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ABSTRACT

This publication describes a four year, field-based program for the preparation of science teachers. It begins with a paper providing an overview of the current Iowa-UPSTEP model. A follow-up paper elaborates various facets of the model. The model integrates theory with a series of field-based clinical experiences in a four year program, providing intensive involvement with contemporary science curricula and attempts to emphasize human values. The science teacher education program consists of three major parts: the science major, the general education requirements, and the professional sequence. Each is described in detail. The summer program which includes a curriculum workshop is described as are intern teaching activities. An interactive curriculatorium, a science curriculum laboratory, was designed and described to include an itemized listing of laboratory kits by title and associated text and chapter of the specified curriculum. A Self-Instructional Laboratory is described and the primary objectives for its use are listed. A brief list of references is included. (Author/EB)

THE IOWA-UPSTEP MODEL

for

Science Teacher Education

Edited
by
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Preface

This publication portrays the current status of the Iowa-UPSTEP model for the preparation of highly competent science teachers. We hope that readers will find within these covers ideas that will be stimuli for more effective teacher education. The publication begins with a paper providing an overview of the current Iowa-UPSTEP model. The papers that follow elaborate various facets of that model. We believe the model has a number of creative and promising features. It integrates theory with a series of field-based clinical experiences in a four year program, it provides intensive involvement with contemporary science curricula, and we believe that it emphasizes human values.

Supported in part by a grant from the National Science Foundation, the Iowa-UPSTEP model has evolved over a five year period with rapid changes during the past two years. It is a product of the efforts of a sizeable number of people. In addition to the efforts of staff members over these years, the concern and support of our students, public school teachers, University faculty in several departments, and administrators in the College of Education have all facilitated development of the model. The concurrent existence of good facilities and of many other viable programs in the Science Education Center has provided an environment which has also facilitated model development. Former UPSTEP faculty members have included Drs. Ronald Townsend and William Sharp. We in the Iowa-UPSTEP program are indebted to the support of Howard Jones, Dean of the College of Education and John McAdam, Chairman of the Division of Secondary Education. We are also indebted to the energy and leadership of Professor Robert E. Yager who is Coordinator of the Science Education Center and Director of Iowa-UPSTEP.

This publication is a product of the efforts of a number of people. Those who are listed as contributing authors have also made significant contributions in shaping the evolving model. To these people for their help and their cooperation I am personally grateful.

Vincent N. Lunetta
January 16, 1975

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Iowa-UPSTEP

Program Overview

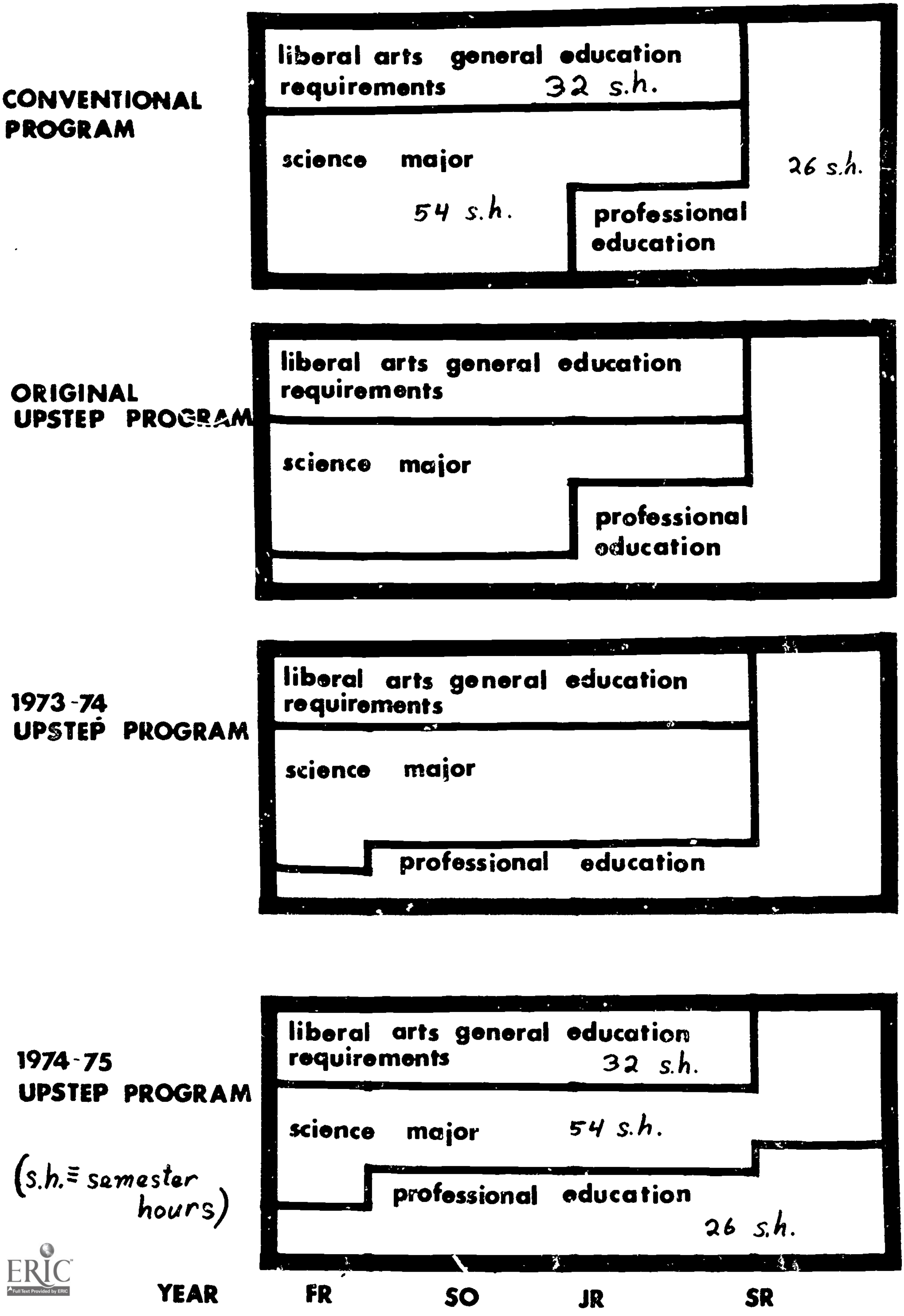
Over the past few years the science teacher preparation program at the University of Iowa has been in the process of gradual evolution. The changes have been stimulated by a grant from the National Science Foundation and by the concern of local teachers and science educators. Figure 1 provides a graphic portrayal of the program changes that have occurred while Figure 2 provides a pictorial overview of the professional sequence built within the series of models. The figures show that as the program has evolved, the professional education sequence has become more thoroughly integrated with the student's total program than it was in the conventional program.

In the conventional program, which is further elaborated in Figure 3, professional courses in teacher education follow the major portion of the student's college program. The conventional program provided for little, if any, formal interaction between the professional education sequence of courses and the courses in the student's major science area. In fact, the student was prevented by the program structure from pursuing these interests concurrently. He could not formally pursue science-related activities with children until late in his college career, and the full semester of student teaching during his senior year precluded concurrent work in his scientific area of interest at that time.

In the current UPSTEP program pictured in Figures 4A, 4B, and 4C seminars and coordinated clinical experiences introduce science-oriented UPSTEP students

Figure 1

IOWA UPSTEP: PREPARING SCIENCE TEACHERS



IOWA UPSTEP
PROFESSIONAL EDUCATION SEQUENCE

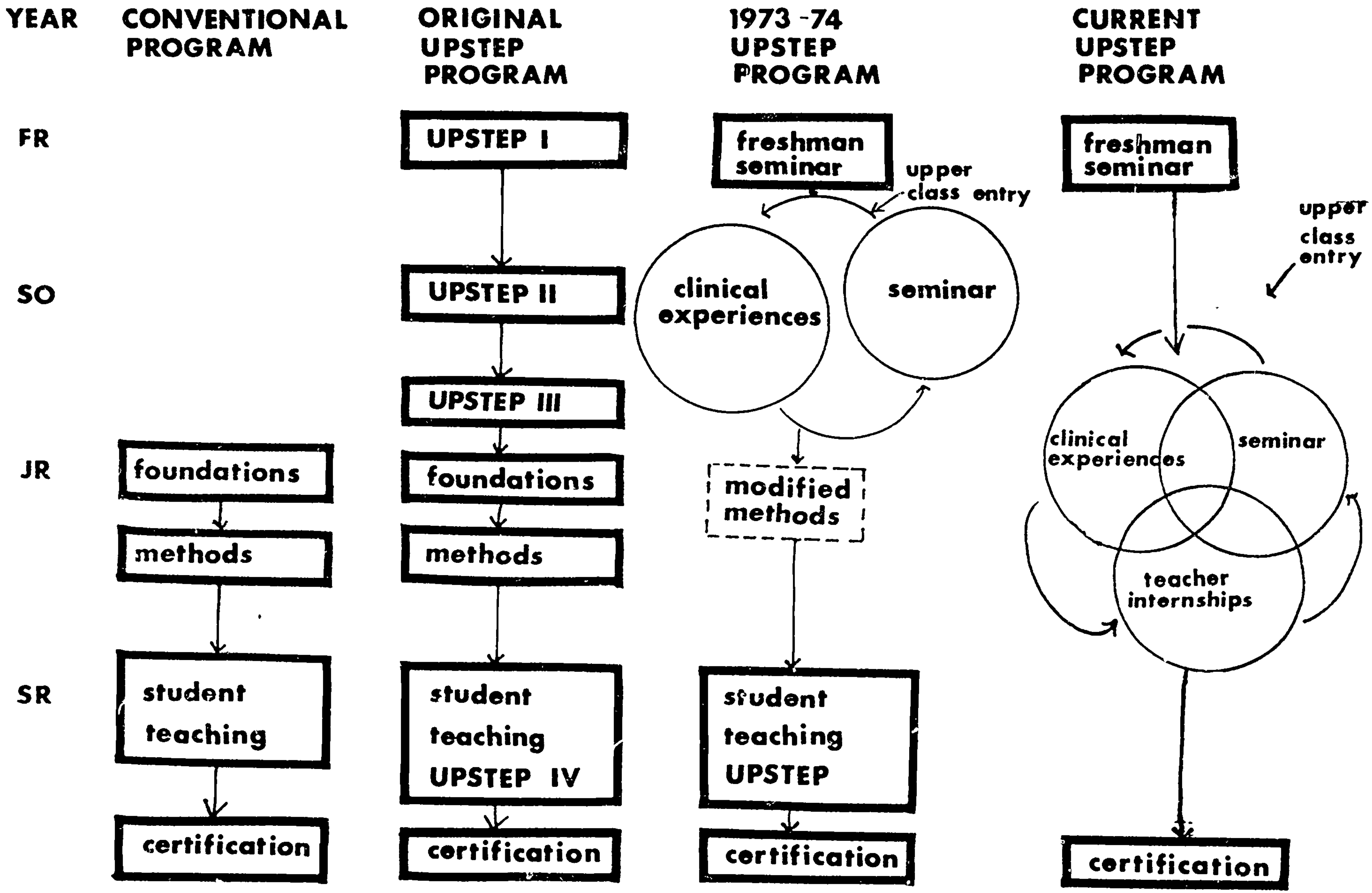
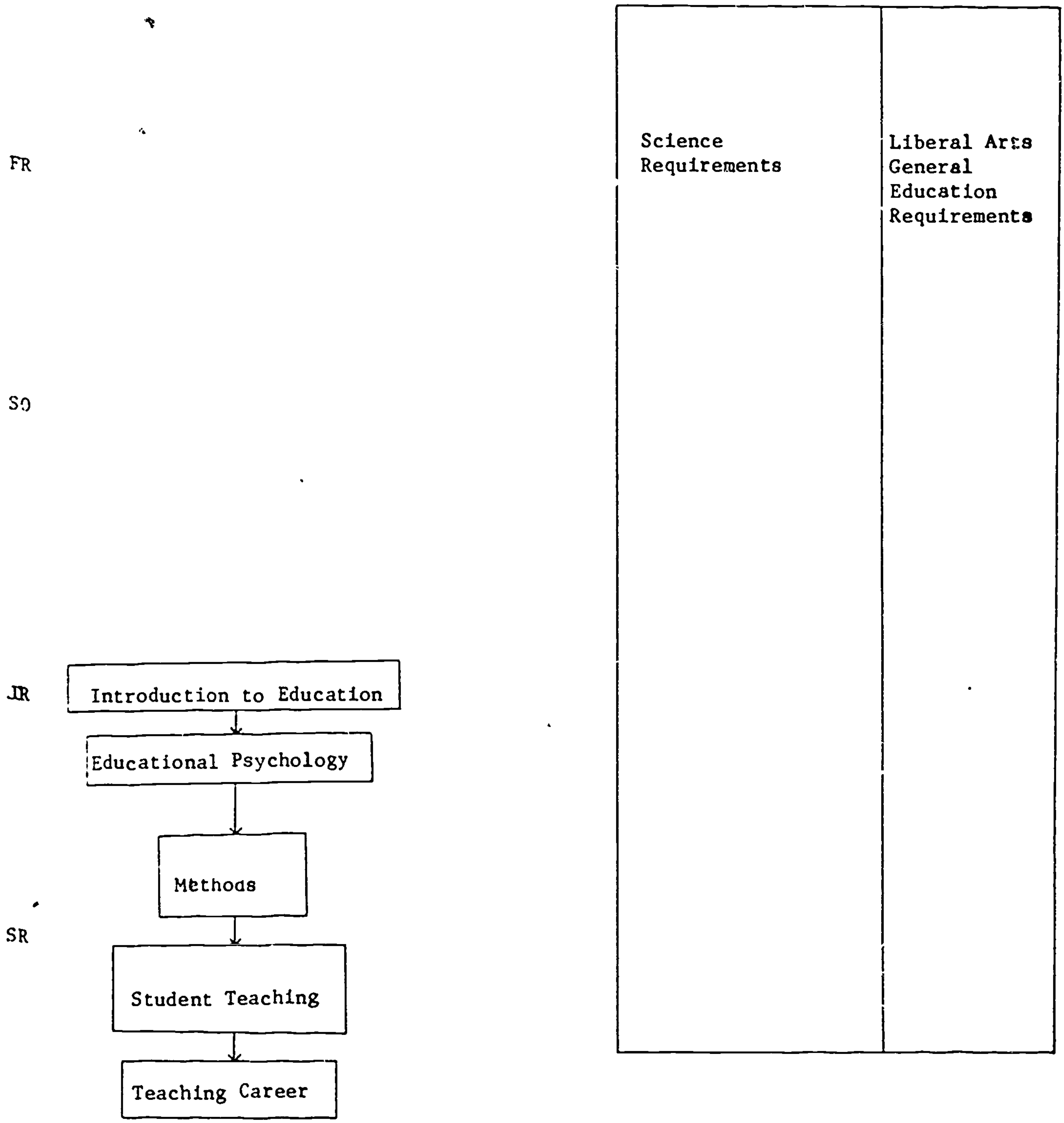


