An Internship: A Framework for Science Literacy and Vocational Goals

Joan Visser
Loyola University Chicago

Follow this and additional works at: https://ecommons.luc.edu/luc_theses

Part of the Educational Psychology Commons

Recommended Citation
https://ecommons.luc.edu/luc_theses/4130

This Thesis is brought to you for free and open access by the Theses and Dissertations at Loyola eCommons. It has been accepted for inclusion in Master's Theses by an authorized administrator of Loyola eCommons. For more information, please contact ecommons@luc.edu.

This work is licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 License.
Copyright © 1995 Joan Visser
LOYOLA UNIVERSITY CHICAGO

AN INTERNSHIP: A FRAMEWORK FOR SCIENCE LITERACY AND VOCATIONAL GOALS

A THESIS SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL IN CANDIDACY FOR THE DEGREE OF MASTERS OF ARTS

DEPARTMENT OF CURRICULUM, INSTRUCTION, & EDUCATIONAL PSYCHOLOGY

BY

JOAN VISSER

CHICAGO, ILLINOIS

MAY, 1995
Copyright by Joan Visser, 1995
All rights reserved.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF FIGURES</td>
<td>v</td>
</tr>
</tbody>
</table>

Chapter

I. INTRODUCTION
   - Research Questions              | 1    |
   - Significance of the Study       | 2    |
   - Plan of the Study               | 3    |

II. REVIEW OF RELATED LITERATURE
   - Operational Definitions        | 4    |
   - Training of the Preservice Student | 5    |
   - Methods of Effective Instruction| 9    |
   - Reflective Thinking and Teaching| 14   |
   - Clinical Supervision of Preservice Teachers | 22   |

III. METHODOLOGY OF THE STUDY
   - The SCIENCE 2001 Project        | 26   |
   - Program Implementation          | 28   |
   - The Loyola Student Participation| 30   |
   - The Supervisory Process         | 33   |
   - Data Collection                 | 35   |
   - Data Analysis                   | 36   |

IV. THE RESULTS
   - Intern Journals                 | 54   |

V. THE CONCLUSION
   - Implications                    | 63   |
   - Limitations of the Study        | 64   |
   - Concluding Remarks              | 67   |

Appendix
   - Implications                    | 70   |

BIBLIOGRAPHY                        | 94   |

VITA.                                | 98   |
<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Student Outcomes.</td>
<td>11</td>
</tr>
<tr>
<td>2. Data Collection Summary</td>
<td>36</td>
</tr>
<tr>
<td>3. Frequency of Journal Process.</td>
<td>55</td>
</tr>
<tr>
<td>4. Frequency of Reflective Stages.</td>
<td>56</td>
</tr>
<tr>
<td>5. Frequency of Exit Interview Responses</td>
<td>57</td>
</tr>
<tr>
<td>6. Present Vocational Goals.</td>
<td>58</td>
</tr>
<tr>
<td>7. Undergraduate Vocational Goals.</td>
<td>58</td>
</tr>
<tr>
<td>8. Future Vocational Goals</td>
<td>59</td>
</tr>
<tr>
<td>9. Pretest/Posttest Scores</td>
<td>60</td>
</tr>
<tr>
<td>10. Posttest Scores</td>
<td>61</td>
</tr>
<tr>
<td>11. Posttest Scores</td>
<td>62</td>
</tr>
<tr>
<td>12. Posttest Scores</td>
<td>62</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experiential Learning</td>
<td>45</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Since 1992, Loyola University, Chicago graduate and undergraduate students from the School of Education and the College of Arts and Sciences were able to participate in a program designed to assist with teaching science to elementary students. The SCIENCE 2201 program was developed to support the goals of NSTA, AAAS, and the state of Illinois. It was supported through the funds from a competitive state grant.

The interns, future teachers and scientists, participated in science inservices developed for elementary school teachers. As part of their responsibility they assisted in the elementary classroom, led after school science clubs, and attended science inservice training. These responsibilities became the framework for developing science literacy within the Loyola University, Chicago community, as well as the elementary schools of Chicago, Illinois.

As university students became involved in the program, and elementary schools began using the interactive approach to teaching science, several patterns in learning began to emerge. Among the data collected from the university interns over a three year period, statements such as "I'm learning so much", "I never knew science could be so much fun", and "I'm sure now that I want to be a teacher" continued to surface. These emerging patterns sparked interest and led to studying and surveying the collected intern data to determine the significance of this learning experience, especially for the Loyola students.

Research Questions

Using this program as the framework for studying the effect of training along with the university academic program the questions began
to form. The importance of training that combines the knowledge of learned material with the preparation of "how" to apply this knowledge in the workplace became the focus of the research.

This study examines both education - the attainment of knowledge - and training - the practical application of knowledge - as requirements for professional preparation (Cruikshank & Metcalf, 1990).

Framing the training of the university participants meant equipping them with science knowledge and skills, and the teaching strategies that enabled them to pass this knowledge on to elementary school students. Both curriculum content and instructional delivery affect student learning. Training in the "hands-on" approach to teach science was the link between science curriculum and instruction. The discovery-based approach encouraged all learners to understand the scientific processes of reasoning and deductive thinking (Walburg, 260). Expectations were that they could then communicate this scientific knowledge to others.

Based on this theory-to-practice project, two questions were formed for this study. First, did the Loyola University interns improve their knowledge base in program experience? Second, did this internship experience contribute significantly to the Loyola intern's preparation for future vocation?

Significance of the Study

Should the university student receive an education centered on attaining knowledge only, or should part of this process include training? This question is one educators debate and research in an effort to fully prepare university students for the realities of the professional workplace. In other words, not only should the "what" of education be emphasized, both the "how" must also be included in this preparation (Cruikshank & Metcalf, 1990). The attempt in SCIENCE 2001 is to increase the amount of field training in specific skills and strategies used in the professional world. In this way education and
training would be a better integrated educational effort.

In learning how to teach science, the participants were also learning science. This happened in two ways. First the modeling of good instructional methods were observed and experienced through the inservice training. Second, by forming the program with a discovery-based approach to learning, and encouraging investigation and problem solving skills, the university student also had opportunity to become more science literate.

Plan of the Study

This chapter introduces and establishes the goals significance, and plan of this study. Chapter II reviews the literature discussing the related issues, namely methods of effective instruction, reflective thinking, and clinical supervision. Chapter III describes the methodology of the study; Chapter IV provides an analysis of the data; and Chapter V presents the results and conclusions of the study.
Several areas of literature were selected to review the relevant questions designed for this study. These areas include: 1) the training of preservice students, 2) the practice of reflective teaching and learning, 3) the supervision of preservice teachers, and 4) methods of effective instruction.

**Operational Definitions**

**Preservice Student**

For the purposes of this study, preservice undergraduate student is one who is actively pursuing educational and vocational goals through a prescribed college program. These students are both undergraduate and graduate students without previous professional experience in the workplace.

**Reflective Teaching and Learning**

In general, reflective teaching and learning "refers to all efforts to cause teachers to be more thoughtful and wise about educating" (Cruikshank, 1991). It also includes those programs in which participants become more thoughtful and wise about their own instruction (Cruikshank, 1991).

**Supervisory Role**

The supervisor of the preservice teacher assumed the role of mentor and formative evaluator. This formed the basis for the procedures and strategies to improve the preservice student’s learning and classroom behavior.

**Effective Instruction**

For the purposes of this study, effective instruction are those
means by which the learners become more efficient and effective in managing all types of learning experiences (Smith, 1991). Through active participation in the teaching setting, and from the mentor feedback, the preservice participant has teaching experience training and opportunity to reflect upon the classroom experience.

**Training of the Preservice Student**

Entering 1990, much has been written by Donald Cruikshank, Dona Kagan, and others on the notion of just how students are prepared for teaching and entering their chosen vocation as well prepared practitioners. Cruikshank and Kim Metcalf explore this topic in the published article, "Training Within Teacher Preparation." After discussing the difference between education and training based on existing articles and research, Cruikshank and Metcalf define training as "Training, then, connotes the development of a variety of behaviors depicting know-how across a wide spectrum of human activity" (p. 469). In the training of educational professionals, the preservice student gains content knowledge through the general education courses, and knowledge of the teaching disciplines, child development, effective teaching strategies, and classroom management. Then knowledge must lead to practice, which then begins the training aspect of preservice education. During this stage of learning, the preservice teacher learns how to teach science, to use the principles of child development, infusing lessons with effective classroom management techniques, and developing meaningful, effective lessons. This becomes the "know-how" of teacher education.

Do any general themes or conclusions appear in recent teacher preparation articles and research? Dona Kagan in the 1992 article, "Professional Growth Among Preservice and Beginning Teachers" discusses these themes and conclusions with the intent of synthesizing the information. Among the 27 empirical studies examining growth among preservice teachers, five areas were discussed. Several of these had
significance for this study. Those are:

1. Requisites for Growth During Practica and Student Teaching (p. 140).

2. What Can Happen When Novices Try to Teach With Little Knowledge of Pupils and Procedures (p. 142).

3. Comprehensive Evaluations of Practica or Student Teaching Experiences (p. 148).

A summary of common themes suggests these conclusions to the above studies.

Indications are that inadequate knowledge of pupils and ineffective instructional procedures deprive the student of certain necessary classroom skills. Kagan concludes that preservice teachers must:

1. Acquire useful knowledge of pupils. Direct experience appears to be crucial.

2. Observe skilled, seasoned teachers who question and reflect on pedagogical beliefs and also serve as positive role models.

3. Participate in University courses which adequately prepare the student with knowledge of classroom procedures and pupils (p. 142).

Other studies show results of what can happen when preservice teachers try to teach with little knowledge of pupils and procedures.

1. Inability to focus on pupil learning.

2. Instructional plans focus on discouraging misbehavior rather than lesson content.

3. Little background for integrating management and instruction (p. 145).

Existing research, Kagan concludes, indicates that the university courses generally prove inadequate in preparing the preservice teacher for classroom experiences. They leave the preservice teacher unprepared to deal with classroom control and discipline, and the information presented in courses is rarely connected to the students experiences in the classroom (pp. 162 & 163).

Based upon the synthesis of these recent studies, Kagan recommends these changes in existing preservice education programs.
1. **Provide procedural knowledge that integrates management and instruction. An understanding of what works and why it works.**

2. **Address the needs and concerns of the students.**

3. **Recognize the importance of routine self-reflection through biographical histories and growth as a professional educator.**

4. **Promoting extended experience with pupils in a classroom setting.**

Kagan concludes:

...the practice of classroom teaching remains forever rooted in personality and experience and learning to teach requires a journey into the deepest recesses of one's self-awareness, where failures fears, and hopes are hidden. That may not conform to what one traditionally envisions as professional preparation, but perhaps it is time to acknowledge that teaching is not a traditional occupation - not in the clean, technical sense of that term. Classroom teaching appears to be a peculiar form of self-expression in which the artist, the subject, and the medium are one. (p. 164).

Anne Reynolds outlines in the article, "What is Competent beginning Teaching?", the necessary expectations for beginning teachers based on the current research in effective teaching. Beginning teachers should enter the first year of teaching with certain skills:

1. **Knowledge of subject matter.**

2. **Ability to find out about the students and school.**

3. **Knowledge of strategies, techniques and tools for creating and sustaining a learning community and the skills and abilities to implement these tools.**

4. **Knowledge of pedagogy appropriate for content areas that will be taught.**

5. **The ability to reflect upon their own actions and student responds in order to improve their teaching and tools with which to accomplish this (p. 26).**

Along with this, according to Reynolds, the beginning teacher needs to be proficient in planning lessons which enable students to relate new learning to prior learning understanding and experiences, develop rapport with students, establish and maintain fair and appropriate rules and routines for the classroom, arrange the physical and social learning environment that promote learning and understanding,
assess student learning using a variety of measurement tools and adapt instruction according to the results, and reflect upon teacher and student actions in order to improve teaching (p. 26).

Reynolds concludes by stating that teacher education and induction programs must be structured to insure that students have an adequate knowledge base before entering the teaching profession.

Herbert J. Walberg in the article, "Productive Teaching" suggests certain programs that assist teachers and preservice students and foster effective teaching practices and growth as a professional educator. Inservice training, states Walberg, has proven to have substantial effects.

1. Authoritative planning and execution seem to work best; informal coaching by itself seems ineffective.
2. Instructor responsibility for design and teaching of the sessions works better than teacher presentations and group discussions.
3. The best techniques are observation of classroom practices, video-audio feedback, and practice.
4. The best combination is lecture, modeling, practice, and coaching.
5. Federal, state, and university sponsored programs appear more effective than a locally initiated programs (p. 53).

The need for teacher education programs which integrate the instruction in sound pedagogical practice, as well as practical experience within the classroom setting is necessary to becoming a well-prepared teacher.

Section Summary

As this literature indicates, the need for training along with academic courses becomes necessary for the education of the future teacher. The "what" (content courses) and the "how" (training opportunities) of teaching need to work "hand-in-hand". Research studies also indicate that the best service training includes lecture content along with a "hands-on" approach that encourages practice, modeling, and supportive coaching methods. These concepts appear in the
Recent science literacy research indicates:

1. Five percent of students understand the scientific approach to problem solving and the development of knowledge (Miller, 1983).
2. Six percent of adults in the United States can be considered science literate (Miller, 1989).
3. The age and number of high school science courses completed are not predictive of literacy level (Miller, 1989).
4. Males are more science literate than females, possibly because of how science is taught and the reward mechanisms that may favor masculine approachers to science learning (Baker, 1991).
5. Most Americans know little science; part of a knowledge base needed to thrive in the modern world (Hirsch, 1987).
6. There is an agreeable need for citizens who understand and appreciate science (Gatewood, 1968).

So begins John E. Pennick’s article entitled, "Teaching for Science Literacy." The article resumes by defining science literacy. He lists various expert’s definitions and summarizes these by stating "all indicate that our students should leave school appreciating and understanding the nature of science and the role of science in society" (p. 172).

Pennick goes on to say that science experts agree that the science literate persons have these qualities:

1. Demonstrates interest in science and technology.
2. Has an understanding of some basic science concepts.
3. Has the ability and desire to learn more, expanding interest and understanding on one’s own.
4. Takes action, seeks out, and applies knowledge in ways that demonstrates these interests.
5. Appreciates science and feels that knowledge is useful in resolving everyday problems and issues.
6. Understands the nature and history of science in relation to
present-day efforts, ideas, and practices.

7. Effectively communicates science ideas to other.

These characteristics demand student activity and initiative. Clearly these are not adequately developed in the traditional teacher active, student passive classroom. This implies active involvement of both instructor and learner. Not only should these characteristics be fostered in the science classroom, but in most curricular areas. Therefore an integrated curriculum with an experiential student approach appears necessary if these goals are achieved.

These characteristics define a "science literate" classroom:

1. Teacher developed materials, rather than textbooks only.
2. A flexible, ever-changing curriculum, curriculum containing relevant issues.
3. Students involved in curriculum planning and directly active in solving problems.

The NSTA (National Science Teacher Association) position statement (1986) introduction defines the level of science education in preschool and elementary education. First of all science should be an integral part of the school program. It should be used to "integrate, reinforce, and enhance" the basic curricular areas with the outcome of making learning more meaningful for children.

A carefully planned and articulated elementary science curriculum should provide:

1. Daily opportunities for nurturing children's natural curiosity.
2. Opportunities for children to explore and investigate their world using readily available instructional materials with a "hands-on approach."
3. Fosters and understanding of, and interest in, and an appreciation of the world in which the students lives.
4. Classroom experiences that provide meaningful challenges and opportunities for intellectual development.
The report proceeds with outlining the characteristics of a model science program.

