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Motivating a Fifth and Sixth Grade Classroom Interest by Teaching Science Units at the Center of the Curriculum

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MOTIVATING A FIFTH AND SIXTH GRADE CLASSROOM INTEREST BY TEACHING SCIENCE UNITS AT THE CENTER OF THE CURRICULUM

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CHAPTER I

INTRODUCTION AND PURPOSE

Teachers are always faced with the need for motivating their students in some manner so that the regular curriculum might become challenging as well as become a functional tool to them. It is precisely this which the writer had in mind when he became aware of the need for motivating a group of fifth and sixth grade students during the school year of 1960-1961.

There are many ideas written about how or what to use to motivate the children so that school studies might become more interesting as well as more practical. This writer decided to do research in the classroom by using science as a motivational device at the center of the curriculum. It was hoped that the specific categories chosen--the studies in magnetism, electricity and electronics--would bring about a normal or higher growth in the skills and knowledge which constitutes the elementary school curriculum.

JUSTIFICATION FOR THE STUDY

During the writer's student teaching experience, while directing a class in magnetism, electricity and electronics, he noticed that practically all students were greatly interested in these areas. As a matter of fact, many of these students tried to do experiments at home by themselves.

It was quite obvious that there had been considerable interest on the part of these children. The principal, Eyler Elliott, and the supervising teacher, Jack Hailey, of the Garfield Elementary School, in Yakima, Washington, had mentioned that the children's parents were pleased with the study.

Because of the interest these students exhibited the writer (the teacher) considered the possibility of using these science categories as motivating devices in making the regular curriculum studies more interesting. He also hoped that these science units might contribute some science knowledge which might satisfy youth's yearnings for understanding his scientific environment.

A considerable number of writers have written about the pros and cons of the importance of science in the curriculum of today. Some claim that the sciences do not receive the time they deserve in the classroom. Other writers complain that the present curriculum is so full with subjects which are basic necessities that more time for science would deprive students of subject matter that makes for a well-rounded background. It is suggested that the solution might be found in placing the sciences at the center of the curriculum. It is contended that children enjoy the mysteries of the sciences so that they will work more seriously on the regular studies to obtain privileges in the interesting sciences. Children will waste less time in disinterested study of regular subject matter in order to enjoy the study of the phenomena of their environment. The important thing is that the sciences be made interesting enough so that they become motivational.

In this experimental study the writer offers the hypothesis that interesting science studies and projects at the center of the curriculum will motivate fifth and sixth grade students toward realizing their need for learning the basic tools of reading, language, and arithmetic, etc. It is hoped, further, that young students might become interested in science research, the crying need of modern times.

THE EXPERIMENTAL PROBLEM STATED

The problem was to set up a classroom situation in which fifth and sixth grade students were able to use the study of magnetism, electricity, and electronics in such a way that interest and motivation toward regular curricular studies could be stimulated. The following devices were chosen to evaluate the experiment: (1) interest and motivational questionnaires, (2) a science completion test, (3) The Iowa Basic Skills Test, and (4) the behavior journal.

The class was to be taught the regular studies for several weeks before introducing the study of magnetism, electricity, and electronics. The purpose was to allow time for the teacher to become acquainted with the students and to observe how well they would work without special motivation. After several weeks of regular teaching the study in science was to be introduced by providing manipulative motivational devices and materials (which are discussed in Chapter III).

The reason for introducing the many devices was to allow the students to observe what these gadgets and manipulative materials were as a whole. They were to use and play with them as well as to study them. In this way they could relate them to their past experiences. It was felt that once they had become acquainted with these devices the students would be ready to make projects of their own.

The students were to be encouraged to do research work, as well, since an adequate science library was to be made available wherein they could find instructions for making all kinds of projects not already demonstrated.

After the students became acquainted with the devices they were to be allowed to choose the project they preferred to build. Students were to be encouraged to work independently or in committees and were to be given the help needed to accomplish some success in making their chosen project.

Those boys and girls who devoted greater effort in the regular curricular studies were to be allowed privileges to work with science projects. Extensive records were to be kept on the regular studies to determine which pupils were entitled to science privileges.

Shortly after the motivating devices were introduced the teacher planned to explain and demonstrate some teacher-made projects. Schematic diagrams of a simple diode radio, code oscillator, and an electronic amplifier were to be placed upon the bulletin board. Several science periods were to be taken to explain these diagrams and the various symbols designating electronic parts and what their functions were.

Because this science set up was available upon work benches in the classroom the students had full access to them at all times. The pupils themselves determined the amount of time they had to manipulate and experiment. They simply had to show the teacher that they were working up to their individual level of ability before they were allowed science privileges.

LIMITATIONS OF THE STUDY

The study was limited because:

1. The classroom consisted of two grades, a fifth grade and a sixth grade, which left little time for the teacher to provide the amount of individual help desirable not only in the science specialty but also in the regular studies.

2. The 1960-1961 school year was the teacher's first year of teaching and, therefore, he had no previous experience with many classroom problems.

3. Many of these children had serious behavior problems and they needed to learn self-discipline and self-restraint for independent research.

4. The effectiveness of the experimental program was reduced to some extent because, at the suggestion of the principal, the time available for working at the science table was reduced to allow for longer periods of time to be spent on the language arts after the month of February. The experimental equipment was removed in March. The actual time used for the experiment was restricted to approximately five months of the school year.

CHAPTER II

REVIEW OF RELATED RESEARCH

A significant number of authorities have written about the problem of bringing science into the regular school curriculum. Some would have it set up as a separate subject and recommend that much more time be devoted to it than has been done in the past. Other authors claim that the basic studies--the three r's and others--are of utmost importance and they suggest neglecting science if there were not sufficient time for it in the crowded curriculum. Still other authors contend that if schools really want to teach the felt needs of the students in their schools they can't, under any circumstances, leave science out of the schools. Many authors intimate that students are constantly alert for strange phenomena and they must be given the opportunity to satisfy their yearning for scientific discovery. Furthermore, one way to make students understand the need for basic skills learning may be to provide problem-solving sciences which are interesting to students so that they might recognize how beneficial basic learnings are to them. The problem is how to determine in which sciences students are interested.

Sam S. Blanc said: ". . . Very little has been done to scientifically discover the areas and topics in which the pupils are actually interested and which they would like to study (3:161)."

In another article Mr. Blanc speaks about research in the area of student interests in the sciences:

> . . . Zim published a report of a comprehensive series of investigations into science interests of adolescents in 1940 . . . . As a unit in the study of adolescents, this investigation attempted to explore the typical science interests and activities and to interpret their significance to these young people . . . . The general conclusions reached in this study were as follows:
>
> 1. Although there is evidence that interests change gradually with age during the adolescent period, these interests are permanent enough to warrant their use in curriculum construction.
> 2. School science does not seem to be an important source of adolescent interest; many of these develop through outside activities which are thus potential sources of education.
> 3. Both sexes exhibit a strong interest in topics related to health, growth, and reproduction, but, in general, boys are more interested in electricity and mechanics, while girls show a preference for biological aspects of science.
> 4. Certain science areas are more productive of specific adolescent interest than other areas.
> 5. The science interests of adolescents are specific rather than general.
> 6. Adolescent boys are about five times as active in science as girls.
>
> Drill, in the study of children's interests in science made in 1945, attempted to obtain reasons for interest in certain topics. On the basis of 47,330 contributions submitted by 10,453 children the following conclusions were reached:
>
> 1. Forty per cent of all the contributions throughout the grades indicated interest in science phenomena.
> 2. Boys showed [sic] greater interest in science than girls.
> 3. A slight advantage was shown in favor of biological science over physical sciences.
> 4. Seventh and eighth grade children showed keen interest in maintaining health.
> 5. Children were interested in specific science items rather than in scientific generalizations.
>
> . . . There were a number of differences in the specific areas of interest between boys and girls, but, in general, there was more agreement than disagreement

on what both boys and girls would like to study in science. The field of interest which was of greatest interest to pupils at all levels was physical science (2:166-68).

Hubert M. Evans speaks about interest, motivation, and the need to use science to integrate the total teaching-learning situation:

> . . . Most educators are familiar with the psychological dictum, "no motivation: no learning." Most of us would agree that interest and motivation go together and are essential to learning. Yet how seriously; how often are they interpreted intrinsically rather than extrinsically; how often are they used systematically and constructively as criteria for judging the educational worth of classroom experiences. The answer is, surely, not often enough. This suggests, to me at least, the need for research and action focused on the development of the kinds of learning situations where pupils have a fair opportunity to develop intrinsic interests and motivational patterns which will lead to genuine learning of the sort specified in our educational goals and objectives. It is my opinion that this represents the correct approach to ridding the classroom of the "felt need" of the teacher to invoke the traditional psychological threats and repressions as motivational devices, all too common in our classrooms today.
>
> The science educator is fortunate in that he may develop such a variety of learning situations traditional to his work as a teacher. That many of these learning situations are often underdeveloped could be the understatement of the year. What I am referring to here specifically are field work, the laboratory and demonstration experience and student projects. It is not that science teachers are unaware of these learning situations or that they do not utilize them from time to time. The point is that the interest, motivational, and thus learning potential of these experiences are seldom fully developed and integrated. Surely there is room and need here for further research; not to determine or compare the educational worth of the field experience, the laboratory experience, and the project experience, but to find out how the educational potential of these experiences may be fully developed and exploited, and integrated with the total teaching-learning situation of which they are a part (6:412).

Helen J. Challand feels that students use certain content to solve problems. She stated: " . . . When a child selects and uses certain content in solving problems, he is improving his understanding of the functional use of subject matter (4:363)."

Many people are worried because science uses a technological vocabulary which is so far beyond the average citizen's understanding. One such person is Dwight D. Eisenhower, who has made this comment: " . . . Because of the growing importance of science and technology, we must necessarily give special, but by no means exclusive, attention to education in science and engineering (5:103)."

Illa Podendorf mentioned the need for teachers to provide the proper balance in student background regarding basic learning skills for creative work in science in this way.

> . . . It is the teacher's job to establish the proper balance at each grade level so that children may have opportunities to use reading and writing skills to handle equipment in building and background which is necessary for more creative work in science (11:287).

E. Bernice Owens wrote about the need for schools to provide all children some opportunities to pursue their interests when she said:

> . . . If our schools will provide opportunity for all children to pursue their scientific interests, those children who gain intense satisfaction from the science experiences will have the opportunity to develop science-talent. I feel it important that all children have these opportunities since the studies done by Strauss seem to offer conclusive evidence that the "science-

talented" is not necessarily the individual who has a high I.Q. nor the one who makes high marks in school.

At the same time, it seems important that we heed such warnings as "Science alone will not save us," and "We are in danger of selling our birthright for a mess of pottage if we make the development of scientists our prime objective." Should we not strive to provide opportunity for the development of numerous and varied types of talent by thinking of our science program only as an integral part of the total elementary school curriculum (9:323-24)?

A. Harry Passow preferred to provide for the fast learners according to these statements:

. . . Terman's study of scientists and non-scientists found real differences in the interests, abilities, and social behavior of the two groups. Yet if we are to progress, the scientist and the non-scientist must understand each other and the world of science. Such understanding can come from adequate science programs which are appropriate for different kinds of rapid learners.

