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Development of K-12 Science Handbook for the Thorp School District

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DEVELOPMENT OF K-12 SCIENCE HANDBOOK FOR THE THORP SCHOOL DISTRICT

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DEVELOPMENT OF K-12 SCIENCE HANDBOOK

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A handbook was created for the Thorp School District to provide teachers with science goals and objectives for each grade level. A science philosophy, a sample evaluation sheet, elementary science scope and sequence, a list of current textbooks, and the sequences of science classes were also presented in the handbook. Curriculum guides from several districts were studied before the goals and objectives were written for the handbook. The research on the needs of a curriculum and the past and current trends in science curriculum was reviewed. The literature regarding science curriculum supported the development of the handbook. Recommendations were proposed.

Acknowledgements

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CHAPTER ONE

Introduction

Statement of the Problem

This paper discusses the project, the development of a curriculum handbook for the Thorp School District, Thorp, Washington.

The project was undertaken for several reasons. There seemed to be a lack of continuity in the teaching of science topics in the district. Many teachers were not aware of the objectives being covered in other classes; therefore, they were duplicating the way other teachers in different grade levels were teaching the objectives. The problem was more apparent when new teachers entered the district. Some teachers were not even aware of the major areas that were to be covered in their science classes.

Procedures for evaluating students in science were not used by teachers in the district. Teachers were not evaluating students once objectives had been covered, and they had no way of knowing which objectives had been accomplished by students.

Also, it was evident that students entering seventh grade science classes had not been exposed to some of the major areas of science normally taught in elementary school.

Again, the problem was more apparent when there was a large turnover of the teachers in the district.

Purpose

The purpose of the project was to develop a handbook containing a broad, comprehensive K-12 science curriculum with objectives written for each grade level.

The description of that project is contained within this paper, a report of that project.

Importance of the Project

The development of the project was necessary and important to the teachers and students of the Thorp School District.

There needed to be a broad, comprehensive K-12 science curriculum that would stress common objectives in grades K-12. With objectives written for each grade level, teachers would be more aware of what topics they were to teach in their science curriculum and they would also be aware of the areas taught by other teachers at different grade levels.

A comprehensive K-12 science curriculum would tend to increase the science knowledge in high school students entering from Thorp Elementary School. If objectives were followed in the elementary school, there would be no duplication in the presentation of objectives between grade levels. A comprehensive K-12 science curriculum would also

tend to insure that all necessary areas would be covered by the time a student enters seventh grade.

Another major reason for developing and implementing the project was to have a science curriculum in the Thorp School District that was comparable to surrounding districts. The larger, surrounding districts had a well-developed science curriculum covering grades K-12. Since the content of district curriculum had been questioned by members of the community, the development of a K-12 science curriculum in Thorp School District would allow students and members of the community to feel greater confidence about the content of the science program. A well-developed curriculum would allow these people to study the curriculum and compare it to surrounding districts.

Limitations of the Project

The major limitation in the development of the handbook was the selection of various curriculum guides for study. All science curriculum guides from Educational Service District #105, Yakima, Washington, were used in the research. Curriculum guides from the curriculum library at Central Washington University were used only if they were published in 1975 or later. By limiting the use of curriculum guides to 1975 or later, current curriculum material was used. All guides from Educational Service District #105 were used since they had guides from the surrounding area. This provided a more logical comparison of the curriculum for concerned members of the Thorp School District.

The handbook did not list all objectives for each grade level. The list of objectives can be used as a guide by teachers and should be compared to objectives presented in their textbooks. Some objectives presented in the handbook may not be used and there may be objectives suggested in the textbooks that are not presented in the handbook.

After reviewing curriculum guides from Education Service District #105 and from Central Washington University, it was found that many of the guides did not list behavioral objectives. In some instances only the general scope and sequence was listed. The handbook, therefore, did not list all objectives in behavioral terms.

Definition of Terms

The terms used in the project and this paper have the following meanings:

Curriculum: Curriculum is the planned and guided learning experiences and intended outcomes, formulated through systematic reconstruction of knowledge and experience, under the auspices of the school, for the learner's continuous and willful growth in personal-social competence (23:163).