Table 1

**Student Outcomes**

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Teacher Behaviors</th>
<th>Classroom Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn a variety of skills which facilitate the gathering of knowledge.</td>
<td>Teachers should have a broad science background including 12 semester hours of laboratory or field-oriented biology, chemistry, physics, and geology.</td>
<td>Invite and support curiosity and investigation for personal use.</td>
</tr>
<tr>
<td>Implement knowledge to make rational decisions and assess the consequences of these.</td>
<td>Teachers should have instructional skills which promote teaching teaching science process skills, content, and positive attitudes toward science.</td>
<td>Allow for flexible seating.</td>
</tr>
<tr>
<td>Use information and values to infer the impact of certain events on others in their community.</td>
<td>Teachers should be able to utilize hands-on activities to promote skill development.</td>
<td>Provide necessary resources.</td>
</tr>
<tr>
<td>Appreciate others and the fact that the solution to one problem may create new problems.</td>
<td>Teachers should be able to select appropriate content and teaching methods.</td>
<td>Provide adequate storage.</td>
</tr>
<tr>
<td>Recognize the influence of science and technology in their lives.</td>
<td>Teachers should be able to design classroom settings which promote positive attitudes.</td>
<td>Provide sufficient materials for individual and group work.</td>
</tr>
<tr>
<td>Understand the need for responsible problem solving.</td>
<td>Teachers should be aware of current, innovative teaching methods and materials and apply them to the classroom.</td>
<td>Provide an annual budget for replacement of expendable items.</td>
</tr>
<tr>
<td>Learn a variety of life, Earth, space, and physical science topics used to develop skills in generating, categorizing, quantifying, and interpreting information.</td>
<td>Teachers should show competency in assessing student performance in science literacy, content, application, attitude, and levels of performance.</td>
<td></td>
</tr>
<tr>
<td>Recognize that scientists and technicians are those with personal and human characteristics.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If you want to help kids and teachers learn about the material world, like batteries and bulbs, or pendulums, or earthworms, or butterflies, you give them batteries and bulbs, pendulums, earthworms, and butterflies. And you let them look at them, notice them, figure out their questions, and come to be familiar with these things. You don't give them works about these things, you give them these things (p. 32).

These are the words of Eleanor Duckworth on "Thinking About Teaching."

She is reflecting on the way people learn.

She goes on:

And now that I'm teaching teachers about teaching and learning, I don't want to give them words about teaching and learning, I want to give them teaching and learning. I want them to have the phenomena of teaching and learning to live through and think about, just as the kids live through and think about flashlights, batteries, and bulbs (p. 32).

This embodies teaching for understanding.

Howard Gardner in The Unschooled Mind, stresses the importance of hands-on science instruction. In the early school years he emphasizes the need for the cultivation of a reflective attitude. Young children should be encouraged to ask very natural questions. "Why do I have a shadow?" "What makes my shadow long?" The teacher must then direct learning by encouraging observation, trying experiments, and motivate students to answer their beginning questions (p. 212).

During the middle childhood year Gardner, the student should experience an education that fosters the use of technology to facilitate learning, student initiated projects, and regular discussions with peers. These methods, along with the hands-on approach to learning, will prepare students for the discipline of secondary and higher education studies (p. 223).

Robert M. Smith defines how people learn in this way. "Implicit in learning to learn is the notion of gradually becoming more efficient and effective in managing all types of learning activities" (p. 11). At the conclusion of the article "How People Become Effective Learners", Smith proposes these methods of learning:

1. Teaching becomes understood primarily as a learning-and-learner-centered process.
2. Education assists people to learn more efficiently and effectively.

3. Teachers must challenge learners to ask more questions, examine assumptions, and pose and solve problems.

4. The student must be led to the limits of his/her knowledge, and understood as an individual learner.

5. Learners need to interact with content, and anchor new content with prior content knowledge.

6. Feedback and assessment are directed to ask - "what was learned?", "what obstacles were encountered?", and "what are the implications for further learning?" (p. 13).

Donald Cruikshank and Kim Metcalf begin the article, "Improving Preservice Teacher Assessment Through On-Campus Laboratory Experiences" by discussing two assumptions regarding education. The first assumption states that school achievement is enhanced through better teaching. Secondly, that improved teaching will follow from increased and more rigorous testing of practicing teachers, and preservice teachers (p. 86). Cruikshank and Metcalf propose that offering the preservice teacher multiple forms of on-campus laboratory experiences involving them in job-related tasks would be of value (p. 86).

Thomas O. Jewett introduces the article, "Science Knowledge and Attitudes of Preservice Elementary Teachers" by citing a research finding that little of the school day was given to the teaching of science (p. 12). These four reasons were cited:

1. Lack of teacher content knowledge.
2. Lack of equipment and materials.
3. Lack of instructional time.
4. Teacher attitude toward science (p. 12).

In response to this, he conducted a survey of preservice teachers in their senior year, and reported these findings:

.119 students had an average of 2.34 science courses in high school, and 2.94 science courses in college.

Course work consisted of:

- 58% life sciences
- 21% earth sciences
- 13% physical sciences
- 8% general science
Most people teaching elementary school today have no physical science background, and if chemistry and physics were studied, high school was the last experience, possibly as long as 30 years ago.

Those surveyed then were given the IGAP sample test which showed the average score of 77%.

Attitude toward the subject of science was very positive, two-thirds of the students liked science.

Ambivalence in teaching science may be explained by the fact that 75% had been taught science through the lecture/book method (p. 12).

Jewett's answer to this cycle of lecture/textbook teaching are these:

Colleges and universities should require more science course work at the undergraduate level, equally distributing the course work among the sciences.

Science must be taught with a combination of content instruction, a modeled process approach, and hands on methods. These should also be emphasized in the science methods courses (p. 12).

He concludes the article by stating that if the integration of science course work with educational methods course work happened in the preservice teacher's preparation, knowledge base, confidence and attitude toward teaching science would be much improved. To do this the science and education departments must work in a cooperative, team effort to solve this problem and ultimately effectively teach today's students (p. 13).

Section Summary

The reported articles and research emphasize the need for effective, hands-on, content laden science teaching. The elementary school education, high school teaching, and college instruction all need to improve the offered science training. The program described in this paper attempts to answer this need at both the college level, as well as in the elementary school training.

Reflective Thinking and Teaching

Reflective thinking is not a new idea. In 1933, How We Think by John Dewey was published. He explained reflective practice and its importance in understanding how learning happens. Since then, much has been written and researched indicating that a reflective attitude and
use of certain "reflective teaching" strategies provide the teaching professions with a means to integrate theory with practice, and constantly improve the quality of teaching and learning within our educational systems. The following literature discussion focuses on the areas of defining reflective thinking, the process of reflective thinking, the procedures used to promote reflective thought, and the results of this strategy on the teaching task.

Reflective thinking, according to John Dewey, consists of turning a subject over and over in one's mind, giving the idea "serious and consecutive" consideration. In the chapter "What is Thinking", Dewey metaphorically describes reflective thought as a chain. The consecutive ordering of ideas, each determining the next thought until it reaches the outcome, and the reflective portions growing out of one other form the chain. Each phase is a step in the reflective thought process, until a chain of thoughts is formed to a common end.

The aim of reflective thinking is a conclusion. Thoughts must lead somewhere. The common phrase, "Think it out" suggests an entanglement of ideas that, through thought, reaches a particular answer or goal.

Reflective thinking leads to inquiry. Thinking should motivate questioning. "Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and further conclusions to which it tends constitutes reflective thought."

Reflection implies belief of evidence. Proof is the ground of belief. Truths (or facts) suggest other truths (or facts) leading to belief on the grounds of evidence describe the operation of reflective thinking.

Dewey describes reflective thinking as involving two phases; a state of doubt, hesitation or perplexity in which thinking begins, and the act of searching and inquiring to find the answer to the doubt or
perplexity.

To be genuinely thoughtful, we must be willing to sustain and protract the state of doubt which is the stimulus to thorough inquiry, so as not to accept and idea or make positive assertion of a belief until justifying reasons have been found.

Using Dewey's literature as a basis for defining reflective thinking, the Elementary Teaching Program at the University of Wisconsin expands the definition of reflective practice. A distinction between reflective action and routine action is made.

"Reflective action entails the active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it, and the consequences to which it leads. Routine action is guided primarily by tradition, external authority, and circumstance" (Zeichner & Liston, 1987, p. 24).

Again, in keeping with Dewey's concept of reflective action, hoped for student outcomes were those orientations of open-mindedness and responsibility, and the skills of observation and analysis. This, along with the technical skills of teacher training, described the central goals of the curriculum.

The use of student journals was one means of promoting reflective action. The journal entries contained this information:

- the ways students thought about their teaching and their development as teachers.
- the classroom, school, and community contexts.
- systematic reflection on their actions in classroom and work contexts (p. 31).

The journals were shared on a regular basis with the supervisors and were an integral part of the supervisory process.

The results after many research studies geared toward ascertaining the effectiveness of the reflective theme, the authors conclude, "The preparation of reflective student teachers is a necessary first step for those of us who work in university programs of teacher education" (p. 45).

Gipe and Richards discuss the considerable differences defining
reflective teaching and various program agendas in "Reflective Thinking and Growth in Novices' Teaching Abilities". By synthesizing the multitude of literature, one governing assumption is evident. "That is, the link of prospective teachers' reflective thoughts to their teaching behaviors" (Cruikshank, 1984; Dewey, 1904, 1933; Zeichner, 1981-1982). "Prospective teachers who in some way reflect about their work, or who extend their reflections to include broader educational concerns, will improve upon their teaching abilities" (p. 53).

Cruikshank and Applegate explain reflective teaching as providing opportunity to teach and then reflect on the teaching experience with the intention of improving subsequent practice. Thinking about what happened, why it happened, and what else could have been done to reach goals states the procedure of reflective thinking (p. 553).

D.D. Ross, in an effort to introduce reflective thinking to college juniors, defines reflection as a way of thinking about educational matters that involve the ability to make rational choices and assume responsibility for those choices. She goes on to explain the reflective process in this way:

- recognizing educational dilemma.
- responding to a dilemma by recognizing similarities to other situations and its unique qualities.
- framing and reframing the situation.
- experiment with the dilemma and discover consequences and implications of the solutions.
- examine consequences and solutions by determining whether they're desirable (p. 1).

Drawing on Dewey's theories, Ross states that in order for students to become reflective practitioners these actions are also necessary:

- open-mindedness
- willingness to accept responsibility for decisions and actions.
- ability to view situations from multiple viewpoints.
- the ability to search for alternatives to a solution or decision
Because past studies had not demonstrated a link between reflective thinking and growth in the novice teacher's teaching competencies, the research done by the authors was implemented to find a significant link between reflective thinking and novice growth in teaching skills.

Through the project PROTEACH, the authors of the article began the research using reflective thinking as a means of growth in the teaching skills of preservice teacher. The design of the program, in its basic form, consisted of a course divided in four sections focusing on these perspectives:

1. Using the school as a context for understanding educational research.
2. Presenting the historical context of educational research.
3-4. Focusing on teacher effectiveness research (p. 2).

The strategies used in this course fostered the development of reflection by modeling reflection and providing guided practice in reflective thinking and teaching. Results of this study were based on the analysis of theory to practice papers which focused on reflection.

What was learned about the students perspective through reflective thinking?

1. Most students in this study were able to view things from multiple perspectives, to recognize the importance of making decisions based on consideration of multiple factors, and to recognize the impact of context of one's teaching practice.
2. The level of reflection demonstrated by students does not seem to change over time.
3. The topic of the theory-to-practice papers did not seem to influence the level of reflection demonstrated by the student.
4. Students were able to analyze a teacher's practice in detail or critique a teacher's practice with perspective.
5. Students were attempting to understand the nature of the link between teacher actions and children's learning and developing criteria for making decisions about the selection and use of instructional practices (p. 7).

The essential first step in the development of becoming a
reflective practitioner is the ability to recognize the elements of competent teaching (Schon, 1987).

Drawing on Donald Schon's work, Karen Osterman in the article "Reflective Practice A New Agenda for Education", emphasizes the importance or reflection as a key element in professional growth. Schon concludes, she states, that skilled practitioners are reflective practitioners using experience as a basis for assessing and revising existing theories of action and develop more effective action strategies.

The "artistry" of knowing is acknowledging that learning comes about by carefully studying the performance of extremely competent professionals (Argyris & Schon, 1974, p. 133). "Reflection is concentration and careful consideration, and reflective practice is the mindful consideration of one's professional actions" (p. 134).

Osterman defines the reflective process by separating the terms, reflection and reflective practice. The process takes this form:

. practitioners step back and examine their actions and reason for the actions.

. practitioners then reflect on the effectiveness of these actions.

. practitioners use this new perception to develop alternative approaches (p. 134).

This results in professional development whereby practitioners become more skillful and effective. The practitioner is lead to greater self awareness, develops new knowledge of professional practice, understands problems which confront practitioners, and influence the workplace in a supportive fashion.

Schon, Dewey, Lewin, and Piaget all trace a common theme - that learning is dependent on the integration of experience with reflection (Kolb, 1984). All acknowledged that learning is a sequential process of four stages: concrete experience, observation and reflection, formation of abstract concepts or generalizations, and active experimentation (p. 135).
What are the characteristics of reflective pedagogical thinking? How can we know it is present? How can we develop this in teacher education programs? The Collaboration for the Improvement of Teacher Education (CITE) attempted to answer these questions through a preservice teaching project that promoted students' reflective thinking. Curriculum, methods and sociological issues through a structured field experience and course work became the framework for reflective thinking. Third and fourth year education students participated in the project.

This project was outlined in the article "Reflective Pedagogical Thinking: How can we Promote it and Measure It?" Using Shulman's (1987) definition of the reflective process - "reviewing, reconstructing, and reenacting and critically analyzing on's own and the class's performance, and grounding explanations in evidence" - the researchers believed that reflective teachers were able to apply educational principles and techniques within a framework of their own experience, contextual factors, and social and philosophical values (p. 24).

After extensive literature research, the CITE group began putting the program together to answer the research questions. Guided experimentation and analysis of field experiences helped future teachers develop reflective methods to solve puzzling, everyday, decisions. The preservice teachers experience began with teaching a lesson followed with writing a reflective journal response. The account contained what was done, why they thought it was successful or unsuccessful, and what was learned from the experience. The next stage was a "think aloud" interview based on the reflection journal used during the teaching week. They were asked, during the fifteen minute interview, to identify one successful teaching event, to describe why they thought it was successful, and discuss any conditions that may have influenced the outcome. They were encouraged to describe issues or concerns that came to mind as they described the event. Then, the same process was used
with a less successful teaching experience.

The study results offered this conclusion - Students appeared to be meeting the goal of using contextual information and pedagogical principles to analyze teaching events. The reflective journals, and the "think aloud" interviews supplied data that, when analyzed qualitatively and quantitatively, provided sound basis for this conclusion.

Studies continue to indicate the value of reflective teaching and thought. Karen C. Stoiber of Northern Illinois University found that prospective teachers involved with curricula aimed at promoting reflective processes compared to groups in a control condition and a technical instruction group, resulted in higher-rated pedagogical reasoning and a greater sense of responsibility to student and learning environment (p. 136). The reflective approach also produced positive effects on the preservice teacher's perceptions of themselves as problem solvers and their ability to generate problem-solving strategies.

What do teachers say about reflection? Christine Canning (1991) researched this question and wrote the findings in an article entitled with the above question. Using the process of writing reflective journals these findings were listed:

- Teachers learned to ask questions of themselves, prompted by being aware of a conflict between what they professed to value and what they were doing in actual practice.

- Teachers found that reflection was an intrapersonal experience leading to changes in self-concept, changes in perception of an event or person, or plans for behavior change (pp. 20, 21).

A final comment by the author noted that the researchers in this study finished the work with two observations - first, that contributions to the cultivation of attitudes and behavior that contribute to fruitful reflection must be fostered in college classrooms and schools, secondly, that all involved in teaching students must cultivate the reflective practice in order to understand the benefits of this strategy (p. 21).
Section Summary

Although research does not clearly indicate the link between a master teacher and reflective practice, the value of reflective thinking through journal writing is clear. The act of retelling a teaching experience, analyzing the event, and planning a better teaching approach follows John Dewey's chain of thinking. This creates active problem solving and the outcome is improved pedagogical thinking and instructional behavior.