Adequate science programs will have varied purposes. For all rapid learners, whether potential producers or consumers of science, the program should result in basic understandings and meanings which constitute science in general education. The emphasis should be on ideas, concepts and relationship and not on information alone. The program should stimulate intellectual attainment and scholarship for all. It should develop inquiring minds, ignite curiosity and reward constant seeking of responses to the question "Why?" It should provide students with problem solving experiences and an understanding of the process involved. The program should stimulate a desire for learning, seeking, and studying (10:105).

Steven J. Mark indicated the need for teaching science in every grade, including the kindergarten. He claimed:

. . . Science should be structured in the elementary grades along the same lines of significance as the three r's. Psychologists have proved that children, even those in kindergarten, are ready to learn to read, write, count, and study science sooner than what most teachers believe them to be ready for these experiences.

> The children come to school with a greater wealth of knowledge about their world than did children of years ago. This has been made possible by their great interests in reading, television, and travel. There is a need for children in the elementary grades to spend less time in the sand box, in finger painting, in the making of dolls, and in building block houses. More time must be spent on the meaningful content.
>
> Starting with kindergarten, each child should be given opportunities to master basic science content and concepts in terms of his needs and abilities. Functional science vocabulary must not be overlooked. Science, as a basic subject, should be taught in each grade. It should be organized in such a manner that each teacher knows the science experiences the children had the previous years, those they are to have this year, and those they will have the following year. Such planning results in continuity in the science program (8:558).

Illa Podendorf feels that children may not be capable of being creative at first. She realizes that there are different definitions for the word creativity:

> The word creativity has different meanings for different people depending upon individual points of view and circumstances . . . . The discovery by children that an electric circuit may be shorted if certain things are done or that air expands where it is heated are examples.
>
> Career scientists must be creative--they must do that which has never been done before. Children can be expected to be creative to some degree. They are busy learning what is already known in the field of science. It is our job as teachers to help children gain command of sufficient background and to gain it in such a way that they will get experience doing something which in their experience has never been done before. They need the practice and the thrill of putting to work and coming out with new ideas and achievements. Not every child is equally creative. But every child can profit from experience in using the creative ability which he has (11:286).

A. Eldred Bingham points out that to teach creatively interest must be awakened and then it must be followed-up by developing it. He relates what happened when these interests were brought to the fore:

> To teach creatively one must either discover or awaken interests in children and then develop these interests. Teaching must be adjusted to a wide range of ability, interests, and ambitions . . . . The boys and girls must share in the planning activities as well as in the doing activities. All will not learn exactly the same things, although most of the members of any class will learn many of the same things. Able and interested ambitious children will be stimulated to do their best.
>
> Each will be encouraged to develop his unique talents. Some will learn to read and write and figure, using quite different materials than others. Of course, for particular techniques certain materials may be used by all--but this common experience will comprise but a small part of the total class activity. Reference materials of many kinds will be used extensively in connection with the solving of problems or the doing of projects. Many experiments will be done.
>
> The enthusiasm and devotion of the teacher will permeate the room. In short, the teacher will have arranged a situation where each child is stimulated to think and act creatively and is concerned to help others do the same (1:271-72).

Illa Podendorf recognizes the problems the teacher faced in attempting to organize the class so that all students were able to benefit fully in the use of available equipment and time when she points out:

> The difficulty which many teachers face is to find a way to organize the class so that each child will have an opportunity to use the available equipment without a waste of time on the part of other children. Many times the size of classes or the lack of equipment makes carrying out a program of individual experimentation extremely difficult (11:288).

Arnold M. Lahti makes these suggestions in how the classroom might be set up for teaching science:

> One of the important questions the classroom teacher would ask is, "How can it be done in the crowded classroom?" We all agree, I'm sure, that a laboratory period for everyone is not the answer for an elementary school.

> The science corner has been used, primarily in the primary grades, for exploration of objects and manipulation of materials. Perhaps, the science corner can be adapted for the individual experiments. Materials can be placed upon the science table. Along with the materials is included a sign which asks the question to be solved by the manipulation of the materials . . . . Can experiments be found which can be set up in the science corner or on a table so that children who have completed other work may spend some time trying to solve the problems. This seems just as appropriate as allowing the child who is finished to read, draw, use clay, or do some other activity. If the children are interested in this sort of thing they must actually ask questions and design experiments to answer the question. This is the crucial aspect of scientific discovery and, parenthetically, creativity in any area in human knowledge (7:322).

Illa Podendorf intimates that elementary schools need not turn out scientists, but rather should provide these children with a science background when she declares:

> . . . Children have a natural interest in science. The nature of the science content makes it possible to give children many opportunities to be creative. Elementary science teachers are not expected to turn out finished scientists--they are expected to give children the opportunity to acquire suitable content backgrounds and to give them experiences that will be a good foundation for doing scientific research and for making creative contributions (11:289).

CHAPTER III

THE EXPERIMENTAL DATA

EXPERIMENTAL SETTING

The experiment for motivating regular curricular interest through the special emphasis of science units at the center of the curriculum was carried out at the Ruth-Childs School, an elementary school within the Yakima, Washington, Public School District. This is a five room unit separated a short distance from the larger Jefferson Elementary School of which it is a part. The first three grades were separate classrooms. Grades four, five, and six were split into a fourth and fifth grade combination and a fifth and sixth grade combination classroom. It is the latter group which was involved in this experiment. The number in the class never exceeded twenty-seven at any one time and twenty-three of these students were in attendance throughout the experiment (eight boys and six girls in the sixth grade, and six boys and three girls in the fifth grade).

To do this research it became necessary to secure permission from the supervisors of the district. The first person contacted was the elementary supervisor of the Yakima Public Schools of Yakima, Washington, Miss Helen Peterson. She was very cooperative in discussing this problem. Since she could see no possibility of finding, within the district, another fifth and sixth grade combination classroom which might be used as a control class she suggested that other means of evaluating the results for one class should be considered. The questionnaire, the Iowa Basic Skills Test, a science completion test, and a behavior journal were chosen for this purpose.

Miss Peterson suggested that permission for this research be obtained from the principal, Mr. Joseph Brown. Mr. Brown considered the project "very comprehensive" and suggested that it be inaugurated. He suggested that Mr. Milton Martin, the superintendent of the Yakima Public Schools, be informed about the project. This was done. Mr. Martin gave his complete endorsement of the study.

The experiment was conducted during the months of October through March of the 1960-1961 school year. The time involved was about five months. The beginning of the year (six weeks) was used for review, and survey tests were given to determine where these students needed help. Wood carving provided some information as to how these students could handle tools. The latter part of the school year, i. e., after March, was used to complete the study courses, and to review the regular subjects.

THE EXPERIMENTAL ACTIVITIES

After the first six weeks the teacher decided that the time had come to introduce the experimental program by giving the students the various questionnaires, the completion test, and The Iowa Basic Skills Test. No information of the science plans was divulged. Some of these means for evaluating the results of the experiment were given again at the end of the experiment to compare the earlier and later results.

The manipulative materials, teacher-made project demonstrators, such as the simple radios, simple telephones, the five-position code oscillator, magnetic coils and others, were introduced gradually. These were demonstrated by the teacher during a couple of science periods. After these items were displayed on the work benches the students were advised that they would be permitted to manipulate and play with them after their regular studies had been completed satisfactorily. When it appeared that everyone had used some time in getting acquainted with the above mentioned gadgets other equipment and materials, the permanent and electro-magnet, iron fillings, dry-cell batteries, power packs, transformers, record player, electronic amplifier, volt-meter, compass, oscilloscope, tools, miscellaneous electronic parts and wire as well as other items, were introduced. Some of these things may be recognized in figure one, on the following page, which shows two work benches pushed together to provide space for displaying some items mentioned.

The students seemed surprised at what they found on the work benches. A couple of girls mentioned that these

FIGURE 1

The Science Table Display

things were of more interest to boys than to girls, but after the teacher had denied that this should be true all cautiously approached the science tables to acquaint themselves with what was available. They soon threw caution to the wind.

The study of magnetism was emphasized as long as there was considerable interest. A science period was used to explain the various materials. Those students having extra time were encouraged to make reports from research. Several reports were well done and were given orally during a science period or exhibited on the bulletin board. After this all students were asked to make a demonstration on the magnetic lines of force (see Figure 2). This was done by

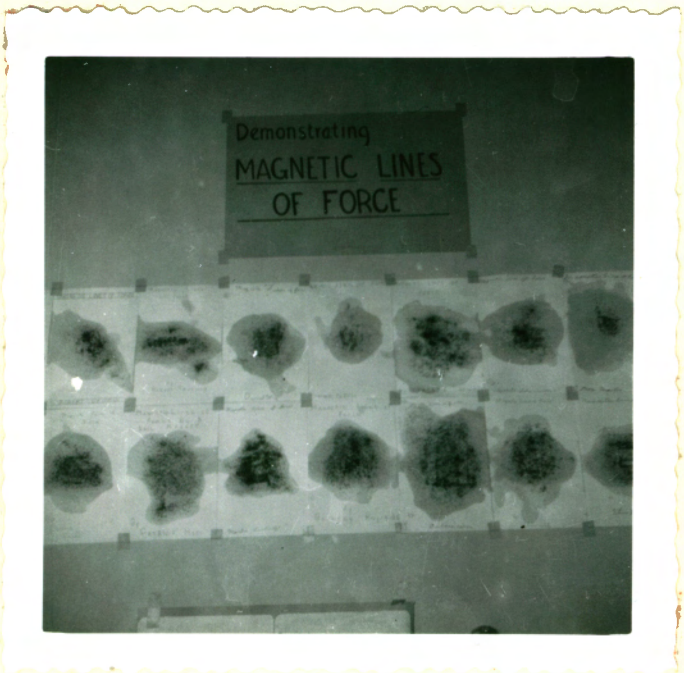

FIGURE 2

Demonstrating Magnetic Lines of Force

placing the permanent magnet under stiff paper, using a charcoal igniter to melt wax onto the paper, spreading the iron fillings over the hot wax and then allowing it to cool. The students were now able to see and visualize the magnetic lines of force.

The students were eager to make the project demonstrating the magnetic lines of force. Many wanted to remain after school hours to manipulate science materials.

These students were very awkward in the use of the tools needed. This, then, became a good lesson in the use of tools. Safety first was an essential practice because there was the possibility of getting burned by the charcoal igniter. Another problem encountered during this class project was how to convince students that they couldn't all make their projects at the same time. They had such a "now or maybe never" attitude about getting the project done that it became a lesson in sharing the equipment.

The students enjoyed the study of magnetism for several weeks. There was a definite trend toward getting more of their regular study assignments completed on time. Some even requested assignments ahead of time for homework--assignments such as are often found at the end of the textbook chapters. There was no definite trend toward better grades from tests at first. This appeared to be due to students' inability to retain many facts from reading materials. There was a trend toward better study habits. Some students, however, worked faster than accuracy permitted in arithmetic. This habit was eliminated, to some extent, by requesting that the students do their work over.

The second all class project was to make tin can telephones. This introduced the study of sound vibrations.

The project on simple telephones incorporated science with art and citizenship because the students were encouraged to draw cartoons on art paper. This was used to wrap the sides and one open end of the tin can telephone (see Figure 3). The drawings suggested the need for sharing the party-line telephones with politeness.

FIGURE 3

Simple Tin Can Telephones

This telephone required such components as a tin can, open at both ends, and a button tied to a waxed string, after being inserted through a small hole in the stiff paper cover at one end of the tin can. Two cans connected together by one waxed string were used interchangeably as transmitter or receiver.

