Formative evaluation: a model for instructional material development and revision in public school industrial arts education

Marvin Irwin Sarapin
Iowa State University

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Formative evaluation: A model for instructional material development and revision in public school industrial arts education

by

Marvin Irwin Sarapin

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of DOCTOR OF PHILOSOPHY

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>x</td>
</tr>
<tr>
<td>CHAPTER I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Evaluation Goals and Roles</td>
<td>3</td>
</tr>
<tr>
<td>Problem of the Study</td>
<td>12</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>12</td>
</tr>
<tr>
<td>Need for the Study</td>
<td>12</td>
</tr>
<tr>
<td>Questions of the Study</td>
<td>24</td>
</tr>
<tr>
<td>Assumptions of the Study</td>
<td>25</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>25</td>
</tr>
<tr>
<td>Procedures of the Study</td>
<td>26</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>29</td>
</tr>
<tr>
<td>CHAPTER II. REVIEW OF LITERATURE</td>
<td>31</td>
</tr>
<tr>
<td>Introduction</td>
<td>31</td>
</tr>
<tr>
<td>Schools of Evaluation</td>
<td>33</td>
</tr>
<tr>
<td>Comparison of the Schools of Evaluation</td>
<td>40</td>
</tr>
<tr>
<td>Contemporary Evaluation Models</td>
<td>41</td>
</tr>
<tr>
<td>Comparison of the Evaluation Models</td>
<td>68</td>
</tr>
<tr>
<td>Formative Evaluation in Industrial Arts</td>
<td>70</td>
</tr>
<tr>
<td>CHAPTER III. THE FORMATIVE EVALUATION MODEL</td>
<td>79</td>
</tr>
<tr>
<td>Introduction</td>
<td>79</td>
</tr>
<tr>
<td>Model Syntax</td>
<td>83</td>
</tr>
<tr>
<td>The Formative Evaluation Model</td>
<td>89</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>The Conceptual Model of Formative Evaluation</td>
<td>90</td>
</tr>
<tr>
<td>The Procedural Model of Formative Evaluation</td>
<td>92</td>
</tr>
<tr>
<td>CHAPTER IV. METHODOLOGY</td>
<td>102</td>
</tr>
<tr>
<td>Designing the Model</td>
<td>102</td>
</tr>
<tr>
<td>Testing the Model</td>
<td>108</td>
</tr>
<tr>
<td>CHAPTER V. FINDINGS</td>
<td>149</td>
</tr>
<tr>
<td>Designing the Model</td>
<td>150</td>
</tr>
<tr>
<td>Testing the Model</td>
<td>154</td>
</tr>
<tr>
<td>Chapter Summary</td>
<td>162</td>
</tr>
<tr>
<td>CHAPTER VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS</td>
<td>163</td>
</tr>
<tr>
<td>Summary</td>
<td>163</td>
</tr>
<tr>
<td>Conclusions</td>
<td>173</td>
</tr>
<tr>
<td>Recommendations</td>
<td>176</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>179</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>186</td>
</tr>
<tr>
<td>VITA</td>
<td>188</td>
</tr>
<tr>
<td>APPENDIX A: SANDERS AND CUNNINGHAM FORMATIVE EVALUATION MATERIALS</td>
<td>190</td>
</tr>
<tr>
<td>APPENDIX B: STUDY PERSONNEL</td>
<td>194</td>
</tr>
<tr>
<td>APPENDIX C: PHASE (1.0) EVALUATION INSTRUMENT AND DATA</td>
<td>197</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>CONTENT</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>D</td>
<td>GRAPHIC COMMUNICATIONS TECHNICAL CONTENT TAXONOMY, DEFINITIONS, AND OBJECTIVES PRIOR TO EVALUATION</td>
</tr>
<tr>
<td>E</td>
<td>PHASE (2.0) EVALUATION INSTRUMENT, DATA, AND RESULTS</td>
</tr>
<tr>
<td>F</td>
<td>PHASE (3.0) EVALUATION INSTRUMENT, SUMMARY FORM, AND DATA</td>
</tr>
<tr>
<td>G</td>
<td>INSTRUCTIONAL PACKAGES</td>
</tr>
<tr>
<td>H</td>
<td>INTRINSIC TRYOUT TEST SITE LOCATIONS, INSTRUMENT, AND SUMMARY FORM</td>
</tr>
<tr>
<td>I</td>
<td>PAY-OFF TRYOUT INSTRUMENTS</td>
</tr>
<tr>
<td>J</td>
<td>PHASE (4.0) EVALUATION PAY-OFF TRYOUT DATA</td>
</tr>
<tr>
<td>K</td>
<td>MODEL ASSESSMENT INSTRUMENT AND DATA</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1. Role-dimension matrix in formative and summative evaluation 7
Figure 2. Distinction between intrinsic and pay-off evaluation and formative and summative evaluation 9
Figure 3. Procedures for a Tylerian evaluation paradigm 38
Figure 4. Six innovative evaluation models 44
Figure 5. Three matching problems in the methodology of evaluation 48
Figure 6. A layout of statements and data to be collected by the evaluator of an educational program 51
Figure 7. A representation of the processing of descriptive data 53
Figure 8. Decision-making settings 56
Figure 9. Types of decisions 57
Figure 10. Total program evaluation model 63
Figure 11. A flow chart designed to facilitate comparisons of program performances with standards 64
Figure 12. Discrepancy evaluation stages and content 65
Figure 13. Problem solving block 67
Figure 14. Formative evaluation conceptual model 77
Figure 15. Analogue symbology used in model building 85
Figure 16. A hypothetical model at the second level of detail 86
| Figure 17. | The formative evaluation conceptual model | Page 91 |
| Figure 18. | The formative evaluation procedural model | 93 |
| Figure 19. | Time line interface between the Institute schedule and the model testing research | 113 |
| Figure 20. | Activity package format | 127 |
| Figure 21. | The revised formative evaluation conceptual model | 174 |
| Figure 22. | A classification of information needed in formative evaluation | 191 |
| Figure 23. | A structure for planning formative evaluation in product development | 192 |
| Figure 24. | Iowa Industrial Arts Cadre participants | 195 |
| Figure 25. | Institute personnel participating in the study | 196 |
| Figure 26. | Graphic communications technical content taxonomy | 201 |
| Figure 27. | Definition of terms | 202 |
| Figure 28. | Field test locations | 241 |
| Figure 29. | Model assessment interview feedback | 279 |
LIST OF TABLES

Table 1. Advantages and disadvantages of three definitions of evaluation 42
Table 2. The CIPP evaluation model 59
Table 3. Comparison of contemporary evaluation models on selected characteristics 71
Table 4. Graphic communications developmental goals prior to Phase (1.0) evaluation 116
Table 5. Priority rank order of graphic communications developmental goals after completing Phase (1.0) 119
Table 6. Summary of overall ratings of worth and congruence of instructional objectives by priority goal order 124
Table 7. Sampling strategy for assessment activity on prototype materials 130
Table 8. Results of Phase (3.0) decision making 133
Table 9. Field test packages and schools 137
Table 10. Descriptive data format 142
Table 11. Results of Phase (4.0) pay-off tryout evaluation activities 147
Table 12. Information-gathering activities for evaluation feedback 152
Table 13. Data sources for evaluation feedback 153
Table 14. Effect of formative evaluation on goals 155
Table 15. Effect of formative evaluation on objectives 155
Table 16. Effect of formative evaluation on interim materials 157
Table 17. Attitude of teacher/developers towards developing and using goals 158
Table 18. Attitude of teacher/developers towards developing and using objectives 159
Table 19. Attitude of teacher/developers towards developing new instructional materials 160
Table 20. Attitude of teacher/developers towards field testing new instructional materials 161
Table 21. Summary of techniques and procedures appropriate for formative evaluation 193
Table 22. Mean, standard deviation, and priority rank order of ratings for graphic communications developmental goals 199
Table 23. Developmental goals and objectives prior to Phase (2.0) assessment 203
Table 24. Mean, standard deviation, overall rank order of ratings of worth of developmental objectives for graphic communications 215
Table 25. Mean, standard deviation, and overall rank order of ratings of congruence among developmental goals and objectives for graphic communications 216
Table 26. Instructional objectives resulting from Phase (2.0) 217
Table 27. Mean ratings of assessment activity on prototype materials 223
Table 28. Package 626 pay-off tryout written test descriptive data 263
Table 29. Package 626 pay-off tryout practical test descriptive data 263
Table 30. Package 629 pay-off tryout written test descriptive data 264
Table 31. Package 629 pay-off tryout practical test descriptive data 264
Table 32. Package 630 pay-off tryout written test descriptive data 265
Table 33. Package 630 pay-off tryout practical test descriptive data 265
Table 34. Package 635 pay-off tryout practical test descriptive data 266
Table 35. Mann-Whitney U test (Package 626 written test) 267
Table 36. Mann-Whitney U test (Package 626 practical test) 268
Table 37. Mann-Whitney U test (Package 629 written test) 269
Table 38. Mann-Whitney U test (Package 629 practical test) 270
Table 39. Mann-Whitney U test (Package 630 written test) 271
Table 40. Mann-Whitney U test (Package 630 practical test) 272
Table 41. Mann-Whitney U test (Package 635 practical test) 273
Table 42. Model assessment raw data 278
ABSTRACT

The objective of this study was to investigate the feasibility of adopting or adapting a formative evaluation model to facilitate the collection and use of feedback data for public school industrial arts teachers during the formative period of instructional material development. Specifically, the problem of this study was to design and test a formative evaluation model for the development, tryout, and assessment of curriculum materials in public school industrial arts education.

In the first phase of the study selected evaluation frameworks were reviewed, an analogue symbology was defined, and a formative evaluation model was developed. A conceptual model was advanced to communicate these four components of curriculum development and assessment: (1) identifying and ordering goals, (2) identifying and operationalizing objectives, (3) developing interim materials, and (4) field testing products. A procedural model was developed to expand the specificity and heuristic quality of the formative evaluation model.

In the second phase of the study the formative evaluation model was tested using the curriculum development efforts of the Graphic Communications Institute conducted at Iowa State University by the Department of Industrial Education. During
the summer sessions of 1976 and 1977 and the 1976-77 school year, Institute participants identified, developed, tested, and revised exemplary learning activities in graphic communications to implement The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12 (1975).

It was found that selected information-gathering activities and data sources identified produced evaluative feedback to curriculum developers facilitating the development, assessment, and revision of educational goals, objectives, interim materials, and instructional products. It was also found that employment of the formative evaluation model increased the participants' degree of positive attitude towards the curriculum development and assessment process.

The conclusions of this study were based on the findings related to specific research questions. The conclusions were:

1. A formative evaluation model can be developed to facilitate the development, tryout, and assessment of curriculum materials in public school industrial arts education. 2. A formative evaluation conceptual model can be adopted to facilitate collection and use of evaluative data for feedback to industrial arts curriculum developers enabling informed decision making during the curriculum development, assessment, and revision process. 3. A formative evaluation model is a useful tool for communicating and promoting the understanding of the goals,
roles, and procedures of formative evaluation. 4. The application of the formative evaluation model can assist the industrial arts curriculum developer to identify the activities and information sources that can be utilized to evaluate efforts for curriculum development, tryout, and assessment. 5. The formative evaluation procedural model can be adapted for organizing and conducting curriculum development, assessment, and revision in public school industrial arts.
CHAPTER I. INTRODUCTION

What comes to mind when one hears the word evaluation? Two questions to be addressed are: (1) Evaluation of what? and (2) Evaluation for what purpose? Insight into these questions can be gained by examining examples of evaluation from the world around us.