Figure 2

Figure 3

Science Teacher Education

Conventional Program



IOWA UPSTEP PROFESSIONAL EXPERIENCES

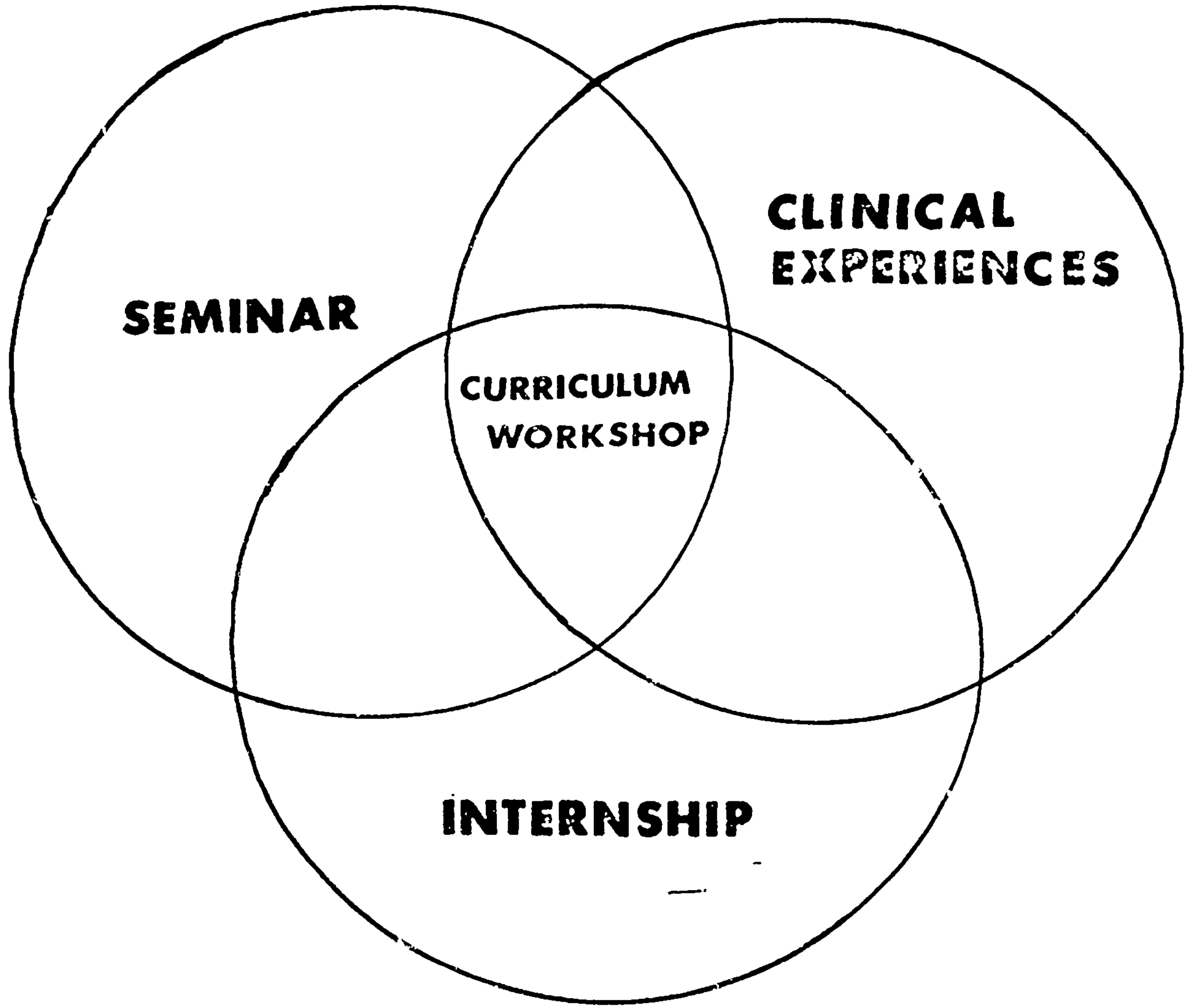


Figure 4A

CLINICAL EXPERIENCES

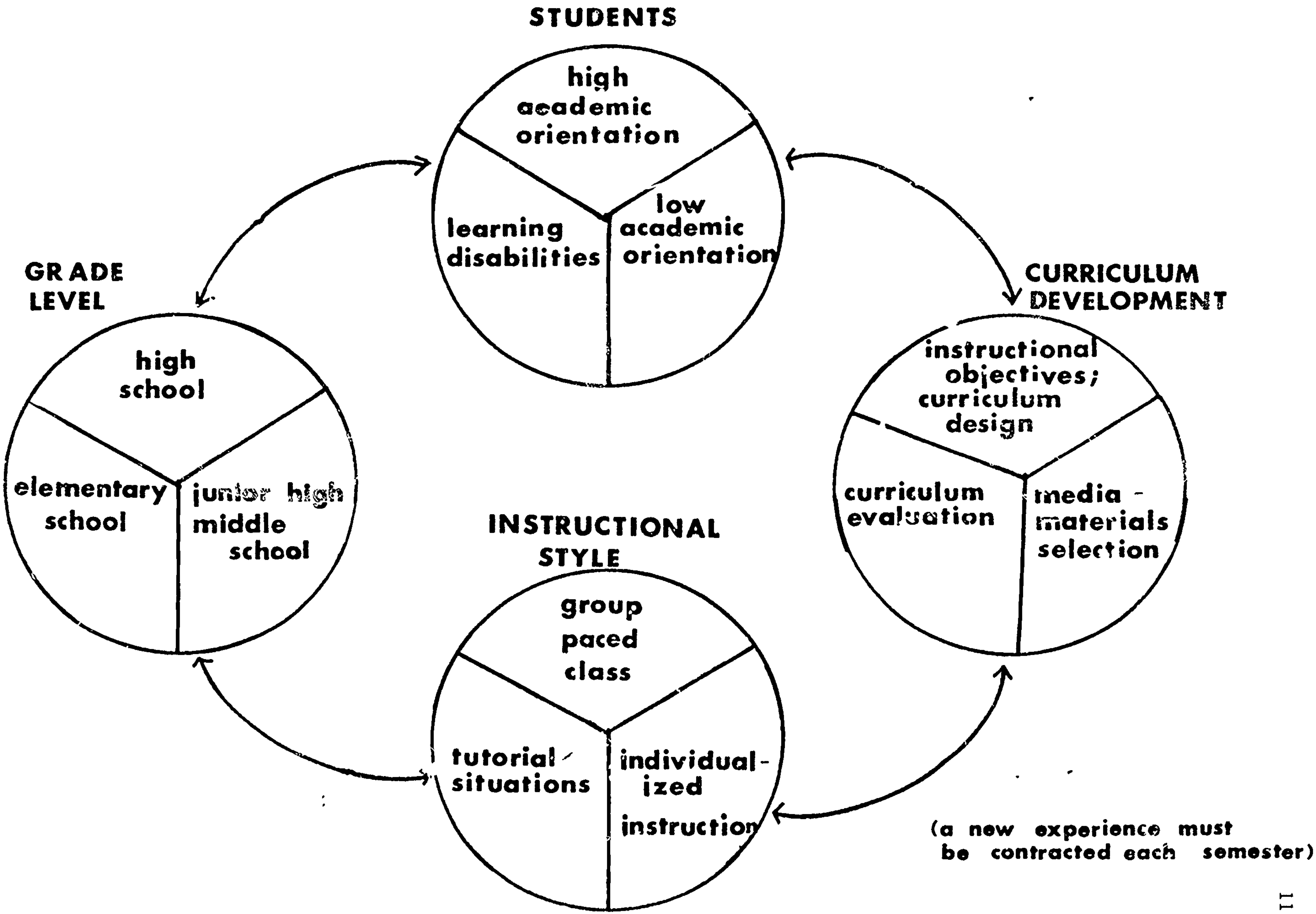
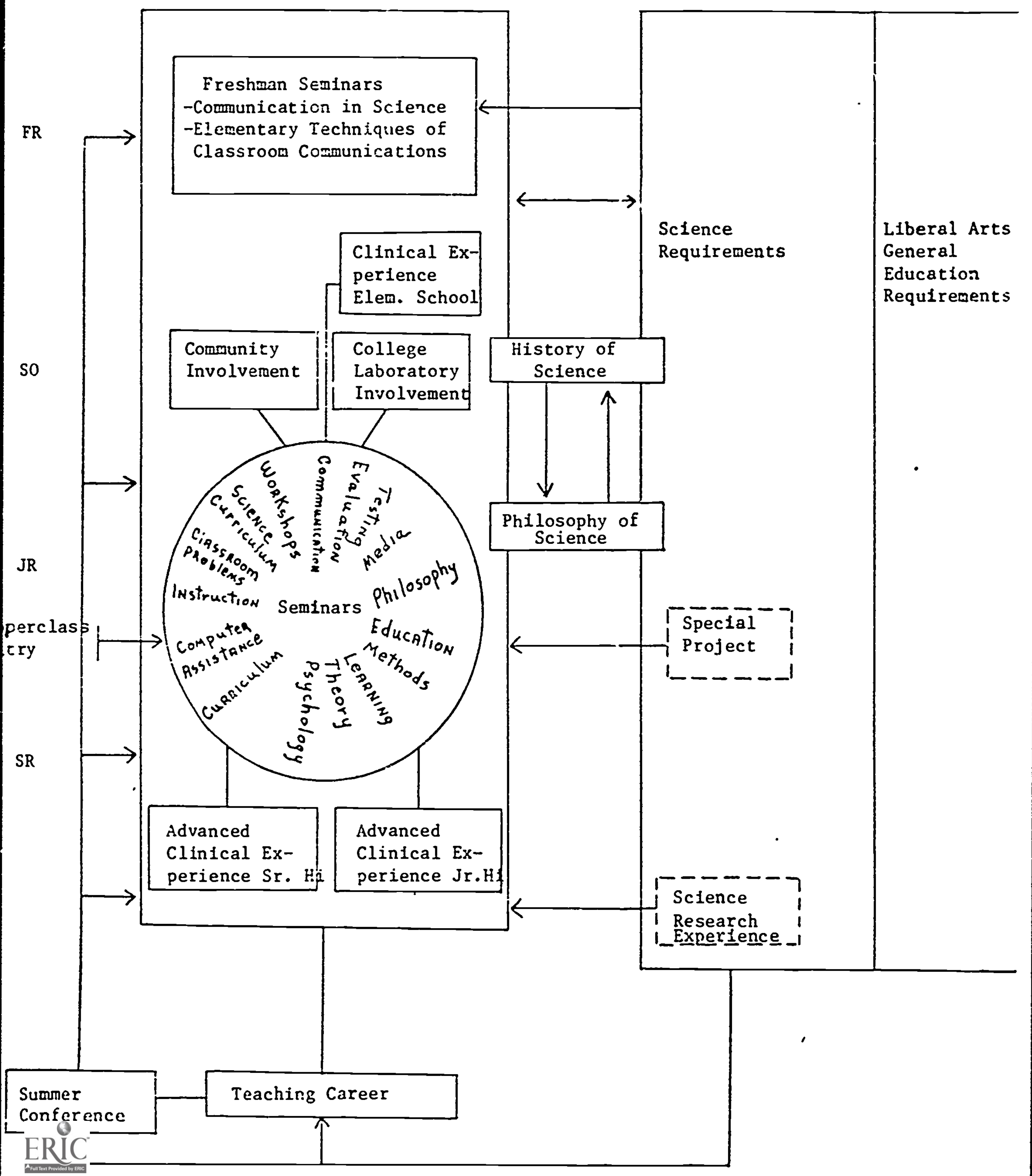


Figure 4B

Figure 4C

Iowa-UPSTEP

Current Program



to issues and strategies in science education early in their college years. These students also enroll in courses in history and philosophy of science which have been designed especially for persons with an interest in science education. Students may now enter the UPSTEP program at the beginning of any semester. Although an optimum four-year sequence has been designed, we want to allow science-talented students to use the program as a vehicle for exploring teaching as a career. We also know that many potentially talented science teachers do not develop that interest until after their initial college years. Hence, we believe that the UPSTEP program should have entry points for new students each semester. When a student does elect to enter the program, he selects a clinical experience in cooperation with the staff and participates in the seminar series. The upperclass program is now heavily centered around clinical experiences and coordinating seminars. These clinical experiences include activities related to teaching in a variety of school and community settings. UPSTEP students select assignments in college laboratories, in a hospital school, and in elementary, junior high, and high school classrooms. They assist students, teachers, coordinators, and principals in performing specific tasks (Figure 4B).