Two other types of simple telephones made were the carbon rod and razor blade types (see Figure 4). Both

FIGURE 4

Carbon Rod, Razor Blade and Tin Can Phones

require a box as a sounding board. Earphones, and dry cell batteries were placed in series with either the carbon rods or the razor blades. A pencil lead was placed between the two carbon rods and a paper cone was thrust through a hole in the box near the carbon rods and pencil lead. The razor blade telephone required a pencil lead lying across the edges of the blades (the blades were placed in slots cut into the top of the box for erect placement) over which the student spoke. The telephone sounds were faintly heard in a quiet room when earphones and telephones were separated by two copper wire lines extended from one room to another.

Since these latter two telephones were not very sensitive in amplifying sounds above the surrounding noises the students soon lost interest in them.

Magnetism and the telephones were studied for about two months. The students had become accustomed to the science specialty as a source of interest, relaxation and fun. The categories in electricity and electronics were introduced simultaneously after this time. The teacher made five-position code oscillator was introduced to bring about more variety in motivating devices (see Figure 5, page 24).

Most of the students became interested in the Morse code and spent some time making dots and dashes. Only one, however, learned it by memory (see Figure 15, page 34). Had there been more teacher directed time with the students they might have become accomplished enough to run a simulated communications net. This could have been beneficial socially because it tended to promote the learning of self-discipline and self-restraint since each student had to send messages in his turn.

The five position code oscillator was a simple gadget (Figure 6, page 25) using such electronic parts as a selenium rectifier, neon lamp, earphones, keyer, three condensers and two resistors. A diagram of this code oscillator is shown in Figure 7, page 26. The diagram shows only the one-position code oscillator, but five places were

FIGURE 5

Students Practicing the Morse Code

arranged by placing the extra four sets of earphones and keyers in series with the first earphones and keyer. Two students made the one-position code oscillator from the diagram placed upon the bulletin board (see Figure 7, page 26). Different colored yarn had been used to differentiate the different symbols or parts by color. The diagrams of the simple diode radio and the phonograph amplifier were placed upon the bulletin board too (see

Figure 7, page 26). These diagrams were discussed thoroughly by introducing each symbol and the part it represented. The functions of these parts were explained in detail to give

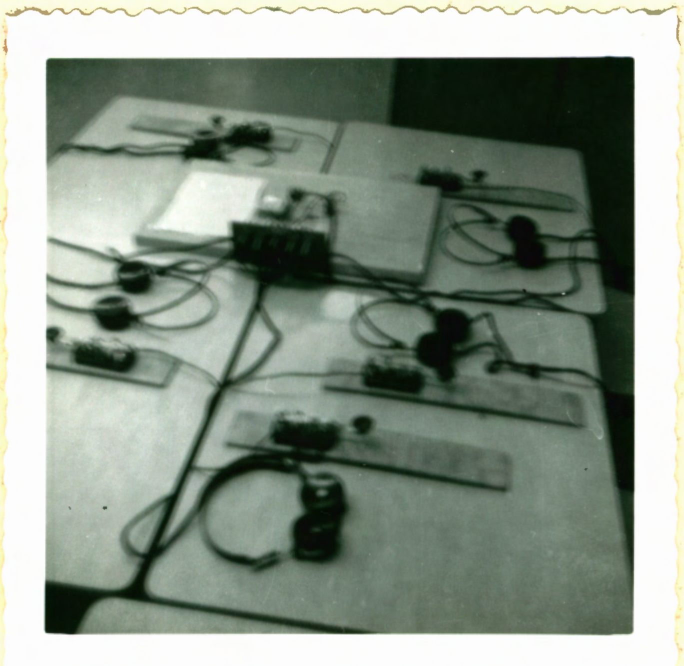

FIGURE 6

The Five-Position Code Oscillator on Desks

concreteness. It was found that many of the students were fascinated with diagrams and symbols.

There were occasions when the bright students needed special work which made them feel that they were accomplishing something more than the routine expectations in the regular studies. Figure 8, page 27, is such a project. Two sixth grade girls were asked if they would like to draw a poster which symbolized the three categories of the science specialty study. In this project the girls had the opportunity to use design and lettering to incorporate art with science. They had integrated learning in at least two subjects.

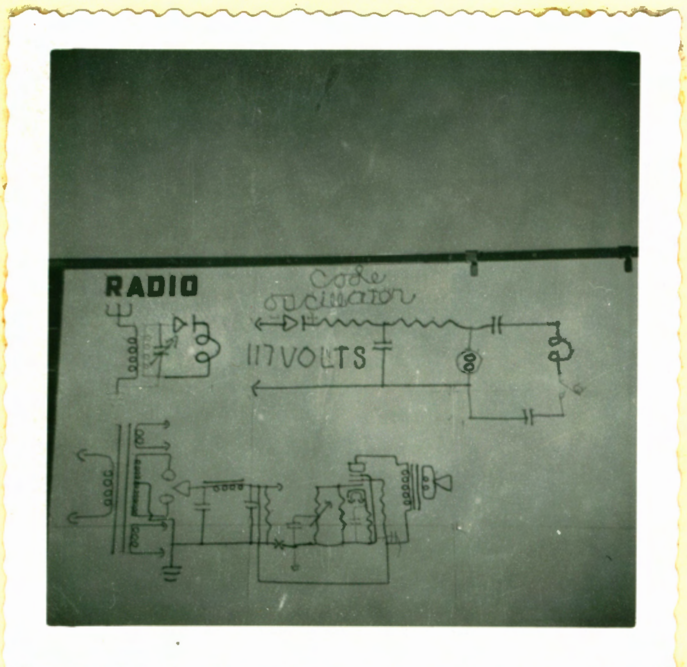

FIGURE 7

Diagram of the Simple Diode Radio,
Code Oscillator, and
Phonograph Amplifier

Two other sixth grade girls integrated the history of early radio with art (see Figure 9, page 28). This poster was partly copied and partly original. These girls were anxious to make a nice poster (Figure 10, page 29 shows them working on Figure 9). They used science research books which explained many of the scientific processes by pictures (see Figure 11, page 30). The girls learned the history of the early crystal radio they were making by noting the use of earphones, the old-fashioned clothing and the mustache worn.

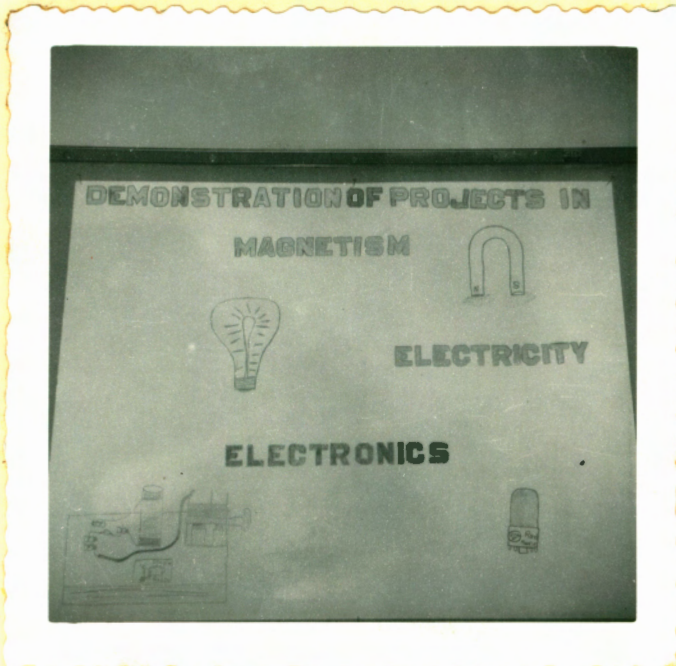

FIGURE 8

Symbolizing the Categories of Magnetism, Electricity and Electronics

These fifth and sixth grade students were encouraged to do research, but this skill came slowly for many of them. They were just beginners in research. They were slowly learning how and where to find information which explained science by the printed word as well as by pictures (see Figures 10, page 29, and Figure 11, page 30).

This work prompted relaxation from the routine studies as well as promote scientific and artistic learning.

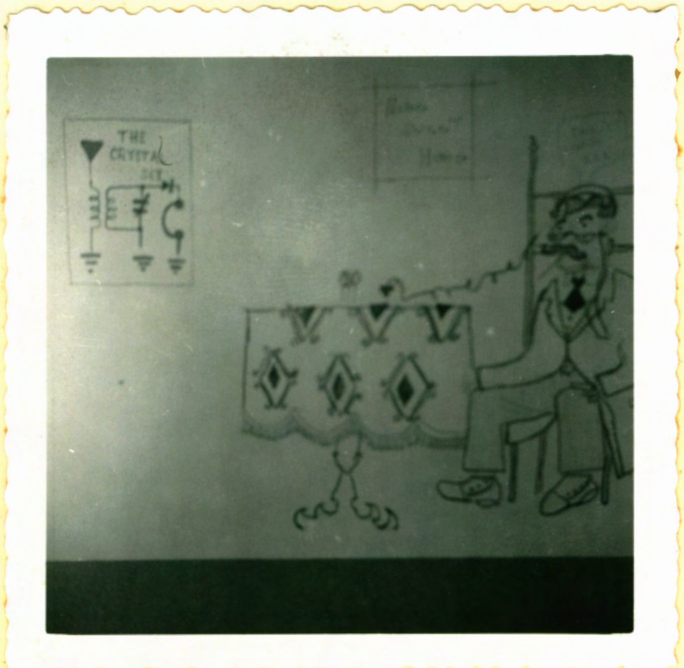

FIGURE 9

A Poster Integrating Art With Science

Although the girls, shown in Figure 10, were making an enlarged copy of a picture it was research---a new experience which should help them work independently later in life.

FIGURE 10

Two Sixth Grade Girls Getting Ideas
For Drawing a Poster
Through Research

The functional processes these boys and girls learned about in science were about as abstract as anything could be. Pictures, (see Figure 11), however, made these abstractions somewhat more understandable when they used abstract reading

FIGURE 11

Learning the Process of Radio Detection
Through Symbols

with abstract diagrams of electronic gadgets. Symbols of electronic parts became specific and functional when they built their projects. Learning had become practical and enlightening through specific experiences. Enthusiasm reigned high when the students were successful in their interesting projects (see Figure 12, page 31, and Figure 13, page 32).

Figure 12 shows a sixth grade girl who successfully made a simple phonograph, the product of her own research. She went into hysterical laughter when she heard the first sounds come from the simple cone made of a sheet of paper.

FIGURE 12

A Successful Project, a Simple Phonograph

She learned how to use several tools to fashion her project. The mysteries of amplifying sounds through such simple devices brought her the realization that mysteries become understandable through research.

Another surprising thing about this girl was that she wanted to make something different than the rest of the class. She didn't make something that others hadn't made before, but it was her first experience.

In Figure 13 students are shown going about their business of testing and exploring. While other classmates were working on their regular school studies these boys and

FIGURE 13.

A Smiling Expression Indicates
a Satisfying Experience

girls were doing their independent science studies to find out how and why their projects worked.

In Figure 14 two girls were working at their seats. These projects were of such a nature that after a certain stage in the building progress there was little danger that the students' seat tops might have been damaged. They used

FIGURE 14

Students Working on Science Projects
at Their Seats

protection boards when they were needed. In the mean time these boards were stacked in a portable clothing closet.

