, place the containers in a pan (baby bottle sterilizer) with a cover and boil for 20 minutes on three successive days.

3. When the soil-water sterilization is complete, allow to cool and filter through several layers of cheesecloth, catching and saving the liquid.

4. The soil-gelatin media is prepared by combining the following ingredients:

a. 100 cc of the soil-water prepared as directed above. Baby bottles may be used for measurement as they are graduated in cubic centimeters.

b. 895 cc of water

c. one gram of sugar (about the size of a pea)

d. 0.5 grams of potassium phosphate (from drug store or high school science teacher)

e. 2 grams of dehydrated gelatin from local supermarket

5. Heat the above mixture until the contents are dissolved.

6. Pour the dissolved mixture into about five Pyrex containers (baby bottles) and repeat the sterilization process as indicated in step Number 2.

7. When the media has been sterilized, it may be poured into petri dishes or Pyrex containers that have been sterilized in an oven at 350°F for 30 minutes. If the media is not to be used immediately it may be stored in a refrigerator and melted in a water bath when needed.

Isolation and Sterile Technique

1. Pour melted and sterilized soil-gelatin into petri dishes or similar sterilized Pyrex dishes, keeping the cover removed only long enough to pour the media. The media should cover the bottom to a thickness of one-quarter inch. Allow the media to solidify.

2. Place soil, humus, leaves, or other organic material on the media or allow the dish to remain exposed to the air for 3 or 4 hours. Set the dish aside and examine every few days. Many types of mold as well as bacteria will develop. The dish should not be uncovered unless isolations are to be made, as there may be some harmful bacteria on the dish.

3. To isolate individual molds, an inoculating needle is needed. This can be made by inserting a straight pin in the eraser end of a pencil. To make a transfer, heat the end of the pin to redness and allow to cool. Touch the pinhead to the mold to be isolated and transfer the mold by streaking the pinhead across a new, sterilized soil-gelatin petri or Pyrex dish. In a few days, if the isolation was successful, the new dish will contain only the mold isolated.

4. Microscopic investigations of living molds can be made by transferring some of the mold, using the inoculating pin, to a glass culture slide that has been prepared in the following manner.

a. Place two glass microscope slides together with tooth picks between and secure with a rubber band on each end of the slides.

b. With a piece of glass tubing, or the glass portion of a medicine dropper that has been sterilized, transfer some melted soil-gelatin which has been inoculated with a culture in between the two slides.

Experience with molds

Streaming of the cytoplasm can be observed by growing bread mold and using the slide culture technique. Once the bread mold is well established, observe a single hypha under the microscope. Streaming of the cytoplasm can be readily observed. Do changing conditions such as a change in temperature affect the movement?

The molds such as Aspergillis and Penicillin can be cultured using the slide or culture dish technique and used to study spore producing structures. How are they formed? What functions do they perform? Why are there so many of them?

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SCIENCE INTERESTS IN THE 70'S: A SURVEY OF THE INTERMEDIATE GRADES

James F. Slaybaugh, Jr.

Knowledge of the specific science interests of students in the intermediate grades is of value to professors of methods courses to prospective elementary teachers, and to in-service teachers. Educators engaged in teacher training responsibilities, by being aware of the interests of elementary pupils, can improve the preparation of teachers in specific areas by giving more attention to the content and methods of these categories. Equally important is attention to the areas which students like least. By stressing interesting teaching methods those areas least liked by students could be enhanced. In-service educators can likewise give more emphasis to these areas in the science curriculum.

In order to determine what the interests of fourth, fifth, and sixth grade students in the year 1970 would be, a survey was made of all of the intermediate grades in the Gettysburg Area School District. Thirty classrooms were surveyed and completed questionnaires were received from 820 students. By coincidence 410 boys and 410 girls completed the questionnaires.

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The format of the survey instrument to be used was given careful consideration. The basic question was whether the instrument should be structured or unstructured. A structured questionnaire would list areas of science to be used as a checklist. The unstructured type would ask the student to write which area of science he liked most and the area he liked least. The decision was made to use the unstructured form so that students would not be influenced by having specific areas listed. The final format was a duplicated sheet which asked the student to answer four questions:

1. What do you most like to study in science?
2. Why do you like this best?
3. What do you least like to study in science?
4. Why are you not very much interested in this?

Twelve categories of science were selected as major interest areas. These areas are (1) The Earth: Land and Water (2) Stars, Sun and Planets (3) The Air and Weather (4) Animals (5) Plants (6) The Human Body (7 Chemistry and Atomic Energy (8) Heat and Light (9) Simple Machines and Engines (10) Magnetism and Electricity (11) Sound (12) Airplanes and Space Flight. The answers given by the students were classified as accurately as possible from the unstructured answers. Those returns which did not answer the question in terms of areas of science, those unable to be read due to spelling or legibility, and those giving interests which could not be placed into the twelve categories were grouped into a separate category of "Not Classified".

Four questions will be answered by this survey. The questions will be answered in table form showing the number and percent choosing the particular area of science. The table numbers correspond to the numbers of the following questions:

1. What areas of science do intermediate grade children like best?
2. What areas of science do intermediate grade children like least?
3. What areas of science do intermediate grade boys like best?
4. What areas of science do intermediate grade girls like best?