Clinical Supervision of Preservice Teachers

In the past decade, research studies sought to remedy the instructor supervisor relationship with the view to providing a successful model for teacher growth in instruction. These studies eventually resulted in the clinical supervision mode. With this model an attempt has been made to improve the supervision of the instructor with the end result being teacher growth.

What is clinical supervision? Morris Cogan and Robert Goldhammer define the process as the "Ongoing involvement of teachers and supervisors working in a collegial, collaborative environment" to improve instruction (Miller & Miller, p. 18).

Robert Goldhammer, in his 1969 book, Clinical Supervision, defines this process as:

Given close observation, detailed observational data, face-to-face interaction between the supervisor and the teacher, and the intensity of focus that binds the two together in an intimate professional relationship, the meaning of "clinical" is pretty well filled out (McGreal, p. 25).

Morris Cogan formulated eight stages of supervision:

. Establishing the Teacher-Supervisory relationship
. Planning with the teacher
. Planning the Strategy of Observation
. Analyzing the Teacher-Learning Process
. Planning the Strategy of the Conference
. The Conference
. Renewed Planning (Miller & Miller, pp. 18, 19).

This process moves from the supervisor taking the first step in creating and building a spirit of collegiality with the instructor, then together
reviewing materials and strategies that comprised the instructor’s lesson, observing the lesson and collecting data, then analyzing the events of the observed instruction, planning the questions and strategies of the conference, and finally collaboratively planning the proposed changes in the teacher’s work, and determining the next observation and supervision cycle.

In recent years clinical supervision and effective school research have been closely linked. In order for instruction to improve, the supervisor must be knowledgeable about effective teaching, and be able to apply these principles to assist in changing teacher behavior. This will lead to effective schools. As a result, encouraging effective instruction became the goal of the clinical supervision model.

During the 1980’s, Madeline Hunter formulated a specific clinical supervision design to be used in the schools. This model combined many aspects of supervision previously reviewed. This plan featured a teaching/supervision model which linked a prescribed version of teaching to supervision. Supervision was conceived to assist teachers with determining the cause and effect relationships between teaching and student learning. The attempt was made for the supervisory visits of the administrator to improve classroom teaching and student learning.

In order to improve teacher observation and conferencing by the supervisor, Madeline Hunter’s plan defined the supervisory conferences having two discrete functions:

1. The promotion of the teacher growth in effective instruction. The “instructional conference” must be diagnostic and prescriptive.

2. It is a tool for teacher evaluation. The teacher is rated and is allowed to review the observation data (Hunter, 1980, p. 408).

Knowing this, Hunter then sets definite guidelines that must be present for the supervisory conference to achieve these goals. The supervisory conference must:

- Have a primary purpose.
Insist that the principles of learning that apply to teachers must also apply to supervisors. In other words, the supervisor must be an educational leader in order for the teacher to learn effectively.

Acknowledge that teaching behavior is best improved through analysis of teaching behavior (Hunter, 1980, pp. 408, 409).

The Hunter model includes a seven step program outlining effective lesson planning and teaching. In this way the teacher knows how to plan and this offers both the teacher and supervisor common ground for beginning the evaluating process.

In the article, "Clinical Supervision: a Conceptual Framework", Robert J. Krajewski lists several concepts which offer a foundation for constructing supervision models.

1. Clinical supervision must contain deliberate intervention into the instructional process.

2. A clinical supervision model must create productive tension for both the teacher and the supervisor.

3. Clinical supervision is a technology for improving instruction (audio and video tapes, and analysis instruments significant to the collection of data).

4. Clinical supervision, if goal oriented, is systematic yet flexible.

5. Clinical supervision requires mutual trust and rapport nurturance.

6. Clinical supervision fosters role delineation (p. 41, 42).

As the literature on the nature and purpose of the supervisory conference is reported and analyzed, it becomes apparent that beliefs concerning clinical supervision have remained consistent through the years.

Section Summary

The literature suggests a basic model for supervising within a classroom framework. The close working together of supervisor and teacher enriches student learning. The importance of collaborative work, collected data, mutual trust, and educational knowledge and leadership continues to be of central importance within the supervisory models. The format of the program presented in this paper uses the
supervisory model to enrich undergraduate teaching and elementary student learning.

Discussion and research continue to assist in understanding, articulating, researching, and implementing the effective clinical supervision model. The essential part of the supervisory conference is the context for the teacher and supervisor to review the observed teaching. The interactions during the conference between instructor and supervisor must be pleasant for both parties and particularly beneficial for the teacher. Data related to the observed teaching experience must be collected to facilitate and effective, helpful conference. Researchers generally agree that supervisors need to know certain strategies for data collection from classroom observations. By selecting a few key elements from the teaching, watching for patterns of teacher behavior or classroom incidents, and paying attention to the teacher's pedagogical strengths, the supervisor and teacher have reliable data to assess the effectiveness of teaching and student learning.
CHAPTER III
METHODOLOGY OF THE STUDY

Introduction

For nearly a half-century, the educational process seemed to be one of sorting out the "sharp" students from those who appeared to be less able. The "sharp" student was encouraged to go to college and pursue a rigorous academic program, while the others received less academic preparation and focused on the vocational training that prepared them for a lower skill entry level job. The "sharp" student prepared for a professional career (O’Neill, 1995, p. 4).

The practice of "applied learning" has begun to change this trend. The integration of academic learning and skill training prepares today's students for the workplace. This kind of learning motivates the student to learn content, then comprehend means of transferring this knowledge and using it for the workplace. The reason for learning becomes evident when academics and training are linked (Cruikshank & Metcalf, 1990).

The SCIENCE 2001 Project

The SCIENCE 2001 project drew on the idea of linking academic education with a hands-on training to be used in the workplace, namely the elementary and junior high classrooms. The project began at Loyola University, Chicago in 1991. SCIENCE 2001 began as a collaborative effort between the Department of Natural Science in the College of Arts and Sciences and the Department of Curriculum and Instruction in the School of Education. In this way scientists and educators offered scientific literacy to five important populations:

- undergraduate non-science majors.
- graduate and undergraduate education majors.
elementary school teachers and administrators.

elementary school students – especially those at risk.

families and extended community.

The approach to this project was three-fold. First, the training of Loyola students, particularly the elementary education students, was included to meet the new goals of scientific literacy in a multi-ethnic setting by promoting service-learning. Secondly, an inservice program was developed to offer assistance to the community and private school elementary teachers to improve the science in their classrooms. Last, efforts to increase scientific literacy in the family and community were developed through a family science night and interactive cable television program called SCIENCE*POWER.

These goals were implemented over a three-year period funded by the Illinois State Board of Education, Archdiocese of Chicago, and a number of local businesses, organizations and public and private charitable foundations. The first year was devoted to building networks. Along with expanding the year one networks, the second year focused on the training of students, teachers, and community. Teacher education majors and science majors served as interns and worked with teacher participants in the classrooms and in after school science clubs.

The challenge was to meet the new goals providing leadership of scientific literacy using the Illinois Goal Assessment Program (IGAP) as the guide for stating these goals. During Year Three 48 outstanding teacher participants were identified and asked to continue to work with the project to increase their knowledge base in science and to develop activity based science instruction. Additional responsibilities include in offering workshops for their school personnel so the circle of science literacy would grow. These participants were expected to take leadership responsibility, culminating in working with school administrators to revise the science curriculum for the school.
During this phase, the undergraduate students developed science clubs at each school to improve the science interest and achievement of at-risk students. Undergraduates assisted students with this learning by implementing the teaching strategies by selecting appropriate learning materials offered through the inservice training.

The family and community were reached through a Family Science Night, and an interactive science program \textit{SCIENCE$^*$POWER} viewed on cable television.

\textbf{Program Implementation}

How did this happen? How were various populations, elementary teachers and administrators, elementary school students, Loyola University students, families, and the community taught and exposed to hands-on science instruction?

The primary vehicle for this task were the monthly science inservices. Using the Loyola school semester as the time frame, four meetings were scheduled per semester. Classroom teachers, college students, and Loyola faculty and staff participated in presenting and learning science concepts through a hands-on approach which teachers were expected to use with the young students in the elementary school. Loyola faculty explained science content, and provided hands-on application of the concepts for the participants to actively experience so they were prepared to present the lesson to their students. To further assist the science learning, teacher received the necessary classroom materials. Science content, hands-on-approach to science education, and effective instructional methods were the significant characteristics of this training. In keeping with the NSTA report concerning the characteristics of a model science program, teachers were prepared to teach science in an effective way (Table 1, p. 11).

Along with this, methods in integrating the science theme and lessons with other curricular areas were presented. In this way teachers and their students were given opportunity to make connections
with math, language arts, the fine arts, social studies as well as science learning. Each session supplied the participants with detailed "handouts", all the necessary science materials, and motivation to implement hands-on science in their respective classrooms.

Each school formed an after school science club. In the beginning, responsible students, showing a keen interest in science and working with others, were encouraged to join this club. The clubs were multi-aged groupings, focusing on hands-on science activities, and encouraging individual and group projects. The science club was led by a Loyola student, with a schoolteacher serving as a mentor and resource for the undergraduate.

The elementary student had other tasks as well as attending and participating in the club. Each participant was encouraged to present a science activity, learned from the club, to the students in the classroom. In this way, the club "mushroomed" to include other children in the schools, and gave the young student an opportunity to be a "science leader". These groups also planned hands-on science activities that were part of the Family Science Night. In this way their leadership in science was also featured to the broader community.

Again in the words of Eleanor Duckworth,

If you want to help kids and teachers learn about the material world, like batteries and bulbs, or pendulums, or earthworms, or butterflies, you give them batteries and bulbs, pendulums, earthworms, and butterflies. And you let them look at them, notice them, figure out their questions, and come to be familiar with these things. You don’t give them works about these things, you give them these things (Meek, 1991, p. 32).

During the three years, the family and community being involved in hands-on science instruction was an important ingredient in this project. A "Family Science Night" was a successful project inviting the children and parents of the school communities to Loyola University to experience hands-on science. The project provided many activities, as well as activities supplied by the school science clubs. Everyone was encouraged to participate in the various activities with the children.
and the result was a delighted group of all ages enjoying the wonders of science! The interactive SCIENCE*POWER cable television show also served as a vehicle to reach the greater Chicago community. This program demonstrated science concepts in a hands-on fashion, and children were invited to call in with their observations and ideas. The taped video was also offered for classroom use by the participating teachers.

Over the three year project, these programs remained the foundation. The format varied, in an effort to improve and offer a sound, effective approach, however the inservices, science clubs, and community involvement was the framework for promoting science literacy and meeting the challenges of effective science instruction at various stages of learning.

The Loyola Student Participation

SCIENCE 2001 became the framework for improving science literacy among Loyola University, Chicago graduate and undergraduate students. These student participants were given a title: Interns. Who are these interns and how were they recruited? In order to inform the students of the opportunity to serve their community, faculty from both departments explained the internship duties to their classes. With that, and generally "passing the word" students began to inquire. The intern candidates were interviewed by faculty and staff, selected, and informed of intern responsibilities. The result was a cadre of interns composed of both education majors and other majors enrolled in natural sciences courses.

How did they function within the project’s framework?

1. The interns attended all science inservice meetings participating in all the activities.

2. The interns assisted faculty and staff in the necessary preparations for the inservice meetings.

3. The interns were assigned to a school. Here they assisted the
classroom teacher combined with leadership in a science club.

4. The interns kept a reflective journal account of classroom and science club experiences.

5. The interns met weekly with the intern supervisor.

6. The interns assisted with the preparation of and participation in the "Family Science Night."

7. The interns were encouraged to go beyond this basic framework and use creativity to extend their learning and resources through other activities within the framework.

Using this basic framework, the intern duties need to be explained more comprehensively. As studies have indicated, university courses have inadequately prepared the preservice teacher with knowledge of classroom procedures and pupils. Understanding of what works, and why it works must be part of the university education (Kagan, 1992). Beginning teachers should have knowledge of subject matter, opportunity to find out about the students and schools, knowledge of instructional strategies, and a means to practically implement these tools (Reynolds, 1992).

This, then, becomes the rationale for including students in the teaching inservices. Here they received science content instruction, instructional methods, and the opportunity to work with a classroom teacher in implementing the science lessons. During the week following the inservice, the intern joined the classroom teacher for a two to four hours a week and assisted with the teaching of the inservice material. This offered opportunity to know pupils and procedures by actually teaching in a classroom setting. Interns were also scheduled to assist with the preparations for the inservice by compiling materials and making ready for the teacher's arrival. This encouraged them to ask questions, view materials, become cognitively prepared for the anticipated presentation, and working collaboratively with faculty and staff in a professional manner.
After school science clubs were established at the participating schools. Teachers targeted the students who attended, and assisted the intern leaders with choosing curriculum and gathering materials and resources. These clubs were the vehicle for the interns to experience planning lessons, implementing instructional methods, and opportunity for managing pupils and learning activities. The culminating event for the science clubs was participating in the Family Science Night. Each club planned hands-on experiences for the visitors based on the science concepts they learned through the club experience. The intern was responsible for planning and supervising this project. The interns then recorded their teaching experience, and their reflection in weekly journal entries. They were encouraged to relate classroom and science club events, both successful and unsuccessful, and use the reflection to improve on the experience. The guideline for success was discussed through learner response to the lesson. Three questions needed to be answered in determining lesson success.

To what extent was the learner satisfied?

What contributed to their learning?

What was learned about teaching and learning?

This offered opportunity to step back, examine actions and reason for the actions, reflect on the effectiveness of those actions, come up with remedies and a new perception to make the next teaching event even better (Osterman, 1990, pp. 134, 135). This also follows Dewey's chain of thought - the consecutive ordering of thoughts and ideas, determining the next thought until an outcome is reached (Dewey, 1933).

The journals were read by the supervisor and used for discussion during the supervisory conference. Using the clinical supervision model for the conference, the purpose was to assist in the intern reflection process with the outcome of effective teaching and student learning. Mutual trust and rapport was achieved between intern and supervisor so that effective teaching was the main product and focus.
Each week the individual interns met with the intern supervisor. Using a modified clinical supervision model, the conference offered support and motivation to assist the intern in the teaching experience. Discussion of the numerous "teacher decisions", opportunity to analyze teacher practice, observing student response to the lessons and activities with a focus on the link between instructional methods, teacher action, and student learning were processed during this meeting (Ross, 1989). This effort provided the intern an opportunity to be thoughtful and wise about educating and their own instruction (Cruikshank, 1991).

The Supervisory Process

The journal entries served as a means of recalling certain classroom and science club events. These, then, became the framework for the supervisory conference. The recounting of success, frustrations, questions, and pupil response provided the supervisor with information concerning the intern and the teaching/learning events. These reflections enabled the supervisor to analyze whether the intern's classroom experiences provided the conditions necessary for student growth (Gipe & Richards, p. 55). The supervisor sought to lead the intern to greater understanding of the teaching-learning process, solutions for the intern's concerns and frustrations, and inspiration, plus practical ideas, to face the challenges of the next teaching event.

The goal of this process was to assist the intern with receiving vocational training that offered with help gaining knowledge, practical training, assistance with problem solving, and encouragement to become a stronger leader and teacher.

The "seven concepts" of Robert Krajewski provided a foundation for the content and structure of the supervisory conference. This framework provided the necessary rationale for an effective conference between intern and supervisor.

1. Deliberate intervention into the instructional process by
analyzing the lesson data and cooperatively working toward teacher improvement characterized the process with both intern and supervisor roles delineated.

2. Productive tension was created between intern and supervisor by analyzing successes, weaknesses, then receiving constructive assistance, and building a plan for improvement.