Figure 15 shows a boy who had a mental block toward books. This was not because he lacked reading ability. He couldn't stand the thought of opening his book to read. Science projects and the Morse code interested him very

FIGURE 15

A Mental Block Toward Textbooks
Didn't Limit Success in Science

much. He didn't get many days at the science table, but after he got permission to make his chosen project--a simple diode radio--he had more initiative and ability than most of the others in his class. He knew how to use tools. He used his own wood-burning set to burn the schematic diagram upon the wooden base.

Figure 16 shows two sixth grade boys who were very interested in science project building. Here they discussed what a specific component would do in their phonograph amplifier. They didn't obtain a full understanding in how

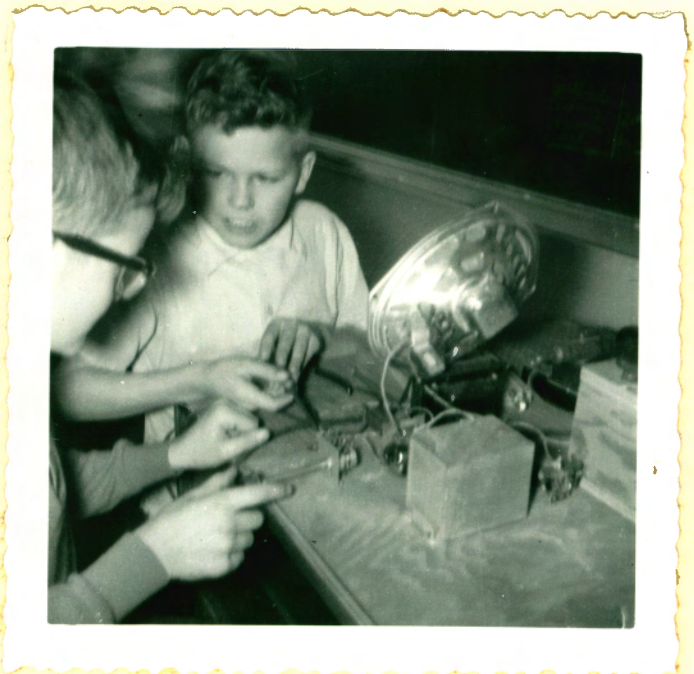

FIGURE 16

The Serious Business of Project Building

it works, theoretically, but they have had a real building experience.

Figure 17 provides further proof that these young boys are interested in science projects. This boy is expecting to hear his code oscillator to oscillate just like the teacher's code oscillator did. He knows what he is listening for because he has heard the sound before.

FIGURE 17

The Serious Business of Exploration by a Young Experimenter

It is just a matter of placing the correct electronic components in the correct position in the right circuit.

Figure 18 shows fifth grade girls listening to their own simple diode radio signals through earphones while adjusting the oscilloscope to see the signal too.

A few weeks before this picture was taken these

FIGURE 18

Hearing the Radio Signal Through Earphones
While Seeing It By Using an Oscilloscope

girls feared to touch any equipment. They have become professionals since then. They have learned to use more of their sensory faculties extremely well.

There is little doubt that these boys and girls were interested in the special science experiments. They were eager to get to their projects at all times. They were just as eager to enjoy their functional projects because they played with them at every opportunity.

There appeared to be motivation toward the regular curricular studies. This was apparent when the students turned their work in on time more often and asked for assignments ahead of time--for homework. There were a few, however, who were irresponsible. Some of these used fictitious answers to show that their work was finished so that they could get back to the science table. These students may have been overstimulated as well as irresponsible.

It was quite obvious that the students learned something about the sciences they studied--some learned more and some learned less. All of the students involved must have acquired some background in the science categories studied to help them understand their scientific environment better.

The above statements are conclusions made from observing the students' activities, their behavior and interpretations made from the pictures included in "The Experimental Activities". The interpretation of the interest and motivation questionnaires and test information has been recorded in the following pages.

EVALUATION OF THE EXPERIMENT

Up to this point the teacher's generalized point of view on the experimental activities has been given.

The information from The Iowa Basic Skills Tests, the I.Q. information, a science completion test, the pupils' questionnaires, and the behavior journal has been organized into tables from which one may interpret what results are indicated statistically. From these data can also be determined what the student, the learner, thought about the experiment.

Table I, page 40, is a sixth grade Iowa Basic Skills Test data chart. It places the number of students into five one-tenth point categories between 3.5 and 10.4, before and after the experiment.

Table I, shows a rather consistent pattern of pupil dispersement. From the mean average data one may note that there has been a full year of growth in the basic skills, with the exception of the work skills and arithmetic where there is a variation, above and below, of one month, above or below the full year.

Table I indicates considerable variations in the average gains in vocabulary and work skills, but with less variations of gains in the other skills. The composite average gain is exactly one year after the experiment, compared to nine-tenths of a year of gain before the experiment.

TABLE I

THE SIXTH GRADE IOWA BASIC SKILLS TEST DATA CHART

	Vocabulary		Reading		Language		Work skills		Arithmetic		Composite	
	B	A	B	A	B	A	B	A	B	A	B	A
10.0-10.4 . . .		1										
9.5- 9.9 . . .				1		1						
9.0- 9.4 . . .		1										1
8.5- 8.9 . . .	1	1	1	1	1	1						
8.0- 8.4 . . .				1							1	
7.5- 7.9 . . .	2		1	1				2		2		3
7.0- 7.4 . . .		2		1	1	2		1		1		
6.5- 6.9 . . .		3	2	1			1	1	2	5	2	1
6.0- 6.4 . . .	2	2		2		2	1	3	1	2	1	4
5.5- 5.9 . . .	2		3	2	2	3	3	3	5	2	2	1
5.0- 5.4 . . .	3	2	2	1	4	1	5	3	3	1	4	3
4.5- 4.9 . . .	2	1	2	2	1	3	2		2		1	
4.0- 4.4 . . .			2		3		1				2	
3.5- 3.9 . . .	1				1							
Mean average	5.9	6.9	5.7	6.7	5.3	6.3	5.3	6.2	5.5	6.6	5.6	6.6
Average gain	1.5	0.6	0.7	0.9	1.0	1.0	0.5	1.3	0.9	1.1	0.9	1.0

NOTE: The letters "A" and "B" under each subject indicate that the data was obtained after and before the experimental study.

Table II, page 42, shows data from The Iowa Basic Skills Tests for the fifth and sixth grades. Table II merely shows the individual composite scores and class score averages before and after the experiment.

Table II reveals data tending to prove that science at the center of the curriculum has kept the average composite scores for both the fifth and sixth grades normal to higher since both grades gained one full year of growth in the basic skills (see Appendix A, pages 71-73).

One may conclude, from Table I, and Table II, that the fifth and sixth grade students' gains in basic skills were at least normal. This would verify the writer's contention that interesting science units at the center of the curriculum motivate enough students to keep the regular class average gains at the normal or higher scores inspite of the time used for the extra special studies.

Table III, page 42, divulges individual and class averages in I.Q. data (see Appendix B, page 74). Table III shows the average I.Q. for both grades to be very similar since the average fifth grade I.Q. appears to be 107 and that for the sixth grade 106. One may conclude, therefore, that these students are of average mental ability according to national norms.

Table IV, pages 43 and 44, consists of information from a science completion test developed by the teacher. This test was intended to evaluate voluntary learning, by

TABLE II

THE IOWA BASIC SKILLS TEST COMPOSITE DATA
BEFORE AND AFTER THE EXPERIMENT

Fifth grade					Sixth grade				
	Name	Sex	Before	After		Name	Sex	Before	After
1.	D. F.	M	4.3	5.2	1.	D. B.	M	6.9	8.5
2.	J. H.	M	4.8	5.7	2.	E. C.	M	6.0	6.7
3.	R. K.	M	5.4	6.5	3.	M. E.	M	5.4	5.8
4.	S. R.	M	5.9	5.8	4.	F. G.	M	4.9	5.5
5.	T. T.	M	4.7	5.9	5.	R. G.	M	5.8	7.2
6.	G. W.	M	5.5	6.7	6.	B. T.	M	4.7	5.3
7.	L. D.	F	4.6	5.6	7.	C. W.	M	5.9	6.6
8.	E. W.	F	4.6	6.2	8.	B. C.	F	5.6	6.9
					9.	C. C.	F	6.8	8.4
					10.	N. G.	F	4.8	5.6
					11.	P. M.	F	8.6	9.6
					12.	B. R.	F	7.2	8.4
					13.	B. W.	F	5.8	6.9
Average			5.0	6.0	Average			6.0	7.0

TABLE III

STUDENTS' I.Q. DATA

Fifth grade				Sixth grade			
	Name	Sex	I.Q. score		Name	Sex	I.Q. score
1.	D. F.	M	90	1.	D. B.	M	116
2.	J. H.	M	100	2.	E. C.	M	86
3.	R. K.	M	118	3.	M. E.	M	96
4.	S. R.	M	125	4.	D. F.	M	114
5.	T. T.	M	125	5.	R. G.	M	113
6.	G. W.	M	108	6.	B. T.	M	80
7.	L. D.	F	87	7.	C. W.	M	125
8.	E. W.	F	104	8.	B. C.	F	112
				9.	C. C.	F	100
				10.	N. G.	F	69
				11.	P. M.	F	121
				12.	B. R.	F	124
				13.	B. W.	F	120
Average			107	Average			106

TABLE IV

A COMPLETION TEST IN SCIENCE FOR EVALUATING FIFTH AND SIXTH GRADE INTEREST AND LEARNING

Test question	Before experiment				After experiment			
	correct		incorrect		correct		incorrect	
	5th	6th	5th	6th	5th	6th	5th	6th
1. How is a telephone made?	1	6	8	8	5	12	4	2
2. Why magnets attract iron or steel?	3	3	6	11	4	10	5	4
3. How many poles has a magnet?	6	14	3	0	8	11	1	3
4. What happens when two south pole magnets meet?	1	6	8	8	8	10	1	4
5. Explain magnetic lines of force.	0	2	9	12	3	8	6	6
6. Name five things using magnets.	11	16	34	54	23	41	22	29
7. Explain conduction in electricity.	0	0	9	14	0	4	9	10
8. Describe alternating transformers.	0	0	9	14	1	6	8	8
9. How may one develop alternating current from direct current?	0	0	9	14	2	4	7	10
10. How is voltage made?	0	1	9	13	1	4	8	10
11. What is voltage?	0	1	9	13	1	4	8	10
12. How does A.C. voltage enter homes?	5	7	4	7	6	7	3	7
13. What is current?	0	0	9	14	2	6	7	8
14. What is power?	0	0	9	14	2	6	7	8
15. How may voltage be increased?	0	1	9	13	1	5	8	9
16. How may voltage be decreased?	0	1	9	13	1	5	8	9
17. What is a conductor?	4	3	5	11	1	4	8	10
18. What are insulators?	1	4	8	10	1	9	8	5
19. Name three materials which conduct voltage.	3	10	24	32	15	27	12	15
20. Name five insulating materials.	8	14	37	56	6	24	39	46
21. Describe a condenser, its function.	0	0	9	14	3	5	6	9
22. Tell how to make a second telephone.	4	5	5	9	8	13	1	1

TABLE IV (continued)

23. How is sound developed?	0	3	9	11	1	7	8	7
24. How is sound volume increased?	0	0	9	14	1	0	8	14
25. Describe a radio frequency signal.	0	0	9	14	1	5	8	9
26. Give frequency range man may hear.	0	0	9	14	3	7	6	7
27. Name five parts used in making radios.	10	19	35	51	25	51	20	19
28. Give dots and dashes of Morse code.	5	21	319	483	84	154	240	350
29. Tell why high frequency signals go shorter distances than low radio frequency signals.	0	0	9	14	3	5	6	9
Total points	62	137	640	955	220	456	482	636

inference, as well as interest in the science projects. The learning and interest may be assessed according to the number of questions answered correctly or incorrectly. Since the test was administered before and after the study, experimental growth comparisons can be made. The results have been broken down to grade level.