The circle at the center of the model in Figure 4C represents the effort to integrate thoroughly all aspects of the activities in professional education. Concurrent with increased emphasis on clinical experiences throughout the college years, there is a reduction in the student teaching requirements which consumed one full semester in the conventional program. Students in the current program enroll for the same number of credit hours in professional education courses as do students in the conventional program. The new program, however, has flexibility that will allow the student to pursue scientific study throughout his college years. In the senior year an advanced clinical experience provides the student with major responsibility for preparing and teaching specific courses in the public schools.

A synopsis of the new four year sequence is presented below.

Freshman Year. In the fall evening seminars and occassional social events introduce incoming students to the University and to issues in science and education. Guests from scientific disciplines are invited to discuss their perceptions of science and teaching with the UPSTEP students. The seminars focus upon communication skills and group process. In the spring, students are introduced in a more formal way to issues in secondary school teaching, and they may select a clinical experience in the schools as an option.

Sophomore Year. The fall program consists of a clinical experience in the schools (often an elementary school classroom) and a seminar designed to provide a foundation for the clinical experience. Students participate in seminar meetings once every week; the seminars are devoted primarily to activities designed to make the clinical experiences more productive both for the children involved and for the UPSTEP student. Seminar activities include working with materials from new curricula, discussing field experiences, presentations and interactions with classroom teachers and other professionals, discussions of relevant psychological theory, discussions of appropriate teaching stratgeies, discussions of alternative schools, discussion and use of educational technology, role-playing, micro-teaching, etc. In the spring of the sophomore year students participate in a specially designed section of educational psychology; an UPSTEP clinical experience is again an option. During this time a two course sequence in History and Meaning of Science is initiated.

Junior Year. Junior students take two methods-seminar courses in successive semesters. One of these courses includes an array of clinical experiences in the schools including: (1) development and evaluation of a self-instructional module, (2) levels of intellectual development, (3) slow learner/fast learner case studies, (4) individualizing instruction, (5) human relations skill development, (6) inquiry/discovery teaching and learning. Students in this course are involved and progress through a series of experiences in the Self-Instructional Laboratory. (This lab provides models, resources, and assistance for the design and production of self-instructional modules.) The other junior course provides an intensive review of curriculum resources utliizing the new Interactive Curriculatorium. This laboratory is a center where UPSTEP students and teachers can interact with materials and explore the strategies of new science curricula.) In this course students are involved in simulated teaching experiences, and they perform numerous lab activities their own students will use in the public schools.

Summer Program. The Summer Conference is one of the most valuable features of Iowa-UPSTEP. It is designed to break down pre-service/in-service barriers in teacher education. The program provides two major options for junior students: (1) the students can work as teacher-interns and counselors in the various activities of the SSTP program with high school students (teaching on campus or on extended field trips to natural areas such as Yellowstone National Park): or (2) the students can serve as staff in the UPSTEP Summer Curriculum Workshop for teachers. In that capacity, the undergraduate students help the teacher participants review the resources relating to their own curriculum development objectives and to prepare materials and plans to meet those objectives. Some of these students continue to work on these projects in the schools in a student teaching capacity during the ensuing fall semester.

Senior Year. Teacher-interns participate in an advanced clinical experience that is similar in some respects to student teaching, though normally the experience does not consume a full time semester. Teacher interns assume responsibility for planning and teaching secondary science classes under the supervision of a cooperating teacher. In addition they fulfill a number of "skill" requirements as part of the UPSTEP program. The advanced experience may continue at a reduced pace throughout two semesters, and it may be paired with selected teaching experiences in classes for UPSTEP underclassmen.

The use of clinical experiences in teacher education provides a convenient means to combine the skills and perspective of the university environment with the realism of the public school classroom. The current UPSTEP model has the potential for producing exemplary teachers who have depth in science, breadth in educational competencies, and a variety of experiences with students and teachers in the classroom.

General Education and Science Program Requirements

The science teacher education program consists of three major parts. These are: the science major, the general education requirements, and the professional sequence. Each of these is a part of Iowa-UPSTEP. However, the greatest flexibility (and hence change) has occurred with the professional sequence. At times "Iowa-UPSTEP" becomes synonymous with the professional sequence and how this sequence can (and has) influenced the program in the other two areas.

Iowa-UPSTEP when broadly conceived and defined means the total program. Iowa-UPSTEP has conscientiously moved toward minimizing the somewhat artificial interface separating the three phases of the program. However, there may be merit in specifically describing the general education sequence and the various emphases comprising the science teaching major before looking more carefully at the various facets of the professional sequence which is often termed "Iowa-UPSTEP." (A graphic representation of the various components of the total Iowa-UPSTEP program is displayed in Figures 1 and 4 in the preceding section.)

The General Education Sequence

The student with a science teaching major must complete the same general education sequence as required of all students in the College of Liberal Arts at the University of Iowa. Since some choice of such courses is a possibility, counseling concerning the most desirable choices is available. In general, all students must complete forty semester hours of credit in the area of general education. One hundred twenty-four semester hours are required for graduation.

Since all science teaching majors complete over fifty semester hours of credit in the sciences in addition to the professional sequence, there is no general education requirement in the sciences. Credit in mathematics, social science, historical/cultural area, foreign language, literature, physical education, and rhetoric are required. Each of these facets of the general education sequence will be discussed.

The specific requirement in mathematics varies depending upon mathematics completed in high school, entrance scores on the American College Tests, and major field. If a student has completed two and one-half years of high school mathematics and/or scores a minimum of twenty-three on the mathematics section of the American College Tests, there is no further mathematics requirement *per se*. However, all general science majors are urged to complete mathematics to include pre-calculus (elementary functions). In addition, all chemistry and physics teaching majors must complete one full year of calculus. All biology teaching majors must complete a special pre-calculus course for students in the biological sciences. All of these requirements usually mean that science teaching majors have more than fulfilled the general education requirements in mathematics automatically.

An eight hour block from a long list of possibilities must be elected by all students unless they are excused by special examination. Students planning to teach science are urged to complete this eight hour requirement by completing eight semester hours from introductory courses in political science, sociology, geography, and psychology. All persons applying for a teaching certificate in Iowa must have a course in American government. The course in political science meets this requirement as well as providing credit toward the social science general education requirement. Students majoring in earth science teaching or teaching of environmental studies must take a course in geography. Again, completion of a geography course satisfies a general education as well as a major requirement for these students. Courses in sociology and psychology are considered of value for teaching science in modern secondary schools.

As in the case of social science, the electives which will meet the eight hour requirements in the historical/cultural area are numerous. Science teaching majors are urged to complete courses in the following areas to meet this general education requirement in western civilization, problems in human history, and/or philosophies of man. Unlike the social science area, none of these courses is useful in fulfilling dual requirements. Nonetheless, it is believed that the right electives are important in developing the background and the experiences needed for a superior science teacher.

Unless two years of a single foreign language for the Bachelor of Science Degree (or four years of a given foreign language for the Bachelor of Arts Degree) were completed in high school additional work in the same language or credit in another language is needed. For the student with no previous work in foreign language in high school, one year or eight semester hours of credit must be completed for meeting the Bachelor of Science requirements or two years (12-16 hours) must be completed for persons desiring the Bachelor of Arts degree. It is recommended that all science teaching majors complete language study in the area of French, German, or Russian.

All students must complete one year (eight semester hours of credit) in literature unless they successfully pass the requirement by examination. It is recommended that students majoring in science teaching complete this requirement by completing two courses (all provide 4 s.h. of credit) from the following list:

The Interpretation of Literature

Narrative Literature

American Lives

The Classical View

All students must register for physical education for one year. They may complete credit by examination or on a pass/fail basis. It is recommended that this requirement be met by conditioning as well as experience with recreational sports such as golfing, tennis, canoing, bowling, fencing, swimming, hand ball, volley ball, and others.

Unless the scores on the American College Testing Program are unusually high, students must complete four to eight semester hours of credit in rhetoric (writing and speaking skills emphasized). There is no choice concerning alternative courses. The rhetoric requirement is considered basic and must be started at the first registration at the University and continued until it is satisfied.

Most students in science teaching would complete the general education requirements of the University in the following manner:

Rhetoric - 8 s.h.

Literature - 8 s.h.

Foreign Language (French) - 8 s.h.

Social Science (Political Science and Geography) - 8 s.h.

Historical/Cultural (Problems in Human History) - 8 s.h.

Physical Education - 2 s.h.

It would not be uncommon for a student needing only 4 s.h. of rhetoric or for his completing the foreign language in high school. However, most students who complete our program average forty semester hours in the area of general education.

The Science Teaching Major

General science is a major program area in the College of Liberal Arts at the University of Iowa. It represents one of the largest programs in terms of students enrolled. Basically the major requires forty-four semester hours of credit in at least three departments including biochemistry, botany, chemistry, geology, mathematics, microbiology, physics, and zoology. Twenty hours of the total must be in one department with additional hours in two other departments.

The general science major was initially established for prospective science teachers. However, it now is the most popular program for pre-medical students, pre-dentistry students, and students desiring degrees in Liberal Arts in such allied health fields as physical therapy and medical technology. In most of these cases the students complete only the minimal forty-four hours of credit in these departments.

The science teaching majors all follow the basic plan for the degree in general science. However, as teaching competencies have become more precise in the secondary schools of the sixties and seventies, specific program emphases have been developed to meet these needs. Today there are emphases in biology, chemistry, earth science, environmental studies, and physics. Each of these five programs represent a fifty-three semester hour science teaching major. These five emphases are described as follows:

1) Biology Emphasis. This emphasis consists of introductory courses in botany and zoology with advanced courses in genetics, ecology, physiology, and evolution. Electives in biology are required to provide a minimum total

of twenty-seven hours. In addition, twenty-six semester hours are required in chemistry through organic, historical geology, introductory physics, history and philosophy of science.

2) Chemistry Emphasis. The teaching emphasis in chemistry requires courses through physical chemistry, a course which has a course in calculus as a prerequisite. Credit in physics is required. In addition, a course in astronomy is needed for certification in general science. History and philosophy of science courses are required as they are in the other emphases.

3) Earth Science Emphasis. Credit in geology, geography, and astronomy are required. Basic courses in biology, chemistry, and physics are also a part of the program. Balance between historical and structural geology must be attained with supporting courses in physical geography, meteorology, and astronomy. History and philosophy of science courses are also required as a part of the total of fifty-three hours.

4) Environmental Studies Emphasis. This is the only emphasis that meets only the minimal requirements in general science. This is because environmental studies is viewed as an interdisciplinary teaching field where special courses in the social studies, the humanities, engineering, environmental health are important. Most of these fields are not usually a part of the general science major. Because of the breadth of the area it is easiest to see and to illustrate the connections among professional, general education, and courses comprising the science major within this emphasis. History and philosophy of science is again incorporated into the plan.

5) Physics Emphasis. The physics emphasis consists of a concentration in physics with all basic courses required. All courses, including the most basic ones, require a year of calculus and in most cases two courses beyond. In all cases, students with this major complete all requirements

(except for the methods courses in mathematics) for the minor in mathematics teaching. Courses in chemistry are required to meet minimal certification requirements in this field as well. Again history and philosophy of science are required courses.

All five of the science teaching emphases are rigorous programs where students compete and interact with majors in the respective departments. In most cases the general science teaching major is very similar to a major in the department while providing some considerable breadth and preparation in other related areas. At least half of the courses in each of the respective concentrations are at the hundred level which means that graduate students may also be enrolled for credit or graduate degrees.