Evaluation is part of the decision-making process used daily in almost every aspect of society. Citizens evaluate the relative effectiveness of elected representative government to make judgments in future election campaigns. Industries evaluate their materials, processes, personnel, and products to provide data to make decisions. Employers appraise the worth of their employees in order to make judgments concerning salary adjustments, promotions, and job terminations. At home, people evaluate their lifestyles and make decisions based upon careful appraisal of internal and external criteria. In the schools, we evaluate students, teachers, administrators, staff, curricula, budgets, and other components in order to maintain and improve the educational enterprise.

To facilitate further discussion of these questions, an examination of the definition of the word evaluation was necessary. Two dictionary definitions of the word evaluation found in the literature were:

(1) Evaluation is to determine the significance of worth of [a phenomenon] usually by careful appraisal
and study. (Webster's New Collegiate Dictionary, 1973, p. 395)

(2) Evaluation is the process of ascertaining or judging the value or amount of something by use of a standard of appraisal. (Good, Dictionary of education, 1973, p. 220)

The elements of the two dictionary definitions of evaluation have been incorporated into a single definition by authors in the field of educational evaluation. Worthen and Sanders (1973) combined these elements as follows:

Evaluation is the determination of the worth of a thing. It includes obtaining information for use in judging the worth of a program, product, or objective, or the potential utility of alternative approaches designed to attain specific objectives. (p. 19)

The central theme in each of the definitions of evaluation cited the ascertainment, the determination, and the judgment of worth. However, evaluation in general and evaluation applied to education require an additional component. Cronbach (1963a) noted this component includes "the collection and use of information to make decisions about educational programs" (p. 672). Further reference to this component essential to a definition of evaluation was offered by Stufflebeam et al. (1971).

Educational evaluation is the process of delineating, obtaining, and providing useful information for judging decision alternatives. (p. 40)

The missing component in the preceding dictionary definitions was the specific reference to the relationship between evaluation and decision making. In the initial paragraph of
this introduction, two philosophical questions were raised: Evaluation of what? and Evaluation for what purpose? The preceding citations applied to education revealed that evaluation is a tool utilized to survey, examine, measure, appraise, and compare the relative attributes of an array of educational endeavors. More specifically, educational evaluation involves ascertaining the worth and merits of educational processes and products to supply information for decision making.

Evaluation Goals and Roles

In a paper published in the AERA Monograph 1, Michael Scriven (1967) addressed additional philosophical questions concerning educational evaluation. Scriven's questions were grouped under two headings: evaluation goals and evaluation roles.

Questions concerning the goals of educational evaluation address the end toward which evaluation effort is directed. Questions concerning the roles of educational evaluation relate to the proper or customary function of the evaluation process.

Scriven (1967) held that "evaluation attempts to answer certain types of questions about certain entities" (p. 40). These entities or instruments include educational processes, products, programs, personnel, textbooks, media, and related materials. Scriven identified specific questions among the goals of educational evaluation.
1. How well does this instrument perform (with respect to such-and-such criteria)?

2. Does it perform **better** than this other instrument?

3. What does this instrument do (i.e., what variables from the group in which we are interested are significantly affected by its application)?

4. Is the use of this instrument **worth** what it's costing? (p. 40)

In Scriven's illustration, an instrument referred to any input, process, or product within the educational enterprise. The questions outlined above had a common fibre which was identified by Worthen and Sanders (1973): "The evaluation process has only one functional goal — that of determining the worth and merit of something" (p. 104).

In contrast to the goals of evaluation, the roles of evaluation attempt to answer somewhat different questions. Scriven discussed the roles of evaluation as follows:

The role which evaluation has in a particular educational context may be enormously various; it may form part of a teacher training activity, of the process of curriculum development, of a field experiment connected with the improvement of learning theory, of an investigation preliminary to a decision about purchase or rejection of material; it may be a data-gathering activity for supporting a request for tax increases or research support . . . . Failure to make this rather obvious distinction between the roles and goals of evaluation, not necessarily in this terminology, is one of the factors that has led to the dilution of the process of evaluation to the point where it can no longer serve as a basis for answering the questions which are its goals. (1967, p. 41)
**Formative and summative evaluation**

Two roles of educational evaluation introduced by Cronbach (1963a) and expanded further by Scriven (1967), Grobman (1970), Cunningham (1972, 1973), Sanders (1972), and Sanders and Cunningham (1973) are formative and summative evaluation. The key difference in these roles of evaluation is that the former applies to educational processes and products under development and the latter applies to finished processes and products. In delineating the role of formative evaluation, Cunningham (1972) wrote:

> Formative evaluation [is] the gathering of information which would be of use to the developers of instructional materials, those persons who are trying to choose or produce the parts, the elements which will combine to form a successful whole. Information of concern to developers is usually that which will help them determine the success of their initial efforts, so that modifications can be made. (p. 111)

Formative evaluation incorporates the collection and utilization of feedback data to developers of educational processes and products. The purpose of formative evaluation activities is to facilitate further assessment, revision, and improvement of the educational process or product under development.

In contrast to formative evaluation, summative evaluation represents a somewhat different evaluation role. Cunningham (1972) presented the essence of summative evaluation as follows:
The term "summative evaluation," often used as a point of contrast with "formative evaluation," would refer to the collection of information of use to the consumer of the instructional materials, those who seek to determine what they are getting for their money, what they can expect from the product, whether the product is better than others, and so forth. Information of use to developers will sometimes, but not necessarily, overlap with information of use to consumers and vice versa. (p. 112)

Summative evaluation incorporates the collection and utilization of evaluation data after the educational process or product is completed. The feedback data in summative evaluation is intended to be used by the consumer, the use of the educational process or product. The purpose of summative evaluation activities is to facilitate consumer decisions concerning the ultimate disposition of the educational entity under consideration. Gronlund (1971) further compared formative and summative evaluation in a curriculum development context. Gronlund stated:

During the early stages, when new methods and materials are being tried, evaluation data enable the curriculum developer to determine the effectiveness of the new procedures and to identify areas where revision is needed. When the new curriculum program has been fully developed, evaluation data make it possible to determine the degree to which the new curriculum is effective in meeting the instructional objectives for which it was designed. The first type of curriculum evaluation has been called formative evaluation and the second summative evaluation. The main purpose of formative evaluation is to improve the instructional methods and materials so that greater student learning will result. The main purpose of summative evaluation is to appraise the overall effectiveness of a curriculum program. In this case, the data are not intended to serve as a basis for modifying the procedures, but rather as
a basis for selecting the most appropriate curriculum for school use. (p. 12)

The differences between formative and summative evaluation lie in the criteria of time, audience, and purpose of the evaluation process. A diagrammatic representation to differentiate the roles of formative and summative evaluation is seen in Figure 1.

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<thead>
<tr>
<th>Role</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
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<td>Formative</td>
<td>Formative period</td>
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<tr>
<td>Summative</td>
<td>Summative period</td>
</tr>
</tbody>
</table>

Figure 1. Role-dimension matrix in formative and summative evaluation

The time dimension of these roles has been identified by Grobman (1970) as the formative period and the summative period in a program development context (p. 182). The audience dimension includes two sources: the developer and the consumer of the educational process or product. The purpose dimension, which is a function of the other two dimensions, is equated by how the evaluation data or feedback is utilized.
Intrinsic and pay-off evaluation

The formative and summative roles of evaluation are intricably bound to the goal of evaluation: to evaluate the worth and merit of an entity. Two salient approaches used to collect evaluation data have been identified in the literature. Scriven (1967) presented the following analogy to identify these approaches:

If you want to evaluate a tool, say an axe, you might study the design of the bit, the weight distribution, the steel alloy used, the grade of hickory in the handle, etc., or you might just study the kind and speed of the cuts it makes in the hands of a good axeman. (In either case, the evaluation may be either summative or formative, for these are roles of evaluation, not procedures for doing evaluation.) (p. 53)

Scriven referred to the first data-gathering technique as intrinsic evaluation which incorporated inspection of the instrument itself. The second data-gathering technique was called pay-off evaluation and included examination of "the effects of the teaching instrument on the pupils" (p. 53). Furthermore, Scriven suggested that weighting both intrinsic and pay-off criteria might be a worthwhile compromise in an evaluation study.

In the textbook Educational evaluation: Theory and practice, Worthen and Sanders (1973) presented the following heuristic device to illustrate the formative and summative and the intrinsic and pay-off evaluation distinction.
Feedback in formative evaluation

Developers of educational products including textbooks, programmed instruction, media, and public school curriculum projects need feedback information during the formative period to facilitate the assessment, improvement, and revision of subsequent versions of the developmental products. According to Baker and Alkin (1973):

Substantial amounts of funds are wasted each year on the purchase and installation of educational products that later prove to be inappropriate or ineffective. To prevent such economic and educational waste and the negative effects it could have on the future acceptance and use of educational products, and at the same time, to improve the products ultimately produced, developers should engage to a greater extent in formative evaluation of all products. Formative evaluation data would provide information to developers that would allow them to modify and improve their products before they are distributed. (p. 389)
The importance of collecting and using formative evaluation data as feedback to developers of educational processes and products was further cited in the literature. Grobman (1971) contributed the following in a curriculum development framework.

The most immediate evaluation need of the developmental curriculum process was the feedback of information on preliminary materials during the process of material preparation, to determine the general feasibility and to obtain clues concerning needed change. (p. 439)

The common element of the two preceding citations was the support of curriculum development and evaluation authorities for using formative evaluation feedback data to facilitate the assessment, revision, and improvement of educational processes and products while these entities are being developed. For the purpose of this study, the use of formative evaluation feedback data was applied to curriculum development and improvement efforts in public school industrial arts education.

**Formative evaluation in industrial arts education**

During the last two decades, a substantial amount of innovation and development in public school industrial arts has materialized. Cochran (1970) summarized and compared the curriculum structure of several innovative industrial arts programs developed in the 1960's. More recently, representatives from state departments of public instruction, teacher education institutions, professional associations, and local
public schools have supported and participated in further development in industrial arts for the public schools. One such effort in Iowa resulted in a document entitled, The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12 (1975).

The purpose of this curriculum guide was to offer samples, examples, and resources for curriculum improvement in industrial arts at the local school level. Although the guide did provide a framework for improvement of instruction, it avoided specifying the exact curriculum structure, course content, and learning activities for Iowa industrial arts programs. The purpose of the guide was expressed as follows:

The Iowa Guide for Curriculum Improvement in Industrial Arts has been prepared to assist teachers and public school administrators in improving the quality of their educational programs.

The guide is a framework for local curricula development. It gives the practicing industrial arts teacher and administrator the freedom and flexibility to innovate and develop unique approaches and methodology for a particular locale. (p. 1)

Therefore, it is the task of the local practicing industrial arts staff to adapt the rationale of the curriculum guide to meet the needs of the particular school system. The individual public schools, teaching staffs, and administrators will need to employ a systematic procedure in revising courses, developing new courses, and evaluating curriculum improvement efforts. This study was designed to investigate the feasibility of adopting or adapting a formative evaluation model to facilitate collection and use of evaluation data during the
formative period in the development, revision, and improvement of industrial arts curriculum at the public school level.

Problem of the Study

The problem of this study was to design and test a formative evaluation model for the development, tryout, and assessment of curriculum materials in public school industrial arts education.