Table IV portrays information which could guide an instructor in the selection of science subjects or science categories in which these students, and other students like them, might be interested. The greater the number of points earned for a question the better the chances are that the students are mature enough, as well as interested enough, to study in that specific science area. Therefore, the achievement in the test indicates interest in the material.

Table IV indicates that these boys and girls achieved considerable learning in some areas of the science units studied.

Table V, page 46, shows the points earned in the science completion pre-test and post-test, the achievement by percentile gain made by comparing the pre-test with the post-test, and the amount of percentile gain made as well. The point averages and the percentile averages have been added to the bottom of each grade listing.

Table V, page 46, shows that the previous experiences the sixth grade students had tended to give them an

TABLE V

STUDENTS' RECORD OF POINTS EARNED ON TWO TESTINGS ON A SCIENCE TEST

			Points earned		Achievement in percentile		Amount of gain
Students' initials		Grade	Pre-test	Post-test	Pre-test	Post-test	Per-centile
1.	D. B.	6	16.0	56.0	20.5	72.0	51.5
2.	E. C.	6	4.0	49.0	5.0	63.0	58.0
3.	M. E.	6	25.0	58.0	32.0	74.4	42.4
4.	D. F.	6	14.0	35.0	18.0	45.0	27.0
5.	R. G.	6	3.0	23.0	3.9	30.0	26.1
6.	B. T.	6	2.0	5.0	2.6	6.4	3.8
7.	C. W.	6	22.0	69.0	28.2	88.5	60.3
8.	B. C.	6	7.0	27.0	9.0	34.6	25.6
9.	C. C.	6	10.0	21.0	13.0	25.6	12.6
10.	N. G.	6	1.0	7.0	1.3	9.0	7.7
11.	P. M.	6	15.0	25.0	20.0	32.0	12.0
12.	B. R.	6	12.0	33.0	15.4	42.3	26.9
13.	B. W.	6	4.0	37.0	5.0	47.5	42.5
14.	D. H.*	6	1.0	10.0	1.3	13.0	11.7
Average		6	9.95	32.5	12.5	41.7	29.2
1.	D. F.	5	2.0	12.0	2.6	15.4	12.8
2.	J. H.	5	5.0	26.0	6.4	33.3	26.9
3.	R. K.	5	7.0	27.0	9.0	34.0	25.0
4.	S. R.	5	9.0	19.0	11.5	24.4	12.9
5.	T. T.	5	6.0	18.0	7.7	23.0	15.3
6.	G. W.	5	21.0	48.0	25.6	61.5	35.9
7.	L. D.	5	6.0	13.0	7.8	16.8	9.0
8.	E. W.	5	3.0	20.0	3.9	25.6	21.7
9.	E. S.*	5	2.0	34.0	2.6	43.6	41.0
Average		5	7.0	24.1	8.6	30.8	22.3

*Students who did not complete The Iowa Basic Skills Tests.

advantage over the fifth grade students. Table V indicates that sixth grade students have a class average which is approximately twenty-four per cent higher in gain than that of the fifth grade students in this science test.

Table V discloses that there appears to be a trend in learning more science facts by most students of higher ability, but there are exceptions (see Table III, page 42, and Appendix B, page 74 which shows the general information about each student. See also sixth grade listing number eleven in Tables III, page 42, and Table V, page 46). One such high ability student achieved only a twelve per cent gain while the sixth grade class average was over twenty-nine per cent. Another student who had a high ability rating gained over sixty per cent in achievement which is twice the class average gain (see sixth grade listing number seven in Table III, page 42, and Table V, page 46). This placed this student at the top of the class in the science test. This tends to prove that the high ability student is able to learn more facts than the lower ability student is, providing the former has the interest in the study. The high ability student with the low gain in the science test was a girl who didn't appear highly interested in science, whereas the boy of high ability was extremely interested.

Table V shows which students were interested enough in science to recall answers to a completion test.

Five sixth grade students, D. B., E. C., M. E., C. W., and B. W., may be considered those who retained considerable facts voluntarily since they earned forty-two or more of the possible seventy-eight points obtainable. Four sixth grade students, D. F., R. G., B. C., and B. R., appear to have learned some facts since they gained between twenty-five and twenty-seven points. The other five sixth grade students show point gains of between three and eight-tenths to twelve and six-tenths, which indicates a small amount of facts learned.

Table V shows that the fifth grade students gained a similar point ratio with a lower high point and higher low point score than the sixth grade students did.

One may conclude, from Table V, that the majority of these students learned something from the science units taught.

Table VI, page 49, is the result of a questionnaire which was administered to determine the science specialty interest, and the motivation science brought about toward the regular curriculum learnings. Since the questionnaire was administered before and after the experimental study it should be possible to assess the amount of interest by comparing the data of the questionnaires before and after the study.

Table VI lists these questions so that one may see the results for the fifth and sixth grade classes combined

TABLE VI

EVALUATING SPECIAL SCIENCE INTEREST AND MOTIVATION IN CURRICULAR STUDIES BY QUESTIONNAIRE SURVEY

		Before experiment			After experiment		
Question	Grade and sex	Yes	Not known	No	Yes	Not known	No
1. Interest in magnetism.	5 & 6	15	2	6	17	4	2
	6 - M	6	0	2	7	1	0
	6 - F	4	0	2	4	2	0
	5 - M	4	1	1	5	1	0
	5 - F	1	1	1	1	0	2
2. Interest in electricity.	5 & 6	15	1	7	16	4	3
	6 - M	7	0	1	7	1	0
	6 - F	2	1	3	2	2	2
	5 - M	5	0	1	5	1	0
	5 - F	1	0	2	2	0	1
3. Interest in electronics.	5 & 6	18	1	4	16	5	2
	6 - M	8	0	0	7	1	0
	6 - F	4	1	1	3	2	1
	5 - M	5	0	1	5	0	1
	5 - F	1	0	2	1	2	0
4. Interest in making radios.	5 & 6	18	2	3	21	0	2
	6 - M	8	0	0	8	0	0
	6 - F	4	1	1	5	0	1
	5 - M	5	1	0	6	0	0
	5 - F	1	0	2	2	0	1
5. Capability of reading instructions important.	5 & 6	15	3	5	20	3	0
	6 - M	4	1	3	7	1	0
	6 - F	6	0	0	4	2	0
	5 - M	3	1	2	6	0	0
	5 - F	2	1	0	3	0	0
6. Science specialty motivated curricular interest.	5 & 6	14	4	5	15	6	2
	6 - M	5	1	2	6	2	0
	6 - F	4	2	0	3	2	1
	5 - M	5	0	1	5	1	0
	5 - F	0	1	2	1	1	1

as well as separated for either grade level or sex. The first four questions deal with interest while questions five and six deal with motivation.

Question one, in Table VI, reveals that before the study almost sixty-five per cent of all the students were interested in the study of magnetism, twenty-six per cent weren't interested, and nine per cent were indifferent. After the study seventy-four per cent were interested, nine per cent indicated no interest and seventeen per cent were indifferent.

By breaking question one down according to sex it may be seen that of the eight sixth grade boys six were interested and two were uninterested before the study. After the study seven boys were interested, and one was indifferent. The data show that four sixth grade girls were interested and two were not interested before the study. After the study four girls were still interested while the other two girls were undecided. The data for the fifth grade boys signifies that four were interested, one was uninterested and one was undecided before the study. After the study five boys were interested and one was undecided. The data denotes that one fifth grade girl was interested, one girl had no interest and the third girl was undecided before the study. After the study one fifth grade girl was still interested and the other two girls were not interested.

Question one, Table VI, shows that boys had somewhat more interest in magnetism than the girls. The break down after the study shows that eighty-eight per cent of the sixth grade boys, sixty-seven per cent of the sixth grade girls, eighty-four per cent of the fifth grade boys and thirty-three per cent of the fifth grade girls were interested in the study of magnetism.

In question two, in Table VI, the break down for the interest in electricity appears to be quite similar to question one in that the fifth and sixth grade boys were more interested than the girls.

In question three, in Table VI, there appeared to be more interest for electronics with a little less disagreement between the boys and the girls in both grade levels. A small per cent of the girls, in both grades, were a little less interested than were the boys.

In question four, in Table VI, there appears to be an increased interest in the study of radios compared to the interests in electronics after the study. Only one girl in each of the fifth and sixth grades showed no interest. These students had considerable experience in making simple diode radios, and apparently this brought about the increased interest in this area. This tends to prove that specific functional gadgets create more interest for these youngsters.

In question five, in Table VI, before the study sixty-five per cent of all the students agreed that the capability of reading instructions was necessary in electronics. Almost twenty-two per cent felt that instructions weren't important while about thirteen per cent didn't appear to realize any importance in being able to read instructions. After the study only one sixth grade boy and two sixth grade girls registered a "don't know" opinion, therefore, eighty-seven per cent felt that it was important to know how to read instructions. Some of these students may have learned the necessity for applying their basic learnings to practical problem solving experiences.

In question six, Table VI, sixty-one per cent of the combined fifth and sixth grade classes agreed, before the study, that they would work harder on regular curricular studies if they were allowed to study magnetism, electricity, and electronics. The rest were nearly divided in whether they would or would not work harder. After the study sixty-five per cent agreed that they would work harder when the science specialty was included with the regular studies. Twenty-six per cent were undecided and almost nine per cent weren't interested.

There was every indication that some students became more interested in these science studies as they worked with them. Sixty-five per cent of the students finally agreed that they would work harder with the science specialty at the center of the curriculum. Students indicated that the regular studies had become a little more important to them due to the science specialty.

The most notable information in Table VI is the fact that these fifth and sixth grade students were most interested in making simple diode radios. Ninety-one per cent of the combined classes favored making radios as compared to approximately seventy per cent who were interested in electronics. From this information it seems quite clear that these students appeared more stimulated by specific functional gadgets they made than in the non-functional kind of science. The functional projects tended to stimulate more interest in the regular curriculum because the students could probably understand the need for basic learnings to help them build projects as well as to help them in research.

Table VII, on pages 54 and 55, gives data which help to determine how much interest the fifth and sixth grade students acknowledged they had in the special science project.

Table VII has been arranged to indicate degrees of interest and motivation. It also breaks the information down into the grade levels and sex once more.

Question one, two, and three are interest questions and questions four, five and six are motivation questions.