Curriculum Guide: The development of a curriculum plan put in written form (18:54).

Objective: Objectives state the specific overt changes in student behavior that are expected to result from participation in a unit of learning activities (18:163).

Science: Science is an accumulated and systematized learning, in general usage restricted to natural phenomena. The progress of science is marked not only by an accumulation of fact, but by the emergence of scientific method and of the scientific attitudes (5:4).

Summary

Chapter one has indicated the problems that led to the development of the handbook, the purpose of the handbook, the importance of the handbook, the limitations pertinent to the development of the handbook, as well as the definition of terms. Chapter two will summarize the review of selected literature pertaining to curriculum development and science curriculum.

CHAPTER TWO

Review of Selected Literature

Introduction

The science curriculum has undergone many changes in the past and is now in the process of changing for the future. The review of literature includes a brief overview of science curriculum in the United States, the development of science curriculum, and the current trends in science curriculum.

Overview of Science Curriculum

Profound changes in the science curriculum began in the United States during World War II. Before World War II, science in high school was taken mostly by students preparing for college (17:30). With the war came the rapid development of scientific research and technology. The skills of science and technology were needed in our defense programs.

After World War II, the National Science Foundation (NSF) was established to promote basic research and science education. Millions of dollars were spent on science course development (17:30). (This began taking place in 1950.) From 1957 to 1967, Congress also spent millions of dollars on science education under the National Defense Education

Act (17:30). The NDEA was actually started shortly after the launching of Sputnik by the Soviet Union.

The great influx of money into science and the "space race" caused many evident changes in the science curriculum. The curriculum changed from student-centered to discipline-centered, and it changed from teacher selection of sequences to teacher use of instructional packages containing whole lessons (3:71). Approaches to science laboratory work also changed. Laboratory work was an essential part of the course used to raise problems as opposed to verifying known information (3:71). The science curriculum became interpretive and theoretical instead of descriptive and applied (3:71).

The new trend in curriculum at this time necessitated more inservice training for science teachers. Teachers were finding that their college training was not sufficient. The NSF sponsored several inservice programs for teachers. Teachers were encouraged to go back to their schools and identify students who would excel in science and counsel them into higher education science programs.

Many new programs were developed at this time. In biology the Biological Sciences Curriculum Study (BSCS) was produced. In chemistry the Chemical Education Materials Study (CHEM) was produced. In physics the Physical Science Study Committee (PSSC) was developed. These, and other similar programs in other science areas, were complete with textbook, workbook, laboratory book, films, goals, objectives, and a general curriculum.

Problems with these programs soon developed. First, these programs were geared to above-average students who already had an interest in science (17:30). Average and below-average students were simply left behind. Second, minorities and women were by-passed (17:30). And, third, the science education of students not heading for careers in science was neglected (17:30). Also, there was a much wider gap at this time between the elementary, junior high, and secondary science curriculum.

In the past there generally seems to have been little emphasis on science in the elementary science programs so that there will be a better base for high school and college science programs.

Development of Curriculum

A national study conducted by I. R. Weiss for the National Science Foundation in 1978 showed that science at the elementary level was of less importance than many other subjects (8:645). S. L. Helgeson conducted a study in 1977 that showed that only 50% of the high school students above the tenth grade were taking science (8:645). Several schools at this time began asking for help in the area of science curriculum development. They were lacking in goals, in assessment tools, and they were confused with the onslaught of commercial programs. Also, leadership for establishing goals and objectives was lacking in many schools.

It is important that in districts where curriculum development is taking place that the principal be involved in a leadership role. This may at times create problems since some principals do not have training and experience in this area. The minimum requirements are not the same throughout the United States for all principals. Certification requirements are usually stated in broad terms and usually only one course in curriculum meets the minimum requirements (13:159). This does not provide most principals with much instruction in curriculum. This problem could be eradicated by three actions.