Although a research project is required only in the environmental studies program in general science, such experience is a required part of the Iowa-UPSTEP model. Hence, all science teaching majors are now involved in at least one science department as an undergraduate research student. Many of the teaching majors also gain teaching experience as assistants in elementary laboratories as well. In some cases this experience is counted as academic credit in the particular science department.

Although many courses are required and others have specific prerequisites, there is flexibility in planning programs to meet the specific general science requirements. Every effort is made to prepare students for specific kinds of teaching assignments in the secondary school (grades seven through twelve). All such programs do meet the basic general science requirements of the College of Liberal Arts while meeting the fifty-three semester hour level for the science teaching major.

Freshman Experiences in Iowa-UPSTEP

Charles Silberman, in discussing the present and future needs of teacher preparation programs has said:

> The fact that most education schools delay practice teaching until the student's senior year is another serious, and sometimes fatal, weakness, for it denies students the chance to discover whether they like teaching or not until the end of their course of study.--- [1]

> The central task of teacher education, therefore, is to provide teachers with a sense of purpose, or if you will, with a philosophy of education. [2]

The seminar provided for freshmen as an integral part of the Iowa-UPSTEP model has been organized to meet these needs by establishing an informal atmosphere in which to discuss science, education, and the interface joining the two. These informal discussions lay the groundwork of an educational philosophy, and help students prepare for early experience in field situations.

One of the first goals to be met in laying this groundwork is to establish a camaraderie among students in the program and to establish trust between the students and instructors. This has been accomplished through a series of conferences with the students early in the semester including "ice breaker" and human relations activities including role playing and discussions of the concerns and immediate collegiate needs of the students. Informality characterized the relationships within the class-- no titles or labels were used in addressing the faculty and staff. The availability of the staff for help and counseling has been stressed.

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1. Charles E. Silberman. Crisis in the Classroom. New York: Vintage Books, 1970, p.461

2. Ibid., p.472

Attracting potential teachers with a real aptitude and interest in science is a second major goal of the freshman seminar. Publicity directed to public schools within the state, communication with participants in the Secondary Science Training Program (SSTP), conferences held for high school students, and announcements to the Freshman class drew participants to the seminar. Discussions of the nature of science and education, helped develop the interest of these capable science students in education as a possible career. Their interest was whetted further by discussions of selected educational theory, particularly that of Jean Piaget. They also toured the facilities at the Science Education Center to see theory being put into practice. This tour was coordinated with a discussion of the possibility of science education as an alternative career and an explanation of the Iowa-UPSTEP program. The rationale for pursuing education simultaneously with science as a career was discussed.

Examination of the interface between science and education incorporated the most important and by far the greatest portion of the seminar activities. Speakers including James Van Allen, astro-physics, Keene Swett, geologist, David Moffatt, anatomist and medical educator, and David Woodrow, President of the Queensland, Australia, Science Teachers Association have discussed their current research interests in science and in education. These speakers have been involved in presentations emphasizing informal interactions with the students. With these speakers and with a few films on scientific topics, the nature of science, science as creative expression, education as communication, and the skills required of a science educator were discussed. Also included was an examination of the values held by modern scientists, educators, interested laymen, and various segments of society toward science and teaching.

The value of seminar to the freshmen has been evidenced in their generally very positive attitude toward the seminar topics, their active participation in the discussions, and their consistently high attendance at the sessions despite very heavy commitments to other science courses and careers.

Sophomore Experiences in Iowa-UPSTEP

While there is always some anxiety in students entering the classroom for the first time in a teaching role, our sophomore students often enter a clinical experience that provides more than a normal share. They are in secondary science education, but as sophomores they often participate in a clinical experience in an elementary school classroom. This experience is only one of many unusual experiences the Iowa-UPSTEP program holds for the student preparing to teach science.

The particular clinical experience is designed to occur early in the student's college career and to place the student in an educational setting outside the traditional secondary classroom. The experience is intended to provide a foundation for effective, creative teaching and leadership. It is an Iowa-UPSTEP "teaching preview".

Students spend three hours each week in their assigned classroom and one hour each week in a seminar at the Science Education Center. The seminar instructor is responsible for placement and supervision of the experience throughout the semester. Since the students entering this experience are beginners, it is not intended that this be a student teaching experience in which the student undertakes major teaching responsibilities. It is intended that the UPSTEP student will assist the teacher in a variety of ways in response to plans and directions provided by the teacher working in cooperation with the UPSTEP supervisor. This experience provides the

UPSTEP student with the opportunity to:

(1) develop skills in communicating with children;

(2) observe the characteristics, interests, needs, and developmental processes of individual children;

(3) develop an understanding of the social interactions, value systems. and concerns of pupils;

(4) observe ways in which students think and learn;

(5) observe the organizational structure and inter-personal relationships of the teaching staff;

(6) develop familiarity with certain creative teaching strategies.

One key to the success of the sophomore experience is the degree to which the UPSTEP supervisor can get the student involved in the teaching-learning environment. Following are some specific activities we try to encourage in the student's clinical experience:

(1) observing classroom learning procedures;

(2) aiding the teachers in teaching and administrative duties;

(3) developing some appropriate materials for use in the classroom.

The UPSTEP staff recognizes that the more varied and relevant the activities that students engage in, the more interesting and valuable the experience will be. For that reason we encourage cooperating teachers to be creative in the tasks and to which UPSTEP students are assigned.

The weekly seminar serves as a debriefing session, and students who are in a clinical experience for the first time certainly need this opportunity for discussion and reflection. In addition to the debriefing, there is a weekly topic for discussion. These topics are carefully chosen so that in discussing them, students may draw on their classroom experiences. The topics are selected to provide perspective and relevant resources that can support teaching in the particular clinical experiences. For example, students working in the elementary schools are provided with experiences utilizing activity centered materials. Topics are also selected that will provide a look at new and innovative teaching styles and activities.

Students are required to maintain logs of their experiences. The log has two main sections. In the first section actual happenings are recorded, and the second section is for reactions to the incidents that have been recorded. Students are to record only one or two significant occurrences that they observe each day. The log is not to be a complete diary but only a notation of things of special significance that the student observes. Initially, observations of this sort are very difficult for some students to make; however, they soon become more sensitive to student - student, student - teacher, and teacher - teacher interactions that have a strong bearing on the total classroom environment. In fact, the log serves as a guide to such growth during evaluation.

We feel that through the elementary clinical experience, students who eventually become secondary teachers will have a clearer understanding of what can and does take place in an elementary classroom. Furthermore, we believe it will be easier for the UPSTEP student to discard the "science lecture" stereotype in an elementary school environment than it normally is in a college oriented high school science class. The elementary environment should stimulate the exploration of alternative science teaching styles. Knowledge of good elementary curricula and teaching styles will help secondary teachers to facilitate learning for their own students and it will help them to be good consultants for elementary school teachers who seek their advice regarding appropriate science curricula.

The elementary school clinical experience dovetails with other clinical experiences which place Iowa-UPSTEP students in junior high schools and senior high schools providing them with a first-hand view of the entire K-12 educational sequence.

The History-Philosophy Sequence

The history-philosophy component of the Iowa-UPSTEP program stems from a commitment to a broadened conception of the meaning of "science teaching". "Teaching science" is often conceived to be the relaying of an accurate and up-to-date version of the knowledge contained in the natural sciences. This conception of science teaching is compatible with a conception of science as it was during the Newtonian era. So viewed, science is the product of logical reasoning applied to dispassionate observation of natural phenomena. As such, it is a certain, absolute, and immutable description of Nature. "Change" is a matter of accumulation, resulting in a more complete description. The activity of the scientist is isolated both in the sense of being unique in character and in the sense of being an "intellectual island" insulated from the contemporary culture. If this characterization of science were valid, science teaching could reasonably be conceived as a simple matter of inducing students to absorb the current fund of descriptive information. In fact, to the considerable extent that one's view of science teaching is conditioned by his image of science, it would be difficult to envision the teaching of science in any other way.

Within such a narrow conception of science and science teaching the task of teacher preparation is a relatively simple matter. The teacher education program would need only to provide for mastery of the specific items of information to be taught and of the skills involved in purveying those items. This conception of science, however, is an archaic one. The corollary conception of science teaching is still rather widely held for a variety of reasons, including lack of familiarity with the nature of modern science, the pragmatic value of such a conception in the case of preparing future scientists and the burden of unexamined tradition. Teachers prepared by programs based on this conception are trained in "textbook science" and are capable of providing their pre-college students with a similar expertise. Despite widespread claims concerning the need for this sort of science education in a science oriented culture, honesty forces an admission that the need is a modest one. The life of the average person is such that their ability to function is not seriously affected by a lack of textbook knowledge of science.

From its inception, the Iowa-UPSTEP program has involved what is believed to be a more adequate conception of science teaching. The view of the science teacher as primarily a purveyor of the current paradigms of science has been rejected in favor of a concept both better fitted to the needs of society and in closer agreement with the character of contemporary science. Generally speaking, the science teacher is conceived as not only being trained in science, but educated about science as well. Prepared in this way, the Iowa-UPSTEP graduate is inclined toward a sort of enriched teaching of science for which the more narrowly prepared teacher is totally unprepared.

It would be convenient if the prospective teacher obtained the desired education about science from his courses in science. While those courses do communicate an image of science, it is a grossly distorted image. The major ingredient of the collegiate science course, the textbook, is designed to efficiently induce commitment to current paradigms in the discipline, and not to serve as the source of an accurate conception of science. Unfortunately, the two tasks seem to be inimical to each other and consequently the incidentally created image of science is something to be overcome later. While the future scientist may modify his image of science when he enters research, the future science teacher will very likely never do so unless some special provision is made in his collegiate program.

The Iowa-UPSTEP program makes this provision in the form of two specially designed science education courses. The experiences provided in these courses are intended to revise and significantly broaden and deepen the student's understanding of science until it is reasonable to claim that he is educated about science. Given that common goal, these two courses are structured as complements to each other. In one case the focus is on a cultural-philosophical perspective of science. The readings discussed deal with topics such as the scientist's responsibility to society, the debate concerning explanation in science, the relative and pragmatic qualities of "truth" in science, the limitations imposed by the uncertainty principle, the reality status of quarks and other such entities, the role of creativity in science, laws and theories as different kinds of knowledge, and so on. In the second case the focus is on a sociological-historical perspective of science. Discussions revolve around such topics as textbook vs. historical concepts of development in science, the sociological basis for claims of objectivity, revolutionary vs. evolutionary and other views of change in science, the scientific establishment's reaction to heterodoxical theories, governmental influence on the direction of research, etc.. The research on the effectiveness of these courses which has been completed to date is limited in scope. The results have been positive however. A three-year longitudinal study is currently in its last semester.

Field-Based Methods

This paper reviews a series of field-based clinical experiences which are among those we are currently developing for use in one of the two methods courses in the Iowa-UPSTEP sequence.

Rationale

"The day when teachers are trained by higher education alone is past. The time when public schools attempt this job alone should never come," according to a report to USOE from a higher education task force. (DHEW Publications No. OE 75-12002-7.) The use of the clinical experience in teacher education provides a convenient means to combine the skills and perspective of the university with the realism of the public school classroom. It provides an opportunity for teacher-interns to interact with a variety of teaching styles and models. Many conventional teacher education programs do not provide adequate experiences to which preservice teachers can relate abstract classroom theory. Undergraduates, in particular, in such an environment often consider much of their formal course work in education to be irrelevant. Student teaching, on the other hand, often is not adequately coordinated with theory and with other phases of the teacher education program.

Clinical experiences provide a means by which a variety of controlled experiences with students and teachers in the schools can be integrated within a preservice program. Research has shown that the cooperating teacher often has greater influence on the ultimate teaching behavior of the teacher-intern than does any other person or aspect of the preservice program.[1] This is certainly not an optimum arrangement in a pluralistic world. A series of clinical experiences will provide a wider range of contacts with a variety of teacher models in different classroom environments. Controlled experiences will help teacher-interns develop theory and skills in a real world setting. A clinical experience utilizes modeling, feedback, and practice[2] in a classroom to help teacher-interns develop certain competencies relevant to the teaching-learning process. Clinical experiences provide a vehicle through which teacher education programs can stimulate the development of generalizable teaching behaviors.

Selected Clinical Experiences

The clinical experiences described in this section are selected from those utilized with junior and senior teacher-interns during the Fall semester 1974. The interns were enrolled concurrently in a "methods" seminar for two semester hours and in three semester hours of student teaching. All teacher-interns met daily throughout the semester with one secondary school class in addition to attending a two hour seminar once a week. (Where possible three or four interns were assigned to the same cooperating teacher to expedite communication between our teacher education staff and the cooperating teacher.) Interns were assigned to "self-paced" secondary school classes to provide experience with individualized instruction techniques and to facilitate the particular clinical experiences described below.