Question one, in Table VII, shows that over fifty

TABLE VII

EVALUATING SPECIAL SCIENCE INTEREST AND MOTIVATION TOWARD CURRICULAR STUDIES IN DEGREES BY QUESTIONNAIRE SURVEY

Interest or motivation question	Grade & sex	More fun than work	Hard work and fun	Hard work & no fun	Not known
1. The science studies were.	5 & 6	12	9	2	0
	6 - M	6	1	1	0
	6 - F	0	5	1	0
	5 - M	4	2	0	0
	5 - F	2	1	0	0
	Grade & sex	All year	Part year	Not important	Not known
2. This study should be taught.	5 & 6	15	6	0	2
	6 - M	6	1	0	1
	6 - F	4	1	0	1
	5 - M	5	1	0	0
	5 - F	0	3	0	0
	Grade & sex	Very much	Some	Very little	Not known
3. Enjoyed the study of magnetism, electricity and electronics.	5 & 6	16	5	2	0
	6 - M	7	0	1	0
	6 - F	3	3	0	0
	5 - M	4	2	0	0
	5 - F	2	0	1	0
4. Science motivated interest in regular curricular subjects.	5 & 6	10	8	4	1
	6 - M	4	3	0	1
	6 - F	1	2	3	0
	5 - M	4	2	0	0
	5 - F	1	1	1	0

TABLE VII (continued)

5.	The study encouraged harder work in regular curricular subjects.	5 & 6	13	4	0	6
		6 - M	6	1	0	1
		6 - F	1	1	0	4
		5 - M	6	0	0	0
		5 - F	0	2	0	1
6.	Science study helped to realize importance of regular curricular studies.	5 & 6	21	1	1	0
		6 - M	7	0	1	0
		6 - F	6	0	0	0
		5 - M	5	1	0	0
		5 - F	3	0	0	0

per cent of the fifth and sixth grade students thought the special science project was more fun than work while thirty-nine per cent more thought it was hard work and fun. This left less than nine per cent (two students) who thought the project was hard work and no fun.

Question two, in Table VII, denotes enough interest in the experimental study by fifth and sixth grade students combined so that sixty-five per cent indicated the desire to study special sciences the whole year while twenty-six per cent more preferred to study it only part of the year. This left only nine per cent (two students in the sixth grade--one girl and one boy) who appeared indifferent about the study.

In question three, in Table VII, almost seventy per cent of the fifth and sixth grade students agreed that they enjoyed the study in magnetism, electricity, and electronics very much while almost twenty-two per cent enjoyed the study some. This left less than nine per cent (one sixth grade boy and one fifth grade girl) who enjoyed the study very little.

In question four, in Table VII, it is evident that over forty-three per cent felt the study motivated their interest in regular studies very much and almost thirty-five per cent more agreed the study motivated their interest in the regular studies to some extent. Twenty-two per cent (one sixth grade boy and three sixth grade girls) felt that the study didn't motivate interest in the regular studies.

In question five, in Table VII, one may note that science encouraged fifty-five per cent of the students to work harder on the regular studies. Seventeen per cent indicated some harder work was stimulated, while about twenty-six per cent didn't know what influence science had in encouraging harder work.

In question six, in Table VII, ninety-one per cent of the fifth and sixth grade students thought the science study helped them to realize the importance of the regular studies, four per cent more (one fifth grade boy) agreed it helped a little and another four per cent (a sixth grade boy) felt that it had not helped them to realize the importance of the regular studies.

The data in Table VII reveal that the majority of these fifth and sixth grade students were interested in the special science study and that most of them acknowledged that the study made them realize some importance of the fundamental learnings. Seventy-two per cent intimated harder work was encouraged by the experimental study.

Table VIII, pages 58 and 59, discloses information contained in a survey questionnaire directed to the fifth and sixth grade students which reveals certain knowledge and interest they believe they possessed.

TABLE VIII

SURVEY DATA TO EVALUATE STUDENT SCIENCE INTERESTS, MOTIVATION, ACKNOWLEDGED PREVIOUS SCIENCE UNDERSTANDING, AND WILLINGNESS TO LEARN ABOUT SCIENCE PHENOMENA

		Before experiment		After experiment	
Survey question	Grade & sex	Yes	No	Yes	No
1. I know a lot about magnetism.	5 & 6	11	12	12	11
	6 - M	6	2	4	4
	6 - F	3	3	4	2
	5 - M	2	4	4	2
	5 - F	0	3	0	3
2. I want to learn about magnetism.	5 & 6	19	4	20	3
	6 - M	6	2	7	1
	6 - F	6	0	6	0
	5 - M	6	0	6	0
	5 - F	1	2	1	2
3. I know a lot about electricity.	5 & 6	12	11	8	15
	6 - M	5	3	5	3
	6 - F	2	4	1	5
	5 - M	3	3	1	5
	5 - F	2	1	1	2
4. I want to learn about electricity.	5 & 6	21	2	17	6
	6 - M	8	0	7	1
	6 - F	4	2	2	4
	5 - M	6	0	6	0
	5 - F	3	0	2	1
5. I know a lot about electronics.	5 & 6	4	19	4	19
	6 - M	1	7	2	6
	6 - F	1	5	0	6
	5 - M	2	4	2	4
	5 - F	0	3	0	3
6. I want to learn about electronics.	5 & 6	21	2	18	5
	6 - M	7	1	8	0
	6 - F	5	1	3	3
	5 - M	6	0	5	1
	5 - F	3	0	2	1
7. I know a lot about these projects.	5 & 6	4	19	16	7
	6 - M	2	6	5	3
	6 - F	0	6	5	1
	5 - M	2	4	5	1
	5 - F	0	3	1	2

TABLE VIII (continued)

8.	I want to learn about these projects.	5 & 6	20	3	20	3
		6 - M	7	1	7	1
		6 - F	6	0	5	1
		5 - M	6	0	6	0
		5 - F	1	2	2	1
9.	Projects make school interesting.	5 & 6	22	1	21	2
		6 - M	8	0	8	0
		6 - F	5	1	5	1
		5 - M	6	0	6	0
		5 - F	3	0	2	1
10.	I want to find out if projects make school interesting.	5 & 6	23	0	23	0
		6 - M	8	0	8	0
		6 - F	6	0	6	0
		5 - M	6	0	6	0
		5 - F	3	0	3	0
11.	I would work harder in curricular studies with project work.	5 & 6	17	6	22	1
		6 - M	6	2	7	1
		6 - F	3	3	6	0
		5 - M	6	0	6	0
		5 - F	2	1	3	0
12.	I want to learn if projects make school interesting.	5 & 6	21	2	22	1
		6 - M	7	1	8	0
		6 - F	5	1	6	0
		5 - M	6	0	6	0
		5 - F	3	0	2	1
13.	I believe projects help later in life.	5 & 6	21	2	21	2
		6 - M	8	0	8	0
		6 - F	5	1	5	1
		5 - M	6	0	6	0
		5 - F	2	1	2	1
14.	I want to find out if projects help later in life.	5 & 6	20	3	22	1
		6 - M	8	0	8	0
		6 - F	5	1	5	1
		5 - M	6	0	6	0
		5 - F	1	2	3	0
15.	Projects should be taught all year.	5 & 6	17	6	15	8
		6 - M	7	1	7	1
		6 - F	3	3	3	3
		5 - M	6	0	4	2
		5 - F	1	2	1	2
16.	Science projects are interesting.	5 & 6	19	0	23	0
		6 - M	7	1	8	0
		6 - F	3	3	6	0
		5 - M	6	0	6	0
		5 - F	3	0	3	0

When the data of the pre-questions are compared with those of the post-questions we note favorable growth in student thinking. Once again student interest in these science units as well as the willingness of the students to learn about science is positive.

Although some of these questions are repetitious they serve to show consistencies or inconsistencies in other tables if they are compared.

In question one, in Table VIII, one may note that about fifty per cent of the students, both before and after the experiment, felt they knew considerable about magnetism. Although adults may consider this an exaggeration it seems that the students felt that they really knew a lot about magnetism since they had little background information by which they could gauge their knowledge in the subject.

In question two, in Table VIII, the students consistently indicated considerable interest in the study of magnetism, both before and after the experiment.

Question five, in Table VIII, tends to show that the students agreed they knew very little about electronics, both before and after the experiments.

Question six, in Table VIII, tends to show high student interest in the science study before the experiment, but three students appeared to have been discouraged with the study at the end.

Question eleven, in Table VIII, reveals that before the experiment seventy-four per cent of the students agreed that they would work harder on the regular curricular studies if given the privileges of making science projects. After the experiment ninety-six per cent of the students agreed that they would work harder. This latter percentage is high and somewhat inconsistent with the results of question six in Table VI, page 49, which tends to show that only sixty-five per cent said that they would work harder.

Question fifteen, in Table VIII, signifies that before the experiment seventy-four per cent preferred that the science study should be offered throughout the school year. After the experiment this interest was reduced to sixty-five per cent. The latter percentage is consistent with question two, in Table VII on page 54.

In spite of minor inconsistencies there are a surprising number of consistencies. The writer believes that answers are a true indication of interest because boys and girls of this age tend to express their feelings about things the way they see them.

Up to this point we have evaluated the general data information. Since a behavior journal was kept these anecdotal notes may be evaluated to determine what the teacher observed during this experiment.

Table IX, page 62, breaks this information down to

TABLE IX

CASE HISTORIES RELATED TO BEHAVIOR JOURNAL

	Science Interested			Curriculum Motivated		
Name	Much	Some	None	Much	Some	None
1. D. B	x				x	
2. E. C.	x				x	
3. M. E.	x					x
4. D. F.	x				x	
5. R. G.		x			x	
6. B. T.			x			x
7. C. W.	x			x		
8. B. C.	x					x
9. C. C.	x			x		
10. N. G.			x			x
11. P. M.		x			x	
12. B. R.		x			x	
13. B. W.	x			x		
14. D. F.		x			x	
15. J. H.		x			x	
16. R. K.	x			x		
17. S. R.	x				x	
18. T. T.		x			x	
19. G. W.	x				x	
20. L. D.	x			x		
21. E. W.	x			x		
22. D. H.	x			x		
23. E. S.		x				x

students who appeared to be motivated in the regular curriculum due to the science units. These categories are broken down still further by placing them into degrees of interest or motivation.

Table IX shows that sixty-one per cent (fourteen students) were much interested in the science units, about thirty per cent (seven students) had some interests, and approximately nine per cent (two students) had no interest in the science units. Table IX also indicates that thirty per cent (seven students) were much stimulated in the regular curriculum studies because of the science units, about forty-eight per cent (eleven students) were stimulated by it some, and about seventeen per cent (five students) were not stimulated.

Some of the more unusual cases are explained herewith to give more insight into what took place in the classroom.

Student number three, M. E., was extremely interested in science. But this boy simply couldn't bring himself to study the regular curriculum studies voluntarily. No teacher had been able to encourage him to study those studies he had no interest in, according to information gleaned from his past teachers. Toward the last of the year it was found that he had gotten a book from the public library which had information on electronics. It appears that he had specific interests that he preferred to continue in by himself.

Student number six, B. T., seemed to have little interest in anything pertaining to scholastic learning or science. He was a lad with a low mental ability. He couldn't seem to be able to think creatively.

Student number eight, B. C., was a girl who had exceeding determination to work with science projects. She did not, however, consider it necessary to keep her regular studies up. She would find fictitious answers for test questions and arithmetic problems to show that her work was completed, just to get to the science table. She refused to consider science a privilege for those who did their work satisfactorily.

Student number nine, C. C., was a girl who was very highly interested in science projects even though the science test indicates otherwise (see Table V, page 46). She was motivated in the regular studies too, but she was self motivated for reasons of scholastic grades (see Figure 12, page 31 and Table II, page 42).

Student number ten, N. G., was a girl who had a low mental ability rating. She worked hard on the regular school subjects to attempt to keep up with her friends. She seemed to realize that she needed all her time for the regular studies so she did little more than notice the science activities.

