

EXPERIMENTAL SCIENCE PROGRAM - PHASE I

Edwin B. Kurtz, Jr., Associate Professor of Botany, and
Millard G. Seeley, Professor of Chemistry, University of Arizona, Tucson

Little did we realize two years ago that we would be science teachers in the fifth grade. Yet that's exactly what we were this past year.

For several years University of Arizona scientists have been actively trying to improve instruction in science at all levels. Most of the activity has centered upon senior high school teachers, and numerous summer and in-service institutes have been held for them. It became increasingly clear, however, that the crux of the problem lay in the elementary school science program. And science in the classroom is no better than the teacher, so we began to take a serious look at the science training the future teacher receives in college. As these thoughts jelled, we came to the realization that we didn't know much about the elementary school, its problems, its teachers, or its children. We did not lack for ideas and views, but we certainly had little or no experience or facts to support them. The obvious solution was to enter the elementary school classroom and test our ideas about science teaching and gain insight into the training needs of the elementary school teacher.

With these objectives in mind, we requested permission to enter the classroom from the assistant superintendent and supervisor of intermediate grades of Tucson District One. Frankly, the response to our request was most gratifying. Very shortly two schools were selected. Cragin and Ft. Lowell. Next we obtained the consent and cooperation of the principals and a fifth grade teacher in each school to let us in the classroom. We cannot say enough about the enthusiasm and cooperation we received, throughout the year, from beginning to end, from the school administration and the teachers. This is certainly an encouraging sign for future cooperation between university faculty, the public school administration, and the elementary classroom.

With Seeley working in Mrs. Elizabeth Muir's classroom, and Kurtz in Mr. Edward Smith's room, we began the school year. Although we were generally in agreement as to the principles and methods to be used with the children, we made no attempt to do the same things, study the same areas, or to compare notes during the school year. Rather, we wished to see if we would change certain of our views and arrive at similar conclusions at the end of the year even though we worked independently.

A full description of our separate programs will not be given here. Suffice to say that whatever area of science we chose to cover in the classroom, facts were not emphasized. Emphasis was at all times on student participation and response, discovery, experimentation (mainly quantitative), questioning, formulating ideas and discarding the vague ones, thinking in general, and stimulating curiosity in things and ideas. Formal facts and nomenclature were introduced as needed, and then only as means to an end, not as ends in themselves. Because this was an experimental program, we intentionally attempted the introduction of some concepts that were hard for the children to understand. We wished to see just how far they could go in the thinking process. Nevertheless, as we had guessed, we found that the enthusiasm, curiosity, and uninhibited thinking of the children permit them to arrive at and grasp concepts that they would usually not be exposed to until high school or college. Admittedly,

they did not grasp all concepts in a very sophisticated manner, but the important thing is that they did grasp them and that they arrived at the understanding of them themselves. This we feel is the proper foundation to build on. Thus the ideas of testing unknowns with comparison to controls and knowns, space, time, and coordinate systems, conversions and measurement of energy, reproduction and growth of cells and organisms, elementary ecology of plants and animals, deductive thinking, using arithmetic in experimental calculations, the periodic table, and many others were successfully developed.

At Cragin a special experiment arose. Each day after Kurtz finished teaching in Mr. Smith's classroom, Mr. Smith moved into two other fifth grade rooms and presented science in a similar manner. In the meantime, the teachers in these two rooms were in Mr. Smith's room teaching writing and the arts. In this way Mr. Smith not only had an opportunity to help and observe in his own classroom, but he had an in-service experience teaching science along our experimental lines. His success in presenting science in this way has encouraged us to believe that most teachers could also be trained to do so.

To determine if the latter conclusion is correct is the objective of the second phase of our experimental science program. Again, through the cooperation of the administration of Tucson District One, we have arranged for about 20 volunteer teachers, grades 1 to 6, to attend a seminar each week during the school year. In this seminar we will attempt to show these teachers our method of science teaching in as many areas of science as possible. Their reaction to this method and their successful use of it will be the real test of the experimental program. If these teachers can learn to present science in areas of their own competence along the procedures described, then this experimental program will have been successful.

Reprinted from The Arizona Administrator 1:2, 1962.