Table 1

Areas of Science Liked Best By Intermediate Grade Children

Area	Number	Per Cent
The Earth: Land and Water	267	32.56
Animals	152	18.54
Stars, Sun, Planets	75	9.15
Simple Machines and Engines	57	6.95
The Human Body	55	6.71
Magnetism and Electricity	46	5.61
Air and Water	45	5.49
Airplanes, Space Flight	28	3.41
Plants	24	2.93
Chemistry and Atomic Energy	19	2.32
Heat and Light	8	0.98
Sound	0	0.00
Not Classified	44	5.37
Total	820	

Table 2

Areas of Science Like Least by Intermediate Grade Children

Area	Number	Per Cent
The Earth: Land and Water	142	17.32
Simple Machines and Engines	90	10.98
Air and Weather	77	9.39
Chemistry and Atomic Energy	69	8.41
Magnetism and Electricity	64	7.80
Stars, Sun, Planets	62	7.56
The Human Body	62	7.56
Animals	41	5.00
Airplanes, Space Flight	35	4.27
Heat and Light	31	3.78
Plants	24	2.93
Sound	0	0.00
*Liked all areas or did not state an area least liked	64	7.80
Not Classified	59	7.20
Total	820	

Table 3

Areas of Science Liked Best by Boys in the Intermediate Grades

Area	Number	Per Cent
The Earth: Land and Water	121	29.51
Animals	61	14.88
Simple Machines and Engines	51	12.44
Stars, Sun, Planets	36	8.78
Magnetism and Electricity	33	8.05
The Human Body	25	6.10
Airplanes and Space Flight	22	5.37
Chemistry and Atomic Energy	14	3.41
Air and Weather	11	2.68
Plants	6	1.46
Heat and Light	3	0.73
Sound	0	0.00
Not Classified	27	6.59
Total	410	

Table 4

Areas of Science Liked Best by Girls
in the Intermediate Grades

Area	Number	Per Cent
The Earth: Land and Water	146	35.61
Animals	91	22.20
Stars, Sun, Planets	39	9.51
Air and Weather	34	8.29
The Human Body	30	7.32
Plants	18	4.39
Magnetism and Electricity	13	3.17
Simple Machines and Engines	6	1.46
Airplanes and Space Flight	6	1.46
Chemistry and Atomic Energy	5	1.22
Heat and Light	5	1.22
Sound	0	0.00
Not Classified	17	4.15
Total	410	

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Summary and Conclusions

1. The study of the "Earth: Land and Water" is the area most liked by both boys (29.51%) and girls (35.61%). This topic was the most liked area of the total group (32.56%). The breadth of the topics included in this area may be a contributing factor. Some topics in this area are rocks, oceans, volcanoes, mountains, and conservation.

2. Surprisingly the area of "The Earth: Land and Water" was also the one least liked by the greatest number of students. This area was listed as the "least liked" by 142 students or 17.32 per cent. The breadth of the topic may again be a contributing factor in this choice.

3. The study of "Animals" was the second most liked area for both boys (14.88%) and girls (22.20%). This topic was given second place in the "liked most" category by the total group with 18.54 per cent choosing animals as the favorite area.

4. "The Stars, Sun, and Planets" was the third choice by the total group with 75 students or 9.15 per cent choosing this area for study.

5. The study of "Sound" was not mentioned in any of the questionnaires.

6. The fact that more boys than girls chose the study of simple machines and engines, magnetism and electricity, and airplanes and space flight confirms the masculine attraction to these areas.

7. The reason most given for "least liking" an area was that this topic was "boring" or "uninteresting" to the student concerned.

8. The use of an unstructured type of questionnaire resulted in a number of returns being delegated to "Not Classified". Many of these answered in terms of "not liking the tests", "liking the experiments", etc.

An analysis of the results of this survey might cause educators to ponder the answers to the following questions:

1. Why do children like certain areas of science best?

2. How can the areas listed as "least liked" be improved in status?

Teachers are constantly striving to improve their students' interests in all areas of science. By being alert to the areas most liked and the areas least liked educators will be able to adjust their methods and materials to continue interest and to stimulate interest in the many fascinating categories of elementary school science.

The cooperation of the administrators, the teachers, and the students of the Gettysburg Area Elementary Schools was essential for the completion of this study and is hereby gratefully acknowledged. The assistance of the students in the elementary science methods class at Gettysburg College in completing the statistical results of this survey was of vital importance.

A PROPOSED PROGRAM OF SCIENCE EDUCATION FOR THE ELEMENTARY TEACHER

William N. Pafford

Introduction and Rationale

Many beginning elementary teachers approach science teaching with fear and trepidation. They have customarily completed the minimum requirement in science, which ranges from twelve to twenty quarter hours at most colleges and universities. At some schools all these credits are completed in the same subject area, either biology, chemistry, or physics, for the most part. In this arrangement the teacher may be well prepared, contentwise, to teach elementary science in one field, but she will likely be inadequate outside that one area. Another common practice finds the student required to complete one or more survey courses in each major area of science (biology, chemistry, physics, and sometimes geology). In the latter instance the material which is presented is usually theoretical in nature, so that the prospective teacher actually learns very little which will be of great value in the "real world" of the elementary classroom. Bruce and Eiss have reported on a study in which many elementary teachers described their science programs

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almost unanimously, as being irrelevant, uninspiring, and often overwhelming.[1] It is generally agreed by science educators that elementary education programs at most colleges and universities do not adequately prepare students to be effective science teachers.

The past decade has seen the development of many new and exciting programs in elementary science. The various National Curriculum Projects have resulted in the production of superior equipment and materials, but adoption of these projects has not been particularly rapid. Too often, elementary teachers lack the proper training to effectively implement these new programs.