Student number five, R. G., and number seven, S. R., were both quite interested in the science studies but neither one became mature enough to be permitted to make a project. These boys were quite irresponsible. They were determined to create disturbances which made the classroom noisy and uncontrolled in appearance. These boys had emotional problems.

Student number twenty-three, initials E. S., was absent so much of the year that she had little time for becoming interested or motivated.

In conclusion the teacher feels that except for some of the above mentioned students this fifth and sixth grade class of students tended to be interested in the science units and they were apparently motivated somewhat in their regular studies because of the privileges they had in making functional science projects. A few students, it must be understood, could not excel beyond their levels of ability since they had been self-motivated for high scores already. They had no need for motivating devices to bring about higher achievements. They were already learning at their level of ability. Those students with low mental ability didn't appear interested nor did many show much ability in making projects. The students who appeared to benefit from the science experimental program most were those who had refused to work to their full capabilities--the care free; those students who hadn't realized their school responsibilities as well as those who had learned to dislike school.

CHAPTER IV

SUMMARY AND CONCLUSION

The purpose for the study was to determine if specific science teaching units in magnetism, electricity, and electronics used at the center of the curriculum would motivate student interest in the regular studies. It was also hoped that this experiment would bring about a normal or higher scholastic attainment, while the science experiences involved would become an asset to the student.

The experimental problem was to set up a fifth and sixth grade classroom situation wherein the specific science categories of magnetism, electricity, and electronics could be used to evaluate: (1) student interest in the sciences, (2) what learning might take place in these science units, and (3) student motivation in the regular study curriculum.

The experiment was conducted for about five months in the 1960-1961 school year.

The experimental activities consisted of: (1) teacher made project demonstrators, (2) manipulative materials, (3) equipment needed for making projects, (4) magnetic, electric, and electronic parts, and (5) a teacher specialized in these categories. The students were privileged to use or manipulate the materials, or build projects upon satisfying the demands of getting their daily work turned in according to individual level of ability.

To evaluate the interest students had in the experiment as well as to determine motivation in the regular curriculum studies the following devices were used: (1) student questionnaires, (2) science test, (3) The Iowa Basic Skills Test, and (4) a behavior journal.

The study was limited because: (1) only five months of the school year was used, (2) the number of students was small, (3) this was the teacher's first year of teaching, and (4) the means for evaluating or controlling the study was somewhat limited.

SUMMARY

The data gathered herein indicate that the majority of the students appeared: (1) interested in the science units taught at the center of the curriculum, (2) to learn meaningful facts from the specific science units studied, and (3) to be motivated toward the regular curriculum studies.

The Iowa Basic Skills Test results indicate a full year class average scholastic growth in the basic skills for the school year. This may indicate that enough students were motivated in the regular studies to keep their achievements high to off-set the time used doing research in the science categories mentioned.

Specific science units motivated enough student interest in the regular curriculum study to obtain normal or higher class average achievements in the basic study skills. This achievement was possible despite considerable time used by the students in the experimental purposes.

Most of the students with low mental abilities didn't seem to benefit much by teaching science units at the center of the curriculum.

Most of the high ability students needed no motivating science because they were already working at their individual level of ability. They indicated enough interest in the science units to prove them necessary for their background learning.

Boys tended to be a little more interested in this study than the girls.

CONCLUSIONS

The conclusions that may be made from this research study in the classroom, wherein science units were taught at the center of the curriculum study, are the following:

1. Specific functional sciences can be taught at the center of the curriculum to fifth and sixth grade students for motivating the regular curricular interests. These science units could well replace or share the present status of the generalized science courses now being taught.

2. There appeared to be enough specific science

learning to warrant the setting up of such a program to satisfy the felt needs of the students of our modern times.

3. Student interest appeared especially apparent for those students who tended to be bored with the regular studies and for those students to whom the regular studies had little meaning or value.

4. The writer is of the opinion that the results of this research problem was positive enough so that it might be carried out again under better controlled situations with a larger group of participants. This should bring about a more reliable proof of a workable set up of science units at the center of the curriculum.

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APPENDICES

APPENDIX A

THE SIXTH GRADE BOYS' IOWA BASIC SKILLS TEST RESULTS

Student's name	Test date	Grade	V	R	L	W	A	C
D. B.	10- 2-59	5	7.3	7.3	5.2	5.8	5.4	6.2
	10- 7-60	6	8.4	7.6	6.2	5.9	6.2	6.9
	5-12-61	6	9.0	9.8	7.7	7.3	7.7	8.3
	10-17-61	7	8.5	9.4	8.3	8.6	7.5	8.5
E. C.	10- 9-59	5	3.8	3.8	4.1	5.0	5.0	4.6
	10- 7-60	6	7.0	5.7	5.1	6.2	6.0	6.0
	5-12-61	6	8.2	6.1	5.9	6.0	7.1	6.9
	10-17-61	7	6.7	5.7	6.0	7.5	7.5	6.7
M. E.	10- 2-59	5	5.4	5.5	4.1	5.4	4.7	5.0
	10- 7-60	6	5.7	5.4	4.7	5.0	6.1	5.4
	5-12-61	6	6.4	5.7	4.7	5.8	5.8	5.7
	10-17-61	7	6.5	6.0	4.9	5.2	6.5	5.8
D. F.	10- 9-59	5	3.0	3.0	3.2	4.5	4.8	4.1
	10- 7-60	6	4.8	5.2	4.6	4.3	5.4	4.9
	5-12-61	6	5.9	6.2	4.7	6.4	5.9	5.8
	10-17-61	7	5.6	5.4	4.9	5.9	6.1	5.5
R. G.	10- 2-59	5	5.3	5.6	4.6	5.2	5.4	5.2
	10- 7-60	6	6.7	5.7	5.9	4.8	5.9	5.8
	5-12-61	6	7.3	7.1	6.9	6.9	7.3	7.1
	10-17-61	7	7.4	7.6	6.5	6.7	7.7	7.2
B. T.	10- 9-59	5	4.2	4.2	3.9	3.6	4.4	4.1
	10- 7-60	6	4.8	4.7	4.2	5.5	4.5	4.7
	5-12-61	6	4.5	5.1	4.1	5.0	5.2	4.8
	10-17-61	7	4.4	4.9	5.2	5.5	6.3	5.3
C. W.	10- 2-59	5	4.0	5.1	4.3	5.1	5.3	4.7
	10- 7-60	6	6.0	5.5	5.6	5.3	6.9	5.9
	5-12-61	6	5.1	5.2	5.2	5.9	7.3	5.7
	10-17-61	7	6.5	6.5	5.5	7.4	7.2	6.6

APPENDIX A

THE SIXTH GRADE GIRLS' IOWA BASIC SKILLS TEST RESULTS

Student's name	Test date	Grade	V	R	L	W	A	C
B. C.	10- 9-59	5	5.3	5.3	4.8	5.1	4.4	4.9
	10- 7-60	6	6.2	5.4	5.6	5.2	5.8	5.6
	5-12-61	6	6.0	6.1	6.2	5.7	6.4	6.1
	10-17-61	7	7.4	7.3	6.5	7.0	6.3	6.9
C. C.	10- 9-59	5	6.1	6.1	5.0	5.1	5.5	5.7
	10- 7-60	6	8.8	7.4	6.4	5.6	6.0	6.8
	5-12-61	6	10.6	8.6	7.2	7.1	7.4	8.2
	10-17-61	7	9.9	8.6	8.1	8.0	7.5	8.4
N. G.	10- 9-59	5	4.3	4.3	3.7	4.2	3.9	4.0
	10- 7-60	6	4.7	4.4	4.8	4.8	5.1	4.8
	5-12-61	6	5.1	5.4	5.0	5.4	5.7	5.3
	10-17-61	7	5.6	5.4	5.8	5.5	6.0	5.6
P. M.	10- 9-59	5	7.5	7.5	7.6	6.4	6.6	7.3
	10- 7-60	6	9.8	9.5	9.5	7.1	6.9	8.6
	5-12-61	6	10.2	9.8	10.0	7.8	8.0	9.2
	10-17-61	7	11.0	10.0	10.3	8.4	8.5	9.6
B. R.	10- 9-59	5	5.8	5.8	7.1	5.2	6.3	5.9
	10- 7-60	6	7.0	7.4	7.6	7.0	7.1	7.2
	5-12-61	6	7.8	8.2	8.9	8.0	8.8	8.3
	10-17-61	7	7.2	8.1	10.2	8.3	8.2	8.4
B. W.	10- 9-59	5	4.2	4.2	4.9	6.0	4.9	5.1
	10- 7-60	6	6.0	6.7	5.0	5.0	6.1	5.8
	5-12-61	6	8.2	7.9	5.3	5.8	6.5	6.7
	10-17-61	7	7.0	7.3	6.5	6.3	7.3	6.9

APPENDIX A

THE FIFTH GRADE BOYS' IOWA BASIC SKILLS TEST RESULTS

Student's name	Test date	Grade	V	R	L	W	A	C
D. F.	10- 7-60	5	3.8	4.1	3.9	4.8	5.0	4.3
	9-23-61	6	4.2	5.5	4.4	6.2	5.5	5.2
J. H.	10- 7-60	5	4.0	5.3	5.0	4.3	5.4	4.8
	9-23-61	6	5.0	6.3	5.7	5.6	6.1	5.7
R. K.	10- 7-60	5	5.4	5.0	5.5	5.4	5.8	5.4
	9-23-61	6	6.7	6.7	5.8	6.4	7.0	6.5
S. R.	10- 7-60	5	7.9	5.8	5.0	5.4	5.3	5.9
	9-23-61	6	6.9	6.2	4.7	5.7	5.3	5.8
T. T.	10- 7-60	5	5.0	4.8	4.5	4.7	4.6	4.7
	9-23-61	6	5.7	6.5	5.4	5.7	6.4	5.9
G. W.	10- 7-60	5	6.5	6.0	4.8	5.4	5.0	5.5
	9-23-61	6	6.9	7.3	7.3	5.8	6.4	6.7

THE FIFTH GRADE GIRLS' IOWA BASIC SKILLS TEST RESULTS

L. D.	10- 7-60	5	4.8	4.4	4.8	4.8	4.2	4.6
	9-23-61	6	5.1	5.1	5.8	5.8	6.1	5.6
E. W.	10- 7-60	5	5.0	3.8	5.2	4.7	4.3	4.6
	9-23-61	6	5.0	6.8	5.8	7.2	6.2	6.2