> First, all states should specify definite requirements for professional course work in curriculum as a component of the principal's licensing requirement. Second, internship programs providing the opportunity for "hands on" experiences in curriculum development should be conducted under professional practitioneer supervision. Finally, there is a need to recognize the problem as it affects current practitioners. Such recognition would be a first step in developing inservice programs and/or additional formal education procedures to improve the skills of practicing principals. (13:159)

Although these problems may exist in a district, the principal still must act as a leader in the planning of curriculum. He must be able to show the need for a curriculum and establish a goal for the school in terms of curriculum development.

The science curriculum in many districts is undergoing change. Teachers must be able to bridge the gap from the old to the new curriculum. They need to be able to work on curriculum planning committees and they need to be able to

change their classroom teaching style in order to accommodate the new curriculum.

Curriculum planning involves many different people and there needs to be cooperation from all people involved. A curriculum planning committee should involve the principal as the leader, teachers, students, and interested community people. The entire group needs to plan procedures to be followed and there needs to be a group consensus in decision making (2:13).

There are several advantages in using a variety of people in curriculum planning.

> There is improved understanding in the area of curriculum and classroom procedures on the part of lay people. Those people involved in the planning will also support the program. By involving community members, they develop a pride in their school and the school program quality improves (2:14).

Again, it is important that the principal be involved. He needs to provide encouragement and set the climate for the group at the beginning. As the work of the group progresses he may delegate more authority and become a less evident leader.

In their classrooms, teachers must guide students by making small changes at a time and proceeding slowly from the old curriculum to the new curriculum. Richard L. Butt, Associate Professor, McGill University, Montreal, Canada, states five phases for a transitional curriculum change.

> Phase One: Establishing Two-Way Communication
> The objective of this phase is to establish two-way oral interaction between the teacher and children, and to encourage children to think.

Phase Two: Eyes On
The objective of this phase is to change the focus from the text to real events and materials but without pupils manipulating the materials.
Phase Three: Hands On
The objective of this phase is to introduce pupils to direct manipulation of materials.
Phase Four: Building Group Skills
The objective of Phase Four is to build group skills.
Phase Five: Implementing Pupil Intentions
Phase Five focuses on a gradual increase in pupil participation in making decisions about how and what to learn. (4:117-119)

This transitional curriculum focuses on curriculum content with student input.

Specified procedures need to be followed when revising a science curriculum. The Iowa Department of Public Instruction has developed guidelines for the implementation of a science curriculum.

1. Select science curriculum committee.
2. Schedule time and budget finances for curriculum work.
3. Discuss current problems and trends in science education.
4. Review rationale for science.
5. Review Iowa State Code.
6. Develop a philosophy of science teaching.
7. Modify objectives.
8. Placement of objectives.
9. Assessment of current program.
10. Decide on level of revision required.
11. Assess physical facilities and recommend changes.
12. Match curriculum needs with available curriculum materials.
13. Present to science staff several possibilities.
14. Visit other schools.
15. Pilot possible programs.
16. Notification of administration.
17. Provide inservice for teachers.
18. Evaluate program.
19. Evaluate students.
20. Periodic curriculum review. (8:648)

This implementation schedule will give a curriculum committee a clear idea of steps to be followed in the development of a district-wide science curriculum. Some areas of this schedule may be omitted by districts if they are not applicable.

Current Trends

During the 1970's there was a reform to introduce new subjects in the area of science. There was a break from the traditional curriculum to multidisciplinary approaches. The community wanted new and better coordinated programs in areas such as environmental education, drug abuse education, and sex education. At the same time the community started demanding that schools return to basic education.

This "back-to-basics" movement did not necessarily stress science and, therefore, less time was spent on science in the schools. The United States has, in fact, decreased science requirements while Japan, Germany, and the Soviet Union have increased the science requirement in the schools (9:22). It would seem that the major goal of science education should be to develop scientifically literate citizens in any technologically advanced society.

The "back-to-basics" movement allowed science education to play several different roles. Science education could contribute to increasing knowledge of subject matter and concepts, to improving manipulative skills, to developing logical structures, and to encouraging an understanding of scientific processes and the nature of science (22:633).

