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ABSTRACT

To summarize the implemented program, this report makes use of the practice profile. Inputs, processes, and outputs statements are the ideals for the practice profile and are adapted from the outputs stated in the Discrepancy Evaluation Model. The major project components are: (1) "Critical Mass" (which is what is needed before the systems will operate); (2) "A Firm Foundation" (in which emphasis is on non-human factors that influence the project); (3) "Application to Teaching Science"; and (4) "Product." Each of the above components are presented in expanded practice profile format. Project innovations are highlighted in a meaningful context and dissemination concerns are stated and discussed. Innovations include early (first year) and in-depth classroom exposure. Collaboration among science departments, the college of education, a laboratory school, and public schools resulted in a variety of resources. (RT)

Final Report
Part 3
Practice Profile

Utah Elementary Science Improvement Project

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INTRODUCTION

For the purposes of project summary, this report utilizes the practice profile to summarize the implemented program. Major components are presented in a flowchart format in figure 1. The ideals for the Practice Profile are adapted from the Outputs stated in the Discrepancy Evaluation Model—Inputs, Processes and Outputs statements. In that the major purpose of the Practice Profile is a general summary, the ideals-outputs are stated in more general terms than in the more detailed IPO's related to second and third level components in development of the program.

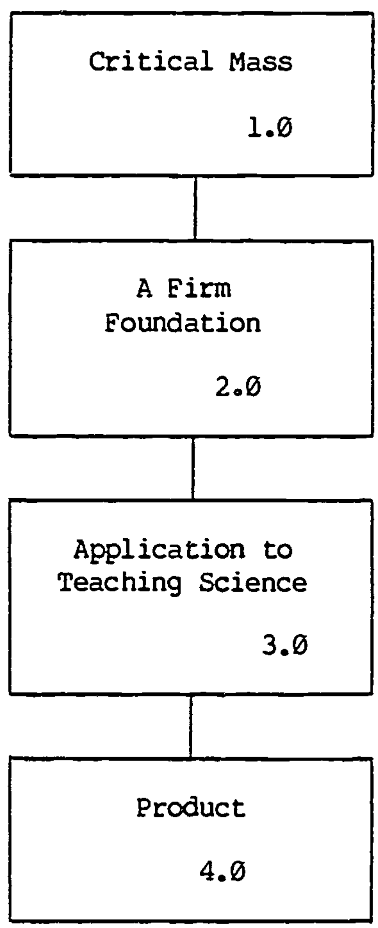

Figure 2. Major Project Components

PRACTICF PROFILE

In the section that follows, each of the four major project components will be presented in expanded Practice Profile format. Where an innovation has occurred, this will be noted under the appropriate subcomponent so that project innovations are highlighted in a meaningful context. Dissemination concerns will also be stated and briefly discussed. These concerns will form the basis of a "How To" manual that is at this point only in draft stage.

1.0 Critical Mass

Critical mass in a nuclear reaction is what is needed before the process is self-sustaining. The same principle applies to this project. The critical mass is what is needed before the systems will operate.

A: Prime Mover

Unacceptable	Acceptable	Ideal
1. A prime mover that is "science content instructor only." 2. A prime mover that has had no curriculum development experience.	1. One or more persons with sound science backgroundand interest in improving science methods courses. 2. The above must have experience in curriculum development. 3. The above must have time allocated for curriculum development.	1. One or more highly competent science educators, preferably with degrees in science education. 2. The above must have curriculum development skills and/or experience. 3. The above must have time allocated for curriculum development.

Innovations

The prime mover innovative aspect of this project was that the project director was both a recognized science educator and curriculum developer. Reputation of the prime mover seemed to be a very significant project component. Without project director credibility, it is doubtful that department, college, across campus, and public school cooperation could be achieved.

Dissemination Concerns:

Are credible prime movers pre-existent or are they made? Either way, how do you get started? (See "The Prime Mover", Appendix 1.)