3. It is essential that the supervisor have necessary qualifications, skills, and expertise in teaching/learning knowledge. Having a seasoned classroom teacher, along with being a university staff member, fulfilled this requirement. In this way the supervisor offered educational leadership.

4. The supervisory process must have the goal of improving instruction. This program focused on the improvement of the intern's instructional role as science teacher and leader. The goal for both the supervisor and intern became improved student learning.

5. The process must be goal oriented, yet flexible. The goal, as stated earlier, was improved instruction. Meeting the each intern's needs, required flexibility within a systematic framework. The conference followed the same format for each intern, however the individual concerns determined the content of the session. Informal dialogue between supervisor and intern created a relaxed setting in which the teaching event could be related and analyzed.

6. Mutual trust and a rapport of nurturing constitutes the proper attitude and environment for a successful conference. A positive attitude by both parties is necessary. Because the supervisor took a "mentor" attitude rather than the "authority" stance assisted in building trust and creating a comfortable atmosphere to discuss and analyze teaching situations and recommended improvements.

7. A distinction between roles is necessary in the supervision process. Both intern and supervisor understood clearly the role each played in the conference. Acceptance of each others roles and
contributions to the conference was essential for building trust and a foundation for learning.

This clinical supervision style involved the cooperative effort of both intern and supervisor to offer the best method for improving instruction at both the university and elementary classroom levels. The quest for better methods of instruction within an environment of mutual trust leads to improved education for all involved.

Data Collection

Both qualitative and quantitative data was assembled over a three year period. Deciding which data to use was a major consideration, since the volume of the material was too much for this study. Therefore, the decision was made to focus attention on the third and final year of the project. The reasons for this were:

1. By the third year the intern journal entries had been refined for effectiveness in collecting information concerning the interns role and reflective thinking.

2. The supervisory role had emerged out of a three year process to discover the proper clinical format.

3. Both a pre and post science test was administered to the interns during the third phase of the project to determine science literacy progress.

4. The interns worked in both the classroom and lead a science club.

5. By the third year of the project, many interns had entered the workplace and offered data relating to vocational goals and SCIENCE 2001 experiences.

The journal data collection included these components:
Table 2

Data Collection Summary

<table>
<thead>
<tr>
<th>Type of Data</th>
<th>Type of Participant</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intern Reflective Journals</td>
<td>University Student</td>
<td>11</td>
</tr>
<tr>
<td>Intern Exit Interviews</td>
<td>University Student</td>
<td>25</td>
</tr>
<tr>
<td>Pre and Post Science Tests</td>
<td>University Student Interns</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>University Natural Science Students</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>University Education Students</td>
<td>84</td>
</tr>
<tr>
<td>Interview</td>
<td>Post Graduate Interns</td>
<td>4</td>
</tr>
</tbody>
</table>

Data Analysis

Intern Journals

It should be noted that of the eleven intern journals used for this study, three belong to natural science students, seven to teacher education students, and one to a graduate student in school administration. A sampling of intern journals were chosen to illustrate the use of these strategies in the classroom and science club. The next decision was to choose key journals used for the analysis of reflective thinking. Several criteria were designed to assist in that decision. The journals needed to contain entries that were systematically entered. Those entries that offered sporadic and brief accounts of the teaching event, lacked sufficient content, or fell behind in recording the teaching event were excluded from the analysis. Entries that recounted the teaching experience, student response, and thoughtful reflection routinely and sequentially were included in this study. These offered substantial content on which analysis and conclusions were based. It was also necessary to have a representative sampling of teacher education majors and those from the science courses. The journals that
contained weekly entries illustrating classroom teaching events, and science leadership experiences were used for this project's purposes.

The intern journals were analyzed in two ways:

- the implementation of effective teaching strategies.
- the level of reflective thinking.

The Implementation of Effective Teaching Strategies

Journal #1 Natural Science Student

1/27 Today we began the electricity experiments with some of the slower students. I don't know if it was supposed to actually be for my benefit or theirs but it was a great experience. We opened all of the supplies and at first just tried to light the light bulb (like we did at the inservice). I asked them some questions and threw in some facts about thermodynamics and tried to introduce the concept in an interesting way. The kids were pretty knowledgeable about electricity. When we put the light bulb in its holder and used the two wires and the battery; they told me that the reason the light came on was because there was a complete circuit! The kids really liked experimenting and this first encounter gave me an idea about how things would go on Tuesday when I introduced electricity to the whole class. I felt more comfortable in today's class because I had things planned out to do and I wasn't just wandering around wondering what to interfere in.

This account reveals several things. The student intern is anxious about teaching the class and knowing the proper role in the established classroom. However, having learned through the inservice a strategy for teaching electricity with the hands-on approach using a battery, wires and a bulb, then observing student success and discovery of actually lighting the bulb and understanding the cause, instilled confidence in the intern and gave a basis for the next time the "whole class" received this lesson.

2/1 My first solo teaching for the science club. First we talked about what life without electricity would be like and listed the things that we use now that require electricity. Then we defined the work system and listed examples of systems on the chalkboard. I then explained that we were going to use a D-cell battery, a piece of wire, and a light bulb to construct a system to light the light bulb. My helpers passed out the materials to the rest of the students that were in groups of three and they experimented. We found which parts of the equipment had to be touched where and found different ways to light the bulb. We also completed the prediction worksheet. Next we used the red piece to construct a system again. We talked about the circuit that was going through the wire. My helpers picked up the equipment and we recapped the lesson.
This entry written a few days later indicates increased confidence and a very well organized lesson that encourages student experimentation and discovery. The focus of this entry is the teaching lesson with less preoccupation of self and adjustments to the classroom experience.

The entry continues:

They (the elementary students) enjoyed showing the rest of the class their discoveries (new ways to light the bulb), and they kept trying. They wanted to try it with 2 batteries or 2 lights or 2 wires...Their example of system was their Nintendo/Sega video games at home. The components were: the T.V., the gamebox, the cable, the adapter, and the plug into the wall.

Student success is obvious. They not only learned the science lesson concept but were able to transfer this knowledge to the "real" world. Engaging "helpers" indicates a cooperative spirit and lively discussion with student experimentation finding all sorts of new discoveries is apparent.

2/7 Because it is Black History month we started out the lesson by talking about a black scientist. We talked about George Washington Carver and all of his contributions to agriculture. We also ate peanut butter cookies in honor of his memory! We then recapped from last week, definition of system examples, and places on each object that have to be touched to make a complete circuit. We talked about the words resistance, series, and parallel. My helpers passed out equipment for groups to build the parallel and series circuits. I miscalculated supplies and I thought the lesson was going to flop. There were too many kids in each group, and they weren't following the diagrams to build the circuits. Just when I was ready to scream and call the lesson a disaster, two groups got the circuits together (one of each) and were demonstrating to the rest of the class what happens when you unscrew a light bulb in each of the different circuits. We drew diagrams of the circuits on the board and students drew the path of the current. We made the analogy to the circuits to an 'el' system. In the series circuit there is only one way for the current to flow. If the train breaks down, no more can get back to the beginning (the station L battery). However, in the parallel circuit there are many paths that the train can take. If one stop is broken, it can go somewhere else. The students wrote the definitions of the key words and drew the diagrams in their science club notebooks.

Several items deserve comment in this entry. First of all, the intern is becoming aware of teaching processes, "and seizing the moment". When learning appears impossible, taking a student discovery as the lesson focus changes a near disaster into a meaningful learning experience for both the elementary student and intern. This intern, a
natural science student, had inservice training without a university education course. The science knowledge assisted the ability to make the "real world" connection with the "el" system. By the end of the entry, her panic has subsided and we read a well worked lesson where students are effectively learning and experiencing science.

This intern is also implementing the integration of language arts with science by using biographical literature to learn about George W. Carver. It is important for students to connect science with other curricular learning and also learn of important contributors to the study of science. Progress in teaching effectively is apparent in these entries.

3/15 Continuing on the energy theme, we talked about sound energy. We talked about objects vibrating and how this gives off a sound. To demonstrate, we built instruments and used them in accompaniment to our poetry readings.

3/17 ...I worked with my group of five on our project (Family Science Night). The class decided they wanted to make alarms for their bookbags, etc. I tried to let them do the designing and building. I think it will work! For the science fair we will have a switch made with tin foil or paper clips and explain how circuits work and how switches apply...we would like to explain series, parallel and short circuits for the fair.

4/10 The kids had made a question board for me - all of the questions that they want to ask me before the year is over. Today I talked about tornados and hurricanes - two of the most popular question topics.

4/16 Today I addressed more questions that the kids had put up on the question board for me. We started by talking about plate tectonics and then volcanoes and earthquakes. The class asked many intelligent questions that led to discussions on 1) how things might have to be built differently in cities that are more prone to earthquakes, 2) what the center of the earth must be like, and 3) how life might be different if all of the continents were connected.

This entry illustrates the confidence to go beyond the inservice lessons and explore other areas of scientific interests the students have. Again, the higher order thinking and application to the "real world" is evident in this entry. The enthusiasm of the students is apparent through the "asking of many intelligent questions." This intern had expressed in earlier entries the hope of questions being asked by students. This objective seems to have been achieved.
The final journal paragraph reflects in this way:

It was my last day with this class. I was very sad to leave because the last few visits have been the best. The kids feel comfortable to ask questions and I know I have improved as the year has gone on. I feel very grateful to have experienced this at a time in my life where it is not too late to integrate it more into my lifestyle.

Comparing the last entry with the beginning account, there is a noticeable change in confidence. Having successfully taught a science club, direct classroom experience, and positive student response has affected this intern with hope of integrating this experience "into my lifestyle".

Journal #7 Beginning Teacher Education Student

1/28 I went to the school to meet the children and to plan out some activities for next week. I put together an activity that deals with electricity and magnets...

2/7 ...I started to put together the science club...Hopefully, this (the lesson) will not be too difficult for the kids...The kids seem enthusiastic and excited. They helped me figure out the what the equipment was for... I have a very optimistic feeling about the science club. I don’t think we’ll have much trouble getting them involved in the activities...

2/14 On Wednesday I put together some plans for the Science Club for next week. It will be about Newton’s 2nd law of motion. It should not be too difficult for the kids. Most of those who are in it are quite smart...The kids are very excited about the club. All of them want to be in it, but we can’t fit them all. I’m happy because the kids and I are getting to know each other. I can’t wait to teach lessons.

2/21 Today was the first day of science club. I feel it went well,... We split all 25 kids into two groups and had them work on different areas. One group worked with electricity..., and the other group did physics with me... They wanted to stay after school and do more science club. I am ecstatic about the students’ reaction. I can’t believe they wanted to go back again the next day. I really enjoy working with the kids.

This is the perspective of a teacher education student who is just beginning to learn how to teach. The slow but progressive orientation to the teaching process is evident, yet indication of hesitancy is apparent in the words "it should not be too difficult". The actual teaching experience, then witnessing the enthusiasm of the pupils to the science lesson led to the remark, "I am ecstatic about the kid’s reaction."
The success of this experience is building confidence. Effective teaching has become an concrete experience. Stronger evidence indicating effective teaching appears in the following entry.

2/21 On Friday I got to teach my first classroom lesson. I taught the kids electricity using parallel and simple circuits. I had them diagram it and write how it worked and why. They worked hard in groups and worked together to figure it out.

I think this was just great. My very first real lesson. I’m so excited that the kids listened to me and that they learned from me. What a great feeling. When I was leaving, they thanked me for helping them. I can’t wait to have my own class one day.

2/28 On Friday, I taught a lesson in class on electricity. We did simple circuits and parallel circuits. The class was divided up into groups and they were to complete the circuits by on having the material and a drawing. They worked together and all figured out how to do it. They also learned symbols for the different parts such as -I I- means battery, _________ is wire, and -b- is bulb. They had to draw the diagrams and label the parts.

I really like the fact that the kids worked so well in groups... Each group did it correctly. I really am enjoying myself with the kids. They listen to me and are polite...The class seems to be learning and all want to do well.

The last sentence of this entry indicates that the lessons taught in the inservice are producing learning and interest for the elementary students. Results of this kind of "hands on" teaching are giving evidence of progress and success to the intern as well.

The successful lessons begin to build and indicate the beginnings of the intern learning to analyze the teaching experience by being aware of student reactions.

3/14 The club now consists of 30 kids...We also discussed the science fair (Family Science Night). The science club is excellent. The students are very enthused about learning. I think at first they are intimidated by my lesson, but once they see how simple and orderly the steps of the lesson are, they enjoy it. The only problem is that we just don’t have enough time at the club to do all the lessons and it is a little rushed...

Today in class we completed the electricity lessons... The kids are all starting to get used to me and treat me as a teacher...

I helped the kids work on their science fair projects. They all tried so hard to make an effort towards the fair...They were proud to show me what they had completed. It’s amazing some of the things that 11-12 year olds can do.

Realizing the success of pupils and seeing effective teaching strategies resulting in applied learning leads to teaching confidence in
4/8 The kids had a dinner party today and I was the guest. I was greeted by Thomas Edison. The kids did an outstanding job with the entire party. They were very excited about it all as was I. They planned everything by themselves and executed their plans great...They chose the food and named it, such as "Electricity Corn" and "Atomic Chicken Nuggets"! ...A group of kids did the "Boogie Chant and Dance" and played the instruments such as plastic eggs filled with rice. They are normally loud and rambunctious, but were quiet and polite during the party. It was just amazing.

4/13 For the last science club, we stole a Loyola Science Night idea. We gave the kids tape and straws and had them put together buildings or other structures. They worked patiently on this the entire period and a the end we gave them science books and treats.

I enjoyed working with the kids and getting to know them. They were like little angels so eager to learn. They were like the perfect class...The teacher I worked with said it best, "The science Club is like a drink of cool water after a drought."

4/15 For my final class lesson I taught how to measure using Newton's as a measure of force. The kids got in groups and were given spring scales and string. They measured books weight in Newtons. They also had a lesson levers.

I've had a great semester! I am really excited about this program...

The evolution from unsureness and hoping the pupils would learn and respond to becoming a confident novice teacher was facilitated by the inservice meetings where science content and "hands-on" teaching strategies were presented. Having instructional methods explained, modeled, and then teaching the lesson to students offers the intern an opportunity to directly experience the "how" of effective teaching.

Journal #5 Graduate Teacher Education Student

2/1 ...During the eighth grade class I helped Beth work with the students building parallel and series circuits. There were only 4 groups to work with so I almost felt like I wasn't very necessary. I helped a few groups understand things, however, by suggesting they try different ways of connecting the wires etc. Mostly my suggestions centered around asking what if you were to connect the battery this way or move this wire. The question I asked most often was "Are you sure all of the wires are connected?" because I could see that the lights should light up. I had the students trace the flow of the electrical current to see why the circuit is broken when one bulb is unscrewed in the serial circuit.

2/3 ...When I walked by an open door in the hallway, I heard some student loudly whisper, "The science lady is here!" ...The project of the day was predictions and experimenting on which way a bulb would and would not light from a battery and why. Some of the students had good responses and reasoning. Many of the
students had difficulty understanding why the bulb wouldn't light up when both wires touched the metal part of the bulb, but it would light up when one wire was moved to touch the silver on the bottom of the bulb. I helped several groups manipulate the wires into position and then trace the flow of the current. After tracing it they realized that in the latter position the electricity must go into the light bulb to get to the second wire, therefore lighting the bulb.

...I began planning for the science club on Tuesday. I decided that we will begin by building a battery using pennies, aluminum foil and paper dipped in salt water. Then we will build switches to place in our electrical circuits. If the advanced students finish with time to spare then I will have them work on constructing a circuit with two switches in it, like one would find upstairs and downstairs in a house, so that either switch turns the light on or off...The coordinating teachers seem to want me to plan out all of the science club in advance, but I'm thinking of a more individualized club where each student has some input on what they are doing. I think the club will be more interesting to the students if they can work in small groups doing different projects. ...This Tuesday when I go in I'm going to see what the students want to do. Each one won't be able to do a different project, but they all don't need to be working on the same project either.