The University of Arizona

November 26, 1962

Report to the Faculty Senate of the ad hoc Senate
Committee Studying the Feasibility of a Proficiency Examination in English

Last spring President Harvill appointed a committee whose task was to consider the possibility of requiring a proficiency examination in English of the students at the University of Arizona. The committee met weekly through April and May and reached the following decisions:

1. It was decided almost immediately that a proficiency examination would be desirable. The committee members had had much experience with upper-division students who are unable to write acceptably on examinations and were aware that this experience was shared by faculty members generally. They were also cognizant of the fact that the investigation of another committee a year ago had shown that 39% of the 1960 graduating class had not taken their English at the University of Arizona and that many of these appeared to be obvious avoiders of our English requirements.

2. It was decided that the proficiency examination should consist of a standardized objective test, such as the Purdue Test in English, and of a theme. It was felt that those students who made a high score on the objective test, the exact level to be determined empirically, should be excused from writing the theme. It was decided that we should exempt from the proficiency test those who had taken English 2 and 4 at this University and those who had made a grade of 2 or better in English 3 at this University. All transfer students would be required to take the test.

The committee recommends that a fee be charged each student taking the proficiency test. The money thus gathered is to be used for buying the necessary supplies and for paying the readers of the themes.

3. The proficiency examination should be given at the beginning and end of each semester.

4. Those who fail the proficiency test will be required to attend a workshop in order to correct their deficiencies. The workshop will be more fully discussed under No. 7. The student who has been sent to the workshop will take the proficiency test again when the director of the workshop decides he is ready to do so.

5. There must be some means devised for forcing the students to take the test by the beginning of their junior year. It was suggested that perhaps something like the withholding of credits would accomplish this purpose. But without some such measure there are many students who would put the test off from semester to semester, probably the very students who would need the workshop most.

6. The members of the committee engaged in the experiment of grading a group of themes provided by the English Department. As a result of this trial it seemed plain that a set of standards for the theme should be drawn up. Perhaps an interested faculty member from each college could be appointed to a committee that would arrive at such standards. The readers of the themes should know very clearly whether the faculty is interested more in orderly and logical structure than in mechanics, how much emphasis is to be put upon misspellings, punctuation errors, sentence errors and so on. We feel that a reasonably clear and workable standard can be evolved.

The University of Arizona
Proceedings of the Faculty Senate

Meeting of Monday

January 7, 1963

The Faculty Senate convened in regular session at 3:40 P.M. on Monday, January 7, 1963, in Room 111 of the College of Business and Public Administration. Thirty-eight members were present with President Harvill presiding. Dr. M.G. Seeley, Dr. Arthur H. Steinbrenner, Dr. Albert B. Weaver, and Mr. W. W. Shirey also were present.

PRESENT: Bartlett, Blecha, Blitzler, Brewer, Carlson, Delaplane, Forrester, Gegenheimer, Gillmor, Gustavson, Harvill, Kassander, Kurtz, Lacy, Little, Livermore, Lynn, Lyons, McDonald, McMillan, Martin, Moore, Muir, H.Myers, L.Myers, Nugent, Patrick, Paylore, Powell, Rappeport, H.Rhodes, J.M. Rhodes, Roy, Siegel, Slonaker, Svob, Vavich, Wallraff.

ABSENT: Conley, Ewing, Gaines, Haury, Hillman, Hudson, Kemmerer, Rosaldo, Russell, Simonian, Windsor.

REPORTS OF EXPERIENCE IN WORKING WITH PUBLIC SCHOOLS IN PROGRAMS OF SCIENCE

INSTRUCTION: President Harvill stated that outstanding service is being given by members of the University faculty in the assistance they are furnishing the public schools of Arizona in helping the schools improve the quality of science teaching. Experimentation has been going on for several years under the leadership of University personnel and good results have developed from this, including better articulation between science teaching in the public schools and that at the University level.

Dr. Harvill explained that under the chairmanship of Dr. Albert B. Weaver a special University committee on Science Education has been studying the matter of improving the training of science teachers. This group also is interested in improving the quality of the science teaching in the schools by teachers already in service.

Because the concern of the University in this matter is so great, President Harvill said he had asked some of the individuals involved with it to report to the Senate today on their activities.