B: Advisory Committee

Unacceptable	Acceptable	Ideal
1. No formally constituted committee. 2. No administration support.	1. A nucleus of interested science faculty, education faculty, classroom teachers and students. 2. Some administrative support. 3. Commitment to carry out assigned tasks.	1. Representation from elementary education (science person and department head), education dean, science department heads, science dean, some science faculty, elementary teachers, elementary principals, college students. 2. Deans willing to host meetings and provide food. 3. Commitment to attend at least 2 sessions yearly.

Innovations

The working relationship of the advisory committee for this project was remarkably smooth. Issues were discussed openly and resolved by consensus. Identified keys to this success were: a diplomatic prime mover, science and education deans committed to the goal of producing the best possible elementary teachers, and science department heads willing to put teaching teachers as a high faculty priority.

Inclusion of classroom teachers and college students helped keep processes in proper perspective.

Important Note:

In five years of advisory committee interactions for this project, no major dissemination occurred among the large group of participants.

Dissemination Concerns:

What are the procedures and politics of forming an advisory committee? Once formed, how do you keep the group intact and moving? (See "The Advisory Committee", Appendix 1.)

C: Viable Teacher Preparation Program

Unacceptable	Acceptable	Ideal
1. A 5th year teacher preparation program.	1. A good 4-year teacher preparation program.	1. SODIA-Science (see Daugs, 1986)
2. Students with a poor science content background.	2. Students with a good general science background.	2. Students with content background in biology, geology, chemistry, and physics.
3. No access to elementary classrooms.	3. Access to elementary classrooms.	3. Access to elementary classrooms.

Innovations

The SODIA program was an award-winning program prior to this project. Innovations include early (1st year) and indepth classroom exposure. Cooperating elementary schools accommodate about 700 college students per year. These students are at various levels in the program.

A critical component of the program is a uniform 20-credit science requirement for all elementary education majors. This requirement includes Biology 101, Chemistry 101, Physics 120, and Geology 101. All but the chemistry have labs. These requirements meet NSTA recommended standards for elementary teachers.

D: Competent Instructors

Unacceptable	Acceptable	Ideal
1. A methods course instructor unwilling to change. 2. A content course instructor that lectures and utilizes textbook content only.	1. A methods course instructor willing to adapt teaching to the processes specified in the course outline. 2. Generally dynamic content course teachers.	1. A methods course instructor with a degree in science education who is willing to adapt teaching to the processes specified in the course outline. Content course faculty who are dedicated to the principle of teaching content and processes appropriate for elementary teachers.

Innovations

The major innovations in this component were initiated by advisory committee discussions of what should be included in the four required content courses. The courses were all modified to include all topics covered in the Utah Core Curriculum (1987) and labs were modified to emphasize science process skills and related equipment. The changes were judged to be appropriate for all college students and courses are therefore open to general enrollment. What was judged ideal for elementary teachers became the standard for all.

Dissemination Concerns:

How do you get the "right kind" of course instructors? What contitutes a "good" role model? (See "Competent Instructors", Appendix 1.)

E: Competent Students

Unacceptable	Acceptable	Ideal
1. Students that cannot pass first level college science courses.	1. Students that have at least a 2.0 GPA in science content and methods courses.	1. Students that have a GPA of 2.7 upon entering elementary education and maintain that GPA until graduation.

Innovations

The uniform 20 credit science foundation and a 2.7 GPA was viewed by students and some faculty as a threat to student survival in the program. This was proven false. Student GPAs are higher than the average for the university in general. Dropout has remained about 50% over the first two years, and is related mostly to early classroom exposure and personal decisions about wanting to teach. ACT scores for students entering elementary education remain at about 21.6, which is higher than the average for all entering freshman. The new requirements have further developed latent science skills.

Dissemination Concerns:

What kind of students do you need to make this program go? (See "Well Qualified Students", Appendix 1.)