I'm searching for resources in the library of other books of science experiments....I'll take them into the classroom so the students can get ideas.

It is evident that this student is much more self reliant, and is going beyond the methods presented in the inservice. This classroom and science club experience is providing a means for this intern to implement much of the learning the university has offered in vocational preparation. The next entry clearly states this fact:

I'm learning much about science through the inservices. Many of the things I had studied before and understood somewhat, but the experiments we've done have brought deeper understanding or understanding of a different aspect. When I begin teaching I'll be much more confident teaching science than I would have other wise. I knew basic science before, but I was never sure of how to convey this knowledge to students. Now I'm learning how to do so.

This entry demonstrates the fact that prospective teachers gain academic knowledge through their education. Training, however, prepares them to do something with what they know and put that knowledge into practice. The training gives opportunity to apply the knowledge of teacher education (Cruikshank & Metcalf, 1990, p. 471).

The journal entries continue to exhibit the implementation of the science lessons with confidence, expanding the themes and exploring
various teaching strategies to enrich the lessons.

The eleven intern journals were surveyed and each effective teaching experience was analyzed and counted by determining if there was a description of the science teaching event, if there was evidence of growing confidence based upon successful teaching and student response, and if that confidence was used to go beyond the inservice training to plan science lessons based on previous lessons and student response.

Intern Reflective Thinking

This internship experience gave opportunity for university students to test strategies and hypotheses in a field setting. After the teaching experience was conducted, the intern wrote a reflective response to the teaching event. Several stages in reflective thinking were noted.

Research studies have contributed to understanding reflective thinking as a necessary act following the teaching event. Those studies have noted various stages of the reflective practice (Gipe & Richards, 1992; Ross, 1989; Stoiber, 1991; Winitzky & Arends, 1991). Figure 1, p. 45, pictures the experiential learning experience (Kolb, 1984, p. 42). The concrete experience (teaching event) leads to the reflective observation. From there the thinking continues to conceptualize the event by analyzing the teaching process, resulting in active experimentation, which is attempting to improve teaching. The process begins again. This serves as basis for the formulation of the six stages of reflective thinking that occur during the reflective thinking cycle.
Figure 1
Experiential Learning

1. Concrete Experience
2. Reflective Observation
3. Abstract Conceptualization
4. Active Experimentation

EXPERIENTIAL LEARNING
Stage 1 - View teaching experience from one point of view - the intern.

Stage 2 - View teaching experience from self-awareness and student response.

Stage 3 - Beginning to analyze the teaching event by recognizing that changes need to occur for effective teaching.

Stage 4 - Process of problem solving is ongoing, and begin to seek the input from others.

Stage 5 - Make and implement decisions for change.

Stage 6 - Evaluate these decisions.

Using the journals #1, #7, and #5 again these stages are traceable, and illustrate the degree of reflective thinking. The number in parenthesis indicates the stage of reflective process.

Journal #1 Natural Science Student

1/25 ...(The teacher) and I decided that I would get to know the kids today, observe, help, and then set up the science things on Thursday...It was a nice experience (1)....(The teacher) introduced me to a girl that will be my buddy for the semester - she is very shy and has little self esteem. She is going to be my helper. This will help me and will hopefully give her some one-on-one contact that maybe she is in need of (1).... We are going to put their questions on quiz boards that will integrate the science into their stuff now. I hope they enjoy it. I know I need to be more animated and interesting. I thought after a few visits I could pass out a report card for them to evaluate me with (1).

This entry indicates the self-absorption of the novice at the beginning of a classroom experience. The ambivalence, unsureness, and nervousness is evident.

Thinking of student response is beginning, but only in relationship to interaction with the intern.
1/26 I feel pretty confident that I won't be alone in my planning though (I feel kind of nervous now). I'll just make a list of questions for my next meeting with the teacher...I guess I should make a lesson plan for tomorrow to introduce science and get ready (1)...

1/27 ...the kids really liked experimenting and this first encounter gave me an idea about how things would go on Tuesday when I introduced electricity to the whole class (1,2). I felt more comfortable in today's class because I had things planned out to do (1)...My "helper" took some equipment home to make a flashlight for Tuesday (her idea!!). She was the first one to get the light bulb to light...and seems very eager to help me...She is thinking of different everyday things that use electricity (2).

It becomes obvious that stage two is beginning, however self is still the center of the experience.

2/1 My first solo teaching in the science club... When I was planning the lesson I was trying to think of ways to make the lecture interesting and how to make them want to answer my questions. I guess I was thinking about in my classes when the teacher asks a question, it is like pulling teeth to get anyone to answer even if they know the answer. The kids weren't like this at all!! When I asked what we use electricity for now, 30 hands shot up. (1,2)...I was surprised how well they worked in groups. They enjoyed showing the rest of the class their discoveries and kept trying.

...My "special friend" enjoyed helping me...They were extremely well behaved, but that might have been because their teacher was sitting by them. Also, I picked one of the talkers to be my helper. I think it went well (2)

Confidence is building and familiarity with students is allowing the intern to think beyond self, and beginning to center thoughts on the student responses.

3/22 I can see that if I ever wanted to get into teaching more, I will have to learn more about keeping control of the group. I try not to let some kids do all of the work, I delegate tasks for each student. However I need to learn how to be effective when I ask them to stop whispering or what to say to ask them to stop talking about kissing boys, etc. (3)

The beginning of analyzing the teaching situation, and not focusing on self only, and recognizing the need to improve certain areas of teaching to promote effectiveness.

4/12 I realize that if I ever went into teaching, I would need to work on crowd control (3)

4/16 The last visit - Today I addressed more questions that the kids had (2). It was my last day with this class. I was very sad to leave because the last few visits have been the best. The kids feel comfortable to ask questions and I know I have improved as the year has gone on (3).
This intern, having no teacher education training, did not progress beyond the third stage, however, learning from this experience is evident in these reflections. Being able to focus less on self, beginning to watch for student response and needs, experiencing successful lessons, and beginning to analyze teaching behaviors was indicated.

Journal #7  Beginning Teacher Education Student

2/21  I feel it (Science Club) ran well. I think it could have run smoother, but by next week we will have worked out the bugs. I am ecstatic about the students' reaction. I can't believe they wanted to go back again the next day. I really enjoy working with the kids. They are such a pleasure even when they are rowdy. They all want to do well and they try so hard. Even one of the kids can hardly read or write, yet he still is so happy to be at school and tries so hard. It's amazing. (1,2)

This entry indicates this intern responds immediately to the science club participants. Self concerns are not the chief focus of this reflection.

2/21  I think this (classroom teaching) was just great. My very first real lesson. I'm so excited that the kids listened to me and that they learned from me. What a great feeling. When I was leaving, they thanked me for helping them. I can't wait to have my own class one day. (1)

Even though student learning was mentioned, the intern was so caught up in the excitement and success of this event, that self was the main concern at this point.

2/28  I really like the fact that the kids worked so well in groups. You could see a difference, though, in how the kids work... The class enjoys learning and all want to do well (2,3)

The beginnings of analyzing the teaching event are contained in this entry. Noticing that cooperative grouping is a successful instructional method leads to the conclusion that the class is learning in a satisfying manner.

3/14  The science club is excellent...we never run out of ideas. The students are very enthused about learning. I think at first they are intimidated by my lesson, but once they see how simple and orderly the steps of the lesson are, they enjoy it. The only problem is that we just don't have enough time at the club to do all the lessons and it is a little rushed...(3)

Lesson analysis has begun. Noticing that time affected the lesson
outcome indicates that reflective thinking is leading to assessing the success of the event.

3/21 ...It is getting easier to teach and quicker to set up and get done (4,5,6)

The beginnings of the last three stages are indicated in that things are becoming easier. Practice, some problem solving, have led to this evaluative statement. The reflective process has assisted in growing as an effective teacher.

Journal #5 Graduate Education Student

2/8 After school we had the first meeting of the science club...I was not as well prepared for the meeting as I would have liked to have been. I didn't have everything exactly prepared, such as paper clips for making switches. The teacher supplied me with the things I needed. I should have checked everything before the students were dismissed to come to the club. I will be better prepared next time. To give me added incentive to be well prepared next time, the teacher from the school are going to stop by to observe the science club to see what it is about. (Nervous? Just a little) (3)

This entry indicates the intern immediately analyzes the situation and has begun the problem solving process. As the entry continues, this analysis continues.

Once I began everything went well. All of the students were very excited about the club so all were attentive and hardworking (2). We made switches using paper clips. I was thinking that more advanced students would be able to ponder the question of how to make an upstairs downstairs switch, but they had little time to do so...For the next meeting I will try to start more promptly so we will have more time to work. This means being better prepared, which I plan to be. I may also ask if the students who are in the science club can be dismissed early to come to the science club room (3,4,5,6).

I plan to make some changes in the science club format...I plan to have more individual flexibility concerning what project the student wish to work on. I want to get away from the whole class lecture. I plan to add to the science club the theme of thinking like a scientist so they will learn the scientific method. I also plan to have the students do more technical reading of how to do the experiments instead of showing them how to do it step by step. I realized the importance of technical reading from a discussion in the instructional methodology class that I am taking (3)... This intern has gone beyond the point of recounting personal and student responses to the teaching event, and has begun the process of analyzing the teaching event with the intent of making positive changes.

The recognition of seeking input from other experts is indicated
in a later entry.

2/15 Today in the science club we divided into four groups, two of which worked on an electric magnet and two of which worked on making a battery... Unfortunately the magnet didn't work. I thought perhaps the wire we had was too large. I spoke with my brother, studying to be an electro-chemical engineer, who said that the magnet probably didn't work because the wire wasn't coated. He gave me some coated wire... The thin coating allows the wires to stay close together which builds a better electrical field. He said to add batteries to the circuit until the magnet becomes warm. Then take away about 3 volts and the magnet will be operating at its most efficient.

The battery worked... Students were excited to hear static through their earphones when they rubbed a wire on the plug. I think that it may be interesting to try to make a bigger battery to see if we could produce enough electricity to light a bulb (1,2,3,4).

...After the club, the teacher said that I could rearrange the classroom as I desired. I put the one table in the center and then clustered the desks in groups of four. The table is by far the better work station, but there isn't a possibility of finding another table for the room (5,6).

Problem solving, seeking advice from experts, making and implementing decisions for change, and evaluating the effectiveness of those changes are beginning in this intern's progress of learning to teach effectively.

Excerpts from following journal entries indicate the later stages in reflective thinking. The teaching event focused on light energy with integration of art appreciation - namely the use of light and reflection in Monet paintings. Using the inservice lessons, the intern not only implements the lessons, but seeks to improve teaching with each presentation.

Today I explored Monet with the fourth graders. After setting up everything as I would need it, I turned off the lights and pulled the shades. The fourth graders seemed uncertain of entering the darkened room and were very quiet. I had their attention. I asked them to try to describe the room as it was last time they had seen it as it was last time they had seen it. They mentioned the color of the chairs or the board. I had them describe what the room looked like in the half-darkness' what was different. I then turned the lights on and had them describe the changes that took place. They noticed the patterns the erasers had left on the board that had been invisible in less light. They noticed how the patterns in my sweater became apparent in the light. I pointed out highlights on the floor and desks. Next I raised the shades to allow the sunshine to light the room even more. Students noticed the highlights on the floor and desks and how the counter looked white because there was so much light.
From this introduction we preceded to talk about how difficult it is to remember details of something one has seen earlier. We also discussed how the amount of light changes the appearance of objects.

We then looked at his (Monet’s) paintings...I pointed out the Haystack series and the Cathedral series...we looked at how colors of light can change appearances by putting different colors of saran wrap over an overhead projector...(1-5).

Stages one through five are represented in this article. This intern has completed the cycle of experiential learning. The inservice lesson has been expanded to included activities initiated by the intern. Student needs and interests have been noticed, and the lesson planned to meet these requirements.

After this lesson description the intern reflects on the event, and makes certain decisions for improvement.

I’ve decided on a few changes. I will bring in an object that will react well to the different lightings. I will spend a little less time on the introduction discussion about lighting differences so I will have more time to dedicate to Monet’s paintings...

3/1 Today I presented Monet to the upper grades. I made the changes that I noted and they seemed to make the presentation flow better in a shorter time period... The students seemed to enjoy this way of looking at how light and color change things...(5,6).

Reflective teaching, in this instance, has led to improved teaching and leadership, with both the intern and students learning science. The reflective process has assisted the intern in analyzing the teaching event and making changes to improve teaching. Being able to evaluate the student response and teaching action led to more successful and student centered learning experiences.

In summarizing journals, the description of student response is characterized and "fun". Occasionally statements are made describing the specific learning that happened took place during the lesson. This, partly due to the novice nature of the intern, but there is little time and opportunity for the intern to follow up the lesson with review, or assessment of student learning. The only response they have opportunity to notice is the immediate student reaction which is demonstrated by enjoyment.
Exit Interviews

During the final year of the project, the interns were asked to respond to an exit interview. These questions were designed to receive input from the students which provided data used to improve the internship experiences and assess the benefits to the university participant. Three questions asked that apply to this study were:

1. In which ways were the inservice meetings helpful?
2. What have you learned or gained from this internship experience?
3. How has this experience contributed to your growth and education in a chosen vocation?

Post Graduate Interviews

Eight questions were used for this interview. Loyola University students who served in an internship capacity during the first three years of this program were asked the following questions.

1. What is your vocation today?
2. How long were you involved with the Science 2001 program as an undergraduate intern?
3. What were your duties as a SCIENCE 2001 intern?
4. What was the major course of study pursued as an undergraduate?
5. Did the internship experience in any way assist in the process of science literacy? Why or why not?
6. What were your vocational goals as a university undergraduate?
7. What are your vocational goals now?
8. Did SCIENCE 2001 assist in your present vocational goals? How?

After interviewing four former interns, the data was categorized and used to determine the internships influence in preparing university participants for their chosen vocation.
Statistical Data

During the final year of Science 2001 a pre and post science test was administered to the Loyola interns. The test used was developed by the state to meet the IGAP (Illinois Goal Assessment Program) science goals. The content of the SCIENCE 2001 inservices was developed to help teacher meet these goals at their grade levels. Several university students, natural science classes and teacher education classes, served as control groups. The post test given to the interns served as the test for the control groups.
CHAPTER IV
THE RESULTS

The purpose of this study was to determine the extent of internship training in preparing university students for vocational success and attain science literacy. What does the analyzed data indicate? The following discussion explains the findings of this study.

Referring back to Table 1 (p. 11) and looking at teaching behaviors suggested by NSTA position statement, the importance of teacher science knowledge, ability to utilize hands-on activities, selecting and implementing effective teaching strategies, and knowledge of materials are recognized as being essential to effective science teaching.

Intern Journals

The intern journal analysis included a charting of the teaching process. Each of the eleven journals studied were read to determine progress in teaching effectiveness. Table 3 illustrates that most of the interns described the teaching event. Fewer comments were cited indicating confidence, however many related instances of going beyond the inservice instruction and preparing lessons that enriched or better met the needs of the elementary students were recounted, and a confidence grew with each science teaching experience.

Table 3 provides a summary description of the frequency of entries made in each journal describing:

1. The science teaching event (S).
2. Evidence of growing confidence built upon successful teaching (C).
3. Using confidence to go beyond the inservice training and plan
activities based on previous lessons and student response (B).

Table 3

Frequency of Journal Process

<table>
<thead>
<tr>
<th>University Department</th>
<th>Journal Number</th>
<th>S</th>
<th>C</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Science</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Teacher Education</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>15</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>8</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Educational Leader Student</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

N = 11 Intern Journals

The Teacher Education students charted show gain in growing confidence and going beyond the inservice lesson. Being future teachers perhaps gave incentive to problem solve and attempt to respond to the students more spontaneously. The natural science interns focused more on the science lesson itself when reporting the experience. Little was mentioned about gaining confidence, however going farther than the inservice lesson was indicated by two science interns. The inference is made that confidence did occur in those instances.