The President first introduced Dr. Millard G. Seeley, Professor of Chemistry. Among his various activities in science education, Dr. Seeley has directed a number of institutes for science teachers under the sponsorship of the National Science Foundation and under the provisions of the National Defense Education Act, the President explained.

Dr. Seeley said that he and the other faculty members concerned were grateful for the opportunity to share some of their experiences with the Senate. He said he would simply report some of the "high spots" of the activities of recent years in order that the Senate could have an over-all view. He explained that in 1956 Dr. Harvill had created a Committee on Science Education, the membership of which represented various science disciplines and the College of Education. The first project for the group had been to prepare proposals to the National Science Foundation asking support of an institute for high school science teachers to be held on this campus during the summer of 1957. The committee recognized that institute programs provide only temporary measure whereby members of the teaching

profession may be "brought up to date." The ultimate goal, of course, should be the establishment of a superior curriculum at the University for students preparing to teach science. Actually, the experience of the past six years indicates perhaps institutes are here to stay indefinitely, Dr. Seeley pointed out. After all, the re-training process is an endless one.

It became evident, Dr. Seeley explained, that the training for science teaching that the science teachers participating in the institutes had received in their college courses had been inadequate. It was little short of amazing how poorly prepared in the subject-matter some high school science teachers were. While this might not seem surprising for the older teacher long out of college, it was disconcerting that the teacher just out of college a few years was also inadequately trained. So the institutes were revised and improved. Where in the early institutes too much material was included and the level of the courses was too high, a more modest amount of material was programmed with more reasonable goals indicated. Later the level of the institutes was stepped up and some earlier participants were brought back for a second institute. They did much better work the second time since their background had been so strengthened by their participation in an earlier institute.

Dr. Seeley agreed that the program of institutes might sound like a tremendous job and he reminded the Senate that three hundred institutes like those at the University of Arizona were being conducted in various parts of the United States. It was no small undertaking to improve the quality of science training in schools throughout the land.

Dr. Seeley said that some public school teachers had complained to University faculty members, asking what, after all, did college professors know about high school teaching. "How do you know what you are criticizing in high school classrooms?" they asked. Dr. Seeley decided he had better find out, so for one semester he went to a local high school each day and taught a third period class in Chemistry "This was almost my Waterloo," he said. "The third period was the hour during which absence reports were picked up. The mere matter of keeping attendance records straight was a chore," he said. In any event, aside from the physical manipulations required in administering the paper work for a class of thirty-two, he found that the students responded well to his efforts to interest them in their subject. Dr. Seeley said he came to realize that unfortunately college professors often fail to share the excitement of their subject with their students. They pass along facts and theories and concepts and laws, but they do not share the thrill and excitement of discovery. This is what is needed to inspire response from the students. Presenting material from the standpoint of discovery and the processes by which knowledge is obtained can result in greatly increased interest and, as a result, greatly increased learning on the part of the student.

Dr. Seeley said that a later experience had been on the level of the elementary school. Dr. Kurtz and he had spent a year working with fifth grade classes. Youngsters at that level can comprehend rather sophisticated scientific concepts, he explained. The difficulty is in communicating with the children because of their limited vocabulary and ability to symbolize. Dr. Seeley told the story of a little boy in his class who could multiply fractions in his head but could not write his answers on paper. He always came up with the correct answers. "I do not know how to write it," he said. His mental processes were more advanced than his ability to symbolize. We do not work hard enough at making our special vocabulary and symbols understandable at a very fundamental level, Dr. Seeley said. At this point, Dr. Seeley asked Dr. Edwin B. Kurtz, Associate Professor of Botany (and a member of the Senate), to speak to the Senate.

Dr. Kurtz commented that so far as the fifth grade teaching experience was concerned, he was sure he and Dr. Seeley learned more than the students did. He said he would like to point out that experiments such as those he and Dr. Seeley had conducted, as well as those Dr. Steinbrenner of the Department of Mathematics had participated in, were similar to others going on in schools across the country. He called the attention of the Senate to the December 22, 1962 issue of SCIENCE (Sci.138:1307.1962.) This article reports, he explained, that similar studies in other parts of the country, conducted completely independently of the University of Arizona program, or of each other, showed that these other experiments had produced essentially the same findings. This is important to know since although the studies at the University of Arizona are limited and the studies at other institutions are limited, together the several limited studies seem to provide some common answers.