Keith B. Lucas has suggested five broad science curriculum objectives for the future.

> 1. To build an awareness on the part of the student of the important role of scientists in the building of an improved future for mankind. Overpopulation and our diminishing energy resources are two problems that must be solved in the future.
> 2. To immerse students in the practice of science in teaching for solutions to significant social, political, and moral problems of both local and universal import.
> 3. To preserve the dignity of the learner while building learning experiences upon individuals' personal assets rather than the structure of academic disciplines.
> 4. To explore the big ideas (major conceptual schemes) of science which have led to man's current understanding of the universe, resulted in far-reaching technological achievements, figured in civilization's major problems, and presented some of the most exciting challenges for the future.
> 5. To ensure that students learn how to learn so that solution of future problems with which they will be confronted will not be prevented simply because the relevant information was not learned in school. (14:318-321)

Incorporating these broad goals into a science curriculum is an enormous task. The public today is insisting that there be some system of accountability for student learning and districts are being asked to provide data regarding student progress. Science educators are stressing a continuous curriculum from K-12 that is not based on individual teacher likes and dislikes and they are stressing a sequence of instruction at the district level. The computer is an important and useful machine in this area. The computer can store the curriculum data that can be easily retrieved and the computer can report on students, classes, grades, schools, and district by content area or by concept.

The science curriculum being developed now is stressing the importance of laboratory experiences in science education.

> The National Science Teachers Association endorses the necessity of laboratory experiences for teaching and learning in science. Adequate support for materials, equipment, and teacher time must be available for schools to maintain quality science instruction. Such a quality program is critical in today's age of science and technology. (25:42)

Summary

This chapter summarized how a science curriculum should be developed in a school district. The review of selected literature also presented ideas that show the development of science curriculum in the past and in the present.

Science educators need to be aware of past and current trends in science when they are planning a science curriculum for their district. Chapter three will describe the procedures followed in the development of the science curriculum handbook.

CHAPTER THREE

Procedures

Introduction

The purpose of this chapter is to discuss the procedures used in the development of the handbook. This chapter is divided into two parts: purpose of the project and the procedural steps used in developing the handbook.

Purpose

As stated in chapter one, the major purpose of the project was the development of a science curriculum handbook for the Thorp School District. The handbook was specifically designed for elementary teachers and secondary science teachers in the district.

Procedural Steps

The problems that led to the development of the curriculum handbook were discussed in chapter one of this paper. After studying these problems in the district and after realizing the importance of such a handbook, several procedural steps were followed in the actual compiling of information and completion of the handbook.

First, a meeting with the principal was conducted so that he was made aware of the existing problems in the science curriculum. The principal at this time was also

made aware of the importance of the handbook and how it would benefit the students in the district. The principal gave his approval for the development of the science curriculum handbook at this meeting.

Second, teachers were interviewed so that a determination could be made concerning what they were teaching in their science classes. It was apparent after interviewing the teachers that they were not following a specific list of objectives for science in their classrooms. Also, the teachers were not aware of what was being taught in other classrooms.

Third, after completing the preliminary work at the school, curriculum guides were studied. Curriculum guides from Educational Service District #105 and from Central Washington University were studied to compile a list of science objectives for all grade levels.

Fourth, other data were collected for the handbook. The scope and sequence currently used by the elementary school was duplicated, a list of all science textbooks used in the district was compiled, and a sample evaluation sheet was designed. After compiling the objectives and collecting other necessary data, the handbook was assembled.

Summary

This chapter described the procedures used in developing the curriculum handbook. The major emphasis of the project was placed on writing objectives and compiling other

pertinent information for the handbook. The handbook will be described in chapter four.

CHAPTER FOUR

Description of Project

Introduction

The handbook was not included in this paper. Therefore, a description of the handbook and a list of the sections in the curriculum handbook are included in this chapter.