1. Self-Instructional Module. Each teacher-intern designs, produces,

and evaluates (with student users) a self-instructional module. This experience covers a variety of tasks in which the intern must be competent. The intern and the cooperating teacher are asked to select a topic for the module: the module is to enrich the course being taught and is to be of value to both the teacher and the intern. Behavioral objectives, prerequisite skills, task analysis, pre- and post-tests, etc., are developed by each student. After the initial module is completed, it is critiqued by other teacher-interns. When the necessary modifications have been made, the module is used by secondary school students and evaluated. Module effectiveness is assessed using the pre- and post-tests and through observation and interviews with student users. Teacher-interns conclude this experience by preparing recommendations regarding revision of the module.

2. Individualizing Instruction. Teacher-interns become intimately familiar with one system of individualizing instruction through daily contact with teachers and students using that system and through careful review of the rationale for individualizing programs in general. The teacher-intern works in a support role in a self-paced classroom keeping daily logs of his activities with students. At two points in the semester each intern summarizes his own position regarding the rationale, techniques, strengths, and weaknesses of individualized programs.

3. Case Studies. Each teacher-intern gets to know two of his secondary students particularly well. Interns are advised to select one student who is having difficulty in the course and one student who is very proficient. Extra time is spent in assisting and talking with these students, and a case study log is maintained on those experiences. Interns are to become familiar with

their students' special interests, skills, frustrations, family orientation, etc. They also examine their responses to certain Piagetian tasks.

4. Levels of Intellectual Development. After introductory readings, video tapes, and discussions in seminar, interns give selected Piagetian tasks to children at different age levels; students in their own secondary school classes are included in the sample. The interns are encouraged to go beyond their own classroom and administer the tasks to their friends and to children that are available to them. A report is prepared summarizing student responses and the inferences that can be drawn from them. In addition, each intern participating in the experience comments on the implications for secondary science teaching of student intellectual development.

In this clinical experience as well as in many of the others, it is not intended that the teacher-interns will become highly knowledgeable concerning details of Piagetian theory and terminology. However, through first-hand experience, they will discover that students in a class are at different levels of intellectual development and that this fact has direct implications for the curriculum and for teaching style.

5. Teaching Style. Through the analysis of selected video tapes in seminar, interns develop quantitative techniques for describing teaching style. They then use a form of the SCAS[3] interaction analysis system to assess interactions in their own secondary classroom. Seminar activities help the interns focus upon goals of science teaching and learning and help them identify teaching behaviors that will facilitate the acquisition of those goals. Interns are then assisted in developing the identified behaviors and skills in their own teaching. They are also given feedback on their progress through the

analysis of audio tapes of their interactions with students.

6. Elementary Activity-Centered Teaching. Interns familiarize themselves with the philosophy and teaching strategies embodied in at least two modern elementary science programs, e.g., ESS, SCIS, or SAPA. They demonstrate these strategies by teaching a unit to their "methods" classmates and then to groups of students in their secondary classroom. The audio tapes of these interactions are analyzed for specified teaching skills according to criteria similar to those utilized in Section 5 above.

7. Classroom Communications. (This clinical experience is among those currently under development.) This experience will be initiated with seminar discussions of incidents selected from our AETS publication, Interactive Incidents.[4] Concurrently, interns will run computer simulations of some of these incidents. Through these experiences interns will be directed to assess the level of authority used by the teacher in communication with his class. Are the interactions dominated by the teacher, by the students, or is there a sharing of influence and dialogue? Interns will be asked to rate interactions in their classroom on an authority scale and on an empathy scale. They are to seek the perceptions of students in the class regarding levels of authority and empathy in classroom interactions, and they are to discuss selected Interactive Incidents with small groups of their students. (Interns have done the latter activity this semester.)

Clinical Experiences #1 - #6 described above have all been used by teacher-interns during the Fall semester 1974 as part of a field-based "methods" course. Interns were excused from one or two of these experiences when they had already developed competencies in a particular area or when they had special alternative needs. These interns were allowed to substitute specified activities for those clinical experiences that were waived. The teacher-interns also enroll in another "methods" seminar in which they intensively review modern secondary science curricula.

References

1. Matthews, C.C., "The Classroom Verbal Behavior of the Secondary School Science Teacher and The Cooperating Classroom Teacher," Summary Report of Doctoral Dissertation, Cornell University, 1966.

2. Wilson, J.T., and Koran, J.J., "Practical Uses of Modeling, Feedback, and Practice," Journal of Educational Technology Systems 2:2, 139-150, Fall, 1973.

3. Matthews, C.C., and Phillips, D.G., Handbook for the Application of The Science Curriculum Assessment System, Tallahassee, Florida, Florida State University, 1968.

4. Lunetta, V.N., and Zalewski, L.J., Interactive Incidents from Classroom, School, and Community, National Science Teachers Association (Washington, D.C.), 1974.

Resource-Based Methods

No term other than 'revolutionary' can adequately describe the changes and developments undergone by the field of science education during the 10 years since the Gage Handbook of Research on Teaching. We have been inundated by revolutionary waves of funding, new curricula, texts and tests, evaluations, denunciations and dissertations. Hurd's (1961) statement that 'it is harder to change the curriculum than it is to move a cemetery' no longer applies. H. Grobman testified that 'by 1967, there were over 70 curriculum projects in science alone.' It would appear that in the interim our curricular cemeteries have become jet-propelled.[1]

First year teachers entering the classroom are faced with a great variety of tasks, many of which they have not previously recognized as part of the teacher's role. One of the greatest of these tasks is to design and implement a curriculum for students. Faced with this task, it is not uncommon for the novice teacher to follow one of two paths: (1) utilize a textbook and accompanying teachers guide in explicit detail, or (2) utilize class notes from a course in his own background as a framework on which to design the curriculum. A second problem facing the novice teacher is the development of an appropriate teaching style. Again, personal experience is often the sole source of background for facing this problem and all too often the beginning teacher merely models the behavior of one of his former teachers.

The Resource-Based methods course has been developed to meet the need for intensive experiences with modern curricula and appropriate teaching styles. Throughout this course interns interact in a series of tasks designed to accomplish the following goals:

a. To gain a working knowledge of the major national curricula, especially in the area of science specialization;

1. Charles E. Silberman. Crisis in the Classroom. New York: Vintage Books, 1970.

b. To gain a working knowledge of alternative science curricula;

c. To gain a working knowledge of resources available for personal development and improvement;

d. To gain a working knowledge of curriculum supplements;

e. To increase skill in the use of appropriate science teaching strategies;

f. To increase skill in adaptation of curricula to local conditions.

Accomplishing these goals has been facilitated through a series of seven correlated experiences in the Fall semester of 1974.

1. In-Depth Examination of a Curriculum in the Major Science Area of Preparation.

This experience had two phases. First, utilizing the Interactive Curriculatorium, each teacher-intern completed nine laboratory activities from a particular science curriculum project. The activities were selected to typify the philosophy and style of the project and to give the teacher-intern first hand experience with the investigations that students perform. As part of the report on these laboratory activities, the interns were asked to explain how the philosophy of the project was exemplified in the laboratory, safety precautions that would have to be emphasized, strengths and weaknesses of the particular activities, and other relevant considerations.

Phase two required development of a major report analyzing various aspects of the curriculum project. To complete the report, the teacher-interns examined texts, tests, equipment, audio-visual materials, supply catalogs, research findings, and other relevant documents. A summary of this data was included in the report which also included comments on ideal classroom layouts and an analysis of the reading and achievement levels of the curriculum materials.

2. <u>Examination of Six National Curricula Outside the Major Science Area of Preparation</u>. As in the examination of the major area curriculum project (#1 above), this experience had two phases. In the first phase, teacher-interns performed one lab activity from each of six curriculum projects not in the intern's area of specialization. An abbreviated form of the report on the curriculum materials was completed for each project.

3. <u>Major-Area Curriculum Project Presentation</u>. Using a combination of lecture, discussion, and laboratory strategies from the curriculum project, each intern made a 30 minute presentation to a subgroup of the class on the curriculum project on which his major report was based.

4. <u>Development of a Resource File</u>. Each intern developed a card file which included the names and addresses of sources of free and inexpensive materials and references to sources of supplementary information.

5. <u>Adaptation of a Non-Inquiry Lab into an Inquiry Format</u>. Each intern selected a conventional non-inquiry laboratory activity. He then prepared an instruction sheet for a group of students such that the students would conduct the lab as an inquiry experience. In addition, the interns were required to prepare a list of materials needed to perform the lab with a class of 30 students in a poorly equipped science classroom.

6. <u>Preview and Analysis of Motion Picture Films</u>. Each student was required to order, preview and analyze various aspects of at least 3 relevant films available from the University of Iowa Film Library.

7. <u>Weekly Seminars</u> were designed to supplement the experiences with curriculum resources. The seminars included an examination of the pattern

of inquiry and concept development in the PSSC and BSCS projects, a review of the support available to the classroom teacher through professional organizations, use of outdoor activities in the local environment, and discussion of individualized and performance based instruction.

Student reaction to this course has been very positive. In combination with field experiences in the Iowa-UPSTEP sequence, students have recognized the utility of course experiences. The only negative note that did appear related to the amount of work required in the two semester hour course. Objectives for each of the experiences were set out in a behavioral format, with appropriate criterion levels specified. It is clear that students have been able to master the tasks reviewed in this paper when requirements were stated in performance terms.

The Summer Program

Iowa-UPSTEP students have the opportunity to participate in one of two special experiences in the summer:

(1) work as teacher interns and counselors in various activities of the Secondary Science Training Program (SSTP) with high school students;

(2) service as staff members in the UPSTEP Summer Curriculum Workshop for Teachers.

SSTP

The first of these options involves work as a teacher intern and resident counselor with secondary students participating in SSTP at the University of Iowa. The Science Education Center has developed a broad series of SSTP activities over the past fifteen years that provide enrichment in the sciences for high school students. Iowa-UPSTEP students have been involved as teacher interns and resident counselors in both the course-based programs on campus and the environmental programs in the field. The course-based programs range from special topics in molecular biology to computer science. The environmental programs provide extended field trips to natural areas such as Yellowstone National Park, the Colorado Rockies, and the "Canadian Wilderness". Under the supervision of certified teachers on the SSTP staff, these activities can provide a unique opportunity for UPSTEP interns to acquire supervisory and teaching experience. The program also provides opportunity for the teacher intern to get to know secondary students through close and intensive daily contact.

Summer Curriculum Workshop

The second option for summer activity for Iowa-UPSTEP students involves participating as staff members in the UPSTEP Curriculum Workshop for Teachers. Primary objectives of the UPSTEP summer workshop are:

(1) to provide experiences for Iowa-UPSTEP students in the solution of "real-world" curriculum problems and in communication with teachers about real issues;

(2) to assist regional school districts and individual teachers in developing effective science curricula.

Teachers and/or school districts are invited to participate in the smmer workshop through brochures and other announcements describing the program. The workshop is directed toward the development of plans and materials for local curriculum implementation. Iowa-UPSTEP staff and undergraduate interns are assigned to participants to assist with activities focusing upon development of appropriate curriculum materials and strategies to solve problems identified by the teacher participants prior to the summer workshop.

In the workshop application, the teacher participant defines the curriculum problem to be worked on during the 2-3 week on campus phase of the program. While on campus, he works in a team with others who have similar curriculum goals. Activities in the workshop are structured around the goals of the participants. They emphasize the collection of resource materials to assist in addressing the problem that has been defined, and the development of ideas and strategies for local implementation. Each undergraduate UPSTEP intern is assigned to a specific team, and he assists in all phases of team activity. He participates in the deliberations of the team, in the collection and review of resources, and in the development of curriculum materials. He is also a participant in general sessions of the workshop.

The 1974 Summer Curriculum Workshop began with group activities designed to facilitate group interaction and to help participants clarify and refine their own curriculum objectives. Subsequent large group, small group, and independent activities were designed primarily to facilitate the attainment of those individual objectives. A review of the curriculum development activities in the 1974 workshop indicates several clusters of objectives:

(1) development of individualized modules;

(2) development of life science mini-courses;

(3) development of health and family life programs;

(4) development of specific resources and activities to supplement conventional science curricula.

Where possible, the UPSTEP staff has attempted to support academic year implementation of the curricula and strategies developed in the summer workshop. Such support is not only of value to the teacher participants and their respective schools, but it also provides an outstanding opportunity for the teacher intern to follow a curriculum development effort through to the difficulties and challenges of implementation. Some of the interns have continued to work with the teachers in ensuing implementation efforts during the Fall semester of 1974 in a student teaching role. When such an arrangement has been made, the UPSTEP intern is involved in evaluation of the curriculum development effort.

Intern Teaching Activities

"... a teacher education program which depends upon a sequence leading from an abstract, theoretical, academic study of education to a final massive dose of experience is unsound." [1] By the time the Iowa-UPSTEP student begins his final teaching internship during his senior year, he will have completed a number of clinical experiences in different classroom environments with a variety of teaching models. He will have worked with elementary and secondary school students, and he will have experienced self-paced as well as group-paced teaching. He may have participated in the curriculum development workshop with in-service teachers. It is upon this broad base of experience that the final internship is constructed.