Dr. Kurtz pointed out that the matter of the training of teachers of science had been receiving attention for some years, prior to the activation of the Science Education Committee or the efforts of Dr. Seeley, Dr. Steinbrenner, and himself. Faculty members of the College of Education - Dr. Blecha, for instance - had long been interested in this subject. Dr. Kurtz explained that to think about elementary school teachers is to think about a vast group of individuals. At present the number of elementary school teachers in the United States is 1,200,000. To maintain an adequate flow of new teachers into the profession, to provide the numbers needed for the growing population, is a gigantic problem in itself, he pointed out, without considering the task of re-training teachers already in the field. In Tucson, he explained, there are fifty elementary schools located over a large geographic area, with an average enrollment in excess of 400 students, some schools having well over 600. The classrooms for many of these students are in temporary buildings that have no gas outlets or running water, thus making it very difficult to give proper science teaching.

Dr. Kurtz said that as a group elementary school teachers are a fascinating group to work with. He said that over the years he had worked with some very good University students, both graduate and undergraduate, "but if you want sheer enthusiasm and a genuine desire to get more information and more knowledge, then work with a group of elementary teachers," he said.

Referring again to the fifth grade program, Dr. Kurtz referred to a reprint from the Arizona Administrator 1:2,1962, entitled "Experimental Science Program - Phase 1", written by Dr. Seeley and himself, which had been distributed to Senate members. A copy of this article is appended to these minutes. The article simply stresses the limitations which must be faced in an elementary classroom, he explained.

Dr. Kurtz said that in the past he had been highly critical of education college faculties and educators, blaming them for the poor quality of teaching in the schools. He said he now has a different view of the problem. It is very difficult to teach and do all the other things teachers are expected to do, he said, for example, (in addition to keeping complicated attendance records), dismissing certain students at a certain time to take their posts on street patrol, or leading your class outside when an unannounced fire drill is suddenly held. These sorts of activities cut sharply into the allotted thirty minutes of time an elementary school teacher has each day for science instruction. The lack of facilities presents still greater problems. Many rooms do not have sinks or running water. Desks are slanted rather than flat so that work projects slide into the student's lap. Rooms cannot be darkened. Some teachers are intolerant of the uncontrolled

chaos in a room which normally has to accomplish the conducting of certain types of scientific experiments. Because of a rabies scare, live vertebrates cannot be taken into classrooms and work that should be done with rats or mice must be done with fish or frogs. In short, he said, the public school science teacher is working under a great variety of handicaps.

Dr. Kurtz said that he thought the University of Arizona should exercise leadership in developing teacher workshops and in developing a teacher consulting service. The high schools need this kind of help from the University and want it. The Arizona Academy of Science has shown some leadership in this area, he explained. Another approach is to bring selected teachers to the campus for conferences, providing them with materials they can take back and use in their classrooms. These teachers can share what they have learned at the University conference with other teachers. University personnel can also help arrange field trips for school science teachers. Dr. Kurtz referred also to the course he and Dr. Seeley are giving called "Experimental Chemistry and Biology for Elementary School Teachers." Teachers from the public schools voluntarily are taking this course, he explained, to improve the quality of their teaching. Dr. Kurtz reminded the Senate also that the University cooperates in the sponsoring of science fairs. He said he believed that all of these activities are beginning to "feed back" to the college level already. Enthusiasm has been aroused and relations between University personnel and high school teachers have been much improved.

Dr. Harvill then called upon Dr. Arthur H. Steinbrenner, Associate Professor of Education and Mathematics. Dr. Steinbrenner said he would limit his remarks in the main to National Science Foundation Institutes. The University now has sponsored a number of such institutes for teachers of mathematics, some being held in the summer and some on Saturday mornings or late afternoons. About \$210,000 has been spent on institutes for mathematics teachers and about a half million dollars on those for science teachers. Certainly we should have some worth-while results from this sort of expenditure, he said. The institutes for elementary schools have been held only in the last two years, he explained. While much attention has been given to improving the teaching of mathematics on the high school and college levels, much attention also has been given to mathematics teaching in the grades. One national program called the "School Mathematics Study Group" has limited its work to the elementary level. In Tucson, twenty-one elementary schools are participating in this program. What is desired is a study of the effects of the program over a period of five years so that a student's performance in mathematics in Grades 5, 6, 7, 8 and 9 (if he starts participating in the new program in grade 4) can be carefully analyzed.