As Hudes and Moriber have pointed out, "The success or failure of the new and often innovative science programs, depends in large measure on the knowledge and the skills of the elementary teacher."[2] The problem is amplified by Ragan and Henderson, as they advocate reform in teacher education: "The most serious handicap faced by school systems as they attempt both to implement the new curricula developed by projects at the national level and to adopt innovations in organization and instruction is the lack of teachers who are prepared for these new programs."[3]

There is additional evidence supporting the need for change in the science component of elementary education programs. In a study conducted at Wisconsin State University, Platville, the Stanford Achievement Test in Science was utilized to compare elementary teacher trainees with eighth graders at the University Laboratory School. The range of scores for the two groups was identical, a fact which surely raises questions concerning the effectiveness of science courses completed by the elementary education majors. In addition, the investigators found no significant correlation between the number of semester hours of science completed by the prospective teachers and their scores on the Stanford Achievement Test. They also stated that the area of science in which courses had been completed did not seem to affect scores on the Achievement Test.[4] It seems unlikely that the subjects of this study gained a great deal from their university science program.

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[1] Matthew H. Bruce and Albert F. Eiss, Science Education for Elementary Teachers, Final Report U.S.O.E. Project No. 7-C-016 (October 1968), p. 11. Cited in Preservice Science Education of Elementary Teachers, AAAS Commission on Science Education, 1969, p. 12.

[2] Isodore Hudes and George Moriber, "Science Education for the Elementary Teacher, Science Education, December 1969, Vol. 53, No. 5, p. 424.

[3] William B. Ragan and George Henderson, Prospects for the Future of American Education, to be published by Harper and Row. Cited in "Preview of of a Coming Book," School & Society, March 1970, p. 186.

[4] Lynn Oberlin, "Science Content Preparation of Elementary Teachers," School Science and Mathematics, March 1969, Vol. 69, No. 3, p. 207-210.

Basic Assumptions

If our colleges and universities are to develop teachers who are qualified to effectively teach modern elementary science, the elementary education curriculum in vogue at most schools must be drastically revised. Certain assumptions must be made when any new program is to be developed; they make up the foundation upon which the program is supported. The writer makes the following assumptions relative to the science education[5] component of the elementary education curriculum:

1. The present teacher education program at most colleges and universities results in the production of elementary teachers who are inadequately prepared to teach modern elementary science.

2. In order to effectively teach elementary science, the prospective teacher must understand and appreciate the importance of science in our modern, technological society.

3. The effective elementary teacher does not fear science; rather she is as enthusiastic about it as she is the teaching of reading, for example.

4. The utilization of an approach which integrates all fields of science will result in better prepared elementary teachers.

5. Active involvement in science results in a more complete understanding than does learning about science.

6. It is impossible to teach "content" and "method" separately.

7. The elementary science program should stress the processes of science.

The Program

The proposed program which is described below draws heavily upon the Guidelines and Standards developed by the Project on the Preservice Science Education of Elementary Teachers.[6] While it is recognized that individual institutions must take into account certification requirements of the various states, the following should serve as a basic core which may be added to as necessary.

One year (either twelve or fifteen quarter hours) of an integrated laboratory science course should be the heart of elementary science education. Topics to be included in such a course should be developed around five major concepts:

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[5]The term "science education" is used to refer to both content courses in the various disciplines - i.e., biology, chemistry, physics, etc. - and methods courses designated specifically as science methods.

[6]AAAS Commission on Science Education, <u>Preservice Science Education of Elementary School Teachers</u>, 1969, 73pp.

1. Matter - composition, structure, and interaction.
2. Energy - conservation, conversion, and transfer.
3. Systems - living and non-living, ecological principles.
4. Nature of the Universe - astronomical principles, historical, geology.
5. Historical Development and Social Implications of Science.

As an example of how various topics may be dealt with within the framework above, let us consider the matter of space exploration. If this topic is included at all in the science education component of most elementary education curricula, it is usually set aside as a field of study that is somehow isolated from other disciplines. In the scheme described above, some aspects of this topic will surely be dealt with in concepts 2, 4, and 5 - and probably in 1 and 3 as well. (It might be well to say here that elementary teachers often tell me they feel extremely inadequate when they attempt to teach a unit on space travel.) In other examples, the topic of heredity will be dealt with in concepts 3 and 5; the topics of growth and reproduction will be dealt with in concepts 1, 2, 3, and 5.

This proposed program will involve a great deal of laboratory work, with prospective teachers being involved in inquiry-type investigations. The laboratory investigations will be designed to illustrate important principles which will also be discussed by the class. Many of these investigations will be simple and easy enough so that they may be modified and used as activities and/or demonstrations in an elementary classroom. It will thus be possible to combine content and method in the course, as attention will be given to the proper way in which to present this material. As an example of the type of activity which may be carried out, let us consider Archimedes' Principle. In the type of science course envisioned by the writer, each student will prepare an overflow can from some sort of container, such as a discarded coffee can. A spring balance will be utilized, and a rock will be weighed both in air and water. The amount of water displaced by the rock will be weighed and this weight then compared to the difference in the weight of the rock in water and in air. While many students today may see this activity demonstrated - it is well-known to most secondary science teachers - it has little meaning when one is only told about it. If each prospective teacher actually carries out this simple investigation, however, Archimedes' Principle becomes clear and the concept of buoyancy has true meaning. In this manner the student will be able to learn how to conduct a similar activity in her own classroom.

It should be strongly emphasized that this course is designed to integrate science, to bring together the various disciplines into a meaningful format. For example, investigations involving light energy will include activities which deal with reception of light by the human eye. Astronomy will also be incorporated into a unit on light energy; each student will construct a simple sextant and sun-dial. The role of solar energy in food production by green plants will be included; chlorophyll will be extracted from leaves and the leaves then tested for starch, some leaves having been exposed to sunlight while other leaves have been kept in total darkness. Once again, it should be pointed out that students will be actively engaged in science rather than being told about it. They will learn it as they live it.

The professor of such a course need not be either a biologist, a chemist, a geologist, or a physicist. Rather, he must know something of each discipline - and he must be willing to learn. He must be concerned with the investigative processes of science and he must be inquiry-oriented. He must be willing to call on specialists in each discipline as needed. This clearly means that some measure of cooperation will be necessary between the professor of elementary science education and professors in specific fields of science.