2.0 A Firm Foundation

In the previous section, critical mass, the emphasis was on human resources. In this section, emphasis will be on non-human factors that influenced the project. There is no intent to infer that either is more important, or that one should preceed the other.

A: Facilities and Materials

Unacceptable	Acceptable	Ideal
1. Inadequate classroom facilities, equipment and materials to meet program goals.	1. Adequate classroom facilities, equipment, and materials to meet major content and methods course goals.	1. Adequate classroom facilities, equipment, and materials to meet all content and methods course goals and objectives.

Innovations

The collaboration among science departments, the college of education, Edith Bowen Lab School, and cooperating public schools resulted in a unique reservoir of resources. They included common to sophisticated science lab equipment and facilities, elementary classrooms at all grade levels, outstanding computer resources, and large amounts of industry donated curriculum materials. Project Wild, Project Learning Tree, The National Energy

Foundation, The Utah Department of Agriculture, The Utah Health Department, and The International Office for Water Education contribute thousands of dollars worth of exemplary curriculum materials every term. Students literally "make money" by taking the course. For a $5.00 lab fee students receive about $70.00 worth of "free" curriculum materials.

Dissemination Concerns:

What are the minimum facilities needed to make a project successful? Can collaboration solve local resource deficiencies? Where does industry fit into other local circumstances? (See "Facilities and Materials", Appendix 1.)

D: Curriculum

Note: Curriculum is both a process and a product. The process involves many human resources. For the purposes of dissemination, it was assumed that the present science methods course curriculum developed for this project would be adapted for use elsewhere. Therefore, the curriculum was viewed as primarily product and not process. Curriculum here refers only to the science methods course.

Unacceptable	Acceptable	Ideal
1. Generating a methods course framework that is completely new and different from the present El. Ed. 401 curriculum framework.	1. Adaptation of the present El. Ed. 401 curriculum framework to local conditions.	1. Total adoption of the present El. Ed. 401 curriculum framework. (See Appendix 1)

Innovations

The El. Ed. 401 science methods course curriculum framework (topics, goals, and objectives) was the result of three important inputs. They included: What does research say should be in a science methods course? What does the most recent thinking say should be in a methods course? What is realistic?

The research literature review was extensive and formed a philosophical basis for the course. The national trend for inclusion of science technology and society concerns resulted in expansion of the course from three credits to five credits. The collaboration with classroom teachers and students on the advisory committee kept things realistic.

Dissemination Concerns:

How do you promote ownership of an external program? Are the needs of elementary programs uniform enough to warrant adaptation? How do you facilitate adaptation to local needs? (See "Curriculum", Appendix 1.)

C: Money

Unacceptable	Acceptable	Ideal
1. Insufficient funds to maintain the required science content and methods courses.	1. Sufficient funds for course offerings.	1. Sufficient funds for all program needs, including curriculum development and project assessment.

The magnitude of this project could not have been carried out without external funding. However, it is important to point out that the program is now self-supporting. Student enrollment in the methods course is about 50 students per term. This constitutes 5/9 of a FTE.

The content requirements for the four basic science courses result in an enrollment of about 250 students in each of these courses per year, generating about 5,000 student credit hours for the college of science. The program "pays", rather than "costs."

3.0 Application to Teaching Science

This section refers only to the major, immediate outcomes of the science methods course. Probably more time was spent on assessing, or figuring out how to assess course outcomes than any other component of the project. Much of the research is not "clean", however, qualitatively, there were no major negative indicators, and in the spirit of formative evaluation procedures utilized from the original Discrepancy Evaluation Model, one can conclude that the methods course is doing what it was designed to do.

In the Practice Profile below, only the major course components are listed. In the Discrepancy Evaluation Model, each of these components has another level of development.

Dissemination concerns are listed only at the conclusion of this section, rather than with each component.

A: Course Requirements

Unacceptable	Acceptable	Ideal
1. Students never understanding course requirements, procedures, and grading.	1. Student understanding of course requirements, procedures, and grading at the end of the course.	1. Students understanding of course requirements, procedures, and grading at the beginning of the course.