Another program is giving attention to improving the teaching of mathematics in kindergarten through Grade 3. The first task is to determine what the children are like, he said. Then attention is given to the actual classroom experience of the teachers. "We want to train the teachers properly while they are in college so that we will not have to retrain them after they graduate," he explained. The University of Arizona Department of Mathematics is participating in a special study sponsored by a group of Minnesota educators, giving special attention to the teaching of mathematics in kindergarten through third grade. Elementary school teachers are genuinely interested in this matter, Dr. Steinbrenner explained. They are enthusiastic participants and are willing to give up their own time after their school hours to work in the institute program. They have to prepare a large amount of work in preparation for this course, in addition to the preparation they must do for their classes. As an indication of the extent of interest, Dr. Steinbrenner pointed out three years ago fifteen participants registered in this

institute. This has now grown to fifty-five. Teachers are replanning their teaching programs in accordance with the new five-year program.

So far as teaching on the secondary school level is concerned, he said, he would predict summer institutes for these teachers would continue indefinitely.

Dr. Steinbrenner explained that the goal of these programs has not been necessarily to attract the superior teacher but rather the average teacher and then strengthen his understanding of the subject-matter as well as his ability to teach it effectively.

At this point Dr. Harvill called on Dr. Albert B. Weaver, Chairman of the University Committee on Science Education to see if he wished to make any comments. Dr. Weaver said he would like to comment on the role of the Science Education Committee. It is an ad hoc committee appointed by the President to coordinate and expedite the work of scientists interested in science education and the work of members of the faculty of the College of Education. "Perhaps it took Sputnik to emphasize the importance of the situation," he said. "In any event, real efforts have been made now for several years to bridge the gap between the science disciplines as taught in the colleges and universities and the teaching of science in the schools. Scientists and educators are now jointly analyzing just what are the problems of education and what has been the cause of the lack of communication between Education and Science."

Dr. Weaver explained that the Science Education Committee has been studying the whole area of National Science Foundation Institutes, trying to see how the retraining job of teachers already in the field might be made most effective and also to recommend how present curricula of teacher training programs might be improved so that science teaching might be better in the schools on all levels - elementary, junior high, and secondary. One result of the work of the committee has been the development of a sequence of new science courses in physics, chemistry, geology, and biology, which students planning to become elementary school teachers will study in the future in addition to a special course in mathematics. Dr. Weaver said the Science Education Committee also desired to widen interest in the Advanced Placement program whereby able students could complete college freshman level science courses while they were still in high school.

Upon completion of Dr. Weaver's remarks, Dr. Harvill said it was in order for members of the Senate to ask questions of the speakers. He said he had a question of his own and that was whether or not there seems to be a tendency toward standardization in the teaching of high school science because of the fact that standard state textbooks in scientific subjects are selected for use in the high schools. Dr. Seeley said he felt that teachers would like standardization in that they would like to be furnished with some sort of printed material which page by page would tell them how to accomplish effective teaching - for instance, the sort of thing that is being discovered through some of the experimentation being conducted locally in science education. Dr. Kurtz said that he felt that standard textbooks in many courses were considered little more than guides and the teachers felt free to go any direction they wanted to so far as the manner in which material was presented was concerned.

Dr. Blitzer asked if anyone knew how successful were the efforts of the Russians to teach science and foreign language at elementary grade levels. Dr. Gustavson said he had visited Russia as a member of the Exchange Group of the State Department to study science education and research in Russia. He had done some

school visiting as a member of this program. He said he was impressed by the quantity and quality of equipment the schools had been furnished. He said there was no doubt that an important factor of this entire matter is how good and how complete the equipment is that the teacher is provided for his or her use in the teaching effort. In a way this is just as important as the teacher's training, he said.

Dean Roy asked Dr. Steinbrenner how the new program for teachers of mathematics differs from traditional training. Dr. Steinbrenner replied that it is largely a difference between concepts and skills. In the old program, he said, drill on skills was emphasized, whereas in the present program, while skills are still included, the aim is to explain basic concepts of mathematics, with the idea that once these ideas are understood, the student will do independent thinking. He also is likely not so often to forget. This is where the difficulty comes in training teachers, since it is not always easy to "get concepts across" to the teachers.