In the teaching internship the UPSTEP intern is given full responsibility for teaching a specified number of group-paced classes under the supervision of one or more cooperating teachers. The classes are primarily in the intern's science major area, but an effort is made to provide classes and environments that the intern has not experienced previously. The internship is designed to complement earlier clinical experiences such that he will have interacted with students in a broad range of grade, ability, and motivational levels upon completion of the Iowa-UPSTEP program.

A key feature of the internship in the Iowa-UPSTEP model is flexibility in scheduling and structure. Options range from a traditional sequence in which the internship is completed in one semester to an internship that

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1. S. E. Hynes and C. E. Coyne. "Accountability in Teacher Education," National Association of Secondary School Principles Bulletin, 55: December 1972, 69-74.

occurs over two or three semesters. Effort is made to arrange internships that will meet the specific needs of individual students providing a broad range of experience.

While the UPSTEP interns have full teaching responsibilities in ost of their classes, their activities are monitored and guided through a number of selected experiences. Specified objectives for the advanced clinical experience are defined for each intern in considerable detail and they include production of:

(1) a rationale of the organization of the curriculum and instruction;

(2) long-term plans and daily lesson plans in advance of instruction. After each unit of instruction the plans will be evaluated;

(3) a daily log of classroom experiences:

(4) at least three audio tapes, 10 to 15 minutes each, demonstrating skill in the use of specific verbal-interaction strategies and process skills;

(5) at least one good evaluative instrument for a class being taught in each of the following categories:

a.) multiple choice test

b.) essay test

c.) matching items test

d.) practical examination:

(6) an item analysis of a multiple choice exam of his own design and interpretation of the results;

(7) a review of standardized examinations which could be used in a current class, giving reasons for his preferences, and indicating special considerations to be made in administering or evaluating the exams.

The objectives also include specifications for the demonstration of skills in:

(8) planning and teaching a scientific principle;

(9) planning and implementing a laboratory activity:

(10) operating selected items of audio-visual equipment;

(11) observation and analysis of the classroom behavior of his own teaching and that of others;

(12) all of the required activities and at least 50% of the optional activities listed on the "Teacher-Intern Activity Checklist".

The UPSTEP staff maintains close contact with the teacher interns and cooperating teachers through weekly seminars and periodic visits. Audio and video taping, personal counseling, three-way conferences between the intern, the cooperating teacher, and the UPSTEP supervisor, and written supervisory reports are all utilized to aid the intern in accomplishing his objectives.

The Interactive Curriculatorium

(A Science Curriculum Laboratory)

Major goals of the Iowa-UPSTEP program include the development of an intensive working knowledge of the philosophy, resources, and teaching styles implicit in the national curricula. Concurrently, a goal of the Science Education Center is to assist teachers faced with curriculum adoption or development problems. The Interactive Curriculatorium has developed as a logical outgrowth of these goals. A combination classroom/science laboratory was remodeled and furnished with publications and selected laboratory materials from major curriculum projects funded by the National Science Foundation (NSF)

Between 9 and 11 representative laboratory activities were selected from each of these NSF sponsored curricula. The materials required for each laboratory activity were assembled and placed in individual kits which were labeled and made available for student use. To complement the NSF-sponsored materials, commercially designed curriculum projects were screened and those that were appropriate have been placed in the "Promising New Materials" section of the curriculatorium (Figure 1). Publications of potential value to science educators such as journals, catalogs, laboratory manuals, and newsletters have been placed in the library section.

The Interactive Curriculatorium has been designed for utilization by various individuals and groups. Iowa-UPSTEP students utilize it on an individual basis as a resource center where materials can be explored and where laboratory activities can be performed prior to classroom use.

NSF Curricula

- Chemical Education Materials Study (CHEMS)
- Biological Sciences Curriculum Study (BSCS)
  - Blue, Yellow, Green
  - Laboratory Blocks
  - Patterns and Processes
  - Interaction of Experiments and Ideas
  - New BSCS Materials
- Engineering Concepts Curriculum Project (ECCP)
- Environmental Science (ES)
- Earth Science Curriculum Project (ESCP)
- Introductory Physical Science I, II (IPS)
- Intermediate Science Curriculum Study 1, 2, 3 (ISCS)
- Project Physics (PP)
- Physical Science Study Committee (PSSC)

Promising New Materials

- Environmental Games
- Ideas and Investigations in Science (IIS)
- Interaction Science Curriculum Project ISCP)
- Interdisciplinary Approaches to Chemistry (IAC)
- Outdoor Biology Instructional Strategies (OBIS)
- Personalized Adventures in Chemical Education (PACE)
- Self-Pacing Biology Experiences (SPBE)
- Technology ↔ People ↔ Environment (TPE)
- Time, Space, and Matter (TSM)

Figure 1

Listing of NSF Curricula and Promising New Materials

The curriculatorium is also used for "methods" seminar meetings and for simulated teaching activities. Classes for inservice teachers find it a convenient meeting place where an abundance of relevant materials is available for "hands on" experiences. Furthermore, individual teachers or committees interested in curriculum change or revision can utilize the Interactive Curriculatorium for purposes of comparing available curricula. It is clear that in a relatively short period of time the Interactive Curriculatorium has become a real asset in our teacher education program.

The curriculatorium was set up in a room that was formerly a combination classroom/science laboratory. There were movable laboratory tables, demonstration tables, and chairs in the room. Attached to the wall on 3 sides of the room was a counter or work surface that extended 30 inches from the wall (Figure 2). To create storage space for equipment and supplies, long sheets of fiber board were inserted between the floor and the counter. Plywood cabinets for storing the kits were constructed and attached to the wall above the counter. In addition, there were two large permanent storage cabinets and a wall bookcase in the room.

Supplies, equipment, and published matter were needed to furnish the room. Some usable materials were available as a result of the closing of the University High School. Materials were borrowed and scrounged from existing programs. Specialized equipment from prior NSF summer institutes was collected and integrated. In several instances, faculty members donated extra copies of books and other publications. Donations of free materials were solicited from commercial publishers

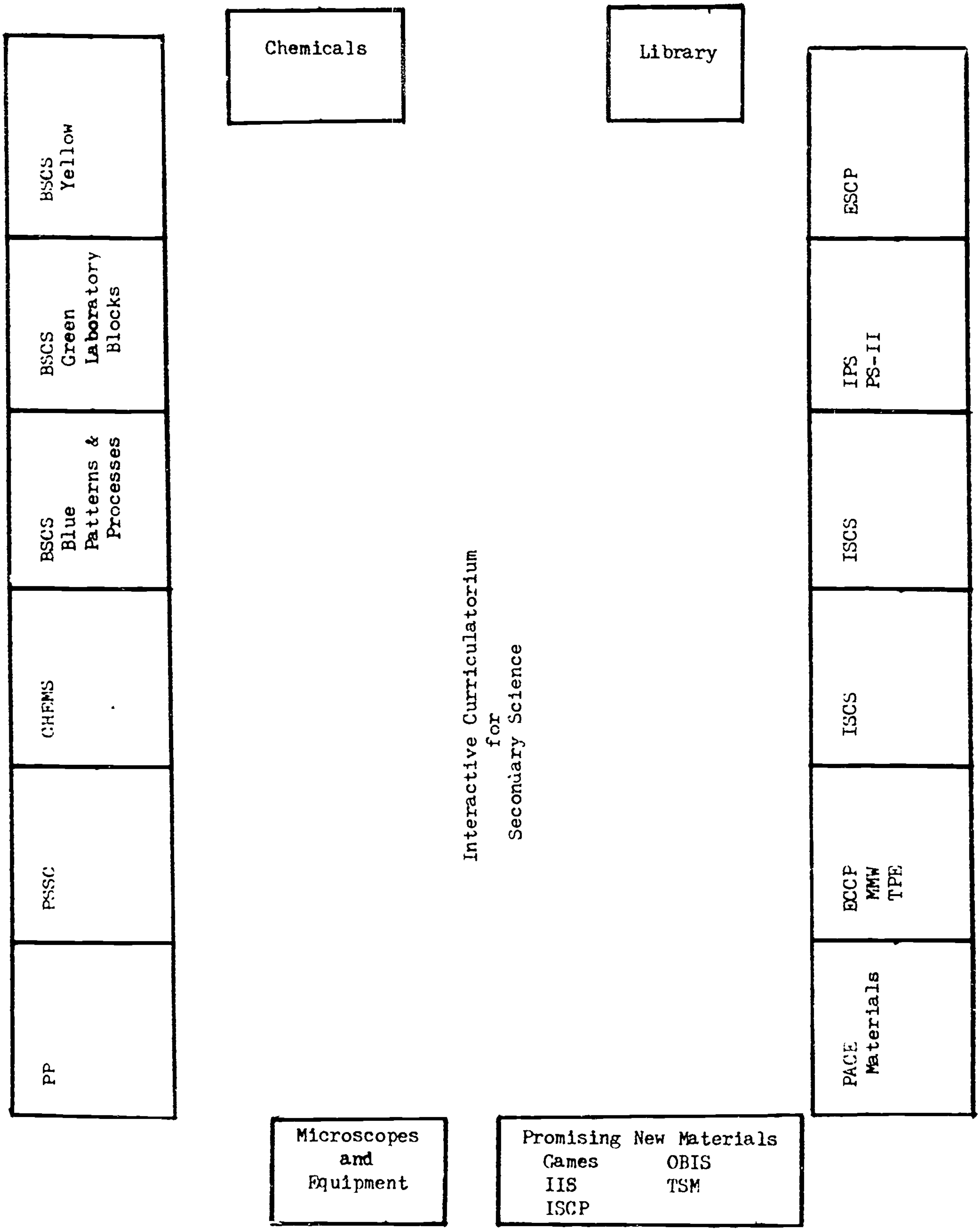

Figure 2

Floor Plan

and supply houses by mail and at conventions. General purpose items were purchased locally, and more specialized laboratory supplies and equipment were ordered from science education supply houses. Some of the specialized curriculum project materials such as the textbook, laboratory manual, teachers guides, and additional materials were purchased from the publishers.

The fiberboard and plywood were painted with bright, attractive colors so that the room would be a cheerful place. The letters of each curriculum project acronym were posted on the appropriate cabinet. Potted plants were also placed around the room.

A large final task was to set up the kits for the individual laboratory activities. First, all experiments in each curriculum project represented were scanned and 9-11 representative activities were chosen from each one. The selection included common experiments, some that would be relevant to the modern generation, some that required minimum equipment, and one or two utilizing sophisticated instrumentation. The ultimate criteria, however, were cost, convenience, and whether or not the lab faithfully represented the style of the project. A list of the laboratory kits that were assembled is shown in Figure 3.

The lab kits were placed in plastic dishpans or frozen food containers that match the decor. A label stating the curriculum project, experiment numbers, pertinent page numbers, and comments about supplementary equipment was placed on the kit.

Since students and visitors are encouraged to perform experiments not found in the kits, general storage areas had to be designated. Chemicals were stored in one permanent wall cabinet while microscopes and other equipment were placed in another cabinet. General purpose items such as clamps, tape, markers, etc. were placed in kits and stored in the movable tables. Surplus equipment and supplies from specific curriculum projects were located in the floor storage compartments.

When the curriculatorium was ready for student use, procedures had to be devised that would allow optimum utilization of the resources. Security measures are necessary because of the value and usefulness of the materials in the room. There are two doors to the curriculatorium, both having one way locks. A very limited number of secretaries, teaching assistants, and professors were given keys to the room. The main door is kept locked at all times. The second door is open from 8 A.M. to 5 P.M. In order to get into the curriculatorium, visitors or students must pass by a secretary's office and through the teaching assistants' desk area. Students have been told that the room is operated on the honor system, but that they should check in with the secretary before entering the room. After gaining access to the room, UPSTEP students have freedom of choice to select the curriculum project, type of experiment, and sequence of kits. They are required to read, set up, and perform a specified number of laboratory activities. If chemical solutions are needed, the student has to prepare them. After completing the activity, the apparatus is to be disassembled, the area cleaned, and the kit returned to the proper location. The student is required to enter the date, time spent in the curriculatorium, and the kit numbers finished in the log or record book. If the student wishes to take materials from the room, a check-out sheet has to be filled out and left on the teaching assistant's desk. If students desire to work in the room during other time blocks, special arrangements may be made with the UPSTEP staff. Requests for special laboratory materials such as living specimens were filled by the teaching assistant when possible.

As the number of groups using the curriculatorium increased, a room reservation system was devised. Reservations are approved by a faculty member and relayed to the secretary or teaching assistant to be put on the schedule for the room.

The remodeling and furnishing of the Interactive Curriculatorium is being completed during the 1974-75 academic year. Minor logistical problems such as the organization of supplies and equipment have to be solved. Despite these inconveniences, the UPSTEP students used the curriculatorium quite successfully during the Fall semester. Valuable feedback has been received from the students, professors, teachers, and other visitors to the curriculatorium and has generated new ideas for improvement. As these changes are incorporated into our program, we feel that the Interactive Curriculatorium will become a particularly valuable component in the education of prospective science teachers.

Figure 3.