Purpose of the Study

The purposes of this study were to:

(1) expand upon the existing body of knowledge in the field of educational evaluation;

(2) help the industrial arts profession understand the goals, roles, and procedures of formative evaluation; and

(3) assist the industrial arts profession to identify the activities and information sources that can be utilized to evaluate efforts for curriculum development, tryout, and assessment.

Need for the Study

The need for this study was established through the review of literature in these four areas of education: (1) curriculum development, (2) educational evaluation, (3) formative evaluation, and (4) industrial arts education.
Curriculum development

The American educational establishment has felt considerable external and internal pressure during the past twenty-five years. Many factors placed new demands upon the enterprise of public education resulting in a reexamination of the goals, instructional contents, and methods of instruction in American education. According to Doll (1974):

The 1950's became a time of ferment: McCarthyism was rampant, a redefinition of morality was beginning to occur, the family as an institution was declining, and complaints about alleged mathematical and scientific illiteracy in the general population were growing. The schools were ripe for the criticism of their programs which followed the blastoff of Sputnik I in October, 1957. Shortcuts to learning were being sought as a means of meeting criticism . . . . Part of that which came to be called "curriculum reform" was a variant of classical efforts at reform, emphasizing indirect ways of changing programs through adding facilities and materials and altering organizational plans. (p. 11)

During this period, many curriculum development projects were initiated to improve curricula for the purpose of correcting the deficiencies caused by a vast technology explosion. Through such means as the National Defense Education Act (NDEA), the federal government provided large sums of money to support public schools (McGivney and Krahl, 1973, p. 89). According to Grobman (1971) the channeling of federal money through the National Science Foundation (NSF) sparked an era of innovation in science and mathematics curricula (p. 437). One specific innovation in educational development was reported by Grobman as follows:
There was an interest in a new tactic for producing student materials in science that would permit faster updating of curricula — a developmental approach.

Basically, this approach involves the production of new curricula, using experimental tryouts of preliminary materials and collecting feedback from such tryouts to be used for improvement of curriculum prior to its release for general distribution. (p. 436)

Today, the need to improve educational programs during the formative period is not restricted to science curricula. The collection and use of feedback during the curriculum development process is needed in all educational disciplines. This point was emphasized by Hastings (1966), who wrote:

Without such feedback, either the decision to revise or the decision not to revise — and most certainly the decision of how to revise — must be based upon feeling tones and the argument of personal preference. (p. 27)

If the educational establishment is to move toward the point of basing decisions about revision and decisions about adoption on educational purposes and outcomes, we need far more evaluation data of all kinds than we have had in any instance to date. We do need, however, somewhat different kinds of data for the two purposes I mentioned — revision and adoption. (p. 28)

These internal and external pressures upon education affected the way educators thought about the theory and practice of curriculum development and educational evaluation. A further need for development in curriculum development and evaluation theory and practice contributed to the need for this study.
Educational evaluation

Along with the need for program development and innovation in curricula came a need for new evaluation methods. According to Worthen and Sanders (1973):

The late 1950s and early 1960s (the post-Sputnik years) were also years which echoed with cries for curriculum reform. Several major new curriculum projects were initiated across the country; with these innovations came the need for new evaluation procedures. Initially, many curriculum developers attempted to use the familiar controlled experimental design paradigm to evaluate their products; however, this approach proved satisfactory for only some of the evaluation needs, and would-be curriculum evaluators were forced to seek elsewhere for additional methodologies. (p. 4)

The educational evaluation community reacted to the need for additional methodologies, and expansion of the evaluator's body of knowledge has occurred since the mid-1950's. One specific example of these developments included the refinement in the use of educational objectives. Bloom et al. (1956), Mager (1962), Krathwohl et al. (1964), Gronlund (1970), and many other authors have stressed the practice of stating and measuring learning objectives operationally. However, the need still existed for research concerning the use of the evaluation process to assess these objectives. This need was pointed out by Stake (1970), who stated:

Few procedures have been cited that have been used successfully (or even tried) for making judgment data a part of the evaluation story. Excuses are many . . . . But none of the excuses is adequate. It does not matter that evaluators seldom find strong correlates between background conditions — including
aims, needs and standards — and educational outcomes ... . Evaluators have an obligation to make a careful search for objectives, standards, and other judgmental data. (p. 205)

The lack of successful procedures to evaluate educational objectives contributed to the need for this study. However, support for research on evaluation in education was further stated by Cronbach (1963b):

Common practice falls far short of the ideal, both in breadth of evaluation and in use of results. If measurement is intended to obtain marks for administrative purposes, better evaluation would not lead to many changes. We take the larger view that evaluation is an essential part of learning and educational planning. It then follows that improved evaluation is the key to a more effective school. (p. 569)

**Formative evaluation**

In the present state of the art of educational evaluation, the need exists for alternative models for handling judgmental and decision-making data. This research need was pointed out by Sjogren (1970). That author wrote:

The comprehensiveness of evaluation requires many decisions by the evaluator. Study is needed on viable procedures for decisions on what to measure and how to handle the mass of data. (p. 315)

Previously, a theoretical introduction was presented on one such model: formative evaluation. In support of efforts to further develop the techniques of formative evaluation, Flanagan (1969) stated:

In the present state of knowledge regarding the principles and practices of education, it is clear that formative evaluation represents a much more
powerful tool than summative evaluation to anyone wishing to improve education. (p. 221)

This is a period of great potential for progress in American education. Such progress can only be achieved if evaluation methods are rigorously used in the development of educational programs. Too often in the past, innovation in education has involved change without real, lasting improvement . . . . A system of evaluation which provides for continuous improvement of all the aspects of the educational program is especially important at this time. (p. 241)

Further support for formative evaluation was found in the literature. Baker and Alkin (1973) stated:

There is no question but that formative evaluation procedures have been most thoroughly refined and implemented at the regional laboratories and R & D centers developing instructional products. . . . . We maintain that the evidence is clear that well applied formative evaluation procedures are equally appropriate for instructional products of all types. (p. 405)

One important contribution to the improvement of education is the collection and use of evaluation data during the formative period of educational processes and products. Although formative evaluation was not a new concept, need still existed for the improvement of the concepts and procedures utilized in this evaluation paradigm. After reviewing several research studies concerning the use of formative evaluation, Sanders (1972) wrote:

Few, if any, formative evaluation studies cover the full range of possible formative evaluation functions in product development; most, perhaps all, formative evaluation studies have some conceptual problems; and few, if any, formative evaluation studies are free of methodological difficulties as the development of the evaluation process currently stands. (p. 131)
This need for improvement in formative evaluation efforts contributed the most important need for this study. Through further research on the concepts and procedures of formative evaluation some of these problems and difficulties may possibly be eliminated. Further support for this need was given by Baker and Alkin (1973), who stated:

While the number of good examples of formative evaluation is expanding, the level of research into the process is relatively limited. Perhaps a compromise to the difficult task of accumulating research data on formative evaluation might be suggested. When formative evaluation activities have been successful . . . detailed technical reports might be made available to the evaluation public. Formative evaluation might improve as a consequence of the technology developed in the course of finding solutions to developmental problems. Both the increase in technology as a result of dissemination of successful procedures and the pursuit of experimental research on the process of evaluation might ultimately remove formative evaluation recommendations from the realm of seers and clairvoyants and thrust it closer to, if not into, the domain of scientific application. (p. 414)

**Industrial arts education**

The efforts to improve American education in the 1950's and 1960's were not limited to science and mathematics. In industrial arts education, research and development has facilitated changes in the definition of the field, the curriculum base, the educational goals and objectives of industrial arts programs, and the teaching-learning strategies employed by public school industrial arts instructors. However, the job of improving instruction in industrial arts has not been easy.
In part, this difficulty was caused by a diversity of opinion concerning the relationship of industrial arts to general education; an exponential increase in the pool of scientific concepts and principles represented by industrial technology; and a time lag between the development of educational innovations and the dissemination of tested classroom products.

According to Streichler (1966):

Diverse views of industrial arts are apparent in curriculum development. To some, it is a motivating activity; to others, an occupational or pre-occupational subject; some view it as general education which serves all students while making provisions for different abilities; some derive its content from a broad interpretation of technology or American industry while others derive content from a delimited analysis of man's practices in industry in converting materials to products; some analyze processes and materials of specific industries to derive content and others analyze functions common to many industries. While the curriculum situation appears eclectic, it seems that the ongoing curriculum research and development programs may lead to a much needed agreement on the values of industrial arts. Once the values are accepted, the various approaches which are and will be suggested for the achievement of value objectives will, of course, need to be tested empirically. (p. 17)

Streichler's statements concerning the need for agreement on, and empirical testing of, values support the need for this study. Formative evaluation serves not only the formulation of educational goals and objectives, but also the collection of feedback data needed for the assessment, revision, and improvement of program criteria.

Streichler (1966), Householder (1969), and Cochran (1970) reported on several research and curriculum development
projects that addressed the need for improvement in industrial arts education during the 1960's. Householder (1969) reported:

Curriculum development has provided one of the major thrusts of industrial arts research efforts during recent years. (p. 9)

Dissatisfaction with contemporary industrial arts programs coupled with a great deal of effort in improving content selection and analysis procedures has led to a large number of proposals for new educational programs for industrial arts. Some of these curriculum proposals were the result of funded curriculum projects; other proposals resulted from the efforts of individuals or small groups with little or no funding. The major factor in all proposals is the emphasis upon industry in a modern technological society as the base for content selection in industrial arts. (p. 11)

The preceding citations supported the emphasis on efforts directed at the improvement of industrial arts during the last several decades. As a result of these efforts, new and innovative programs related to both industry and technology were developed for public school instruction within general education. Ritz (1976) pointed out:

Research of the 1960's and 1970's indicated that alternatives exist in the teaching of industrial arts. The curriculum materials produced by the American Industry Project and the Industrial Arts Curriculum Project are examples of alternatives in content. In recent years state departments have provided direction on the content that should be emphasized in industrial arts instruction. Wisconsin, Kansas, Minnesota, Iowa, Pennsylvania, Maryland and West Virginia have adopted many of the innovative ideas of the 1960's. (p. 71)

However, further need for development, improvement, and assessment of industrial arts at the public school level contributed to the need for this study. One specific component
still needed in the development of industrial arts was a viable method of identifying and evaluating educational goals, objectives, and alternative instructional materials. Sommers and Face (1966) reported:

There has been little effort to evaluate industrial arts in terms of its own objectives . . . . A reasonable search of the literature and survey of leaders in industrial arts revealed a minimal amount of such evaluation efforts . . . . Without the establishment of an acceptable operational structure of objectives, there can be no rational evaluation, and it is not logical to expect educators to support a program of industrial arts when there has been little done to evaluate it. (p. 26)

Although the statements made by Sommers and Face (1966) were originally made as a plea to form a national committee in industrial education to establish objectives for industrial arts, their observation also contributed to the need for this study. Establishment and assessment of educational goals and objectives is a basic component of formative evaluation.

A lack of research on the process of evaluation related to industrial arts education also contributed to the need for this study. Koble and Thrower (1966) stated:

A search of the research studies reveals that little has been done in the area of research in measurement or evaluation techniques. The majority of research projects have used these techniques but few have researched any phase of them.

Koble and Thrower (1966) further identified a need for research on the process of evaluation related to industrial arts. The authors stated:
This area of education is so nearly void of conclusive research that it is impossible to identify gaps, simply because there are not gaps but wide open panoramas. (p. 38)

The concerns expressed in the previous citations for the lack of research on the process of evaluation and the use of evaluation techniques in industrial arts were stated differently by another author. Householder (1969) added:

Program evaluation has been the subject of renewed interest in industrial arts. No doubt some of the motivation has been a direct result of past criticisms of industrial arts practices and procedures. Critical comments have come both from within the profession and from concerned individuals outside of it. Both groups have observed a disparity between objectives and the content of industrial arts programs . . . .