Specifically, Dean Roy asked, what difference would it make in the student when he reached his first high school year? Dr. Steinbrenner said he would hope that the student would have received an improved introduction to independent thinking, not only in mathematics, but in other situations involving quantitative applications.

Dr. Patrick said he had understood several speakers to imply that the typical teacher in both the elementary grades and the high schools lacks a fundamental understanding of the spirit and methods of science. If the teacher has been graduated from college where the science requirement has been at least 8 units and maybe 16, why should this be? Dr. Seeley said that the introductory courses in the sciences traditionally have been designed to provide a foundation for the major in the subject. In the beginning courses in science too often the course has not resulted in the student's discovering the nature and objectives of science. Of course, a major will experience this later. The answer then, Dr. Seeley continued, in training the teacher, is to require him to take as much course work as is required to bring him to the point where he is touched by the exciting spirit of science and enjoys it. This may well require specially designed courses. He said he did not mean watered-down courses.

Dr. Kurtz said there was another point he would like to make. Suppose the teacher in his training has studied 8 units of Botany or 4 units of Botany and 4 units of Zoology. What does she do when a child brings her a rock? What is needed is a broader approach covering the several science disciplines, he said.

Dr. Melvin Rhodes said members of the Senate might be interested in the book, THE PROCESS OF EDUCATION by Jerome Seymour Bruner of Harvard, published by the National Academy of Science in 1959. This book concerns itself with the topics being discussed today and is available in the University Library.

Dr. McDonald said that he understood some of the speakers had concluded that part of the problem was that teachers in the schools did not have enough knowledge of the subject they were teaching. "Are the new courses in science which students preparing to be public school teachers will take to be taught by individuals well trained in the science subject concerned?" he asked.

Dr. Weaver answered, "Yes, indeed, the individuals are well trained. These courses will be taught by respected scientists who also are well acquainted with the problems of the school teacher. Dr. Seeley, for instance, will teach the chemistry course and Dr. Kurtz will teach the course in biology designed for elementary school teachers."

Dean Moore pointed out, in response to earlier comments about equipment, that the State of Arizona was the only state in the union which has not participated in the program of the National Defense Education Act which provides money to buy scientific equipment for the public schools. Dr. Harvill commented that Dean Moore was correct. Federal money is available for this purpose when matched by state funds, but the Arizona legislature to date has not chosen to participate in this program. The State Board of Education on only one occasion went on record recommending such action to the legislature. Since that time the Superintendent of Public Instruction has not placed the matter on the Agenda of the Board of Education meetings. Dr. Harvill said in his judgment it was unfortunate that the schools in Arizona are the only ones in the nation not receiving the benefit of federal assistance which would provide equipment to improve both the teaching of languages and science under the provisions of the NDEA.

Dr. Harvill thanked Dr. Seeley, Dr. Kurtz, Dr. Steinbrenner, and Dr. Weaver for their worthwhile reports to the Senate.

REPORT OF ad hoc SENATE COMMITTEE TO STUDY FEASIBILITY OF PROFICIENCY EXAMINATION IN ENGLISH: The Senate considered the report of an ad hoc Senate committee created earlier to study the feasibility of establishing a proficiency examination in English for the students at the University of Arizona, at some point subsequent to the freshman year.

The report of the committee was as follows:

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1. It was decided almost immediately that a proficiency examination would be desirable. The committee members had had much experience with upper-division students who are unable to write acceptably on examinations and were aware that this experience was shared by faculty members generally. They were also cognizant of the fact that the investigation of another committee a year ago had shown that 39% of the 1960 graduating class had not taken their English at the University of Arizona and that many of these appeared to be obvious avoiders of our English requirements.

2. It was decided that the proficiency examination should consist of a standardized objective test, such as the Purdue Test in English, and of a theme. It was felt that those students who made a high score on the objective test, the exact level to be determined empirically, should be excused from writing the theme. It was decided that we should exempt from the proficiency test those who had taken English 2 and 4 at this University and those who had made a grade of 2 or better in English 3 at this University. All transfer students would be required to take the test.