Laboratory Kits Available in Curriculatorium

Kit	Experiment	Title	Textbook Chapter
	CHEMS		
1	5	Heat Effects (CHEMS)	3
2	10	An Investigation of Reacting Volumes of 2 Solutions of Known Concentration (CHEMS)	
3	11	Reactions Between Ions in Aqueous Solution (CHEMS)	6
4	19-4	Behavior of Solid Iron in a Water Solution of Copper Sulfate (cotton)	19
5	4	The Behavior of Gases (Parry)	2
6	3	The Melting Temperature of a Pure Substance (CHEMS)	1
7	8B	The Formula of a Hydrate (CHEMS)	3
8	7-8	Synthesis of a Metal Oxide (cotton)	7
9	S-1	Determining the Formula of Zinc Chloride (cotton)	7
	BSCS-BLUE		
1	7B	Coacervate Formation	7
2	8B	What Controls the Movement of Materials in and Out of the Cell	8
3	12A	How Can Mutant Strains of Bacteria Be Isolated	12
4	16A	Why Do Plants Develop Chlorophyll	16
5	16B	How Are Traits in Fruitflies Inherited	16
6	16C	How Are A, B, AB, and O Blood Types Inherited	16
7	21B	Measuring CO_2 Concentration of Human Breath	21
8	22B	Do Plants Contain Enzymes That Digest Starch	22
9	25A	What Does Your Touch Tell You	25
	BSCS-YELLOW		
1	3-2	Cells of Living Plants	3
2	5-1	Amino Acid Composition of an Unknown	5
3	9-1	Structure and Function in Paramecium	9
4	24-1	Behavior of Paramecium	24
5	4-1	A Chemical Reaction of Living Systems	4
6	4-2	A Chemical Reaction: Changes in Structure and Energy	4
7	6-1	The Closed Box Mystery	6
8	6-2	Reactions of Cells in Changing Environments	6
9	17-2	The Pigments in a Leaf	17
	BSCS-GREEN		
1	1.2	The Germination of Seeds	1
2	1.5	Interrelationships of Producers and Consumers	1
3	7.3	A Chemical Characteristic of Soils	7

Figure 3.

(Laboratory Kits Available - continued)

Kit	Experiment	Title	Textbook Chapter
	BSCS-GREEN		
4	6.2	Microbial Techniques: Populations	6
5	9.2	Effects of Salinity on Aquatic Organisms	9
6	11.2	Diffusion Through a Membrane	11
7	12.2	A Study of Biochemical Reactions	12
8	12.5	Photosynthetic Rate	12
9	13.3	Rate of Growth: Leaves	13
	ESCP		
1	P-2	Investigating Mass, Volume, and Density	P
2	6-2	Investigating Flow and Change in Energy	6
3	5-2	Investigating the Behavior of a Falling Object	5
4	1-9	Sky Watch	1
5	25-7	Galaxies	25
6	2-2	Rocks and Minerals	2
7	8-2	Investigating Evaporation	8
8	18-6	The Puzzle	18
9	21-7	Investigating Regional Landscapes	21
	IPS		
1	3.12	Freezing and Melting	3
2	9.3	The Size and Mass of an Oleic Acid Molecule	9
3	10.3	Density and Pressure of a Gas	10
4	11.4	Flow of Charge at Different Points in a Circuit	11
5	12.2	The Electroplating of Zinc and Lead	12
6	12.5	Two Compounds of Copper	12
7	15.1	The Heating Effect of a Flow of Charge	15
8	17.2	Gravitational Potential Energy as a Function of Mass	17
9	19.9	The Effusion of Different Gases	19
	ISCS-I		
1	9-1 to 9-7	Energy of Motion	9
2	10-1 to 10-5	Measuring Changing Energy	10
3	10-6 to 10-12	Measuring Changing Energy	10
4	10-11 to 10-14	The Total Energy	10
5	Excursion 8	Forces That Act At a Distance	8

Figure 3.

(Laboratory Kits Available - continued)

Kit	Experiment	Title	Textbook Chapter
	ISCS-II		
6	2-1 to 2-11	Whats the Matter with Bubbles	2
7	Excursion 4-3	A Burning Question	4
8	5-4 to 5-13	Elements	5
9	9-1 to 9-5	Whats the Glue	9
	PP		
1	5	A 17th Century Experiment	2
2	2	Regularity and Time	Into
3	7	Measuring the Acceleration of Gravity Using a Turntable	2
4	7	The Acceleration of Gravity Using a Stroboscope	2
5	39	Waves and Communication: Part A Turntable Oscillators	16
6	39	Waves and Communication: Part B Resonant Circuits	16
7	36	Forces on Currents	14
8	15	Size of the Earth	5
9	19	The Orbit of Mars	7
	PSSC		
1	24	Centripetal Force	12
2	43	The Mass of the Electron	22
3	19	Motion: Velocity and Acceleration	9
4	2 & 3	Reflection from a Plane Mirror and Refraction	2,3
5	47	The Spectrum of Hydrogen and Planck's Constant	27
6	37 & 38	Driving Force and Terminal Velocity - Millikan's Experiment	19
7	16	Diffraction of Light by a Single Slit	8
8	28	Collisions in Two Dimensions	14
9-10	10-14	Waves and Their Properties	6,7
11	36	The Force Between Two Charged Particles	19
	PACE		
1	19-3	ΔH	19
2	Spec. Proj. 17-1	Hardness of Water	17
3	Spec. Proj. 15-2	A Study of Enzyme Catalysts	15
4	18-39	p^H	18
5	Spec. Proj. 8-1	Iron - Copper System	8
6	Spec. Proj. 5-1	Molecules in Motion	5
7	3-30 & 3-31	Physical Changes	3
8	Spec. Proj. 2-1	Separating by Chromatography	2
9	Spec. Proj. 16-2	Ionic Equilibria	16

Figure 3.

(Laboratory Kits Available - continued)

Kit	Experiment	Title	Textbook Chapter
	TPE		
	II-8	Lunar Landing	II
	II-17	Introduction to Logic Circuit Boards	II
	II-18	AND Circuits	II
	II-19	OR Circuits	II
	II-20	Combined AND and OR Circuits	II
	II-21	NOT Circuits	II
	II-22	Odd Number Circuits	II
	III-4	Population Explosion	III
	III-5	Making Money	III
	III-9	Voting Machines	III
	III-10	Teaching Machines	III

Technology ⟷ People ⟷ Environment ⟷

The Self-Instructional Laboratory

With the advent of concern for individualizing instruction in science, the need for good self-instructional curriculum supplements has increased. Teachers who hope to individualize learning activities should be familiar with the potential and limitations of existing self-instructional materials, they should know how to develop and acquire them, and they should be capable of using them effectively with students. The Self-Instructional Laboratory has been developed to provide relevant experiences with self-instructional materials for students in Iowa-UPSTEP and for inservice teachers. Students in the UPSTEP field-based methods course, for example, participate in a clinical experience that involves the design, development, and evaluation with students of a self-instructional module.

The Self-Instructional Laboratory provides an accessible collection of a variety of self-instructional materials, both hardware and software. In addition, it provides an appropriate environment in which students can work with those materials and supporting laboratory apparatus.

There are three primary objectives for the Self-Instructional Laboratory:

1. Self-paced instruction through modules designed to facilitate student understanding of concepts and issues in science education. Most of the courses taught within the Iowa-UPSTEP program lend themselves toward being enriched by self-instructional modules. For instance, we have found that UPSTEP students benefit from working in a self-paced manner with units that introduce various curricula and with selected material taken directly from particular science curricula. The Self-Instructional Lab

provides an opportunity for preservice and inservice teachers to use self-paced curriculum materials in an environment where they can work their way through units of interest at their own leisure.

2. Exploration of the potential and implications of self-instructional modules as a supplement to the science curriculum. To this end, a variety of model modules on specific concepts in science are being prepared. Units are present on topics from mitosis to solar energy. Students are encouraged to go beyond the written word and prepared activities.

3. To make available materials and guidance for the design and construction of self-instructional modules. Once Iowa-UPSTEP students have learned that they can supplement their teaching with appropriate self-instructional modules, resources are provided to enable them to develop and construct modules to support their own teaching. For this purpose tapes, cameras, laboratory apparatus, and various other materials are available in the lab and information and assistance is available on their use.

A wide range of activities should take place in the Self-Instructional Laboratory. Students can use the lab to read through texts and modules, view filmstrip or listen to recordings. They can conduct experiments encompassing days or weeks, as well as those which can be accomplished in a short time. They can view examples of various educational curricula, and work with selected self-instructional materials. Beyond these activities, they can utilize equipment in the Self-Instructional Laboratory to create educational modules or materials to support their own teaching.

Optimally, we would like the laboratory resources to assist the preservice or inservice teacher who wants to offer a module to his students on any subject such as evolution, or soil analysis, etc. We would like to provide him with existing self-instructional modules, activities, or units that are relevant to his needs. We also expect to have self-instructional resources on hand that will provide an overview and introduction to most science curriculum programs. Thus far we have made some progress to this end.

Construction of the Self-Instructional Laboratory. Our task was to set up the best center possible, utilizing hardware which was already on hand in our labs and classrooms. We wanted the final product to be a unit, not a conglomeration of equipment and ideas. We also wanted the design to be practical, relatively inexpensive, and fairly easy to duplicate.

The lab materials available were those that could be found in any high school, i.e., and assortment of various physics, biology, and chemistry apparatus. We also had several lab tables, chairs and a small stock of lumber. One small room (13'x13') was set aside for the lab area. Another similar room was designated as a storage and preparation area.

Six to seven inexpensive carrels were built in the lab area, each having the capacity to function with a variety of materials such as cassette tape players, slide viewers, 8mm filmloop projectors, and various laboratory apparatus. Since we wanted to have as much freedom as possible in setting up experiments within the carrels, some of the carrels were designed to have water, electricity, air and gas. One pair of carrels was designed with only electrical capabilities; a second pair had electricity, gas and air; and a third pair were designed with electricity, gas, air and water. The carrels were placed around the perimeter of the room, keeping the central area available for a larger lab table for storage, and increased lab space for those experiments which might require a greater working area. This central lab table also was equipped with water, air, and gas, and a large sink. Shelving was also designed above the carrels so that some equipment could be readily available for student use.

Six "battle scarred" lab tables were placed around three sides of the room. To resurface these tables we [illegible]d plywood on top and a plastic surfacing material over that. Metal stripping was attached to the edges of the plywood. Pegboard was used to finish the inside of the carrels, commencing at the table level and going up the wall. The dividers between carrels were created by using double thickness pegboard. The size of the booths varies, some being as small as 3 feet in depth and 4 feet in width. These were designed to accomodate a single student working with a fairly small amount of equipment. Other carrels are up to 3 feet by 6 feet and able to accomodate 2 students working together, or an experiment involving large apparatus. The larger carrels allow ample space for projecting slides and/or film loops. An area has also been set aside for small group viewing of 16mm films.

Laboratory Management. The Self-Instructional Lab is open to students from 8 A.M. to 5 P.M. each weekday. The laboratory coordinator is a graduate assistant who maintains an office in the lab. At times, when the coordinator is not available a secretary works just outside the lab who can either help or summon help as necessary. When the coordinator is present he can provide consultation to students and staff or instruction in the use of lab materials. He also provides help in the design and construction of self-instructional modules. When questions arise beyond the expertise of the coordinator, he attempts to contact a specialist who can answer the questions.

A catalogue of the laboratory's resources is available to students and faculty. It contains a list of all modules and materials that are available. In addition, the catalogue contains a brief description of each module. Included are: age or grade level of material, apparatus involved, approximate length of time required to use material, and developers of the material. This catalogue allows students or staff to determine the resources necessary; after a little help in locating materials, students can work alone, for the most part.

The maintenance and security of the lab is the responsibility of the lab coordinator. This includes minor repair work to the apparatus and updating of laboratory materials.

When the laboratory was first used with large number of Iowa-UPSTEP students we observed that the lab was not as "self-instructional" as had been hoped initially. Tape recorders, filmstrip projectors, and a lot of laboratory apparatus were not as "easy" to operate as had been presumed. We have responded to this problem by making more explicit instructions available regarding the location of materials, operating instructions, and where to find help. Items are now labeled more clearly and photographs accompany instructions in some cases.

The lab appears to be functioning more smoothly today than a few months ago. A larger number of students are using the lab and with fewer problems. The Self-Instructional Laboratory has the potential to be an extremely useful resource within the Science Education Center. We are looking forward to its continued growth in variety and volume of materials and student use.

On Program Evaluation

Evaluation has been a significant part of Iowa-UPSTEP since its inception. Data have been collected which have been used as the Iowa-UPSTEP model has evolved during the 1970-75 developmental period with funds from the National Science Foundation. The original proposal prepared in 1969 was based upon specific information concerning the Iowa program and various other national surveys. The Iowa-UPSTEP program began in 1968 at a time when "The Research on Science Education Survey" (ROSES) was completed by David Newton and Fletcher Watson at Harvard University. The University of Iowa was involved with this study as were nearly a thousand other colleges with teacher education programs.