The journals also indicated that the interns began to mature in teaching by proceeding through stages of reflective response to the teaching event. As Table 5 indicates each of the journals could be charted following the six stages of thinking.

1. View teaching experience from one point of view - the intern.
2. View teaching experience from self-awareness and student response.
3. Beginning to analyze the teaching event by recognizing that
changes need to occur for effective teaching.

4. Process of problem solving is ongoing, and begin to seek the input from others.

5. Make and implement decisions for change.

6. Evaluate these decisions.

After surveying the journals to indicate the frequency of the stages noted in these entries, the following table was devised.

Table 4
Frequency of Reflective Stages

<table>
<thead>
<tr>
<th>University Department</th>
<th>Journal Number</th>
<th>Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Natural Science</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Teacher Education</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Education Administration</td>
<td>11</td>
<td>2</td>
</tr>
</tbody>
</table>

N = Intern Journals

All interns viewed the teaching experience from a personal point of view as the chart indicates. Student response to the lessons was noticed and entered as part of the journal data. There appears to be no correlation between stages one and two except to say that most of the eleven interns did progress to the stage of using student response as a measure of a successful lesson. There are fewer interns moving into the analytical stage. The natural science interns noted few of these
instances, while the teacher education interns often analyzed the success or failure of the lesson. The inference is made that the university courses in teacher education prompted these students to be sensitive to student response and analyze the lesson to make improvements. However, the Education Administration, however, interns only identified the single point of view and student response.

The final stages of reflective thinking concerning the teaching event, are only noted by the teacher education interns, however, only three of these go beyond stage three in thinking analytically and implementing changes and making decisions. These seem to be stages that occur with experience and further training.

Intern Exit Interviews

After surveying these responses to the three questions, eight themes emerged. The responses were counted to determine the frequency of each theme. These themes are named and tabulated in the following table.

Table 5

Frequency of Exit Interview Responses

<table>
<thead>
<tr>
<th>Theme</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learned to implement hands-on science teaching methods.</td>
<td>11</td>
</tr>
<tr>
<td>2. Gained new teaching ideas and integrated curriculum methods.</td>
<td>26</td>
</tr>
<tr>
<td>3. Learned science content and concepts.</td>
<td>4</td>
</tr>
<tr>
<td>4. Benefited from hands on classroom experience and club leadership.</td>
<td>43</td>
</tr>
<tr>
<td>5. Confirmed vocational choice.</td>
<td>11</td>
</tr>
<tr>
<td>6. Confidence building experience.</td>
<td>12</td>
</tr>
<tr>
<td>7. Gained knowledge of teaching profession.</td>
<td>13</td>
</tr>
<tr>
<td>8. Enhanced University training.</td>
<td>11</td>
</tr>
</tbody>
</table>

N = 35

Table 5 indicates the most interns generally benefited from the hands on science classroom experience and the science club leadership. This is based on the entire group interns for the final year of the
Second to this was the acquisition of new teaching ideas and integrated curriculum methods. The learning of new science concepts was less noticed and responded to by the end of the training. The other responses indicated the positive reaction to the program by indicating growth in confidence, confirming vocational choices, and assisting in professional and post graduate goals.

**Post-Graduate Interviews**

After interviewing four former interns, the following data was collected.

Table 6

**Present Vocational Goals**

<table>
<thead>
<tr>
<th>#</th>
<th>Vocational Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Project Director of Science 2001</td>
</tr>
<tr>
<td>#2</td>
<td>Chicago Elementary Public School teacher</td>
</tr>
<tr>
<td>#3</td>
<td>Suburban Elementary Public School teacher</td>
</tr>
<tr>
<td>#4</td>
<td>Volunteer Teacher</td>
</tr>
</tbody>
</table>

Table 7

**Undergraduate Vocational Goal**

| #1   | Biology Major - prospective medical student.        |
| #2   | Elementary Education Major/Sociology, Race, Gender, Class. |
| #3   | Elementary Education                                |
| #4   | Pre-Law: Masters of Education Degree.               |
Table 8
Future Vocational Goals

#1. M.A. in Education, then interested in pursuing science education as a chosen profession, completing a Ph.D. program and teaching at the higher education level.

#2. Enter graduate school, pursue a Ph.D. program with the goal of improving schools and school conditions in neighborhoods.

#3. Completing an Masters program and continuing in Elementary Education.

#4. Join the teaching profession in the near future, and hopes to teach in the internship placement school

What is your vocation today? Each of these "intern graduates" is actively involved vocational. When comparing the present work with the vocational goals expressed during the undergraduate years, each has found work in their chosen fields.

The most dramatic vocational path is #1. This intern hoped to enter medical school, and when that did not happen, the internship experience offered and alternative vocational direction. By working with SCIENCE 2001 project a continuing interest in science combined with a graduate degree in education offers this "graduate intern" another vocational opportunity.

The impact of the SCIENCE 2001 experience on the vocational goals of these former interns remains. Because the inservice lessons overlapped with university courses, and provided a "hands-on" science experience, "science learning became more accessible." The science learning and leadership sparked interest and knowledge in science, and also assisted with implementing hands-on science in the current classroom experience. Even when no new science knowledge was learned, application of science learning and the connection between university courses offered a "bigger picture."

All agreed that the leadership skills learned and used in the
internship were highly valued as assisting in their present vocations. Confidence, familiarity with teaching methods and presentation, and contact with children confirmed vocational choices, and prepared each for the workplace.

The interview with the post graduate interns confirms the data supporting the impact of SCIENCE 2001 on vocational goals and science literacy. Tables 6, 7, and 8 are self explanatory. These former interns have found meaningful workplaces, in vocations that are satisfying, and the internship program contributed to their choices and success. Their knowledge of science was intensified by the hands-on approach to teaching and learning, but also through making practical, real world connections between university courses and field training.

**Statistical Data**

The statistical data measures quantitatively the gain in science literacy. Several statistical tests were administered to analyze this data. First of all, a $t$ test was applied to the pre and post tests of the interns to determine significance in science literacy attained through the internship experience.

Table 9

Pretest/Posttest Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of cases</th>
<th>Mean</th>
<th>2-tail prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>12</td>
<td>10.8333</td>
<td>.025</td>
</tr>
<tr>
<td>Posttest</td>
<td>12</td>
<td>11.8333</td>
<td></td>
</tr>
</tbody>
</table>

$N = $ Interns

Table 9 presents the scores between intern pre and post science tests. Using the .05 alpha level, the two tail probability score indicates significant difference. Because .025 is less than .05, this indicates a significant difference in the posttest scores.

Next, a one-way analysis of variance (ANOVA) allowed a look at the
breakdown of scores across the three groups and was used to investigate
the significant difference between the intern post test scores and those
of the control groups.

Group 1 - Teacher education students.
Group 2 - 108 Natural Science students.
Group 3 - 12 SCIENCE 2001 student interns.

Table 10
Posttest Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Count</th>
<th>Mean</th>
<th>F prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>84</td>
<td>10.5000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>108</td>
<td>10.8148</td>
<td>.0841</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>11.8824</td>
<td></td>
</tr>
</tbody>
</table>

The one-way analysis of variance (ANOVA) allowed a look at the
breakdown of the posttest scores of all three groups. As Table 10
indicates significance of F for posttests across groups is .0841. This
number is greater than .05 indicating no significant difference. It is
important to notice, however, that the mean score of group 3, the
interns, is larger than both control groups. There is little difference
in the means between the science and teacher education students.

A post hoc analysis using t tests gives opportunity to obtain a
closer scrutiny of the posttest scores. Table 11 compares the teacher
education students and the interns.

Group 1 - Teacher Education Students
Group 3 - SCIENCE 2001 Interns
Table 11

Posttest Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Count</th>
<th>Mean</th>
<th>2-tail Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>84</td>
<td>10.5000</td>
<td>.012</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>11.8824</td>
<td></td>
</tr>
</tbody>
</table>

The 2-tail probability of .012 is less than .05 showing significant difference in the interns posttest scores. Comparing the mean scores also indicates the interns score being higher than that of the teacher education students.

The t test between the SCIENCE 2001 interns and the natural science students also indicates significant difference between scores.

Group 2 - Natural Science Students

Group 3 - SCIENCE 2001 Interns

Table 12

Posttest Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Count</th>
<th>Mean</th>
<th>2-tail Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>108</td>
<td>10.8148</td>
<td>.042</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>11.8824</td>
<td></td>
</tr>
</tbody>
</table>

The 2-tail probability of .042 is less than alpha .05 indicating a significant difference in the interns' posttest scores when compared with the natural science students.
Questions for this study were prompted for several reasons. The related literature and research indicates that there is a need for improved science teaching. The university is called to provide effective science instruction for their students, and high schools and elementary schools must teach science meaningfully in order to prepare their students for their future. The quest for effective science and teacher education programs is on-going and improvements continue so the teacher cadre of the future is prepared to educate for the 21st century.

Drawing upon the literature stating that science instruction on all educational levels is inadequate, noting that school teachers are ill prepared to teach science, and instructional time spent on teaching science is deficient, leads to the conclusion that programs are needed to remedy these findings. Colleges and universities must require more science coursework, and teach science using the "hands-on" experiential approach (Jewett, 1992). The SCIENCE 2001 project proposed to do these things for elementary school teachers, and undergraduate university interns.

By providing a training experience rooted in the university setting, the preservice student was offered the opportunity to learn and gain practical experience in science, leadership skills, various instructional methods, and acquiring useful knowledge of pupils (Kagan, 1992). A supportive network of experts - university staff, university supervisor, classroom teachers - offered the university intern an opportunity to become experienced in these areas before entering the professional workplace. This offered the integrated approach to
university education by combining academics and training (Cruikshank & Metcalf, 1990).

The student interns experience journals and science tests served as the primary sources of information for this study. Chapter III provided the explanation and use of these journals and tests. This data assisted in answering the study questions and assessing the success of the project's goal of improving teaching and learning science.

Implications

The following questions were designed for this study.

1. Did the science literacy of the Loyola intern improve significantly as a result of inservice instruction, science club leadership, and classroom assistance experience?

2. Did the internship experience contribute to the Loyola student's preparation for future vocation?

The purpose of this study was not to offer a design for successful training, nor to make broad generalizations concerning students involved in clinical training. Rather, the overall purpose was to expand the knowledge of preservice student training, its impact on the individual student and future vocation, and also obtaining beginning knowledge of teaching and science learning.

1. Was science literacy attained?

We learn 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we both see and hear, 70% of what is discussed, 80% of what we experience personally, and 95% of what we teach to someone else.

William Glasser

Accepting this statement as true, teaching others leads to effective learning.

The internship experience required university students to learn science through inservices. As explained in Chapter III, this was accomplished through an experiential approach. After seeing, hearing, and personally experiencing the inservice lesson, the participants were responsible for passing this science knowledge on to elementary students
in the Chicago Public Schools. Because teaching requires personal knowledge of science, and gathering teaching strategies to effectively transmit this knowledge to others, individual growth in science learning is achieved.

The intern journals described science teaching experiences. The accounts of the concrete teaching experience, the reflective observation of that experience, then analyzing and conceptualizing the episode, and finally the active experimentation of revising or initiating a new lesson illustrates the process of learning (Kolb, 1984, pp. 40, 41). "Learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping experience and transforming it (Kolb, 1984, p. 41)." The act of the intern "doing something with science knowledge", means learning took place (Kolb, p. 42).

Teacher education students seemed to most directly benefit from the internship experience. The opportunity to teach science lessons, along with university courses that assisted in focusing on the teaching/learning experience offered these students a chance to learn teaching in a very practical way. The science students on the other hand, had opportunity to assume leadership in directing hands-on science training. This enabled them to communicate their learned science to others, therefore clarifying their understanding of science concepts.

Table 3 (p. 55) illustrates that the frequency of journal responses began with reporting the science teaching experience, sometimes noting increased confidence, which led to expanding science teaching themes beyond the inservice lesson. The natural science interns seldom noted the confidence gain, however indicated many instances when the teaching went beyond the inservice content. The teacher education participants, however, provide the link between confidence gain leading to expanded instruction. In other words, they began generating their own science lessons based on student response and
their leadership in the science clubs. The university teaching preparation courses may have influenced the teacher education interns to be more aware of positive student response leading to confidence, then expanding instruction. The natural science students, however, relied on confident science knowledge to generate new science topics. Even though these differences existed among the intern population, the journals illustrated growth in science knowledge and communication. The conclusion is then, that by the act of instruction – the concrete experience of passing science content on to others – science literacy was attained.

The statistical data gathered from the pre and post testing also assisted in concluding that increased science literacy was attained during the internship experience. Table 9 (p. 60), t test between pre and posttest scores, indicates a significant difference across tests. The conclusion from this statistical data is that science literacy was improved after treatment. However, not all of the seventeen interns completed both the pre and post test.

The one-way analysis of variance (ANOVA) shows no significant difference in the intern scores compared with the control group scores. However, the mean score was greater than the means of the natural science and teacher education groups. The unbalanced group count may have skewed the final results, and a more equal group of participants might have contributed to significance.

In Tables 11 and 12 (p. 62), the post hoc analysis t tests comparing intern posttest scores with each control group, there is indication of significant difference in intern scores. This difference confirms the attainment of science literacy through the internship program.

The post graduate interviews verify anecdotally that science literacy was enhanced and learned through the hands-on teaching/learning experience. The internship offered the avenue for university
and training integration.

2. Did the internship assist the Loyola student in vocational direction and goals?

Noting the importance of reflective thinking as a means of improving instruction (Dewey, 1933), the six stages of reflective thought are illustrated in Table 4 (p. 56). After surveying intern journals, the teacher education students frequency of response in the later stages of reflective thought was greater than that of the natural science or educational administration students. The ability of the teacher education students to reflect on the lesson through student response, analysis of the lesson instruction, and ultimately leading to improved decision making and teaching are necessary ingredients in teacher preparation. The fact that this is noted more frequently among those students when compared with the non-teacher preparations students indicates progress in practically acquiring vocational skills.

The emerging themes in the exit interview illustrated in Table 5 (p. 57), focus on vocational preparation and confirmation. The most frequent response was the impact of the hands-on classroom and science club experience. The new teaching ideas, confidence, gaining knowledge of the teaching profession, and generally enhancing the university experience offered the evidence that vocational progress was apparent, and a product of the internship experience.

Tables 6, 7, and 8 (pp. 58-59) clearly display the vocational past, present and future aspirations of four post graduate interns. All plan on pursuing graduate level degrees in the area of education, on in higher levels science related instruction. All hope to teach and make a difference in the greater Chicago neighborhood schools and community. All indicated that the internship experience assisted them in framing their vocational direction.

**Limitations of the Study**

1. The role of the supervisor and mentor was an important one.
Meeting with each intern and discussing the classroom and science club experiences, fitting the proper instructional methods with the lessons, encouraging creative problem solving, and providing coordination between university and the elementary classroom offered a crucial service to the project. However, data detailing the supervisory conferences would have supplied meaningful information charting the vocational and science literacy progress of each intern. The effectiveness of the supervisory role in the process could have been evaluated.

2. Secondly, obtaining all intern pre and posttest scores, and a more balanced count within the intern and control groups would contribute to a more accurate statistical data collection.

3. Interviewing and collecting data from the cooperating elementary school teachers and charting the progress of the interns would have added another dimension and means of collecting intern information.

4. Working more closely with the university faculty in integrating the inservice training and field experience would have offered benefit to the total university educational experience.