Description of Handbook

The handbook suggested the major science objectives to be presented to students in each grade level. No attempt in the handbook was made to cover all goals and objectives for each grade level since they could be obtained through textbooks and manuals. The preface of the handbook indicated that individual teachers may wish to add objectives of their own, but that the objectives listed in the handbook that correspond to objectives in the textbook should not be deleted from the curriculum. It was also stated in the preface that the general scope and sequence should be followed in the elementary school as it was written by textbook publishers.

Many objectives in the handbook were presented in more than one grade level. It was important that all objectives be presented in the lower grades so that students would have some understanding of the concept when it was presented

in a higher grade level in a different and more challenging form. This would be an asset to students when they enter junior high and senior high science classes.

The following sections were included in the curriculum handbook:

1. Preface.

2. Science philosophy.

3. Objectives for grades K-6 in the areas of life science, physical science, earth science, and health education.

4. Objectives for living science in the areas of cells, chemistry, the human body, the human senses, behavior, and plants.

5. Objectives for earth science in the areas of astronomy, geology, the atmosphere, oceanography, and the earth's surface.

6. Objectives for physical science in the areas of electricity, chemistry, heat, light, sound, energy, and forces.

7. Objectives for biology in the areas of living things, the metric system, chemistry, cells, energy, reproduction, evolution, plants, animals, and dissections.

8. Objectives for chemistry in the areas of general chemistry, chemical formulas, states of matter, solutions, organic chemistry, chemical reactions, and the periodic chart.

9. Objectives for physics in the areas of matter and energy, force and motion, heat, sound, light, waves, electricity, and the structure of matter.

10. Sample evaluation sheet.

11. Current elementary science scope and sequence.

12. Sequence of science classes.

13. Current textbooks.

14. List of references.

A copy of the handbook as completed for the District and for the project requirement is attached for the convenience of the reader.

Summary

The major portion of the handbook suggested science objectives for the Thorp School District. The other sections of the handbook that were listed in this chapter were included in the curriculum handbook as an aid to teachers in the district. Chapter five will discuss the summary, conclusions, and recommendations of the project and this paper.

CHAPTER FIVE

Summary, Conclusions, and Recommendations

Summary

There has been a concern with the lack of continuity in the science curriculum among the teachers of the Thorp School District. Some students entering high school science classes have not been exposed to a few of the basic science concepts that should be introduced in the elementary school.

The specific purpose of the project, as indicated by this report, was to develop a handbook containing a broad, comprehensive K-12 science curriculum with objectives written for each grade level.

The use of this curriculum handbook by the teachers in the Thorp School District may provide a logical sequence of events for the teachers and students to follow. The students will be able to investigate, to observe, to experiment, to hypothesize, to organize, and to learn for themselves the principles and major concepts of science as suggested within the handbook.

Conclusions

Major conclusions were reached by the writer after assembling the curriculum handbook and researching the literature.

1. The science curriculum has undergone radical changes during and after World War II. During the late 1970's and early 1980's the public demanded more curriculum changes. In order to be accountable, school districts have had to make the necessary revisions in their curriculum.

2. The development of a science curriculum in a school district needs to involve all teachers of science in grades K-12. It is important that the principal or curriculum supervisor be involved in the leadership of curriculum development. Input from the community is also needed during this time.

3. The development of the curriculum handbook for the Thorp School District will give teachers more explicit directions to help in planning their lessons. The curriculum handbook may also allow them to become familiar with science objectives being taught by other teachers.

Recommendations

The writer recommends that:

1. The curriculum handbook be adopted by the Thorp School District board of directors.

2. The handbook be implemented in both the elementary and secondary schools.

3. Copies of the curriculum handbook be made available to the public and to Educational Service District #105, Yakima, Washington.

4. The science curriculum be continually updated to remain current and encompass new areas of science.

5. The curriculum handbook be evaluated and revised if necessary on an every-other-year basis, with input from the community.

Finally, while not specifically derived from the project, a comment regarding science seems appropriate. It was apparent from the literature that there was a great impetus in science education during the late 1950's and early 1960's. To the writer, this impetus seems to have been somewhat lost in the schools of the United States today. This writer strongly recommends that since we are entering a highly scientific and technological future, that much more emphasis be placed on science education in the elementary and secondary schools.

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