It is indeed refreshing to note the interest in the evaluation of the attainment of the objectives of industrial arts. While research efforts have not yet provided conclusive evidence that industrial arts objectives have in fact been achieved, the assessments . . . provide a necessary step toward the accumulation of such evidence. Additional research efforts are needed preferably using contemporary statements of industrial arts objectives as guidelines. (p. 42)

The need for continual development, revision, and improvement in the industrial arts curriculum at the public school level further contributed to the need for this study. This need was reinforced in *The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12* (1975), which pointed out:

Regardless of the process used for curriculum development, no curriculum is ever perfect, nor complete, nor can it remain static. Weak points and inconsistencies will continuously arise in even the most carefully developed program . . . . The individual teachers, curriculum committees, and administrators should therefore strive to continuously evaluate and refine the industrial arts curriculum. (p. 8)
This study was designed to formulate an evaluation model for the purpose of continual development and evaluation of curriculum materials in public school industrial arts. This study was conducted to test the applicability of a formative evaluation model to facilitate the identification and assessment of educational goals, instructional objectives, and subsequent instructional materials in industrial arts education at the public school level.

**Summary of the need for the study**

The authorities cited revealed a need for further research concerning the structure and use of evaluation techniques as applied to education in general and industrial arts education in particular. The need for feedback data during the formative period of development of educational entities was supported. The concept of formative evaluation was identified as a useful tool for providing feedback to educational developers. However, the need for further research on the structure and use of formative evaluation was suggested in the literature.

The lack of research concerning the objectives and methods of evaluation used in industrial arts was identified as a contributing need for this study. Furthermore, the need for continual evaluation and refinement of the industrial arts curriculum was supported. Therefore, it was held that there was sufficient need to justify this study.
Questions of the Study

The objective of this study was to investigate the feasibility of adopting or adapting a formative evaluation model to facilitate the collection and utilization of feedback data for public school industrial arts teachers during the formative period of instructional material development. Specific questions derived from the two elements of the problem were advanced to facilitate the execution of the study. The two elements of the problem were the (1) design, and (2) testing of a model for formative evaluation in public school industrial arts. The questions of the study were:

**Designing the model**

Question 1.1 What information-gathering activities produce evaluation feedback for public school industrial arts curriculum developers?

Question 1.2 What evaluation data sources provide evaluation feedback for public school industrial arts curriculum developers?

**Testing the model**

Question 2.1 What effect does the use of a formative evaluation model have on the goals, objectives, and interim versions of materials developed by public school industrial arts teachers?
Question 2.2 What effect does the use of a formative evaluation model have on the attitude of teachers involved in the process of curriculum development, revision, and improvement?

Assumptions of the Study

(1) Formative evaluation represents a viable paradigm for the collection, organization, and utilization of feedback data for development and revision of educational instructional products in industrial arts education.

(2) The public schools, industrial arts teachers, and public school industrial arts students selected to participate in this study were reliable and valid target populations for a formative evaluation study.

(3) The sampling techniques and the statistical methods used in this study were adequate and valid.

Limitations of the Study

Interpretation of the findings of this study was delimited within the context of the limitations of the study. Specifically, those limitations were:

(1) The research was limited to formative evaluation of selected industrial arts developmental goals, objectives, interim materials, and instructional products.

(2) The teachers developing goals, objectives, and interim materials in this study were limited to the participants of
the 1976 Graphic Communications Institute conducted by the Department of Industrial Education at Iowa State University.

(3) The expert panel of judges used in this study was limited to the Iowa Industrial Arts Cadre.

(4) The public school classes used to test the tryout phase of the model were limited to schools utilizing the instructional materials developed by the Graphic Communications Institute.

Procedures of the Study

1. Predevelopment activities.
   1.1 Develop prototype formative evaluation model.
      1.1.1 Review selected evaluation literature.
      1.1.2 Identify relevant concepts.
      1.1.3 Formulate the prototype evaluation model.
   1.2 Identification of the target populations for the assessment of the evaluation model.
      1.2.1 Identify members of the evaluation panel of expert judges.
      1.2.2 Identify the curriculum developers.
      1.2.3 Identify the field test sites.

2. Implementation of the prototype evaluation model.
   2.1 Evaluation of educational goals. (Phase 1.0)
      2.1.1 Develop a five-point Likert-type scale instrument for the evaluation of developmental goals.
2.1.2 Administer the Likert scale instrument to the teacher/developers and the evaluation panel.

2.1.3 Calculate mean, standard deviation, and rank for the goals.

2.1.4 Provide feedback data to the teacher/developers.

2.1.5 Develop revision recommendations as needed.

2.2 Evaluation of objectives. (Phase 2.0)

2.2.1 Develop a five-point Likert-type scale instrument for the evaluation of instructional objectives.

2.2.2 Administer the instrument to the teacher/developers and the evaluation panel.

2.2.3 Calculate mean, standard deviation for objectives.

2.2.4 Provide feedback data to the teacher/developers.

2.2.5 Develop revision recommendations as needed.

2.3 Evaluation of interim materials. (Phase 3.0)

2.3.1 Develop a checklist instrument to facilitate review of the developed instructional materials.

2.3.2 Evaluate interim materials using an interview of the teacher/developers.

2.3.3 Analyze data resulting from the interim material evaluation interviews.
2.3.4 Provide feedback data to the teacher/developers.

2.3.5 Develop revision recommendations as needed.

2.4 Evaluation of products. (Phase 4.0)

2.4.1 Select schools and students for tryout of interim materials.

2.4.2 Develop field test instruments.

2.4.3 Conduct intrinsic and pay-off tryouts.

2.4.4 Analyze data as a result of the material tryout.

2.4.5 Provide feedback on material tryout to the teacher/developers.

2.4.6 Form revision recommendations as needed.

3. Assessment of the evaluation model

3.1 Identify strengths and weaknesses of the model.

3.1.1 Develop model assessment interview materials.

3.1.2 Conduct model assessment interviews.

3.2 Develop revision recommendations as needed.

3.3 Specify evaluation model revisions.
Definition of Terms

Educational Evaluation: Educational evaluation is the process of ascertaining the worth and merits of educational processes and products to supply information for decision making.

Feedback: The term "feedback" is one that psychologists have borrowed from the field of electronics. It refers to a process whereby data are "fed back" into a system (either a human organism or a group can be considered a system) in order to modify and correct its behavior (Lindgren, 1956, p. 5).

Formative Evaluation: Formative evaluation refers to the process of judging a fluid process or product that can be revised in form. The results of formative evaluation studies are given to persons directly involved in the process or in developing the product (Cunningham, 1973, p. 217).

Formative Period: The formative period is the period during which materials are being developed. The initial preparation of experimental materials, the preliminary classroom tryouts, and the revising and additional experimental tryouts typify the formative period (Grobman, 1970, p. 5).

Industrial Arts Education: Industrial arts, as a curriculum area, are those phases of general education which deal with technology--its evolution, utilization, and
significance; with industry—its organization, materials, occupations, processes, and products; and the problems and benefits resulting from the technological and industrial nature of society (Maley, 1973, p. 3).

Model: A model is a well-developed descriptive analogy used to help visualize, often in a simplified or miniature way, phenomena that cannot be easily or directly observed. Each model is thus a projection of a possible system of relationships among phenomena, realized in verbal, material, graphic, or symbolic terms (Snow, 1973, p. 81).

Quasi-Experimental Design: The term quasi-experimental design represents a group of research designs "that are distinguished from true experimental design." They are designs in which random assignment to experimental treatments is not possible because subjects are members of intact groups (Borg and Gall, 1971, p. 372).
CHAPTER II. REVIEW OF LITERATURE

Introduction

The growth of educational evaluation during the past fifteen years has been compared to the development of educational psychology at the turn of the century. At the end of the nineteenth and the beginning of the twentieth century, schools of thought were prevalent in psychology. Snelbecker (1974), in the text Learning theory, instructional theory, and psychoeducational design, labeled the period of 1900 to 1930 as "the era of 'schools' of psychology" (p. 54). These schools of psychology included structuralism associated with Edward Titchener; functionalism influenced by John Dewey; behaviorism originated by John Watson; Gestalt psychology influenced by Wetteimer, Kohler, and Koffka; and psychoanalysis pioneered by Sigmund Freud. The schools of psychology delineated psychological theory and attempted to account for a wide array of learning at the basic science level.

The following twenty years of development in educational psychology was labeled "the era of comprehensive learning theories" (Snelbecker, 1974, p. 62). The comprehensive learning theories built upon the scientific foundation of previous work attempted to account for a wider array of learning, and delineated basic science principles and findings to generate applied science methodologies including attempts to improve classroom instruction and student learning.
Numerous examples of the influence of psychological theory in the improvement of education were discussed in the literature. According to Sanders (1972):

Functional psychology and the influence of Stanley Hall had a tremendous influence on methods adopted by teachers. But other schools of thought, namely Pavlov's reflexology, Watson's behaviorism, psychoanalysis, Gestalt psychology, and Thorndike's connectionism, all influenced the curriculum of teacher education programs in the present century. It is worth noting that no educational psychologist accepted all of these views, for several were incompatible, but instead he would choose, in an eclectic manner, those principles that were most useful in teaching children better. (p. 15)

The thesis of this illustration was that the field of educational psychology went through three specific stages in development: (1) theory generation, (2) expansion of theory through research and development, and (3) educational utilization. The eclectic adopting and adapting of specific principles from the learning theories for the improvement of classroom instruction and student learning was labeled "psychoeducational design" (Snelbecker, 1974, p. 159).

Approaching the evaluation theory development process, a parallel to that of educational psychology was used. Chapter Two utilized a parallel development by tracing the dominant schools of evaluation thought that evolved over the past seventy years; by identifying specific evaluation models that expanded upon the body of knowledge of evaluation; and by eclectically selecting evaluation principles and concepts which
appeared useful in evaluating public school industrial arts curriculum development and revision.

Schools of Evaluation

The Research Advisory Committee of Phi Delta Kappa published an evaluation text entitled *Educational evaluation and decision making*. This work, the result of a committee venture under the chairmanship of Daniel Stufflebeam, recognized three specific schools of evaluation thought which have emerged in education since the beginning of this century. Other authors have added: "In education, at least three different schools of thought about how evaluation should be defined have co-existed for at least 30 years" (Worthen and Sanders, 1973, p. 20).

Evaluation as measurement

The first school of evaluation thought identified was the measurement school. According to Lange (1974):

This concept of evaluation has been in existence since the history of mankind. However, for the majority of this time evaluation was performed very informally. Everyone evaluated and made judgments based upon personal observations. During the early 1900s the concept of evaluation in education began to receive formal definition. The first thirty years of this century has been called the testing movement in evaluation and led to the development of measurement procedures in the form of standardized tests. (p. 22)

Additional insight into the evaluation as measurement school of thought was found in the literature. Worthen and Sanders (1973) wrote:
In the early 1900s Robert Thorndike, called the father of the educational testing movement, was instrumental in convincing educators of the value of measuring human change. The measurement technology for determining human abilities flourished during the first two decades of this century in the United States.