After one year of such a science program, the prospective elementary teacher should be required to complete one other course. The title does not matter, but this course will involve (1) a thorough investigation of two or three major National Curriculum Projects in elementary science, with each student working through representative levels or units, and (2) a thorough study of recent literature in the field of elementary science education. This course will acquaint elementary teachers with modern trends and ideas in elementary science. It is recommended that three quarter hours of credit be given for this segment of the program.

Adoption of this proposal means that prospective elementary teachers will have a special science program designed for them alone. In recent years administrators of teacher education programs have tended to resist such special programs, on the grounds that too much specialization at the elementary level is undesirable. Such a statement is illogical; most elementary teachers will be required to teach science. This means that they should be specialists in teaching science, as far as possible. A very small percentage of the elementary schools in this country utilize special science teachers, especially in the lower grades.

Professors involved in this program must have some knowledge of the psychology of learning and they must be able to integrate various fields of science. Both science and elementary education departments must be concerned with the production of well-qualified elementary science teachers and they must cooperate fully with each other as they work toward this important goal. In the past, cooperation between science and education departments has been sadly lacking at most institutions. Differences must be resolved if a program of elementary science education is to result in the production of elementary teachers who are capable of teaching science effectively in our modern age.

TAPED INSTRUCTION IN SCIENCE METHODS COURSES

Harrie E. Caldwell

The primary goal of an educational system is to equip each child with the knowledge, skills and attitudes which will enable him to function effectively and efficiently during his adult life. Since all children have different backgrounds and few children progress at the same rate, greater attention is being given to ways of providing for individual differences. Team teaching, homogeneous grouping, modular scheduling, independent study and individually prescribed instruction are currently being adopted by the more progressive schools as a way to cope with the differences in students.

Even in the most traditional school, teachers recognize that children are not all alike and, usually, are not ready for the same experiences at the same time. To provide for individual differences, in the typical classroom setting, teachers often assign different tasks, or modifications of the same task, to different students or groups of students. However, moderating several different lessons at the same time is not an easy chore.

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To solve the problem of moderating the activities of several groups of students a teacher devises schemes for organizing the classroom, or the activities, so that his presence is not required all of the time by all students. One, relatively unused, way to provide directions for students is to record the instructions on an audio tape. A student or group of students, using a tape recorder and other materials required by the lesson, may proceed through a lesson without the teacher. Although the novelty of using a tape recorder wears off, this technique is, at least initially, inherently motivating.

The following example is part of a script which could be recorded on an audio tape and then used by a student, or group of students, with little or no help from the teacher.

Example:*

Objective:

At the end of this lesson the child will be able to demonstrate how to measure the volume of objects using the displacement of water method.

Materials:

A plastic graduated cylinder, a beaker or container of water, a large bolt, a stone, a key, a small pencil, and a spool of thread.

Script:

1. Hello. I am going to tell you some things. Each time the bell rings stop the tape and do as you were instructed. Let's practice. Put your finger on your nose, stand up and turn around. (Bell).
2. Did you forget to stop the tape first? O.K. Pat your head four times. (Bell)
3. Very good! When the bell rings you are to find the beaker of water and the plastic graduated cylinder. (Bell)
4. Now fill the graduated cylinder with water up to the 50 milliliter mark. (Bell)
5. Check the water level. Make certain it is even with the 50 milliliter mark on the side of the cylinder. (Bell)
6. Put the beaker to one side. (Pause) Find the large bolt. Tie a piece of string to the bolt. (Bell)
7. Hold the loose end of the thread and let the bolt drop slowly into the water in the cylinder. Watch the water as you do this. (Bell)
8. Do not continue until you can describe what happens to the water level when the bolt is put into the water. (Bell)

*Based on a script developed by a Syracuse University student: Mrs. Patricia Stauffer.

9. Put the bolt to one side. (Pause) Find the stone and tie a string to it. (Bell)

10. Put the stone in the water and watch what happens to the water level. (Bell)

11. Which makes the water level rise more--the bolt or the stone? (Bell)

Poor readers often suffer in science class, not from lack of science ability, but from lack of ability in reading and following written instructions. The usefulness of taped instructions with poor readers should be obvious. However, it might be argued that good readers could use a script that is written, not recorded. Reading the script would provide practice in reading and following written instructions as well as in learning science. This is true, but there are advantages to using recorded instructions. On the tape one can include jokes or music for motivation and use voice inflections for emphasis. One can also answer questions without the problem of students accidentally seeing the answer too early in the lesson. On the other hand, with written materials it is easier to provide branching exercises for special situations. Students who are having difficulty may branch to a remedial exercise or students with a particular background may skip parts in an exercise. Although branching is possible with audio tapes, it is difficult.

Ground Rules

When developing a taped lesson or the script for a taped lesson there are several ground rules which one should keep in mind. Many of these are good rules to follow when planning any lesson.

1. State Objectives Behaviorally. Describe how students will be able to behave after the lesson as a result of experiences during the lesson.

2. Plan Procedures Which Are Consistent With the Objectives. Make certain that students practice the type of behavior they will be expected to demonstrate. Students will be able to identify, construct, or apply a rule only if they, in the lesson, practice identifying, constructing or applying the rule, respectively.

3. Precede Abstract Symbols (Vocabulary) or Discussion of Phenomenon With Concrete Experiences. Ideas which arise from experience or can be related to experiences are retained longer, and have greater potential for transfer than ideas which cannot be related to experiences. The same may be said for words. A word is a symbol which represents a concept. Without the concept a word has little value.

4. Students Should Be Actively Involved. Scripts should direct students in manipulating materials. They should not lecture.