Concluding Remarks

An Internship: A Framework for Science Literacy and Vocational Goals—this title summarizes the study. In this study we have seen that SCIENCE 2001 provides the framework for interns to gain the science knowledge, and instructional methods to teach science. Integrating the internship experience during the university education offered the intern several opportunities. The internship gave opportunity to reflect on vocational direction. Using the elementary schools as the workplace, university students had opportunity to teach children interactive "hands-on" science lessons, that also increased their science learning. Opportunity for learning science and vocational skills from multiple perspectives - university faculty and staff, elementary school teachers, and the elementary pupils - linked the university with the surrounding
community. Within the university arena these students received preparation for vocation and the twenty-first century.
APPENDIX

QUESTIONNAIRES AND CORRESPONDENCE
What have you learned or gained from this internship experience?

- New ways to teach science
- Reinforcement on how to use trade books in classroom.
- Hands on teaching strategies.
- Actual teaching experience.
- Teaching content for older students - more in depth.
- Teacher was model, then the intern taught other classes same content.
- Learned from both teachers - two different styles, complementing each other.
- Developed positive relationship with students.
- Gained confidence.
- Helpful in student teaching preparation.
- "I loved having books and papers to work with - also using the paper cutter"
- Learned to gain the kids (students) attention - harder with the older kids
- Learned the time and effort it takes to be a teacher.
- Hands on learning vs. academic/lecture approach.
- Confidence builder.
- Learned that some teachers are a bit threatened when others join in a cooperative teaching effort.
- Gained a better sense of what teaching was all about. (S)
- Learned about the dynamics of teaching and attitudes of teachers. (S)
- Seeing education from the role of leader/rather than from the student viewpoint. (S)
- Teaching is a tremendous amount of work. (S)
- Great teaching experience!
- Learned more about science - began to understand science through "hands on" experiments.
- Confident in working with students and presenting ideas. (Some books are just sitting in closets, instead of being used in the classroom).
- Enjoyed working with children.
- I became enlightened - I learned to know I liked the older students. (S)
- Gained computer knowledge and classroom use.
- Learned importance of communicating clearly. (S)
- Learning to be more assertive with students. (S)
- Learned how hard teachers work.
- Confidence building experience.
- Benefited from the inservices.
- Great supply of activities.
- Gained experience with working with different ages in science club.
- Learned from great teachers (both LA SPIN and SCIENCE 2001).
- Learned to teach older students.
- Confidence building.
Learned to be flexible.
Gained much information.
Learned I wanted to teach older kids (5 or 6).
Gained confidence in working with older kids.
Gained my first experience with teaching and getting the message to children.
Learned it was important to work with children at their level in life - "light in the bathroom", "cornflakes come from the sun's energy".
Learned involvement with kids is important, not just "talk" to them.
Learned about great new materials and activities.
Gained from going to school, working with kids and teachers - a good experience.
Interesting inservices.
Gained confidence.
Gained experience in controlling the classroom.
Learned from working with "hands-on" activities - better than abstract - kids enjoy and learn more.
Wished teachers would include the intern and be more responsible for cooperative working situation.
Gained from direct classroom experience.
Learned from getting in front of class and giving short lessons.
Learned to assume leadership.
Gained confidence in working with children - be in charge.
Lot of ideas from inservice.
Learned a lot from inservices.
Learned how to prepare materials.

How has this experience contributed to your growth and education in a chosen vocation?
-I know how to teach a lesson better.
Teach, revise and do better the next time.
Gained confidence that I can teach.
Learned I was more comfortable with younger children.
"YES!" This is what I want to do.
-I know I want to teach in a self contained classroom (6,7, or 8), and if departmentalized I want to teach 6th to 8th grade science.
-I know I definitely want to be a teacher.
-Ideas! Inservice ideas.
-I learned a lot from teaching and watching teachers.
-I know I want to teach elementary students.
-Gained a backlog of ideas from the inservices.
-I learned to change plans and be more flexible.
-Learned classroom management.
-Files of ideas from the inservices.
-Learned about human interaction - worst on one day with students, and with encouragement things were better the next day.
"Hands-on" strategies, rather than textbook learning.
- Great lesson plan ideas.
- Insight into lesson organization.
- Greater understanding of how people learn.
- In working with teachers, I began to form ideas of the kind of teacher I want to be.
- I've begun to consider teaching science. (S)
- I learned a great deal about energy in working with children. (S)
- Pushed me toward education (S).
- I didn't know much about computers before, and learned and enjoyed using them with children. (S)
- Assisted me in applying for teaching assistantships in graduate school. (S)
- Learned to organize presentations. (S)
- Gained more teaching experience through an internship.
- Gained confidence and became more independent.
- More prepared for unexpected situations.
- Important to see a teacher in action - what works and doesn't work.
- Began to see the "characteristics" I need to develop to reach kids.
- Gained lots of usable ideas - those that work with kids.
- Confirmed that I'm in the right field.
- Gained confidence.
- Fun to see kids reaction to learning.
- I really do want to teach.
- I can actually do this - I can teach a class.
- I feel good about choices.
- Contributed to more direct knowledge and experience in the education field.
- Gained confidence.
- Helped with a final paper and exam in a course.
- Gained teaching experience before student teaching.
- Talking, sharing problems and ideas with teachers was helpful.
- Gained classroom ideas.
- Learned from listening to teacher conversations and exchanging ideas.

Rate your work as an intern on a scale of 1 (best) to 5 (worst). Why?
- 1 - I believe I did my best in fulfilling the requirements of the internship experience and learned a lot. (1)
- 2 - I didn't help set up or take down at for inservices. I didn't always meet with Joan consistently. (2)
- 1 - Teachers helped by working around my schedule. (1)
- 2/3 - I wasn't able to do all that I should. Second semester was harder because I always felt I was intruding. (3)
- 1 - Felt guilty I couldn't be involved with classroom more, but scheduling was difficult. (2)
- 1 - Fulfilled all requirements (felt unsure because he missed going to the classroom several times, due to illness and teacher conflicts.) (1)
In which ways did this "hands on" teaching internship assist in preparation for your future vocation?

- Feel more prepared because of variety of teaching experiences (visited a variety of classrooms and assisted a variety of students).

Advantage in being with classrooms teachers in a variety of settings.
- able to talk with teachers informally.
- made connections with many teachers.
- saw first hand how teachers dealt with stress.
- exposure to a variety of teaching methods and materials.
- becoming acquainted with faculty in a professional setting; also meeting in informal ways (faculty room, inservice meetings.)

- Opportunity to practice teaching methods on my own.

- "hands on" classroom experience - being able to do teaching.
  - exposure to a bi-lingual classroom provided experience in special education field.
  - saw all aspects of the teaching profession - positive and negative (political aspects).
  - gave added confidence
  - assisted in transfer to another college.

- offered "hands on" experience; offered independence; a confidence builder.

- Gained experience in working with a variety of children and "hands on" teaching methods.

- Experience in classroom instruction with the entire class; practical learning; "hands on learning"; learned more this semester because of implementing methods of instruction learned in the Loyola classroom; learned more because of this practical application (KWL strategies, read aloud strategies etc.) Obtained a variety of teaching strategies and materials that will be used in future profession.

- discovered that school teaching is a lot of work; teacher preparation before presenting a lesson is important; patience was essential in working with children; only real hands on teaching experience, and this experience offered opportunity to learn.

- offered confidence to enter student teaching experience.
- Confidence builder - especially due to the feedback from the classroom teachers. Secured my commitment to teach in the Chicago public schools.

-offered 'hands on' classroom experience in the sophomore year of college; gave confidence and assurance that teaching was the chosen profession. Obtained ideas and methods that would not have thought of on own. Integration approach was helpful.

- Being in front of a classroom built confidence; "on the spot" training" "hands on" leadership experience.

- Chance to implement new ideas and activities in the elementary classroom.

IN WHICH WAYS WERE THE INSERVICE MEETINGS HELPFUL?

- given more ideas, induced thinking, learned how to implement literature circles, learned integrated curriculum approaches, learned methods in teaching writing and spelling.

- Obtained helpful materials.

- Hands on science approaches proved a less threatening approach for elementary students; provided ideas and student materials; learned curriculum integration; offered a wholistic view of child and educational approach.

Offered new and different ideas; gained student teaching ideas and materials.

- Good ideas for classes and projects; introduction of fine children's literature.

- Learned methods of communicating science to children; learned about and had opportunity to implement literature circles in the elementary classroom; learned and used integration techniques.

- Offered a new "twist" on learning - took "boring science" and made it fun ("hands on" method and approach did this); learned how language arts fit into the science curriculum; gained knowledge of recent trends in education.

- Learned 'hands on' techniques; interacted with elementary classroom
INTERNS EXIT INTERVIEW
5/94

SCIENCE CLUB
HRS. PER WEEK:
TOPICS:

CLASSROOM
HRS. PER WEEK
TOPICS:

PERSONAL BENEFITS OF PROGRAM:

EDUCATIONAL/VOCATIONAL BENEFITS OF PROGRAM

SELF RATING

HELPFUL SUGGESTIONS
Alliance for Community Education
Intern Information Form

Please fill out completely:

Name ____________________________________________

SS#________________________________________________________________________

Local Address_________________________________________________________________

City __________________________ State__________ Zip ____________

Local Phone__________________________________________________________________

Home Address_________________________________________________________________

City __________________________ State__________ Zip ____________

Home Phone__________________________________________________________________

Year _______________ Major ________________________________________________

Community Site ____________________________________________________________

I agree to participate in the L.A. SPIN internship program. I understand that I am required to attend 4 teacher inservices and I will be assigned a community site. I will spend 3 hours per week at this site implementing the lessons I have developed. In return, I will be provided the instructional materials necessary to complete these tasks, and I will receive a stipend of $150 for the 20 hours worked at the site.

Signature ___________________________ Date __________________________
1. A building contractor buys a 100 acre piece of woodland next to a small lake. The contractor removed 30% of the trees. Which of the following would most likely occur first?

A. Decrease in water run-off  
B. Increase in water pollution  
C. Increase in water run-off  
D. Decrease in fish population

2. | MEASUREMENT | COLUMN A | COLUMN B | COLUMN C | COLUMN D |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>3</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assuming the data in this table are accurate, which column of data would allow you to make a prediction most easily about the size of measurement 5?

A. Column A  
B. Column B  
C. Column C  
D. Column D

3. Genetic engineering involves a process whereby a foreign strand of DNA is inserted in the existing DNA of a cell. This process is now used to produce pharmaceuticals and substances of industrial importance biochemically. As more knowledge is gained about this process, which would be an area least likely to benefit?

A. Production of wine, beer, and cheese  
B. Production of insulin by bacteria  
C. Production of metals  
D. The fight against cancer

4. In an experiment dealing with seed germination, students were asked to measure the daily growth rate of the root area in millimeters (mm). Student A collected the following results:

<table>
<thead>
<tr>
<th>Day</th>
<th>Measurement (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 mm</td>
</tr>
<tr>
<td>2</td>
<td>4 mm</td>
</tr>
<tr>
<td>3</td>
<td>student absent</td>
</tr>
<tr>
<td>4</td>
<td>8 mm</td>
</tr>
<tr>
<td>5</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

According to good laboratory procedure, the results of day 3 should be

A. recorded as 0 mm.  
B. recorded as 2 mm.  
C. recorded as 6 mm.  
D. left blank

5. This graph shows how many grams of potassium chlorate can be dissolved in 100 milliliters of water at different temperatures.

If a chemist wants to dissolve 200 grams of potassium chlorate in one liter (1000 ml) water, what is the lowest water temperature she can use?

A. 20° C  
B. 50° C  
C. 80° C  
D. 100° C
6. A student did an experiment in which a cart was rolled down a one-meter incline. The student increased the height of the incline while keeping the length of the incline the same. Which statement best describes the relationship between the height of the incline and the total distance a cart would roll down the incline and across a flat surface?

A. As the height of the incline increases, the average distance rolled decreases.
B. As the height of the incline increases, the average distance rolled stays the same.
C. As the height of the incline increases, the average distance rolled increases.
D. As the height of the incline increases, the average distance rolled may either increase or decrease.

7. A disease kills all the carnivores on an island. What will happen to the other organisms on the island after a few weeks?

A. Herbivores would decrease and producers would increase.
B. Herbivores and producers would decline.
C. Decomposers would be affected by the disease.
D. Herbivores would increase and producers would decline.

8. According to the chart, which is the best insulator?

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Water Temperature After 30 min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jar wrapped in cotton</td>
<td>80° C - 52° C</td>
</tr>
<tr>
<td>Jar wrapped with wool cloth</td>
<td>80° C - 64° C</td>
</tr>
<tr>
<td>Jar wrapped with polyester</td>
<td>80° C - 48° C</td>
</tr>
<tr>
<td>Unwrapped jar</td>
<td>80° C - 24° C</td>
</tr>
</tbody>
</table>

A. Polyester cloth
B. Cotton cloth
C. Wool cloth
D. Unwrapped jar

9. This is a scale drawing of a classroom that measures 5 m by 8 m.

What is the scale?

A. 1 cm = 1 m
B. 1 cm = 2 m
C. 1 cm = 3 m
D. 1 cm = 5 m

10. Which is the least important in an experiment?

A. Controlling important variables
B. Making measurements quickly
C. Making measurements accurately
D. Recording data honestly
7. An astronaut experiencing "weightlessness" is handed two identical boxes. One of the boxes is hollow and the other is completely filled with a solid block of lead. How can the astronaut determine which is which?

A. Hold the boxes at arm's length one in each hand.
B. Use a standard equal arm laboratory balance.
C. Try to shake each box.
D. Drop the boxes.

8. Study this drawing. All springs are made of the same material.

Which is true?

A. No force acts on Spring A.
B. Equal forces act on all the springs.
C. Spring C has the most force on it.
D. Less force makes a spring stretch more.

9. Which set of animals pictured below would biologists put together in the same class?

A. [Images of different animals]
B. [Images of different animals]
C. [Images of different animals]
D. [Images of different animals]

10. For four weeks a plant has been growing as follows. The first week it is one centimeter high. The second week it is two centimeters high.

Which graph shows this growth?

A. Graph A
B. Graph B
C. Graph C
D. Graph D

11. If you had to find who was the fastest runner in your school, which way would be best?

A. The 5th grade boys run against 6th grade boys.
B. Students the same age run against each other.
C. Each person runs the same distance and is timed.
D. Younger runners get a 15 step head start.

12. If someone tells you that a new car is green, what is communicated to you?

A. An inference
B. A hypothesis
C. An observation
D. A measurement
11. Two groups of identical plants are put in two identical pots of soil. They are both kept in the same window and given the same amount of water at the same time of day. Pot A has fertilizer added to it; Pot B does not. The plants' growth is recorded. At the end of the experiment, the plants in pot A are taller and greener than those in pot B. Why is this a controlled experiment?

A. Two groups of plants are used.
B. Everything is the same except for adding fertilizer.
C. Accurate measurements are taken.
D. The same types of plants are used.

12. A poisonous chemical spilled onto a highway and ran into a nearby stream. What should the police do first?

A. Pass laws against water pollution.
B. Warn people downstream.
C. Call scientists to clean up the chemicals.
D. Write an accident report for the judge.

13. Why do scientists continue to search for new ways to conserve fossil fuels?

A. Locating fossil fuels is inexpensive.
B. Fossil fuels are not useful.
C. There is an unlimited supply of fossil fuels.
D. We may run out of fossil fuels.

14. You have a graduated cylinder filled with water to the 5.6 ml line. An object that sinks when added to the water raises the level to 8.7 ml. The volume of the object is

A. 0.31 ml.
B. 3.1 ml.
C. 5.6 ml.
D. 14.3 ml.

15. Joan placed two equal lumps of clay on a balance scale as shown.

\[ \text{A} = \text{B} \]

Then she shaped one piece of clay like this: \[ \text{\_\_\_\_} \]

She broke the other piece into four pieces like this: \[ \text{\_\_\_\_\_\_} \]

Which picture best shows what the balance scale looked like when Joan put the clay back on the balance scale?