The committee recommends that a fee be charged each student taking the proficiency test. The money thus gathered is to be used for buying the necessary supplies and for paying the readers of the themes.

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6. The members of the committee engaged in the experiment of grading a group of themes provided by the English Department. As a result of this trial it seemed plain that a set of standards for the theme should be drawn up. Perhaps an interested faculty member from each college could be appointed to a committee that would arrive at such standards. The readers of the themes should know very clearly whether the faculty is interested more in orderly and logical structure than in mechanics, how much emphasis is to be put upon misspellings, punctuation errors, sentence errors and so on. We feel that a reasonably clear and workable standard can be evolved.

The Senate discussed the proposals at some length and raised a number of questions. Action on the matter was deferred until a later meeting.

Warren W. Shirey
Secretary pro tem

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With these objectives in mind, we requested permission to enter the classroom from the assistant superintendent and supervisor of intermediate grades of Tucson District One. Frankly, the response to our request was most gratifying. Very shortly two schools were selected, Cragin and Ft. Lowell. Next we obtained the consent and cooperation of the principals and a fifth grade teacher in each school to let us in the classroom. We cannot say enough about the enthusiasm and cooperation we received, throughout the year, from beginning to end, from the school administration and the teachers. This is certainly an encouraging sign for future cooperation between university faculty, the public school administration, and the elementary classroom.

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school or college. Admittedly, they did not grasp all concepts in a very sophisticated manner, but the important thing is that they did grasp them and that they arrived at the understanding of them themselves. This we feel is the proper foundation to build on. Thus the ideas of testing unknowns with comparison to controls and knowns, space, time, and coordinate systems, conversions and measurement of energy, reproduction and growth of cells and organisms, elementary ecology of plants and animals, deductive thinking, using arithmetic in experimental calculations, the periodic table, and many others were successfully developed.

At Cragin a special experiment arose. Each day after Kurtz finished teaching in Mr. Smith's classroom, Mr. Smith moved into two other fifth grade rooms and presented science in a similar manner. In the meantime, the teachers in these two rooms were in Mr. Smith's room teaching writing and the arts. In this way Mr. Smith not only had an opportunity to help and observe in his own classroom, but he had an in-service experience teaching science along our experimental lines. His success in presenting science in this way has encouraged us to believe that most teachers could also be trained to do so.

To determine if the latter conclusion is correct is the objective of the second phase of our experimental science program. Again, through the cooperation of the administration of Tucson District One, we have arranged for about 20 volunteer teachers, grades 1 to 6, to attend a seminar each week during the school year. In this seminar we will attempt to show these teachers our method of science teaching in as many areas of science as possible. Their reaction to this method and their successful use of it will be the real test of the experimental program. If these teachers can learn to present science in areas of their own competence along the procedures described, then this experimental program will have been successful.

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7. Obviously the largest and most adventurous item in all the committee's recommendations is the establishment of the workshop. The committee estimated that there would be about 2500 juniors next fall and that 1/3 of these would fail the test; that we would have approximately 800 people to be sent to a workshop. The workshop would need (1) a supervisor, (2) seven instructors or 21 teaching assistants, (3) a large room, (4) a secretary (it seems necessary that a file would have to be kept on every student and that a report would have to be sent to the colleges each month concerning the student's progress or lack of it.)

7 instructors @ \$5,000	\$ 35,000
1 supervisor @ \$7,500	<u>7,500</u>
	\$ <u>42,500</u>
Operating cost	<u>4,000</u>
Approximate Total	\$ 50,000

The following capital equipment would also be necessary:

2 desks	\$ 300.00
1 large table	300.00
Small tables	700.00
Filing cabinets	200.00
50 chairs	1,250.00
1 desk chair with arms	61.25
Electric typewriter	320.00
Bookcases	<u>120.00</u>
Approximate Total	<u>\$4,000.00</u>

The expense seems high but the committee felt that it could not recommend anything less. It is to be hoped that as teaching machines, and programmed materials generally, become available that they would be efficiently used in the workshop. Developments of this kind might result in reducing the operating costs.

Respectfully submitted,

Donald M. Ayers
 O. M. Hartsell
 Jimmie S. Hillman
 A. L. Muir
 Louis Myers
 R. C. Neff
 Albert Picchioni
 Donald White
 J. W. Huggins, Chairman