5. Provide For All Predictable Student Responses. Questions which require a student response, if asked, should be phrased so that most students will give an expected response. It is only possible for a tape to provide the expected response and then provide directions for students who give that expected response. A tape cannot provide analytical feedback. It cannot listen to the response, analyze the response and then choose from an assortment of reactions on the basis of the response. Make certain all students will be able to give the expected response and then provide reinforcement by giving the correct answer

Application in Science-Methods Courses

The author has developed a number of lessons for use in teacher training and utilizing these in his science-methods course. However, for the past three years one methods-course exercise has been to have teachers develop taped instructions for activities they could use in their own classes. The following assignment is given:

Assignment: Choose a SAPA exercise and read the Teacher's Guide for this exercise thoroughly. Choose one activity (it may be the generalizing experience) described in the booklet and prepare a script for this activity. If the activity is too short (the lesson will last less than 20 minutes) choose another activity or do two of the. Your script, if read onto an audio tape, should provide one child (listening to the tape and using appropriate materials) with the experiences which are necessary to accomplish the objective of the activity. Be certain you specify the objective of the activity.

This exercise is beneficial to teachers who attempt to do an acceptable job because it forces them to think about the students reaction to each statement they make. The resultant script also provides feedback to the instructor regarding the teacher's skill in applying the ground rules when planning lessons and in asking appropriate questions or giving appropriate instructions. Another advantage to this exercise is that it is inherently motivating. Teachers will choose this exercise over the preparation of a lesson plan, probably because they view the product as useful; something they can implement in their own classes. Several teachers have borrowed scripts from a file maintained by the instructor. One teacher has developed tapes for math and another is investigating the effectiveness of several scripts for her master's thesis.

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AN INVESTIGATION OF THE STATUS OF THE NEW ELEMENTARY SCIENCE PROGRAMS IN TEACHER-TRAINING INSTITUTIONS OF OHIO, KENTUCKY, PENNSYLVANIA, AND WEST VIRGINIA

Richard N. Avdul

STATEMENT OF THE PROBLEM

It is the purpose of this study to (1) examine the status of teacher-trainee preparation of selected new elementary science programs in methods classes; (2) identify characteristics of the methods courses; and (3) examine opinions of the instructors about the new science programs. It is hypothesized that there will be no significant differences among rank of instructor of location of school by state on the questions comparing instructors' opinions about the new programs.

For the purpose of this study, new science refers to the major experimental programs in elementary science. References are made to American Association for the Advancement of Science (AAAS), Conceptually Oriented Program in Elementary Science (COPES), Elementary Science Project (ESP), Elementary Science Study (ESS),

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Elementary School Science Project (ESSP, California, Illinois, Utah), Intermediate Science Curriculum Study (ISCS), Minnesota Mathematics and Science Teaching Project (MINNEMAST), School Science Curriculum Project (SSCP), Science Curriculum Improvement Study (SCIS), and the Quantitative Approach to Elementary Science.

THE PROCEDURE

Responses were collected from 133 instructors of elementary science methods courses representing 94 colleges/universities from Ohio, Kentucky, Pennsylvania, and West Virginia. The findings of the study were based on the data obtained from a questionnaire survey. Questions from the first portion of the instrument called for multiple-choice and open-ended responses. The second portion of the questionnaire called for responses relating to questinns on opinions about the new science curricula. Subjects responded to one of four choices labeled "Very significant," Moderately significant," Slightly significant," or "Not at all significant."

Data were subjected to statistical analysis using item analysis, correlation tests, and chi-square tests for significance.

MAJOR FINDINGS

The most significant findings of this study are:

1. Respondents do indicate commitment to the new elementary science curricula.

2. The importance of providing elementary school teachers with training in the new science programs is recognized by the majority of the respondents.

3. Opinions about the new courses do not differ by respondents regardless of location of school or academic rank.

4. Instruction in the new sciences is offered to some teacher-trainees, and then only to a limited extent. Emphasis in the new curricula is primarily described as introductory-descriptive.

5. Budgets for science departments are notably inadequate, and the appropriations for new science materials are likewise insufficient.

6. Types of new science materials found in university classrooms vary considerably and are found only in limited quantity.

7. Personal interest in developing new programs and reading about them are significant factors that influenced respondents for teaching the new sciences in their classes.

8. In the opinion of the respondents, the major obstacles for implementing new science curricula into the elementary schools include lack of teacher training and lack of educational theory for teaching science, lack of desire for changing the established science programs, and the costs of the new programs.

9. Insufficient time in the school day or "conservatism" in elementary schools are not considered by the respondents as problems in implementing new programs.

10. The findings disclose that the respondents believe that teaching the new sciences is necessary to (1) stimulate the professional growth of teachers, (2) promote self-confidence in classroom teaching, and (3) generally improve classroom performance.

RECOMMENDATIONS

Based on these findings, it is recommended that all teacher education programs include in the preparation of prospective teachers training in more than one of the science-process approaches. Additional funds should be appropriated so that prospective teachers can experience the new programs in the same manner children will experience them in the classrooms. Research is also needed to determine the degree and methods in which prospective teachers are being trained in the process approaches.

PRE-SCHOOL SCIENCE PROJECT

Lloyd M. Bennett
Rose F. Spicola
Linda Helton

"Why does a puddle of water disappear on a hot day?"

"Does a fish breathe?"

"Why do the pupils in your eyes change size?"

"What are the liquids in a common thermometer?"

If you are heading for a nearby encyclopedia for answers to these science questions, ask a three, four, or five year old instead. Graduate and undergraduate students in elementary science education classes who participated in The Texas Woman's University's Pre-School Science Project have found that children below six are not only interested in answers to questions such as these, but can understand them. Additionally, there are many other basic science concepts, processes, and facts in science that are equally interesting to and that can be readily learned by preschool students.