The purpose of the ROSES survey was to collect, analyze, and report basic statistical data about the institutions, instructors, and students involved in teacher education programs in America. The study consisted of two parts. In Phase One, a pair of questionnaires was mailed to 1) the person responsible for the science education program at each of 992 institutions and 2) to the instructor(s) of the science methods course(s) at each institution. In Phase Two, a series of visits were made to 37 colleges and universities in 22 states engaged in the preparation of science teachers. The institutions were selected (not randomly, but purposefully) to represent all sizes and types of schools, as well as to provide geographical distribution. Three activities were planned at each institution: 1) an interview with the instructor(s) of the science methods course(s), 2) interviews with a random sample of students in the science methods course, and 3) observations of the science methods course in session. A pair of student questionnaires, one sent before the methods course began and one sent after the course was completed, was mailed to the students enrolled in the methods courses at these institutions.

In April of 1967, the questionnaires constituting Phase One of the study were mailed. Each of the 992 institutions received one copy of the booklet for instructors and 2 to 10 copies of the booklet for students, depending on the size of the institution. A total of 333 copies of the first booklet were returned (34%); 667 individuals from 420 institutions returned copies of the second booklet. Some institutions returned only the instructor booklet, some only the student booklet, and some both.

A follow-up letter resulted in an additional response from 243 institutions (25%) in the form of a postcard reporting minimal information on the institution's science education program. Finally , there was evidence (usually a letter) that an additional 53 institutions (5%) had no program for the training of science teachers. With all three forms of response (returned questionnaires, postcards, and "no program" letters), some response was secured from 725 institutions for a response rate of 73%.

The ROSES report represents the most complete and comprehensive study of teacher education programs in science ever completed. The summary paragraph of the body of the report provides the setting and the framework from which Iowa-UPSTEP has emerged. The report states:

> It is possible to highlight a few of the most obvious trends in science education today. First, the diversity of programs in science education is very great. Whether one talks about methods courses, practice teaching arrangements, course requirements, or almost any other aspect of teacher preparation programs, there are examples of almost every conceivable pattern to be found somewhere in the nation. Second, the lack of basic, objective evidence on the effectiveness of teacher education programs is striking. The courses and programs described in the report are almost entirely acts of faith with little or no feedback or follow-up information to support the practices that institutions follow. In view of some of the student comments reported in the study, the demand for a further investigation of the effectiveness of these programs seems to be a critical priority. Finally, the isolation of science educators from their colleagues at other institutions seems to have some serious implications for programs for the preparation of science teachers. The chaos in the profession to which we referred above is probably one consequence of the inability of science educators to confer about and agree upon the goals and structure of the teacher preparation program in the sciences. The times call for strong professionals to assume leadership roles in the focusing of energy and efforts in science education.

Iowa-UPSTEP, as conceived in 1969, begun in 1970, significantly expanded and developed during 1973-75, is a comprehensive program encompassing many facets of innovations tried singly and in limited ways elsewhere. The nature of the model 1969-75 has been described and diagrammed in previous sections of this volume.

Several studies were completed prior to the formulation of the original UPSTEP plan. Of special importance for longitudinal studies of Iowa-UPSTEP and teacher education in science at the University of Iowa during the 1965-75 decade are studies by Darrell Jensen, Lynn Glass, and Melton Golmon.

Jensen conducted an extensive review of the total teacher education program at Iowa in 1971. His study focused upon evaluation of the various parts of the teacher education program by in-service teachers. By means of specially designed questionnaires he was able to discern that past graduates were quite critical of the professional sequence. It was criticized for failure 1) to be integrated with the various courses comprising it or as a total program, 2) to be concerned with the real world of local communities and schools and, 3) to offer preparation for using the new curricula and approaches utilized in progressive schools. Introductory courses in education and the educational psychology course were seen as unrelated to other courses; methods courses were not practical enough; student teaching, though practical, was not an integral part of the program and there were often philosophical differences between the University supervisory staff and cooperating teachers.

The Glass study was concerned with an analysis of teacher education programs in Iowa. The nature of various programs (their staffing patterns, the numbers of new teachers produced, the numbers and places graduates employed, problems with respect to preparation and employment) were analyzed and considered. Much of these data are important in considering the status of science education in Iowa in 1970. A follow-up study in which Iowa-UPSTEP graduates are included and considered as a sub-group should prove especially interesting. Hence, the Glass study can be considered important like the Jensen study in terms of baseline information for future comparisons of teachers prepared by the new model.

The Golmon study was completed as an analysis of the nature of the pre-service program (methods and student teaching) at Iowa immediately preceding the development of the UPSTEP model. It provides specific baseline data while illustrating that instruction in methods and experience in student teaching do have demonstrable affects upon students engaged in such activities. Pre-service experiences were shown to affect attitudes, philosophies, and self-concepts of the junior and senior students enrolled in such a concentrated professional sequence during the end of a four year program.

A major evaluation report concerning the first two years of Iowa-UPSTEP was completed by Edward L. Pizzini in 1972. The Pizzini study was the first attempt to measure specific results of phases of the UPSTEP program. Pizzini was able to demonstrate that personal contacts with practicing scientists can affect student attitudes concerning scientists and what scientists do. Further, he showed that considering value clarifications, human relationships, and simulated learning situations can have dramatic influences upon improvement of self-concepts. Such positive changes during the early collegiate years was equal to or excelled changes that Golmon was able to identify in college juniors and seniors. Pizzini also showed that early experiences (at freshman and sophomore levels) in schools (and other field centers) could affect philosophies of teaching as well as to cause the development of knowledge concerning selected educational phenomena and procedures. Pre-service programs were shown to affect students positively when begun with the initial collegiate experiences.

During the 1972-73 year following Pizzini's two year study, some major problems occurred with respect to transition from the UPSTEP experiences to the existing professional sequence. Much information was sought from the participants and their help resulted in some new plans for significant changes in the program sequence. We continued to collect data from UPSTEP students, University staff members, and control groups of students. Significant changes in the staff resulted and caused additional problems with respect to data collection and interpretation. This transitional year resulted in much descriptive information that resulted in significant changes in the model which has been described earlier. Perhaps a review of these data is not as important as a consideration of the extended model that resulted and the effect of these changes upon the students enrolled. A listing of program features and the growth that each has caused in students is hence reported.

The recruitment phase (prior to enrollment as freshmen). Various recruitment devices have been used in identifying thirty new freshmen participants each year. School visitations (many in cooperation with recruitment for Junior Academy and Secondary School Training Program participants) continue as a major activity. About twenty-five percent of the new UPSTEP students result from previous participation in a summer SSTP program--usually following the junior year in high school. A fall symposium held on the campus each fall also results in a significant number of new program applicants (about twenty-five percent). Teachers involved in UPSTEP Summer Conferences and/or teachers involved in various Project ASSIST activities assist with recruiting another twenty-five percent of the new students. Faculty advisors, student-student contacts, and unsolicited inquiries result in the remaining twenty-five percent of the new participants. A study of the relative effectiveness in terms of completion of the program and quality of participation remains to be completed.

The freshmen experiences. The freshman year is now characterized with a series of seminars and courses designed to introduce students to the University, to leading scientists, to human awareness activities, and to the career field of education. Results from questionnaires, opinionnaires, and other survey instruments permit us to conclude that these freshman experiences produce measurable gains in terms of student perception concerning the nature of science and scientists, concept of self, understanding of basic concepts and procedures in secondary education, ability to communicate and to relate to others. Comparisons of groups and relating these outcomes to specific activities and a specific staff remains to be accomplished.

The sophomore year. The experiences typically occurring at the sophomore year include early exploratory experiences in schools, special seminar series concerned with learning theory and measurement skills, courses in philosophy and history of science. Data have been collected regarding the early exploratory experiences in schools and other learning situations. Such data reveal that these experiences affect the philosophy of teaching, views toward such concepts as discipline, teacher role, curriculum, individualization, and student evaluation. Since the experience with the special seminar concerning learning theory and measurement skill has been incorporated into the model only during the current year, we have no data concerning the affects of such experiences upon our participants. In contrast, UPSTEP students have been involved with experiences in philosophy and history of science since the very beginning of the Iowa-UPSTEP program. In 1973 Robert Boes conducted a major study concerning the impact of such courses upon students, especially the pre-service science teacher. The special philosophy and history of science sequence results in student growth in the areas of understanding the nature and meaning of science, the interrelationships of science and society, and science as a human activity and a major area for thought. Further work is needed in terms of measuring the relationships of these experiences to later study of science and later teaching of science.

The junior year. The typical activities for the junior year consist of two methods courses--one directly related to an initial internship experience and the preparation of learning materials (especially modules produced in our self-instruction laboratory), and the other related to learning resources (especially related to experiences in our interactive curriculatorium). Experience to date enables us to report that students can produce usable and effective learning modules; they can analyze their relative worth and re-develop them with improvements; they can work with students in trying new materials; they do have knowledge of most of the new curricular materials; they can demonstrate their ability to perform laboratories and other activities from the new programs. The attitudes as well as specific skills of these third year students continue to be more positive concerning science and teaching.

The summer program. Between the junior and senior year an opportunity exists for UPSTEP participants to work with in-service teachers in special curriculum revision projects and/or to be involved as staff members in science programs for the motivated high school stu-ent (SSTP) and/or the unmotivated secondary school student (Upward Bound). We have been able to measure student increased awareness of the operation of school programs, problems of in-service teachers, and the nature of secondary school curriculum. Also, the summer program enables students to increase their skills in working with secondary school students and in developing learning materials. Differences can be observed between students involved in such summer experiences and those who have not been involved.

The senior internship. This normal experience at the senior year includes extended and advanced experiences as teaching interns in courses in various science disciplines at various academic levels and often involving more than one master teacher. Again, the 1974-75 academic year is our first experience with this part of the model as common practice. Indications are that the resulting teachers are less like the single model that occurs when students are placed with a single cooperating teacher in one school and in one discipline for student teaching. Interns with such variations of experience appear more flexible, more confident, more knowledgable, and more enthusiastic. We continue to collect information while awaiting the opportunity for measurement of specific differences that new in-service teachers demonstrate over teachers produced with more conventional internship experiences.

Specific competency lists are being formulated for each aspect of the Iowa-UPSTEP model. At this point in time these lists are still incomplete and techniques for observing and measuring their attainment remain to be perfected. Such observation and measurements represent major information for our formative evaluation efforts. Indeed, they have provided the basis for the development of the model as it exists today. Such evaluation efforts are a fundamental part of the model and will continue to affect its nature and its form.

Although there is much information available regarding the effectiveness of the Iowa-UPSTEP model and various features that comprise it, the model has changed significantly since its beginning in 1970. In fact, there are no students that have been produced from a four year program that have experienced the model as it currently exists. Teachers will be entering the field as in-service teachers in numbers significant enough to study during the 1975-76 academic year. The following year as well as the 1977-78 year will result in significant total numbers (and specifically numbers that have experienced the complete current program) that can be studied for completion of the program of formative evaluation.

A supplementary grant is being sought that will permit us to complete a longitudinal study of teacher education at Iowa and specifically a formative evaluation effort of the Iowa-UPSTEP model. Such supplementary funding will enable us to complete comparisons of students who experienced the conventional program, students involved with various intermediate UPSTEP programs, and students who have experienced the Iowa-UPSTEP model as it has evolved at the end of a five year developmental period (1970-75). Such supplementary funding will also permit us to develop modules that can be used in disseminating the model and specific evaluation modules that can be used at other institutions and for third-party summative evaluation efforts.

We have followed the work centered in the Association for the Education of Teachers in Science (AETS) as the 1973 <u>In Search of Promising Practices in Science</u> <u>Teacher Education</u> volume was prepared and published. We were involved with

Ronald Atwood's analysis and synthesis of the information in this volume. We participated and helped conduct the AETS national analysis of competency-based program. We are aware of and have assisted with the AACTE most recent calls for more cooperative teacher education programs that are fully field-based. In this time of great concern for improved teacher education programs, however, we are reminded of the concerns expressed in the ROSES report in 1968. Newton and Watson indicated then that the courses and programs studied and identified in their major national survey were almost entirely acts of faith. There was little or no feedback or follow-up information to support the practices that any institutions followed. They commented upon the complete and striking lack of basic and objective evidence concerning effectiveness of teacher education programs. It was in recognition of this major problem that the Iowa-UPSTEP plan has been and continues to be predicated upon the position that the model must be submitted to careful scrutiny and continuous study concerning its strengths and weaknesses. This kind of search for information must continue until student graduates who have experienced the current model if the potential for Iowa-UPSTEP is to be realized. Certainly major study of the Iowa-UPSTEP graduates as in-service teachers will represent the most significant evaluation of the model that is possible. We look forward to a comprehensive study of Iowa-UPSTEP: 1968-70 -- the embryonic phase; 1970-75 -- the developmental phase; and 1975-78 -- the formative evaluation phase. We expect such evaluation efforts to provide focus and insight for science teacher education. It will provide the needed information for establishing the strengths (and weaknesses) of the model based on evidence and direct observations rather than upon faith which has characterized the situation in the past when such evaluation was not conducted.

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