The development of standardized achievement tests for use in large-scale testing programs was a natural outgrowth of the measurement movement. Also, teacher-made achievement tests flourished and formed a basis for most school grading systems. Techniques of personality and interest testing were also developed during this period. The military and industry began to use these new tools to evaluate applicants or recruits as a part of personnel selection and classification. (p. 3)

The concept that was evident from the above illustration was the close tie between the educational measurement school of evaluation and the development and use of measurement theory in psychology. The transition in the study of psychological behavior from introspection to more objective procedures served as a model for educational evaluators to study student learning.

The measurement school of evaluation was defined mathematically by Stufflebeam et al. (1971). Their symbolized definition of this evaluation school was:

\[ E \equiv M. \]  
(1)

The identity in Equation 1 should be read: evaluation (E) is identical to measurement (M) (Stufflebeam et al., 1971, p. 10). This definition is characteristic of the evaluation as measurement movement associated with Thorndike. An
The operational definition of this school of evaluation was offered by Thorndike and Hagen (1961) when they wrote:

The term "evaluation" as we use it here is closely related to measurement. It is in some respects more inclusive, including informal judgments of pupil progress. It also includes more definitely the aspects of valuing — of saying what is desirable and good. Good measurement techniques provide the solid foundation for sound evaluation, whether of a single pupil or of a total curriculum. (p. 27)

Examples of this measurement school of evaluation were numerous in the literature. Stanley and Hopkins (1972) further illustrated this definition by stating:

We use the word evaluation to designate the summing-up process in which value judgments play a large part, as in grading and promoting students. We consider the construction, administration, and scoring of tests as the measurement process. Interpreting such scores — saying whether they are good or bad for a specific purpose — is evaluation. (p. 3)

Common to the aforementioned illustrations was the foundation of measurement and judgment in educational evaluation. The measurement movement in education was closely associated with the measurement movement in psychology. Under the measurement paradigm, educational progress and worth would be assessed in psychometric terms using norm referenced data produced from achievement tests, scholastic batteries, teacher-made tests, and similar instruments. Decisions on what to test, when to test, and how to interpret resulting test data were examples of the judgments indicated in the previous examples.
The educational measurement school of evaluation represented an attempt to increase the objectivity of observation in education through the collection and use of quantifiable and qualifiable data. This definition of evaluation made plausible mathematical and statistical manipulation of the assessment data produced in the evaluation of educational entities.

**Performance-objective congruence**

The second school of educational evaluation thought identified was the performance-objective congruence school. This second major thrust which began during the 1930's introduced educational objectives and the assessment of congruence between stated objective and achievement (Lange, 1974, p. 22).

Stufflebeam et al. (1971) presented the following symbolized definition of evaluation in terms of this school of thought. This definition was:

\[ E = (P=O). \]  \hspace{1cm} (2)

The definition of Equation 2 should be read: evaluation (E) is the process of determining the congruence between performance (P) and objective (O) (Stufflebeam et al., 1971, p. 11). Ralph Tyler has exemplified this definition of evaluation through his work including the Eight-Year Study of the 1930's and the National Assessment of Educational Progress of the 1960's and 70's.
The performance-objective congruence school of evaluation focused on both student and curriculum characteristics within the educational enterprise. This definition of educational evaluation promoted the use of feedback concerning the degree of correspondence between stated objectives and observable student, teacher, and program performances or output. Concomitant with this definition are two types of evaluation: (1) product evaluation including the assessment of student attainment of stated objectives, and (2) process evaluation which assesses the procedural barriers included within the learning environment. However, product evaluation is the more common element in this school of thought.

An example of the performance-objective congruence definition of educational evaluation was illustrated by Smith and Tyler (1942), who stated:

An appraisal of an educational institution is fundamentally only the process by which we find out how far the objectives of the institution are being realized. (p. 5)

An educational program is appraised by finding out how far the objectives of the program are actually being realized. Since the program seeks to bring about certain changes in the behavior of students, then it follows that an evaluation of an educational program is a process for finding out to what degree changes in the students are actually taking place. (p. 12)

The basic procedures in assessing the congruence between performance and objective have changed little since the Eight-Year Study. Smith and Tyler (1942) reported the general
procedures in developing the process of evaluation. A representation of those procedures is presented in Figure 3.

1. Formulating objectives.
2. Classifying objectives.
3. Defining objectives in terms of behavior.
4. Suggesting situations in which the achievement of objectives will be shown.
5. Selecting and trying promising evaluation methods.
6. Developing and improving appraisal methods.
7. Interpreting results.

Figure 3. Procedures for a Tylerian evaluation paradigm (Smith and Tyler, 1942, p. 15-28)

Review of current literature on educational assessment indicated little change in performance-objective congruence evaluation procedures. This school of evaluation was built upon the foundation and instrumentation of the measurement school but placed more emphasis on using behavioral objectives as learning criteria. The work of Bloom et al. (1956), Mager (1962), Krathwohl et al. (1964), Gagne (1965), and Gronlund (1970, 1971) has served as models for operationalizing desired student objectives and program objectives; constructing taxonomies of objectives in the learning domains; and writing criterion-referenced measures.
The behavioral objectives associated with the performance-objective congruence definition, represented by Equation 2, give this school of evaluation thought built-in criteria for the assessment of educational processes and products. However, opponents of performance objectives including Combs (1972), Griffin (1973), and Wight (1973) cited the possible reduction-istic effect in the identification and use of performance competencies. These opponents of performance objectives pointed out several other problems that could occur with the misuse of behavioral objectives including: the restriction of educational evaluation to the lower level of the learning domains, the focus on trivia or mundane learning, and the de-humanizing tendency associated with the mechanics of using objectives.

Professional judgment

The third school of evaluation thought identified by Stufflebeam et al. (1971) was represented by the identity

\[ E \equiv PJ. \]  

The evaluation definition symbolized in Equation 3 should be read: evaluation (E) is identical to professional judgment (PJ) (Stufflebeam et al., 1971, p. 14). Further insight into the professional judgment school was given by Worthen and Sanders (1973), who stated:
The accreditation movement, which began in the late 1800s, became stronger during [the 1930s] and began for the first time to gain a solid foothold in educational practice. With the establishment of formal accrediting agencies for schools and colleges came the institutionalization of at least a quasi-evaluation process in American education. (p. 3)

In addition to accrediting associations, this school of evaluation is exemplified by graduate school student advisory committees, grant institution review committees, and professional review boards. The professional judgment definition of Equation 3 is evidenced in many current evaluation practices where judgments are based on opinions of experts, whether or not criteria in reaching those judgments are clear (Worthen and Sanders, 1973, p. 20).

Evaluation by professional judgment can have the advantage of being expedient and easy to manage. Professional judgment can be rendered and utilized without excessive instrumentation or substantial delay between collection and utilization of judgmental data.

Comparison of the Schools of Evaluation

Within each school of evaluation thought exists a body of evaluation theory and methodologies for conducting evaluation. Worthen and Sanders (1973) retrospectively compared these schools as follows:

If one defined evaluation as essentially synonymous with professional judgment, the worth of curriculum X would be assessed by experts observing the curriculum in action, examining the curriculum materials or, in some other ways, gleaning sufficient information
to record their considered judgments about the curriculum. If evaluation is equated with measurement, the curriculum might be judged on the basis of student scores on standardized tests in relevant subjects. If evaluation is viewed as a comparison between performance indicators and objectives, behaviorally stated objectives would be established for the curriculum and relevant student behaviors would be measured against this yardstick, using either standardized or evaluator-constructed instruments. (p. 21)

A further comparison of the three schools of evaluation thought seen in Table 1 was adopted from Stufflebeam et al. (1971). This heuristic device compared the definitions, advantages, and disadvantages under each school of evaluation.

Contemporary Evaluation Models

During the past ten years, considerable development in the theoretical base of educational evaluation has taken place. These developments have built upon the theory and practice of the three aforementioned schools of evaluation. Several evaluators have attempted to delineate models to serve as frameworks for both the study and application of educational evaluation. According to Worthen and Sanders (1973), new definitions for evaluation developed over the last ten years are seen both implicitly and explicitly in the writings of "Stake (1967), Provus (1969), and Stufflebeam (1971)" (p. 20).

Another source identified what was considered the six best known developers of educational evaluation models. The developers and the names of these six evaluation models are presented in Figure 4.
<table>
<thead>
<tr>
<th>Definition</th>
<th>Advantage</th>
<th>Disadvantage</th>
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<tbody>
<tr>
<td>I. Evaluation as Measurement</td>
<td>Builds directly on scientific measurement movement.</td>
<td>Narrow instrument focus.</td>
</tr>
<tr>
<td>( E \equiv M )</td>
<td>Objective.</td>
<td>Inflexibility because of time and cost to produce new instruments.</td>
</tr>
<tr>
<td></td>
<td>Reliable.</td>
<td>Judgments and the criteria for making them are obscure.</td>
</tr>
<tr>
<td></td>
<td>Data are mathematically manipulable.</td>
<td>Variables currently considered as not measurable are eliminated, or labeled unimportant.</td>
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<td></td>
<td>Norms and standards emerge.</td>
<td></td>
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<tr>
<td>II. Congruence between Performance and Objectives</td>
<td>High degree of integration with the instructional process.</td>
<td>Places evaluator in technical role.</td>
</tr>
<tr>
<td>( E \equiv (P=O) )</td>
<td>Data available on both student and curriculum.</td>
<td>Focused narrowly on objectives.</td>
</tr>
<tr>
<td></td>
<td>Possibility of feedback.</td>
<td>Elevates behavior as the ultimate criterion of every educational action.</td>
</tr>
<tr>
<td></td>
<td>Objective referent and built-in criteria.</td>
<td>Focuses on evaluation as a terminal process.</td>
</tr>
<tr>
<td></td>
<td>Possibility of process as well as product data.</td>
<td></td>
</tr>
</tbody>
</table>
III. Professional Judgment

E ≡ PJ

Easy to implement. Brings all variables into consideration. Takes experience and expertise into account. No time lag while waiting for data analysis.

Dictated mainly because of ignorance or lack of sophistication. Questionable reliability. Questionable objectivity. Not susceptible to ordinary scientific prudential measures. Both data and criteria are ambiguous. Generalization very difficult.

Figure 4. Six innovative evaluation models (Wenig, 1974)

Further identification of the developments of the 1960's and 70's to expand upon the theory and practice of educational evaluation was seen in the literature. Lange (1974) pointed out:

A number of individuals have devoted considerable effort to develop definitions and generating frameworks for evaluation. Although many definitions and frameworks have been published, most are similar in content to those described by Scriven, Provus, Stake, Guba and Stufflebeam. (p. 25)

Other authors in the field of curriculum development singled out three evaluation models. Saylor and Alexander (1974) stated:

Three models that we believe constitute at the present time the best approaches to evaluation . . . are Robert Stake's Congruence-Contingency model, the evaluation methodology and model presented by the Phi Delta Kappa National Study Committee on Evaluation, of which Daniel Stufflebeam was Chairman . . . , and
the Discrepancy Evaluation model, developed by Malcolm Provus for the Pittsburgh Schools. (p. 304)

Analysis of the preceding illustration provides consensus regarding the identification of evaluation models developed in the last decade. Four specific models were repeatedly cited. Therefore, the following section of this chapter reviewed the basic framework presented by (1) Scriven, (2) Stake, (3) Stufflebeam, and (4) Provus.

Methodology of evaluation (Scriven)

In the AERA Monograph 1, on curriculum evaluation, Michael Scriven (1967) presented a paper entitled "The methodology of evaluation." In this paper, no heuristic devices were given to model evaluation theory. However, Scriven's work has served as a cornerstone for numerous other developers of educational evaluation, including Bloom et al. (1971), Cunningham (1973, 1974), Lawson (1974), Sanders (1972, 1973), Sanders and Cunningham (1973), and Worthen and Sanders (1973).