Dr. Lloyd M. Bennett is an Associate Professor of Science Education at Texas Woman's University, Denton, Texas.

These college students, supervised by two Texas Woman's University professors and a graduate assistant, were assigned to pre-school groups in schools, nurseries, and day-care centers in Denton. The children involved represented a varied socio-economic and culturally-different population, including Mexican-American, Negro, and Anglo-American children. After observing the youngsters in their work and play, the teachers-in-training each designed a unit of instruction in science to teach to their particular group. Some of the students taught in pairs utilizing team teaching techniques with their group.

The units of instruction were broken down into brief lessons and taught in a two- to three-week period to the children. The topics included temperature, animals, the five senses, weather, use of the sense of sight, and categorization.

Many of the college students involved were surprised at the interest and eagerness of the children. Others learned that they had to strive to make the lessons more concrete. Some noticed a lack of certain understandings among children from less advantaged backgrounds.

All of these reactions, in addition to the results of pre- and post-evaluations for each child, were helpful in clarifying and modifying the objectives of the lessons and were useful in answering some of the major questions which several years ago led to the initiation of the Pre-School Science Project: (a) What concepts, facts, and understandings of science can pre-school children learn? (b) How many concepts, facts, and understandings make up an adequate teaching unit for the three- to five-year-old children's maturation level and attention span? (3) How can these science understandings be presented for maximum learning and retention? (d) How can the science program be devised to fit within the pre-school curriculum? (3) How can science understandings be evaluated realistically and accurately?

The college students reported that the most successful lessons generally involved student-centered activity. In the unit on temperature, the children became fascinated with an old discarded thermostat which the teacher had brought to school. They began to search in the halls of their building for the thermostat which controlled the temperature in their own room.

In the unit on the sense of sight, the children took turns being the teacher and demonstrating on their individual flannel boards a pattern of geometric shapes for others to copy. They also had fun looking at patterns of shapes for others to copy. They also had fun looking at patterns of shapes and trying to reproduce them from memory.

The three and four year olds who participated in a unit on the five senses were delighted by a game in which they could run about the room touching and naming all the cold objects, the hard objects, the soft objects, or the rough objects.

Five year olds who are learning about animals were visited by a real dog and by a living gold fish. They also made a trip to a nearby farm to see many of the other animals they had heard about in the lessons.

Another group of five year olds was taught weather concepts. One of the ways in which they learned that wind moves things was by making a paper airplane and taking it outside to fly it with the wind and against the wind.

Because these children were young did not prohibit the use of scientific terms. For example, the teacher-in-training who worked with children on a unit about temperature recalled that, after one particular lesson, a lad was asked to name a liquid found in a thermometer. The child paused, asked the teacher not to tell him, then admitted that he could not remember. But moments later he suddenly shouted out excitedly, "Mercury!".

The teachers-in-training working with pre-schoolers found that teaching science to this age group involved daily evaluation and reteaching. Some also learned that lesson plans often had to be changed in mid-stream to accommodate the unforseen interests of the children.

Game-like activities were found to be the most beneficial methods in addition to the use of many materials. The pre-school child can understand a number of things when the process is demonstrated to him and when he is able to manipulate the materials for himself. Therefore, the college students found that it was necessary to try to have on hand enough supplies so that each could work independently and discover answers through his own involvement.

Because of the short interest span of many young children, frequent changes in activity, even within a fifteen-minute lesson, are important. The teachers-in training used stories, songs, games, art activities, demonstrations by teacher and by the children, as well as a variety of other techniques.-- all to teach science!

Fitting science into the pre-school curriculum was a natural union in most cases, for the teacher had to call upon other areas of learning and integrate them into the science lesson. Language, including vocabulary, comprehension, and expression, cannot be excluded from a pre-school science lesson. Art and music are helpful in making the science concepts concrete, fun and relevant. Social studies is an obvious part of pre-school science, such as the study of farm life integrated into the study of animals or a discussion of different places where people live and work combined with a unit on temperature and seasons. Physical activity is a must in any lesson for pre-schoolers. They learn best, generally, when they can stand, move, touch, bend, run, sit, and lie down.

The purpose of this project was not to make young children experts in science but to help the children begin to build basic understandings of the nature of science and scientific processes. The college students encouraged their groups to "find out," to hypothesize or "guess," and to estimate. The children were guided in drawing conclusions and generalizations based on their experiments.

The teachers-in-training felt for the most part that the children in their groups enjoyed the challenges presented them, looked forward to the daily activity, and liked learning the "why's" and "how's" of weather, temperature, animals, and so forth. Such results could have important implications for pre-school programs throughout the state.

READING GROUPS IN THE SCIENCE CLASS

Donald A. Vannan

Although I am a teacher of methodology in elementary science education, I feel that reading is the most singularly important subject taught in the elementary school curriculum. Of course, elementary science is at least second in importance.

Additionally, I am aware that science teaching in the primary and intermediate grades across the country tends to degenerate into lessons involving reading only, because many teachers shy away from teaching and working the somewhat unpredictable experiments and demonstrations which frequently arise in the subject area of science. This condition, obviously, must be changed. Reading, in itself, is excellent, but must be supplemented with regular field trips, individual discussions in small groups and as a class whole, and experiments and demonstrations with the discovery and inquiry approach emphasized. Any reading that is done in elementary classrooms can be strengthened and improved upon. The enrichment of science can only be aided by the enrichment of the science reading program.

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For any good reading program, the teacher should take into account the individual differences in children and specifically, the reading levels, reading speed, and comprehension levels of his pupils. In science classes, however, the children are usually given only one textbook (the basal text adopted by the district), or one textbook plus one or more resource books on the same grade level.