Innovations

The use of DEM format for program goals, objectives, and IPO's greatly facilitated student understanding for what was to happen in the course. This format was referred to throughout the course. Students also used the model innovatively. They skipped class when they felt they were competent in a specified component.

B: Pretesting Level of Scientific Literacy

Unacceptable	Acceptable	Ideal
1. Inability to perform at the 80% level on any component of the scientific literacy pretest.	1. Remediate any areas on the scientific literacy pretest where performance was below the 80% level.	1. Entry into the methods course at the 80% competency level in all four content areas, process skills, and attitude toward science.

Innovations

The scientific literacy pretest is innovative in and of itself. It assesses science content knowledge in life, earth/space and physical science, assesses science process skills, and attitudes toward science.

A major problem and innovation related to the pretest was adapting it for self testing on the computer. The graphics presented major challenges which were overcome as part of a masters thesis (Allred, 1988).

The test can now be either computer or paper and pencil administered. The fringe benefit to the student is a practical introduction to computer-mediated testing.

C: Remediation

Unacceptable	Acceptable	Ideal
1. Student unwilling to remediate any identified weaknesses.	1. Student utilization of available technology for remediation.	1. No remediation requried.

Innovations

Video cassettes (Visual Insights, 1985) and study guides (Lewis and Ostlund, 1986) have been identified that can be used by students on an individual basis to remediate content and process skills deficiencies. These materials are good enough that many students not needing remediation request the opportunity to experience the materials.

D: Science, Technology, and Society (STS)

Unacceptable	Acceptable	Ideal
1. No exposure to STS.	1. Exposure to the basic concepts of STS as elementary grade curriculum.	1. Exposure to the basic concepts of STS as elementary grade curriculum.
		2. Experience an STS investigation with a scientist as a mentor.
		3. Apply the principles of STS "thinking" to teaching in an elementary classroom.

Innovations

Science, technology, and society as a "discipline" are a very recent innovation. The trend seems to emphasize a future oriented curriculum. The advisory committee felt that the STS movement was relevant enough to devote 2/5 of the five credit course to this topic. At present, this project may include the only elementary science methods course in the country with a major STS component, hopefully preparing graduates for tomorrows curricula.

Another major innovation in this component was a 10-hour time block in which small groups of students carried out STS investigations working with a real scientist. From 5-7 science faculty donate their time each term.

E: Core Curriculum

This is a local need. No ideal is listed here because the core is an externally mandated requirement imposed by the Utah Board of Education. This is a component that may or may not be adapted to other states. The innovation lies not in the core requirement, which is very traditional, but rather in the manner of student exposure to the core.

Innovations

The Utah Elementary Science Core has been expanded into a resource guide for teachers. The core is a set of standards and objectives. The resource guide includes one or more lesson plans to achieve each objective, reference to up to eight publisher produced lessons to achieve each objective and ties across to curriculum for each objective. These resources are presented as a computer-mediated curriculum resource used in conjunction with a classroom practicum. When a cooperating teacher assigns a student to teach a science topic, the student is provided a core curriculum standard and objective. The student then uses this number to review or printout the appropriate resources using a computer located in the classroom. The classroom computer is tied into a centrally located hard disk system.

NOTE: Development of this resource for another area would require thousands of hours. This factor alone precludes dissemination of this component. However, where there was interest, the principles of computer-mediated curriculum retrieval could easily be adapted.

F: Basic Principles, Skills, and Methods of Teaching Science

Unacceptable	Acceptable	Ideal
1. Student performance at less than the 80% level on measures of specified course outputs.	1. Course outputs may be modified to meet local or term to term needs. 2. Students will perform at the 80% or better level on measures of specified course outputs.	1. Student will exhibit all the behaviors specified for component 6.0 in the course outline.