To Scriven, evaluation was seen as a methodological activity and his article developed a framework for evaluation of educational entities. This concept of curriculum evaluation was operationalized as follows:

The activity consists simply in gathering and compiling of performance data with a weighted set of goal scales to yield comparative or numerical ratings, and in the justification of (a) the data gathering instrument, (b) the weightings and (c) the selected goals. (Scriven, 1967, p. 40)
Throughout the process of evaluation outlined above, Scriven was concerned with assessing the worth and merits of educational entities. Within this methodology, the assessment of the goals of an educational entity, the assessment of the evaluation procedures, and evaluation of the educational entity are tantamount.

A major contribution to the field of educational evaluation resulting from Scriven's work was the articulation of two concepts alluded to four years earlier by Lee Cronbach. In the article "Course Improvement Through Evaluation," Cronbach (1963a) pointed out:

The greatest service evaluation can perform is to identify aspects of the course where revision is desirable . . . . Evaluation, used to improve the course while it is still fluid, contributes more to the improvement of education than evaluation used to appraise a product already placed on the market. (p. 679)

Scriven (1967) distinguished these two roles of educational evaluation as formative evaluation and summative evaluation (p. 42). Formative and summative evaluation in Scriven's paper dealt with evaluation of educational entities on a conceptual level. Later developments in the formative-summative evaluation distinction have included evaluation of student learning (Bloom et al., 1971) and evaluation of educational products and curricula elements (Sanders and Cunningham, 1973). No matter which of the four sources one selects, the basic assumptions of formative and summative evaluation are consistent.
Formative evaluation deals with the evaluation of educational entities in the various stages of development. Summative evaluation assumes a finished disposition: as in grading of students at the end of a course of instruction or as in judging the worth and merit of a completed curriculum after considerable field testing.

Scriven (1967) did not attempt to claim that formative evaluation was a new concept. Rather, he pointed out: "curriculum builders almost automatically engage in formative evaluation" by judging developmental materials, by field testing these materials, and by getting feedback for future revisions (p. 43). However, he did attempt to give new substantiveness to the methodology of conducting both formative and summative evaluations.

The essence of Scriven's methodology included the use of goals, construction of a test question pool, and both intrinsic and pay-off examination of the educational goals and the test question pool. The educational goals identified in this evaluation framework include any developmental targets agreed upon by educational developers. Within the formative evaluation paradigm, the very goals which guide the development of the educational entity become subject to judgment of worth and merit. In the formative stage of development goals can be revised and reevaluated.
The test question pool was seen by Scriven as an "operational encapsulation of the goals" (p. 58). The use of the test question pool serves both formative and summative evaluators. Testing during the formative stages of development serves as feedback to developers on the merits of interim versions of educational processes and products. Summative testing serves as final confirmation of student learning or program success.

Within the framework of Scriven's methodology of educational evaluation, three matching problems existed. These problems are summarized in Figure 5.

1. Matching goals and course content.
2. Matching goals and examination content.
3. Matching course content and examination content.

Figure 5. Three matching problems in the methodology of evaluation (Scriven, 1967, p. 59)

The problems in Figure 5 are similar to the procedural outline under the performance-objective congruence school of educational evaluation. However, Scriven's methodology suggested two different approaches for evaluating how well the above problems are solved. The two approaches identified by Scriven were called intrinsic and pay-off evaluation. Scriven
(1967) illustrated these approaches as follows:

The first approach involves an appraisal of the instrument itself; in the analog this would involve evaluation of the content, goals, grading procedures, teacher attitudes, etc. We shall call this kind of approach intrinsic evaluation. The criteria are usually not operationally formulated, and they refer to the instrument itself. The second approach proceeds via an examination of the effect of the teaching instrument on the pupil, and these alone, and it usually specifies these rather operationally. It involves an appraisal of the differences between pre- and post-tests, between experimental groups and control groups, etc., on a number of criterial parameters. We can call this pay-off evaluation. (p. 54)

Under the intrinsic and pay-off paradigm, both professional judgment and test measurement are called for. The intrinsic component of this framework could make use of professional judgment to assess the internal qualities of an educational process or product. Examples of these internal qualities include the examining of educational instruments for content validity; the judging of the test question pool for content validity and congruence with both goals and instrument content; and the appraisal of the developmental goals for face validity.

The pay-off component of this evaluation framework includes both experimental and quasi-experimental design associated with educational research. Thus, Scriven's evaluation framework represents an attempt to bridge the gap between the three schools of evaluation identified earlier in this chapter. Scriven's ideas called for judgment, measurement, and
objectives or operationalized goals in the methodology of educational evaluation.

Countenance of educational evaluation (Stake)

In an article entitled "The countenance of educational evaluation," Robert Stake (1967) presented an evaluation framework which called for two basic acts in the evaluation of educational programs. According to Stake (1967), "both description and judgment are essential" in educational evaluation (p. 525). The conceptual framework for evaluation provided by Stake called for the gathering of data from several different sources through several different methods. Within Stake's model, evaluation data collected would include information concerning antecedents, transactions, and outcomes of an educational entity (p. 528). Stake's definitions of these attributes of evaluation were as follows:

**Antecedents** An antecedent is any condition existing prior to teaching and learning which may relate to outcomes. The status of a student prior to his lesson . . . and the investments in community resources are examples of educational antecedents.

**Transactions** Transactions are the countless encounters of students with teacher, student with student, author with reader, parent with counselor — the succession of engagements which comprise the process of education.

**Outcomes** Outcomes are the abilities, achievements, attitudes, and aspirations of students resulting from an educational experience. Outcomes are the consequence of educating. (p. 528)
According to Stake, "antecedents, transactions, and outcomes are the elements of evaluation statements and have a place in both description and judgment" (p. 528). A matrix presentation of this model is seen in Figure 6.

Figure 6. A layout of statements and data to be collected by the evaluator of an educational program (Stake, 1967, p. 532)
Stake considered educational goals, objectives, and intents to be synonymous. Educational intents, according to this model, included more than just the intended student outcomes of an instructional instrument. In Stake's view:

Intents includes the planned-for environmental conditions, the planned-for demonstrations, the planned-for coverage of certain subject matter, etc., as well as the planned-for student behavior. (p. 530)

Two additional facets of the countenance of evaluation framework provide the rationale for processing descriptive evaluation data. These facets include: (1) finding the contingencies among intended antecedents, transactions, and outcomes; and (2) finding the congruence between intents and observations (p. 532).

A school program is congruent when its intended antecedents, transactions, and outcomes transpire. Therefore, this framework suggested that an evaluator should collect information about a program's intended and observed antecedents, transactions, and outcomes and should describe discrepancies and congruence that result. However, Stake (1967) pointed out:

The relationships or contingencies among variables deserve additional attention. In the sense that evaluation is the search for relationships that permit the improvement of education, the evaluator's task is one of identifying outcomes that are contingent upon particular antecedent conditions and instructional transactions. (p. 534)

The countenance of educational evaluation framework contained suggestions for both the formative and the summative evaluator. According to Stake, the formative evaluator is
interested in the contingencies pictured in Figure 7. Stake suggested that

Formative evaluators should look for covariations within the evaluation studies, and across studies, as a basis for guiding development of present and future programs. (p. 539)

Descriptive data

Figure 7. A representation of the processing of descriptive data (Stake, 1967, p. 533)
Stake further suggested that summative evaluation of educational entities should follow a different model. In that model, summative evaluators would judge the goodness-of-fit of an available curriculum to an existing school program by learning whether or not the intended antecedents, transactions, and outcomes for the curriculum are consistent with the resources, standards, and goals of the school (1967, p. 539).

**CIPP evaluation model (Stufflebeam)**

The CIPP evaluation model has been generated and reported through a series of articles and textbooks including Stufflebeam (1966, 1967, 1969) and Stufflebeam et al. (1971). Two components of this evaluation framework incorporating judgment and decision making were evident in the definition:

> Educational evaluation is the process of delineating, obtaining, and providing useful information for judging decision alternatives. (Stufflebeam et al., 1971, p. 40)

According to this definition, the major purpose of educational evaluation is to serve decision making. In a program development context, the decision maker is an agent of the program developer. In Stufflebeam's framework, the role of the evaluator is to delineate, obtain, and provide information to the decision maker (1971, p. 215).

The methodology of evaluation, as specified by Stufflebeam (1969), includes "four functions: collection, organization, analysis, and reporting information" to the decision maker
Furthermore, according to this framework, information which services decision making must be:

- valid (suited to variables of interest), reliable (reproducible), timely (available when the decision-maker needs it), credible (trusted by the decision-maker and those he must serve), and pervasive (available to all decision-makers who need it). (Stufflebeam, 1967, p. 129)

An integral part of this evaluation framework included the structure of decision making. Stufflebeam et al. (1971) conceptualized four different types of decision situations as seen in Figure 8.

The schema seen in Figure 8 represented the interactions of a 2 x 2 classification matrix. The two classification variables were (1) information grasp representing high or low understanding of the variables under study, and (2) degree of change representing a continuum from small to high amount of change associated with a particular educational situation. The interactions among the classification variables created the four decision-making settings: metamorphism, homeostasis, incrementalism, and neomobilism.

Metamorphic decision settings are utopian situations in which large degree of change is associated with a high information grasp and according to Stufflebeam et al. (1971) is primarily theoretical and not often seen in education (p. 67). Homeostatic decision settings represent situations in which high information grasp accompanies a small degree of change. Incremental decision settings have low information grasp with
<table>
<thead>
<tr>
<th></th>
<th>HOMEOSTASIS</th>
<th>METAMORPHISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>Activity: Restorative</td>
<td>Activity: Utopian</td>
</tr>
<tr>
<td></td>
<td>Purpose: Maintenance</td>
<td>Purpose: Complete change</td>
</tr>
<tr>
<td></td>
<td>Basis: Technical standards and quality control</td>
<td>Basis: Overarching theory</td>
</tr>
<tr>
<td>INFORMATION</td>
<td>INCREMENTALISM</td>
<td>NEOMOBILISM</td>
</tr>
<tr>
<td></td>
<td>Activity: Developmental</td>
<td>Activity: Innovative</td>
</tr>
<tr>
<td></td>
<td>Purpose: Continuous improvement</td>
<td>Purpose: Inventing, testing, and diffusing solutions to significant problems</td>
</tr>
<tr>
<td>G R A S P</td>
<td>Basis: Expert judgment</td>
<td>Basis: Conceptualization, heuristic investiga­tion and structured inquiry</td>
</tr>
<tr>
<td>LOW</td>
<td>SMALL DEGREE OF CHANGE</td>
<td>LARGE</td>
</tr>
</tbody>
</table>

Figure 8. Decision-making settings (Stufflebeam et al., 1971, p. 62)
small degree of change and such activities are "for purpose of continuous improvement in a program" through congruence evaluation (Stufflebeam et al., 1971, p. 68). Neomobilistic decision settings represent situations in which low information grasp accompanies large degree of change. "Neomobilistic decision making denotes innovative activity for inventing, testing and diffusing new solutions to significant problems" (Stufflebeam et al., 1971, p. 69).

A second classification presented by Stufflebeam et al. (1971) represented the types of decisions associated with educational programs. This classification is presented in Figure 9.