APPENDIX B

GENERAL INDIVIDUAL STUDENT INFORMATION

Students' initials		Grade	Birth date	I.Q.	Lang. I.Q.	Non-lang. I. Q.	Test date	C A	M A
1.	D. B.	6	4-11-49	116	117	115	9-23-58	9- 6	11- 2
2.	B. C.	6	7- 9-48	112	96	127	9-23-58	10- 2	11- 4
3.	E. C.	6	4-22-48	86	92	80	9-12-59	11- 1	9- 7
4.	C. C.	6	2-21-49	100	97	103	9-23-58	9- 7	9- 7
5.	M. E.	6	12- 8-47	96	85	106	9-23-58	10-10	10- 5
6.	D. F.	6	3- 2-49	114	115	112	9-23-58	9- 7	10-11
7.	N. G.	6	5-23-47	69	75	62	9-23-58	11- 4	7- 9
8.	R. G.	6	6- 6-49	113	125	100	2-23-58	9- 3	10- 5
9.	D. H.	6	7-22-46	68			5- 1-57	10-10	7- 5
10.	P. M.	6	1-15-49	121	134	108	9-23-58	9- 8	14- 2
11.	B. R.	6	4- 1-49	124	122	126	9-23-58	9- 6	11-10
12.	B. T.	6	10-30-47	80	89	70	9-23-58	10-11	8- 8
13.	B. W.	6	5-29-49	120	110	129	9-23-58	9- 4	9- 4
14.	C. W.	6	5-29-49	125	115	135	9-23-58	9- 7	9- 4
1.	L. D.	5	7-24-50	87	100	74	10-15-59	9- 3	8- 0
2.	D. F.	5	11- 8-49	90	103	76	10-15-59	9-11	8-11
3.	J. H.	5	2-15-49	100	85	115	10-15-59	10- 8	10- 7
4.	R. K.	5	6-24-50	118	104	131	10-15-59	9- 4	11- 0
5.	S. R.	5	4-20-50	125	131	118	10-15-59	9- 6	11-10
6.	E. S.	5	3-31-50	123	115	131	10-15-59	9- 7	11- 9
7.	T. T.	5	8- 9-50	125	131	118	10-15-59	9- 2	10- 6
8.	G. W.	5	2-18-50	108	117	100	10-15-59	9- 8	10- 6
9.	E. W.	5	7-18-50	104	114	93	10- 5-61	10- 2	10- 6

APPENDIX C

Pupil's name <u>class data</u> Date <u>10-17-60</u> Grade <u>5 & 6</u>

An Evaluation on Science Interest in Magnetism, Electricity, and Electronics at the Fifth and Sixth Grade Level

1.	(a) I know lots about magnetism	11
	(b) I don't know much about magnetism	12
2.	(a) I would like to learn about magnetism	19
	(b) I don't want to learn about magnetism	4
3.	(a) I know lots about electricity	12
	(b) I don't know much about electricity	11
4.	(a) I would like to learn about electricity	21
	(b) I don't care to learn about electricity	2
5.	(a) I know lots about electronics	4
	(b) I don't know much about electronics	19
6.	(a) I want to learn about electronics	21
	(b) I don't want to learn about electronics	2
7.	(a) I know lots about science projects studying magnetism, electricity, and electronics	19
	(b) I don't know much about these projects	4
8.	(a) I would like to learn about these projects . .	20
	(b) I don't care about these projects	3
9.	I think these projects:	
	(a) would make school more interesting	22
	(b) would not make school more interesting	1
10.	(a) I want to find out if these projects make school work more interesting	23
	(b) I don't care to find out if these projects make school work more interesting	0
11.	If I get to work on such projects in school:	
	(a) I would work harder on regular school work . .	17
	(b) I wouldn't work harder on regular school work .	6

12. (a) I want to find out if these projects make regular study more interesting 21
(b) I don't care to find out if these projects make regular study more interesting 2

13. I think these projects:
(a) may help later in life 21
(b) will not help later in life 2

14. (a) I want to find out if these projects will help later in life 20
(b) I don't care to find out if these projects will help later in life 3

15. I think projects in magnetism, electricity, and electronics:
(a) should be taught the whole school year 17
(b) should not be taught the whole school year . . 6

16. (a) I think science projects are all very interesting 19
(b) I don't think science projects are interesting 4

APPENDIX C

Pupil's name <u>class data</u> Date <u>3-7-61</u> Grade <u>5 & 6</u>

An Evaluation on Science Interest in Magnetism, Electricity, and Electronics at the Fifth and Sixth Grade Level

1.	(a)	I know lots about magnetism	12
	(b)	I don't know much about magnetism	11
2.	(a)	I would like to learn about magnetism	20
	(b)	I don't want to learn about magnetism	3
3.	(a)	I know lots about electricity	8
	(b)	I don't know much about electricity	15
4.	(a)	I would like to learn about electricity	17
	(b)	I don't care to learn about electricity	6
5.	(a)	I know lots about electronics	4
	(b)	I don't know much about electronics	19
6.	(a)	I want to learn about electronics	18
	(b)	I don't want to learn about electronics	5
7.	(a)	I know lots about science projects studying magnetism, electricity, and electronics	16
	(b)	I don't know much about these projects	7
8.	(a)	I would like to learn about these projects . . .	20
	(b)	I don't care about these projects	3
9.		I think these projects:	
	(a)	would make school more interesting	21
	(b)	would not make school more interesting	2
10.	(a)	I want to find out if these projects make school work more interesting	23
	(b)	I don't care to find out if these projects make school work more interesting	0
11.		If I get to work on such projects in school:	
	(a)	I would work harder on regular school work . . .	22
	(b)	I wouldn't work harder on regular school work .	1

12. (a) I want to find out if these projects make regular study more interesting 22
    (b) I don't care to find out if these projects make regular study more interesting 1

13. I think these projects:
    (a) may help later in life 21
    (b) will not help later in life 2

14. (a) I want to find out if these projects will help later in life 22
    (b) I don't care to find out if these projects will help later in life 1

15. I think projects in magnetism, electricity, and electronics:
    (a) should be taught the whole school year 15
    (b) should not be taught the whole school year . . 8

16. (a) I think science projects are all very interesting 23
    (b) I don't think science projects are interesting 0

APPENDIX C

Pupil's name <u>class data</u> Date <u>3-8-61</u> Grade <u>5 & 6</u>

Determining What Interest and Motivational Results This Study Had Upon Students Through the Following Questionnaire

1. I liked the study of magnetism, electricity, and electronics:
   (a) very much 16
   (b) some 5
   (c) very little 2
   (d) I don't know if I liked it or not 0

2. I think the study of magnetism, electricity, and electronics helped me to become interested in other subjects:
   (a) very much 10
   (b) some 8
   (c) very little 4
   (d) I don't know if it helped or not 1

3. The study of magnetism, electricity, and electronics helped me learn:
   (a) much more in regular subject matter 13
   (b) a little more in regular subject matter 4
   (c) very little more in regular subject matter . 0
   (d) I don't know if it helped me or not 6

4. I think what I learned in magnetism, electricity, and electronics will help me later in life:
   (a) very much 20
   (b) some 1
   (c) very little 1
   (d) I don't know if it will help later or not , . 1

5. I think these science projects were:
   (a) more fun than work 12
   (b) fun and hard work 9
   (c) very little fun but were hard work 2
   (d) I don't know what to think of this special study 0

6. I think specialities like magnetism, electricity, and electronics should be taught:
   - (a) the whole school year 15
   - (b) part of the school year 6
   - (c) the study isn't important 0
   - (d) I don't know if it should be studied or not . 2

7. The study of magnetism, electricity, and electronics made me realize that to know the regular subject matter well:
   - (a) was very important 21
   - (b) may help some 1
   - (c) makes little difference 1
   - (d) I don't know if it helps or not 0

8. My parents think the study of magnetism, electricity, and electronics was:
   - (a) very important 16
   - (b) was probably all right 2
   - (c) was of little importance 0
   - (d) I don't know what my parents think about it . 5

APPENDIX C

Pupil's name class data   Date 10-17-61   Grade 5 & 6

Please Place an X in the Space You Wish to Answer in the Following Interest and Motivational Questionnaire

1. Are you interested in the study of magnetism?
   (a) Yes 15
   (b) No 6
   (c) I don't know 2

2. Are you interested in the study of electricity?
   (a) Yes 15
   (b) No 7
   (c) I don't know 1

3. Are you interested in the study of electronics?
   (a) Yes 18
   (b) No 4
   (c) I don't know 1

4. Are you afraid of electricity?
   (a) Yes 12
   (b) No 10
   (c) I don't know 1

5. Would you like to build radios or amplifiers?
   (a) Yes 18
   (b) No 3
   (c) I don't know 2

6. Can you use tools used in electricity and radios?
   (a) Yes 16
   (b) No 1
   (c) I don't know 6

7. Do you think you can learn safety first so that you can work in electricity and radio work?
   (a) Yes 20
   (b) No 1
   (c) I don't know 2

8. If you had the chance to work in electrical and radio work would you promise to work as a mature responsible person?
   (a) Yes 19
   (b) No 2
   (c) I don't 2

9. Do you think you can do good work in magnetism, electricity, and electronics without being able to read instructions or do arithmetic well?
   (a) Yes 5
   (b) No 15
   (c) I don't know 3

10. Would you work harder on regular subjects (reading, arithmetic, etc.) if you were given a chance to work with magnetism, electricity, and electronics?
   (a) Yes 14
   (b) No 5
   (c) I don't know 4

APPENDIX C

Pupil's name <u>class data</u> Date <u>3-7-61</u> Grade <u>5 & 6</u>

Please Place an X in the Space You Wish to Answer in the Following Interest and Motivational Questionnaire

1. Are you interested in the study of magnetism?
   (a) Yes 17
   (b) No 2
   (c) I don't know 4

2. Are you interested in the study of electricity?
   (a) Yes 16
   (b) No 3
   (c) I don't know 4

3. Are you interested in the study of electronics?
   (a) Yes 16
   (b) No 2
   (c) I don't know 5

4. Are you afraid of electricity?
   (a) Yes 7
   (b) No 10
   (c) I don't know 6

5. Would you like to build radios or amplifiers?
   (a) Yes 21
   (b) No 2
   (c) I don't know 0

6. Can you use tools used in electricity and radio?
   (a) Yes 10
   (b) No 1
   (c) I don't know 12

7. Do you think you can learn safety first so that you can work in electricity and radio work?
   (a) Yes 22
   (b) No 0
   (c) I don't know 1

8. If you had the chance to work in electrical and radio work would you promise to work as a mature responsible person?
   (a) Yes 20
   (b) No 2
   (c) I don't know 1

9. Do you think you can do good work in magnetism, electricity, and electronics without being able to read instructions or do arithmetic well?
   (a) Yes 0
   (b) No 20
   (c) I don't know 3

10. Would you work harder on regular subjects (reading, arithmetic, etc.) if you were given a chance to work with magnetism, electricity, and electronics?
   (a) Yes 15
   (b) No 2
   (c) I don't know 6

APPENDIX C

Pupil's name <u>class data</u> Date <u>10-17-60 & 3-7-61</u> Grade <u>5 & 6</u>

A Science Test Evaluating Student Experience and Knowledge of Magnetism, Electricity, and Electronics

1. Tell how you may make a simple magnet.
2. What causes a magnet to attract iron or steel particles?
3. How many poles does a magnet have?
4. If a south pole of a magnet is placed near a south pole of another magnet what happens?
5. Explain magnetic lines of force.
6. Name five things in which magnets are used.
7. What is induction in electricity?
8. Describe an alternating current type of transformer.
9. How can you develop alternating current from a direct current?
10. How is voltage made or developed?
11. What is voltage?
12. How is voltage brought into your home?
13. What is current?
14. What is power?
15. How may we increase voltage?
16. How may we decrease voltage?
17. What is a conductor?
18. What is an insulator?
19. Name five materials which conduct voltage efficiently.
20. Name five materials which make good insulators—that is materials which do not conduct voltage efficiently.

21. What is a condenser and what does it do?

22. Tell how to make a second simple telephone.

23. How is sound developed from the air so it may be heard by man?

24. How do we increase the volume of sound?

25. What is a radio frequency signal?

26. What frequency range can man hear?

27. Name five parts that are used to build a radio.

28. Write the Morse code symbols of the twenty-six letters of the English language and the ten Arabic numerals (0-9).

29. Tell why very high frequency signals go shorter distances than low frequencies.