If the teacher realizes that slow learners and poor readers need books that are at least one or two grade levels below the present grade, even in science, he can go to a lower-grade teacher and ask to borrow one or more books. (Slow learners, in general, are those pupils who have reading and mathematics problems and learn at a slower rate than "average" children.) But these borrowed books are usually those that have been already used, and fairly recently so, unless the children involved have transferred from another school using a different science series.

To compound the problem, what can the teacher do for the gifted child in his classroom? Wouldn't we agree that the truly gifted child tends to read a bit faster and comprehend a bit more readily and completely than the average child? If this is true, how can the teacher meet this child's needs, too, with only one basic text and/or supplementary resource books? And finally, how can this teacher meet the needs of all three reading groups in his science class at the same time--the slow learners, the average learners, and the truly gifted?

The following suggestions might be of some use to the reader in attempting to meet the above problems, or adaptation of these ideas might be made to meet the uniqueness of certain districts with special problems like "closed-mindedness," "sports-above-all," and "help-for-the-college-bound-only."

I am of the opinion that the best general program for elementary science instruction in the typical school <u>not</u> involved with experimentation in a national program is that of an overall package of basal text plus supplementary textbooks on several grade levels, or rather, the so-called <u>multi-level approach</u>. My support for this approach involves my own experience (five years as an elementary teacher, plus nine years of working with prospective teachers of elementary science at the college level) and current programs which stress multi-level instruction to meet the needs of many different children in typical classrooms.

The classroom teacher will find help in the use of Bond and Tinker's <u>Reading Difficulties, Their Diagnosis and Correction</u> (Appleton-Century-Crofts, c.1957). This resource book will aid the teacher not only in science, but in all subjects. Specific reading problems are found in science which are not generally characteristic of other elementary subjects, and the authors treat this area quite well.

It is possible to meet the needs of children with different reading, comprehension, and speed levels in science. Here is a step-by-step procedure on how to do so:

(1) Separate the class into three reading groups as you would do in a typical reading class. Check the reading speed and comprehension notes on each child's performance from his reading class. Use these notes as a guide in setting up science reading groups.

(2) Prepare the following work one day in advance of the lesson:

a. a regular guided reading lesson (that introduces new vocabulary words), sentences for motivation, and oral and silent reading, etc. (Now, perhaps, boys who hate reading will be learning most of their reading in science class.) This is for the average and gifted groups.

b. enrichment work (as someone once put it, "Not more of the same . . . but a study in depth.") for the gifted. Use encyclopedias and resource (multi-level) books and books borrowed from the local or school library.

A typical assignment might be, "Bill, I would like you to research the following man and see what he has to do with our unit on aviation." Print the name of Leonardo da Vinci on the chalkboard. "And Mary, I would like you to research these people." Print the names Icarus and Daedalus on the chalkboard. "Please be prepared to report on these two men to the class. You may work on these reports immediately following your reading assignment for today."

c. a typewritten or handwritten duplicator master sheet containing the basic concepts of the science lesson for today (obtained from the teacher's edition pages which introduce the unit). Re-write any material at least two grade levels below your present grade level.

EXAMPLE:

The D. C. Heath science textbook, Grade 3, lists the following concept in one of its units: <u>The Indians made their homes from the materials they found about them</u>.

If the textbook has 12, 15, or 20 concepts, place all of these on the master sheet, re-writing the words or phrases as you go, to meet the reading needs of the slow learners. Do a good job on these re-written parts--they may be used for several years. Place these in a folder after running off at least 100 copies.

This material is for the slow learners in the class. We have now reached the point where we can say that we are ready for the science class for the next day. We must remember that this unusually large amount of work in preparing a lesson in science will not have to be done every year because we have just done a conscientious job <u>this</u> year. On the following day, these steps should be taken in teaching the lesson:

(1) Separate the class by reading ability into the slow, average, and gifted.

(2) Place comprehensive questions on the chalkboard for the average and gifted to complete when they have finished their silent and/or oral reading. Inform the gifted that they may use library or resource books to investigate some special people who are important in aviation history when they have finished the questions on the board. Have these names on one or more 3x5 cards on your desk or print them on the board as previously suggested.

(3) Pass out the duplicated sheets to the slow learners and instruct them to read the sentences (concepts) carefully and then have them open their books to read the paragraphs containing the information itself.

This way, the slow learners are doing some reading, which is important, ut they are not frustrated by being given too much.

Start all three groups simultaneously with the motivating sentences, and then fall back to the slow learners to help them individually. Inform the slow group that they are responsible for answering the comprehensive questions on the chalkboard, too.

This is possible because the comprehensive questions are derived from the asic concepts in the teacher's edition. When finished with the questions, the low learners may read any additional paragraphs in the lesson--if they wish to o so. It should be noted that they do not have to finish the entire assignent which the average and gifted children are reading. The slow learners hould already have the basic concepts read, and much of the remaining words re extra explanations and superfluous verbiage.

Think back to your own experiences in reading. Do you remember the verbage--or the concepts? The slow learners have been spared from having to ead to the point of frustration. They are learning at a faster rate than efore. They should be happier, or at least more confident of themselves and heir abilities. They are not holding up the other groups and do not feel ushes and pushed at too fast a pace. This is non-pressure reading.

It may be that when some of the average children finish their reading ssignments, they may wish to do some of the "gifted" work. Fine! Perhaps hey can even move up into that group in the near future. Likewise, some of he slow learners may reach a point at which they can also ask for some addiional work in the lesson. Excellent! Mobility is good, even in science eading groups.