<table>
<thead>
<tr>
<th>INTENDED</th>
<th>ACTUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENDS</td>
<td></td>
</tr>
<tr>
<td>PLANNING DECISIONS to</td>
<td>RECYCLING DECISIONS to</td>
</tr>
<tr>
<td>determine objectives</td>
<td>judge and react to</td>
</tr>
<tr>
<td></td>
<td>attainment</td>
</tr>
<tr>
<td>MEANS</td>
<td>IMPLEMENTING DECISIONS to</td>
</tr>
<tr>
<td>STRUCTURING DECISIONS</td>
<td>utilize, control and refine procedures</td>
</tr>
<tr>
<td>to design procedures</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9. Types of decisions (Stufflebeam et al., 1971, p. 80)
According to Figure 9, educational decisions may be classified by (1) intended ends or goals; (2) intended means or procedural design; (3) actual means or procedures in use; and (4) actual ends or attainment. Furthermore, Stufflebeam et al. (1971) stated:

This schema provides for the identification of four types of educational decisions serviced by four special types of evaluation: (1) planning decisions to determine objectives, (2) structuring decisions to design procedures, (3) implementing decisions to utilize, control, and refine procedures, and (4) recycling decisions to judge and react to attainment. (p. 80)

Associated with the four types of decisions in education, four types of evaluation were identified. This evaluation model has been named CIPP and stands for context, input, process, and product evaluation. According to Stufflebeam et al. (1971) each of these elements serves decision making as follows:

- Context evaluation serves planning decisions to determine objectives;
- Input evaluation serves structuring decisions to determine project design;
- Process evaluation serves implementing decisions to control project operations; and
- Product evaluation serves recycling decisions to judge and react to project attainment. (p. 218)

The classification system used by Stufflebeam (1967, 1969) to define each component of the CIPP Evaluation Model are presented in Table 2. These components were further summarized as follows:
Table 2. The CIPP evaluation model  (Stufflebeam, 1967, p. 130)

<table>
<thead>
<tr>
<th></th>
<th>Context evaluation</th>
<th>Input evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OBJECTIVE</strong></td>
<td>To define the operation context, to identify and assess needs in the context, and</td>
<td>To identify and assess system capabilities, available input strategies, and</td>
</tr>
<tr>
<td></td>
<td>to identify and delineate problems underlying the needs.</td>
<td>designs for implementing the strategies.</td>
</tr>
<tr>
<td><strong>METHOD</strong></td>
<td>By describing individually and in relevant perspectives the major subsystems of the</td>
<td>By describing and analyzing available human and material resources, solution</td>
</tr>
<tr>
<td></td>
<td>context; by comparing actual and intended inputs and outputs of the subsystems; and</td>
<td>strategies, and procedural designs for relevance, feasibility and economy in the</td>
</tr>
<tr>
<td></td>
<td>by analyzing possible causes of discrepancies between actualities and intentions.</td>
<td>course of action to be taken.</td>
</tr>
<tr>
<td><strong>RELATION TO</strong></td>
<td>For deciding upon the setting to be served, the goals associated with meeting needs</td>
<td>For selecting sources of support, solution strategies, and procedural designs, i.e.,</td>
</tr>
<tr>
<td><strong>DECISION-MAKING IN</strong></td>
<td>and the objectives associated with solving problems, i.e., for planning</td>
<td>for programming change activities.</td>
</tr>
<tr>
<td><strong>THE CHANGE</strong></td>
<td>process.</td>
<td></td>
</tr>
<tr>
<td><strong>PROCESS</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Continued

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>Process evaluation</th>
<th>Product evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To identify or predict, in process, defects in the procedural design or its implementation, and to maintain a record of procedural events and activities.</td>
<td>To relate outcome information to objectives and to context, input, and process information.</td>
<td></td>
</tr>
<tr>
<td>By monitoring the activity's potential procedural barriers and remaining alert to unanticipated ones.</td>
<td>By defining operationally and measuring criteria associated with the objectives, by comparing these measurements with predetermined standards or comparative bases, and by interpreting the outcome in terms of recorded input and process information.</td>
<td></td>
</tr>
<tr>
<td>METHOD</td>
<td>For implementing and refining the program design and procedure, i.e., for effecting process control.</td>
<td>For deciding to continue, terminate, modify or refocus a change activity, and for linking the activity to other major phases of the change process, i.e., for evolving change activities.</td>
</tr>
<tr>
<td>RELATION TO DECISION-MAKING IN THE CHANGE PROCESS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Context Evaluation  The major objective of this stage of the CIPP Model is to define the environment where change is to occur, the environment's unmet needs, and the problems underlying those needs. Context evaluation provides information for deciding upon the setting to be served, the goals associated with meeting needs, and objectives associated with solving problems.

Input Evaluation  To determine how to utilize resources to meet program goals and objectives, it is necessary to conduct Input Evaluation. Its objective is to list relevant capabilities of the proposing agency, strategies which may be appropriate for meeting program goals, and designs which may be appropriate for achieving objectives associated with each program goal.

Process Evaluation  Once a planned course of action has been approved and implementation of the plan begun, Process Evaluation is needed to provide feedback to project administrators and others responsible for continuous control and refinement of plans and procedures. The objective of Process Evaluation is to detect or predict, during the implementation stage, defects in procedural design or its implementation.

Product Evaluation  This form of evaluation is used to determine the effectiveness of the product. The objective of Product Evaluation is to relate outcomes to objectives and context and input to measure and interpret outcomes. The method is to define operationally measured criteria associated with the objectives of the activity, to compare these measurements with predetermined standards on a comparative basis, and to make rational analyses of the outcomes using the recorded context, input, and process information. (Stufflebeam, 1967, p. 129-131)

Stufflebeam et al. (1971) presented an evaluation model for the total evaluation program. This model represented a synthesis of four evaluation concepts presented in previous work. According to Stufflebeam et al. (1971):

These are the three major steps in the evaluation process (delineating, obtaining, and providing), the three classes of change settings (homeostasis,
incrementalism, and neomobilism), the four types of evaluation (context, input, process, and product), and the four types of decisions (planning, structuring, implementing, and recycling). (p. 238)

The model presented in Figure 10 represents a framework for conceptualizing the decisions, activities, and evaluations needed in a total program evaluation paradigm.

**Discrepancy evaluation model (Provus)**

In the 68th Yearbook of the National Society for the Study of Education entitled *Educational evaluation: New roles, new means*, Malcolm Provus (1969) presented a chapter entitled "Evaluation of ongoing programs in the public schools." In that chapter, Provus conceptualized educational evaluation as a decision-oriented activity. His work "attempted to apply evaluation and management theory to the evaluation of programs in a large city school system" (p. 244).

The decision orientation of evaluation given by Provus was similar to Stufflebeam's. However, in the Provus framework three specific decision types were specified. These decisions included whether to (1) improve, (2) maintain, or (3) terminate an educational program (p. 245). An operational definition of evaluation under this decision oriented framework was:

Evaluation is the process of (a) agreeing upon program standards, (b) determining whether a discrepancy exists between some aspect of the program and the standards governing that aspect of the program, and (c) using discrepancy information to identify the weaknesses of the program. (p. 245)
Figure 10. Total program evaluation model (Stufflebeam et al., 1971, p. 236)
A major assumption made by Provus was that a system's analytical network of "processes inputs to produce outputs" could generalizably model evaluation of ongoing educational programs (p. 245). The five-stage systems network developed by Provus (1969) can be seen in Figure 11.

Figure 11. A flow chart designed to facilitate comparisons of program performances with standards (Provus, 1969, p. 247)

The five developmental stages represented in Figure 11 were program (1) definition, (2) installation, (3) process, (4) product, and (5) an optional cost-benefit analysis. The evaluation content of each stage of the discrepancy model
65

summarized by Saylor and Alexander is illustrated in Figure 12.

<table>
<thead>
<tr>
<th>Stages</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Design</td>
<td>Design Adequacy</td>
</tr>
<tr>
<td>2. Installation</td>
<td>Installation Fidelity</td>
</tr>
<tr>
<td>3. Process</td>
<td>Process Adjustment</td>
</tr>
<tr>
<td>4. Product</td>
<td>Product Assessment</td>
</tr>
<tr>
<td>5. Program Comparison</td>
<td>Cost-Benefit Analysis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input</th>
<th>Process</th>
<th>Output</th>
</tr>
</thead>
</table>

Figure 12. Discrepancy evaluation stages and content  
(Saylor and Alexander, 1974, p. 309)

In Stage I, program definitions including description of the objectives, antecedents, processes, and outcomes are developed and become the initial standards for subsequent evaluation efforts. The evaluation scenario under this framework consisted of moving through the first four stages of the flow chart to facilitate the assessment of the congruence between program performance and standards. This closed loop iterative model specified four decision alternatives:

Discrepancy information always leads to a decision to (a) go on to the next stage, (b) recycle the stage after there has been a change in the program's standards or operations, (c) recycle to the first stage, or (d) terminate the project. (Provus, 1969, p. 247)
The stages seen in the Provus (1969) model represented a sequence of structured questions and a problem solving block. The questions asked at each stage were:

**Stage I - Is the problem defined?** At Stage I the evaluation task is to obtain a definition of the program based on the program-content taxonomy. The definition obtained becomes the program-performance information to be compared with the taxonomy. A discrepancy between any component in the program definition and the same component in the taxonomy represents evaluation information. (p. 248)

**Stage II - Is the program installed?** At Stage II the standard for comparison is the program definition arrived at in Stage I. Program-performance information consists of observations from the field regarding the installation of the program's components. Discrepancy information is used to redefine the program or to change the procedures. (p. 249)

**Stage III - Are the enabling objectives being met?** At Stage III the standard is that part of the program definition which describes the relationship between program processes and enabling objectives. Discrepancy information is used either to redefine process and relationship of process to interim product or to better control the process being used in the field. (p. 249)

**Stage IV - Are the terminal products achieved?** At Stage IV the standard is that part of the program definition which refers to terminal objectives. Program-performance information consists of criterion measures used to estimate the terminal effects of the project. (p. 250)

**Stage V - What are the costs and benefits of the program?** Stage V is optional. At this point, if decision-makers have more than one project with similar outcomes available to them for analysis, they may elect to do a cost-benefit analysis to determine program efficiency. (p. 250)

At each point of comparison specified in Figure 11, a discrepancy between program performance and standard would
necessitate the use of a problem-solving block. An example of the problem-solving procedure is presented in Figure 13.

Discrepancy at point X

A — (Q) Why?
— (C) Process Model for defining point X.
— (I) Actual process used.
— (D) Identify breakdown.

B — (Q) What corrective actions are possible?
— (C) Divergent ideation which may produce solution sets.
— (I) Detailed analysis of problem field.
— (D) Selection of ideas which best fit solution requirements as defined by the problem field?

C — (Q) Which correction alternative is best?
— (C) Web of administrative predisposition and value.
— (I) Information which describes hypothetical process alternatives for corrective alternatives (General R staff).
— (D) Definition of corrective action.

Q = Question  C = Criteria  I = New Information
D = Decision

Figure 13. Problem solving block  (Provus, 1969, p. 252)
The employment of the problem-solving procedure seeks decisions (D), to questions (Q), using criteria (C), and some new information (I). Provus reported a sample of the 3,420 potential evaluative questions which exist under this framework.