A. \[ \text{A} \]
B. \[ \text{B} \]
C. \[ \text{C} \]
D. \[ \text{D} \]
16. I am a
A. Freshman
B. Sophomore
C. Junior
D. Senior
E. Post Baccalaureate

17. I have taken the following number of college level science courses:
A. One
B. Two
C. Three
D. Four
E. More than four

18. I have taken the following number of education courses:
A. One
B. Two
C. Three
D. Four
E. More than four

19. I am enrolled in the
A. College of Arts and Sciences
B. School of Education
C. School of Business
D. School of Nursing
E. Other

20. My major is in the area of
A. Humanities
B. Science
C. Social Sciences
D. Education
E. Other

21. I would like to take more science classes.
A. Strongly agree
B. Agree
C. Disagree
D. Strongly disagree

22. Science was one of my favorite subjects in high school.

23. My science classes have given me a better understanding of how science is applied in society.

24. I learn more in my science classes from hands-on science activities.

25. I can use a computer with ease.

26. I like to read non-fiction books.

27. I like to read science fiction.
1. A rectangle 28 mm x 20 mm has its dimensions scaled down 25 percent. What would be the new dimensions?
   A. 20 mm x 21 mm
   B. 21 mm x 10 mm
   C. 21 mm x 15 mm
   D. 21 mm x 20 mm

2. The following structural formula represents a molecule.

   \[
   \begin{array}{c}
   \text{H} \\
   \text{N—C—C} \\
   \text{H} \\
   \text{OH}
   \end{array}
   \]

Which particular atom of this compound is not found in carbohydrates and fats?
   A. Carbon
   B. Hydrogen
   C. Oxygen
   D. Nitrogen

3. Statement (1): You see your image in a mirror.
Statement (2): You see a variety of colors when you look through a narrow slit.

What is the relationship between these two statements?
   A. An observation (1) is explained by a theory (2).
   B. A theory (1) explains an observation (2).
   C. Both are observations.
   D. The theory (1) is contradicted by the observation (2).

4. Suppose that the State Department of Natural Resources recently changed licensing regulations for deer hunting. Licenses are no longer required. There is no designated hunting season and no limit to the number of deer taken. If the number of deer taken increases, how will the food supply of the deer be affected?
   A. It will decrease as the deer population decreases.
   B. It will increase as the deer population increases.
   C. It will decrease as the deer population increases.
   D. It will increase as the deer population decreases.

5. A major threat to living animal communities in the world today is principal reason for this destruction?
   A. Natural disasters such as drought and flooding.
   B. Producers being poisoned by pollutants.
   C. Animal communities growing faster than plant communities.
   D. Humans using natural habitats for their own use.

6. Which statement represents a quantitative observation?
   A. The reactant was orange in color.
   B. The product was very dense.
   C. The temperature in the test tube reached 250° C.
   D. The reactant was hot.
13. What can you do during the winter to save the most energy?
   A. Watch less television.
   B. Lower the thermostat 5 degrees.
   C. Open the windows.
   D. Raise the thermostat 5 degrees.

14. The most important reason for planting grass on bare hill slopes is to
   A. provide food for farm animals.
   B. prevent forest fires.
   C. stop erosion.
   D. supply wild animals with food.

15. A hot air balloon maintained an altitude of 100 meters. The inside air pressure of the balloon was equal to the outside air pressure. What might happen if the air in the balloon cools?
   A. The balloon would get larger and rise.
   B. The balloon would get larger and drop.
   C. The balloon would get smaller and rise.
   D. The balloon would get smaller and drop.
16. I am a
   A. Freshman
   B. Sophomore
   C. Junior
   D. Senior
   E. Post Baccalaureate

17. I have taken the following number of college level science courses:
   A. One
   B. Two
   C. Three
   D. Four
   E. More than four

18. I have taken the following number of education courses:
   A. One
   B. Two
   C. Three
   D. Four
   E. More than four

19. I am enrolled in the
   A. College of Arts and Sciences
   B. School of Education
   C. School of Business
   D. School of Nursing
   E. Other

20. My major is in the area of
   A. Humanities
   B. Science
   C. Social Sciences
   D. Education
   E. Other

Please answer questions 21-27 as follows:

21. I would like to take more science classes.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

22. Science was one of my favorite subjects in high school.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

23. My science classes have given me a better understanding of how science is applied in society.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

24. I learn more in my science classes from hands-on science activities.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

25. I can use a computer with ease.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

26. I like to read non-fiction books.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

27. I like to read science fiction.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree
1. Suppose you recorded these times of sunrise.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>5:02</td>
</tr>
<tr>
<td>May 9</td>
<td>4:54</td>
</tr>
<tr>
<td>May 17</td>
<td>4:42</td>
</tr>
<tr>
<td>May 25</td>
<td>4:37</td>
</tr>
<tr>
<td>June 1</td>
<td>4:32</td>
</tr>
</tbody>
</table>

Study these times and predict when the sun rose on May 15.

A. Approximately 4:15
B. Approximately 4:40
C. Approximately 4:45
D. Approximately 4:55

2. Matthew had a toothache. After four days of eating fresh fruit, his toothache was gone. Matthew decided that the fruit had cured him. Is his conclusion logical?

A. No, because he was the only person to observe this fact.
B. No, because other variables were not controlled.
C. Yes, because it is based on an observed fact.
D. Yes, because there is no way to disprove it.

3. All of the following are true about a hypothesis except

A. it can be tested.
B. it is an intelligent guess.
C. it is one step in the scientific process.
D. it is a proven statement.

4. The theory of biological evolution of all living species was suggested by

A. Charles Darwin
B. Sigmund Freud
C. Albert Einstein
D. Carl Sagan

5. In the prairie, there is a food chain made up of grass, rabbits, and foxes. A drought occurs and kills all the grass. What happens to the population of foxes?

A. It increases.
B. It stays the same.
C. It decreases.
D. It goes down and then up.

6. What causes the seasons?

A. The speed of the earth as it travels around the sun.
B. The distance of the earth from the sun.
C. The tilt of the earth as it moves around the sun.
D. The spin of the earth as it spins around on its axis.

7. Identical plastic cubes are placed in containers 1, 2, and 3. Each container contains a different liquid.

Which liquid is the most dense?

A. 1
B. 2
C. 3
D. All three have the same density.
8. Which graph best shows the temperature gradient as you travel upward in the atmosphere?

A. ![Graph A]
B. ![Graph B]
C. ![Graph C]
D. ![Graph D]

9. The diagram shows a section of a burette.

Which would represent the best reading for the level of solution in the burette?

A. 39.20 ml
B. 39.30 ml
C. 40.70 ml
D. 40.80 ml

10. A student performed an experiment to test how much light a bean plant needed for good growth. All of these conditions must be kept the same except

A. the amount of water.
B. the amount of light.
C. the temperature.
D. the amount of soil.

11. As seen from the moon, the earth would

A. rise and set once every 28 days.
B. rise and set every 14 days.
C. never rise and set.
D. rise and set every day.

12. Coal, geothermal energy, nuclear energy, and oil are energy resources. How are they similar?

A. They are fossil fuels.
B. They pollute the air.
C. They all may be used to turn steam turbines.
D. They are all forms of petroleum.

13. Mass X (2 kg) and mass Y (1 kg) are dropped from a tall building at the same time. Neglecting air resistance, after one second, X will be moving

A. 1/4 the speed of Y.
B. at half the speed of Y.
C. at the same speed as Y.
D. twice as fast as Y.
14. X, Y, and Z represent the three lamps in a circuit which also includes a battery and a switch (S). When the switch is open, X fails to light, while Y and Z do. Which circuit is it?

A. 

B. 

C. 

D. 

15. In the following classification system, on which stem would lettuce be?

A. 

B. 

C. 

D. 

16. I am a
   A. Freshman
   B. Sophomore
   C. Junior
   D. Senior
   E. Post Baccalaureate

17. I have taken the following number of college level science courses:
   A. One
   B. Two
   C. Three
   D. Four
   E. More than four

18. I have taken the following number of education courses:
   A. One
   B. Two
   C. Three
   D. Four
   E. More than four

19. I am enrolled in the
   A. College of Arts and Sciences
   B. School of Education
   C. School of Business
   D. School of Nursing
   E. Other

20. My major is in the area of
   A. Humanities
   B. Science
   C. Social Sciences
   D. Education
   E. Other

Please answer questions 21-27 as follows:

21. I would like to take more science classes.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

22. Science was one of my favorite subjects in high school.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

23. My science classes have given me a better understanding of how science is applied in society.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

24. I learn more in my science classes from hands-on science activities.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

25. I can use a computer with ease.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

26. I like to read non-fiction books.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

27. I like to read science fiction.
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree
1. A man will pass his X-chromosome to
   A. all his children.
   B. all his daughters.
   C. all his sons.
   D. only half his sons.

2. Scientists warn that fossil fuels will be used up in the near future. Why, then, don't we put biodegradable material into that ground so that it can change into coal or oil?
   A. The process would take millions of years.
   B. We do not have the equipment.
   C. We have too much biodegradable material.
   D. Our earth is too big.

3. Which pair is not related?
   A. Darwin - evolution
   B. Galileo - telescope
   C. Edison - microchip
   D. Mendel - genetics

4. A student conducts an experiment in a science class and finds data that are very different from those of other classmates. The student should
   A. use a reliable classmate's data for the lab report.
   B. conduct the experiment until correct data are found.
   C. use only the parts of the data that are consistent with classmates' data.
   D. report the data and give possible explanations for any discrepancies.

5. In the diagram, a radioactive source inside a lead box releases alpha, beta, and gamma particles toward three sheets of material (I, II, and III).
   [Diagram]
   Alpha particles cannot pass through sheets of paper, aluminum, or lead.
   Beta particles cannot pass through sheets of aluminum or lead but can pass through paper.
   Gamma particles cannot pass through sheets of lead but can pass through paper and aluminum.
   To allow particles to go through as many sheets as possible before being stopped, in what order (I, II, and III) would you place the sheets?
   A. I aluminum, II paper, III lead
   B. I paper, II lead, III aluminum
   C. I lead, II aluminum, III paper
   D. I paper, II aluminum, III lead

6. What unit of measure is used to weigh a banana?
   A. Grams
   B. Kilometers
   C. Meters
   D. Liters
7. Which piece of equipment should a student use to determine the mass of a baseball?
   A. Meter stick
   B. Balance scale
   C. Thermometer
   D. Beaker

8. Your teacher gives you two identical flashlights. She tells you that one flashlight doesn't light because one of its parts is not working. Which experiment would be the best way to find the part that doesn't work?
   A. Exchange the two batteries in flashlight A with the two batteries in flashlight B.
   B. Exchange the bulb and batteries of flashlight B with those of flashlight A.
   C. Exchange the bulb and batteries one at a time, replacing each part before the next is tried.
   D. Exchange one of the batteries in flashlight A with one of the batteries in flashlight B.

9. Two students performed the same experiment. Student A obtained the answer of 30 g. Student B obtained the answer of 46 g. The correct answer was 37 g. Both students should
   A. repeat their experiments.
   B. be satisfied with their results.
   C. change their answers to the correct one.
   D. try another, easier experiment.

10. Why does a kilogram of beef cost more than a kilogram of corn?
    A. There are more cows than corn plants.
    B. It takes many kilograms of corn to support one cow.
    C. Cows are larger than corn plants.
    D. Few people like corn.

11. If people want to use energy produced from the sun's energy most efficiently, from which level of the food chain should they take the bulk of their food?
    A. Plants
    B. Insects
    C. Small animals
    D. Large animals
12. The crews of two ships at sea can communicate with each other by shouting through loudspeakers. It is impossible for the crews of spaceships a similar distance apart in space to do this because

A. the temperature is too low.
B. the sound is reflected.
C. the sound barrier has been broken.
D. empty space does not transmit sound.

13. A child weighing 45 kg sits at one end of the teeter-totter and a child weighing 34 kg sits on the other end. What do the children have to do to balance the teeter-totter?

A. The 45 kg child should pick up rocks until it balances.
B. The children should move the board, notch by notch, toward the 34 kg child until it balances.
C. The children should move the board, notch by notch, toward the 45 kg child until it balances.
D. The 34 kg child should slide closer to the middle of the teeter-totter until it balances.


What would you do to increase your pea harvest?

A. Introduce more spiders into your garden
B. Introduce more aphids into your garden
C. Reduce the number of spiders
D. Reduce the number of beetles

15. Consider the evolutionary trend of the skull.

If this trend continues, how might the jaw bone size and the cranium size change over the next 200,000 years?

<table>
<thead>
<tr>
<th>Jaw Bone Length</th>
<th>Cranium Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Longer</td>
<td>Larger</td>
</tr>
<tr>
<td>B. Longer</td>
<td>Smaller</td>
</tr>
<tr>
<td>C. Shorter</td>
<td>Larger</td>
</tr>
<tr>
<td>D. Shorter</td>
<td>Smaller</td>
</tr>
</tbody>
</table>
16. I am a
   A. Freshman
   B. Sophomore
   C. Junior
   D. Senior
   E. Post Baccalaureate

17. I have taken the following number of college level science courses:
   A. One
   B. Two
   C. Three
   D. Four
   E. More than four

18. I have taken the following number of education courses:
   A. One
   B. Two
   C. Three
   D. Four
   E. More than four

19. I am enrolled in the
   A. College of Arts and Sciences
   B. School of Education
   C. School of Business
   D. School of Nursing
   E. other

20. My major is in the area of
   A. Humanities
   B. Science
   C. Social Sciences
   D. Education
   E. Other

Please answer questions 21-27 as follows:

A. Strongly agree
B. Agree
C. Disagree
D. Strongly disagree

21. I would like to take more science classes.

22. Science was one of my favorite subjects in high school.

23. My science classes have given me a better understanding of how science is applied in society.

24. I learn more in my science classes from hands-on science activities.

25. I can use a computer with ease.

26. I like to read non-fiction books.

27. I like to read science fiction.
BIBLIOGRAPHY


VITA

Joan Visser was born on October 29, 1939 in Long Beach, California. She and her husband Duane, have three children, two in-law children, and two grandchildren.

Her elementary and high school training was completed in Ripon, California. She graduated from the University of California at Fresno in 1969. She had taken graduate studies in education at Michigan State University and, with this thesis is completing her Master of Arts in Curriculum and Instruction at Loyola University, Chicago.

She has extensive experience as a classroom teacher, most notably teaching grades four and five from 1974-1992 at Kelloggsville Christian School in Grand Rapids, Michigan. While there she was also active in leadership on various curriculum committees, assistant to the administrator on a number of occasions, teacher representative on the school board, and was involved in training student teachers in the classroom and college seminars.

More recently Joan has been involved in staff development of Chicago Public and private schools at Loyola University. She has also made a number of presentations at professional conferences. Currently she is teaching courses at Loyola University, Chicago, Trinity Christian College, and Chicago Metropolitan Center.

She has been active in music as a choral director, choreographer, music teacher, vocal soloist and musical theater performer. Among her performances she has been a principal player in a Gilbert and Sullivan Musical Theater, soloist and chorus member with Grand Rapids (MI) Opera Association, and has been a soloist and choir member of church and community choral groups.
Professional organizations of which Joan is a member include Christian Educators Association, Illinois Reading Council, Michigan Reading Association, International Reading Association and the Association for Supervision and Curriculum Development. She is also a school board member of the Daystar School in Chicago, Illinois.
THESIS APPROVAL SHEET

The thesis submitted by Joan Visser has been read and approved by the following committee:

Diane Schiller, Ph.D., Director
Associate Professor, Curriculum, Instruction, & Educational Psychology, Loyola University Chicago

Todd Hoover, Ph.D.
Associate Professor, Curriculum, Instruction, & Educational Psychology, Loyola University Chicago

Dorothy Giroux, Ph.D.
Visiting Assistant Professor, Curriculum, Instruction, & Educational Psychology, Loyola University Chicago

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given the final approval by the committee with reference to content and form.

The thesis is, therefore, accepted in partial fulfillment of the requirements for the degree of masters of arts.

[Signature]

Date: April 5, 1995

Director's Signature