UNDERGRADUATE SCIENCE TEACHING METHODOLOGY: A FEASIBLE MODEL

Thomas C. Moon

Certainly this past decade has demonstrated an increased interest in American elementary school science curricula. A wide spectrum of curriculum innovations has blossomed onto the educational scene that profess to focus upon the elementary school child and how he learns science. Many such programs stress the importance of the child within their published materials. And rightly so, for he represents the recipient of that wealth of scientific knowledge deemed important for him as a functioning member of his society. These new science materials also stress the importance of elementary school teachers and how their teaching roles are modified through the introduction of such programs. Across the country workshops and seminars for experienced teachers focusing upon the new elementary science programs have been developed. Yet there must also be instruction in such science innovations for those scores of undergraduate students who have yet to join the teaching ranks professionally. California State College has generated just such a course in elementary science methodology, expressly designed for its undergraduate clientele.

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Perhaps the schematic outline pictured in Figure A gives some indication of the nature of this approach to undergraduate elementary science methodology.

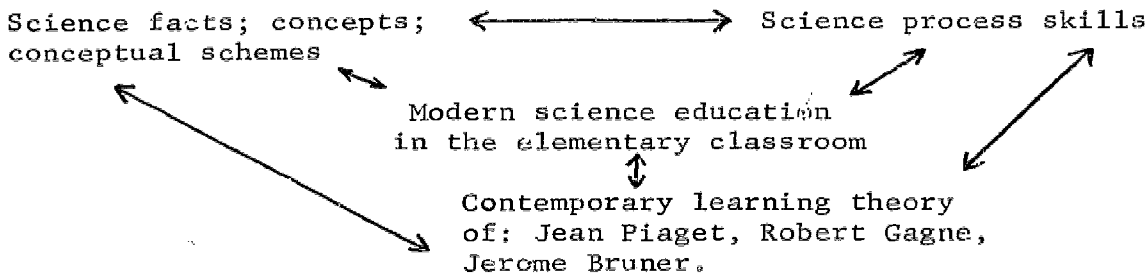

Figure A

Essentially, three basic components are stressed continuously throughout the course's sixteen week sessions. The reversible directions of the arrows in Figure A suggest that there are intimate connections among these three aspects. There is a mutual support among these components that prevents one from easily being divorced from the other two. The end result, a view of modern science education in the elementary classroom, is generated through attempts to create harmony within these subdivisions.

Three of the newer elementary school science programs listed below serve as the primary thrust of the course's activities: 1. AAAS, Science-A Process Approach, 2. The Science Curriculum Improvement Study, and 3. The Elementary Science Study. These programs were chosen for most attention because they have been extensively field tested in elementary classrooms throughout the United States and have evolved into commercial productions currently being implemented in many elementary schools. These programs are critically analyzed through the study of teacher's guides, student manuals, and specimen classroom kits of materials produced by these programs to enhance active student involvement in science experiences. Additionally, the Piaget films on conservation tasks,[1] stressing developmental stages toward mature thought processes, and the various training films sponsored by the Science Curriculum Improvement Study[2] are used to focus upon the teacher's complex role in fostering ideal science experiences for grade school children. Newsletters published by these various programs are also obtained in suitable quantity for individual student distribution.

This course, which has developed under the joint efforts of Professor Hubert Snyder[3] and the author, is heavily laboratory oriented. The students actually perform selected science activities from the three primary programs. For example, the SAPA lessons on the effect of temperature on rate of change and burning time and volume of jars have been used as exemplars of this

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[1]Willard Jacobson and Allan Kondo, <u>SCIS Elementary Science Sourcebook</u> Berkeley: University of California Regents, 1968), p. 137.

[2]<u>Ibid</u>., p. 136

[3]Professor Snyder served as the 1970 President of the Pennsylvania Science Teachers Association.

program's activities.[4] Also, laboratory experiences that are not specifically represented in these new curricula, yet do advocate science process skills, are used. Such experiments using popcorn kernels and alka seltzer, peanuts and a salt solution, and simple pendulums serve as examples.[5]

There are many excellent textbooks currently being produced that ideally would serve the needs of modern science education in the elementary schools. Two such texts used at California State College are those written by Jacobson and Kondo[6] and Hurd and Gallagher.[7] These texts were chosen primarily because they present the historical implications of American elementary school science as well as nicely support those three components graphically displayed in Figure A. In addition, the texts are relatively inexpensive, both being produced in paperback form.

Some schools in Southwestern Pennsylvania are currently implementing samples of these newer science curricular innovations. Field trips are planned each semester for undergraduate students to visit classrooms using these materials. Additionally, some micro-teaching experiences using these science materials has been designed for the undergraduates on a limited basis, involving children from a nearby elementary school. Hopefully, these experiences will be expanded in future course presentations.

Finally, efforts are made to acquaint these students with science curriculum revisions at the junior high and senior high levels as well, so that hopefully they might develop an awareness of some sequence and continuity that good science education attempts to foster throughout the entire educational experiences of American youth.

There is probably no one best way to teach undergraduates elementary science methodology, for much depends upon such factors as physical resources for instruction, individual class size, and the convictions of the instructors themselves concerning what is deemed most important for future elementary school teachers to know concerning good elementary school science. These reflections are offered as one possible alternative to teaching such a course. Thus far, the results of such an approach have been most promising.

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[4]AAAS Commission on Science Education, Guide for Inservice Instruction: Science - A Process Approach. Washington, American Association for the Advancement of Science, 1967, pp. 119-122.

[5]Herbert D. Thier, Teaching Elementary School Science, Lexington, Massachusetts: D. C. Heath and Company, 1970, pp. 225-227, 234-238.

[6]Jacobson and Kondo, op. cit.

[7]Paul DeHart Hurd and James J. Gallagher, New Directions in Elementary Science Teaching, Belmont, California: Wadsworth Publishing Company, Inc., 1968.

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