Innovations

Note: This component includes many of the parts of traditional science methods courses.

G: Exposure to Elementary Science Curricula

Unacceptable	Acceptable	Ideal
1. Student performance at less than the 80% level cn measures of specified course outputs.	1. Course outputs may be modified to meet local or term to term needs. 2. Students will perform at the 80% or better level on measures of specified course outputs.	1. The student will exhibit all the behaviors specified for component 7.0 in the course outline.

Innovations

Project Wild, Project Learning Tree, The National Energy Foundation, The International Office for Water Education, Soil Conservation Service, Utah Dept. of Agriculture, and the Utah Dept. of Health regularly contribute exempliary materials for students use. This contribution is a significant dollar contribution.

Textbook publishers have also contributed classroom sets of materials.

H: Practicum

Unacceptable	Acceptable	Ideal
1. Have no access to elementary classrooms.	1. Have access to elementary schools with cooperating teachers that are competent in teaching science.	1. Have access to a laboratory school with highly competent cooperating teachers.

Innovations

The practicum is an important component of the course. Students spend 1/2 day for 10 weeks in an elementary classroom. They observe model teaching and have an opportunity to teach all subjects. This pass-fail experience is structured in a helping relationship atomsphere.

The practicum is carried out the term after having the methods course.

I: Convocation

Unacceptable	Acceptable	Ideal
1. No opportunity to demonstrate teaching competencies.	1. A culminating experience where students can demonstrate teaching competencies.	1. A culminating experience where students can demonstrate teaching competencies.
		2. Access to elementary classrooms where students can interact with teachers and children.

Innovations

The convocation has evolved into a course highlight. Each term a different science topic serves as a major organizer for a culminating experience. Students use content background process skills and teaching skills to creatively plan a science experience for a given grade level of children. The planned experiences are then taught in an elementary school. Normally, the cooperating school designates a day as science day and the methods students literally take over the school for a day. The program is popular enough that schools as far as 120 miles away have paid travel expenses for the event.

J: **Final Exam**

No ideal is specified for the final exam. The final exam was not consistant from term to term. Project evaluation was often more pressing than student grades so the final was often waived in favor of collecting project data. When a final was administered, it was different every term. Therefore, no standardized data were available.

Dissemination Concerns:

This component constitutes what is normally taught in a science methods course. Most of it will be easily transferable. The utilization of elementary classrooms for the convocation and practicum is very important. How do you establish a good working relationship with public schools? (See "Formation of an Advisory Committee", Appendix 1.)

4.Ø Product

Ultimately, the measure of success of teacher preparation rests in the marketplace. Graduates of the SODIA program were highly employable before the initiation of this project. Though not definite at this point, there are indicators at the practicum, student teaching, and inservice levels that the project has had a positive effect on science teaching.

A: Practicum

Unacceptable	Acceptable	Ideal
1. Students are not able to plan and carry out science teaching assignments.	1. Students are able to plan and carry out science teaching assignments with a reasonable amount of assistance from cooperating teachers.	1. Students are able to utilize computer technology in planning their teaching. 2. Students require a minimum of cooperating teacher help in planning and carrying out science teaching assignments.

B: Student Teaching

Unacceptable	Acceptable	Ideal
1. Students cannot plan and carry out science teaching assignments.	1. Students are able to plan and carry out science teaching assignments with a minimum of assistance from the cooperating teacher or student teaching supervisor.	1. Students are able to plan and carry out science teaching assignments without assistance from the cooperating teacher or student teaching supervisor.

C: Market Place

Unacceptable	Acceptable	Ideal

1. Graduates can't get a job because of teaching incompetence.	1. Graduates of the program are easily employed. 2. Graduates are evaluated as competent elementary science teachers.	1. Graduates of the program are highly sought after, partly because of their science competencies. 2. Graduates become science teacher-leaders in their schools.

Appendix 1

Methods Course Curriculum Improvement

A Users Manual

(See Part 1 of this Report)