Comparison of the Evaluation Models

Analysis of the literature cited rendered several common concepts concerning the theoretical base of educational evaluation. The four frameworks conceptualized evaluation as a multidimensional activity. Scriven presented a formative-summative and an intrinsic-pay-off evaluation distinction. Stake discussed the use of evaluation data matrices for descriptive and judgmental information concerning educational inputs, transactions, and outputs. Stufflebeam differentiated four evaluative components: context evaluation, input evaluation, process evaluation, and product evaluation. Provus made the distinction in the use of evaluation during four stages of program development: design, installation, process, and product.

A combination of traditional evaluation techniques was incorporated within each evaluation framework reviewed. The use of measurement, performance-objective congruence, and professional judgment existed in each evaluation framework either explicitly or implicitly.
Scriven and Stake viewed evaluation as a judgment process. Stufflebeam and Provus defined evaluation as a decision-making process. Both Stufflebeam and Provus were concerned with the exclusive use of experimental or quasi-experimental designs to solve evaluation problems. Stufflebeam (1967) stated:

Experimental design evaluation reflects post hoc on whether a project did whatever it was supposed to. At that time, however, it is too late to make decisions about plans and procedures which have already determined the success or failure of the project. (p. 128)

Stufflebeam's comments provided the basis for identifying different stages or distinctions in the use of evaluative data. These distinctions were seen in Scriven's intrinsic vs. pay-off evaluation; Stake's antecedents, transactions, and outcomes; Stufflebeam's CIPP Model; and Provus' Discrepancy Evaluation Model.

The use of descriptive information was evident in all the evaluation frameworks reviewed. Stake suggested the use of descriptive information matrices to compare the intended and observed inputs, transactions, and outputs of an educational program. Provus called for a definition of a program's intended objectives, inputs, processes, and outputs to serve as the standards for decision making in subsequent stages. The Context portion of the Stufflebeam model relied on description of a program's antecedents. The intrinsic component of Scriven's framework was concerned with inspection of the educational instruments. Further comparison of the four
evaluation models including selected criteria was presented by Worthen and Sanders (1973). Relevant portions of their comparison are reproduced in Table 3.

Formative Evaluation for Industrial Arts

Following the earlier example of the eclectic selection of concepts and principles of the comprehensive learning theories in the field of educational psychology, a parallel phenomenon was called for in evaluation literature. Lange (1974) reviewed evaluation literature and concluded:

> These frameworks for evaluation provide ideas for developing evaluation plans. Each framework presents broad constructs. Although such constructs cannot be implemented they are useful for stimulating ideas that can be implemented. None of these new frameworks provide specific methodological suggestions. They provide no new data gathering or analysis strategies. Their major function is to provide a rationale or basis from which an evaluation plan can be developed. (p. 25)

The evaluation models reviewed attempted to delineate evaluation theoretical constructs. However, the appropriateness of one specific generalizable evaluation model was questioned. Wenig (1974) concluded:

> In the long run, it is better that each individual develop his own model with his own terminology and his own application techniques. When the individual has achieved this, he can begin to achieve the true significance of total program evaluation models in assisting him to gather information that is necessary to make informed judgments. (p. 59)

The above illustrations called for the evaluator to draw upon the theoretical base of all appropriate evaluation
<table>
<thead>
<tr>
<th>Scriven</th>
<th>Stake</th>
<th>Stufflebeam</th>
<th>Provus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>To establish and justify merit or worth. Evaluation plays many roles.</td>
<td>To describe and judge educational programs based on a formal inquiry process.</td>
<td>To provide relevant information to decision-makers.</td>
</tr>
<tr>
<td><strong>Key emphasis</strong></td>
<td>Justification of data gathering instruments, weightings, and selection of goals. Eval. model: combining data on different performance scales into a single rating.</td>
<td>Collection of descriptive and judgmental data from various audiences.</td>
<td>Evaluation reports used for decision-making.</td>
</tr>
<tr>
<td>Relationship to decision-making</td>
<td>Evaluation reports (with judgments explicitly stated for producers or consumers) used in decision-making.</td>
<td>Descriptive and judgmental data result in reports (including recommendations) to various audiences. Judgments may be based on either absolute or relative standards.</td>
<td>Evaluation provides for use in decision-making.</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Look at goals and judge their worth. Determine whether they are being met.</td>
<td>Examination of goal specifications and priorities. Identification of areas of failures and successes. It is up to the evaluator to assist in writing behavioral objectives.</td>
<td>Terminal stage in context eval. is setting objectives; input eval. produces ways to reach objectives; product eval. determines whether objectives are reached.</td>
<td>Agreement of evaluation team and program staff on standards. Comparison of performance against standards to see whether a discrepancy exists.</td>
</tr>
</tbody>
</table>
Table 3. Continued

<table>
<thead>
<tr>
<th>Types of evaluation</th>
<th>Scriven</th>
<th>Stake</th>
<th>Stufflebeam</th>
<th>Provus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2) Intrinsic-payoff.</td>
<td></td>
<td>(2) Input.</td>
<td>(2) Installation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4) Product.</td>
<td>(4) Product.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5) Cost.</td>
<td></td>
</tr>
<tr>
<td>Constructs proposed</td>
<td>(1) Distinction between goals (claims) and roles (functions).</td>
<td>(1) Data matrices: description (intents and observations) and judgment.</td>
<td>(1) Context eval. for planning decisions.</td>
<td>(1) Discrepancy concept.</td>
</tr>
<tr>
<td></td>
<td>(2) Several types of evaluation.</td>
<td>(2) Input eval. for programming.</td>
<td>(2) Feedback and revision of objectives and/or program.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(3) Process eval. for implementing decisions.</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) Bases for forming absolute and relative judgments.</td>
<td></td>
</tr>
<tr>
<td>Criteria for judging evaluation</td>
<td>Implications for design</td>
<td></td>
<td></td>
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<tr>
<td>---------------------------------</td>
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<td></td>
</tr>
<tr>
<td>(1) Should be predicated on goals.</td>
<td>(1) Look at many factors.</td>
<td></td>
<td></td>
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<tr>
<td>(2) Must indicate worth.</td>
<td>(2) Be involved in value judgments.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Should have construct validity.</td>
<td>(3) Require use of scientific investigations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Should be a wholistic program evaluation.</td>
<td>(4) Evaluate from within (formative) or from without (summative).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| (1) Should be panoramic, not microscopic. | (1) Internal validity. |
| (2) Should include descriptive and judgmental data. | (2) External validity. |
| (3) Should provide immediate relative answers for decision-making. | (3) Reliability. |
| (4) Should be formal (e.g., objective, scientific, reliable.) | (4) Objectivity. |

| (1) Internal validity. | (1) Team involvement. |
| (2) External validity. | (2) Assume one-to-one correspondence between design and solution. |
| (3) Reliability. | (3) Compare performance against standards as a tool for improvement and assessment. |
| (4) Objectivity. | (4) Periodic feedback. |

| (5) Relevance. | (1) Experimental design not applicable. |
| (6) Importance. | (2) Use of systems approach for evaluation studies. |
| (7) Scope. | (3) Directed by administrator. |
| (8) Credibility. | (4) Provide continuous evaluation (feedback loops). |
| (9) Timeliness. | (2) Provide relevant and timely information for making decisions. |
| (10) Pervasiveness. | (3) Provide cost-benefit analysis. |
| (11) Efficiency. | (4) Involvement evaluation in program development. |

Very general structure.
Matrices should be included in design.
Table 3. Continued

<table>
<thead>
<tr>
<th>Scriven</th>
<th>Stake</th>
<th>Stufflebeam</th>
<th>Provus</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Discriminates between formative (on-going) and summative (end) evaluation.</td>
<td>(1) Provides a systematic method for arranging descriptive and judgmental data, thus emphasizing inter- and intra-relations between them.</td>
<td>(1) Provides a service function by supplying data to administrators and decision-makers charged with conduct of the program.</td>
<td>(1) Provides a continuous communication between program and evaluation staff through feedback loops.</td>
</tr>
<tr>
<td>(2) Focus on direct assessment of worth, focus on value.</td>
<td>(2) Considers both absolute and relative judgment.</td>
<td>(2) Is sensitive to feedback.</td>
<td>(2) Allows for program improvement as well as assessment either at early stages or at end.</td>
</tr>
<tr>
<td>(3) Applicable in diverse contexts.</td>
<td>(3) Requires explicit standards.</td>
<td>(3) Allows for evaluation to take place at any stage of the program.</td>
<td>(3) A knows alternative procedures in adjusting objectives and in changing treatment.</td>
</tr>
</tbody>
</table>
(1) Equating performance on different criteria and assigning relative weights to criteria creates methodological problems.
(2) No methodology for assessing validity of judgments.
(3) Several overlapping concepts.

(1) Inadequate methodology for obtaining information on key constructs.
(2) Some cells of design matrix overlap; some distinctions not clear.
(3) Possibility of leading to internal strife within program, value conflicts possible.

(1) Little emphasis on value concerns.
(2) Decision-making process is unclear; methodology undefined.
(3) May be costly and complex if used entirely.
(4) Not all activities are clearly evaluative.

(1) Demands a lengthy time commitment; may be expensive to carry through.
(2) Inadequate methodology for establishing standards.
(3) Requires large, expert, well-articulated staff.
(4) Designed for complete evaluation; partial evaluation not considered.
frameworks in delineating specific evaluation plans for specific educational situations. Therefore, the following evaluation conceptualization was developed to guide the remainder of this study:

Figure 14. Formative evaluation conceptual model

This model is the result of a synthesis of both educational planning and evaluation models. An assumption of this design is that planning and evaluation are two salient features of educational product development. Furthermore, it is also assumed that feedback data are utilized throughout the planning-developing-testing continuum.
Specified in this model are four educational planning activities: (1) identifying and ordering goals, (2) identifying and operationalizing objectives which reflect the priority goals, (3) developing instructional materials and programs to implement the goals and objectives, and (4) field testing the developed materials to provide evaluative feedback to developer. Suggested in the model are four different functions of evaluation: (1) assessment of the worth and merit of the identified goals, (2) assessment of the operationalized objectives for validation, (3) assessment of the interim developmental materials for validity and congruence with both the goals and objectives, and (4) assessment of the educational products as applied in the classroom.

This model is offered as a conceptualization of the formative evaluation process. The following chapters of this dissertation will report the procedures needed to implement the model for the development, tryout, and assessment of curriculum materials in industrial arts education at the public school level.
CHAPTER III. THE FORMATIVE EVALUATION MODEL

Introduction

The previous chapter identified three schools of evaluation that influenced education during the past half century. These schools of evaluation included evaluation as measurement, evaluation of the congruence between performance and objective, and evaluation as professional judgment.

The writings of four specific educational evaluation leaders that emerged during the late 1960's and early 1970's were cited and reviewed. These publications included Scriven (1967), Stake (1967), Stufflebeam (1967, 1969, 1971), and Provus (1969). Elements of the educational evaluation rationale of each of these authors were selected and graphically reorganized, forming the conceptual model for formative evaluation presented in Figure 14.

This chapter expanded upon the specificity of the conceptual model for formative evaluation by utilizing a system of visually identifiable geometric shapes and a simple point-numeric code. The expanded model was designed to represent the type and sequence of curriculum planning, development, and evaluation activities needed to implement formative evaluation in public school industrial arts education.
Models and modeling

Review of the literature in science and education revealed considerable use of models and modeling. Nuthall and Snook (1973) suggested that "models may be used for imitation, description, explanation, prediction or persuasion" (p. 47). The term model was used in a wide variety of contexts by authors associated with both science and education. Nuthall and Snook (1973) also noted: "the term model suffers from the ambiguity that comes from constant usage in a variety of contexts" (p. 47). Model cars, model cities, model children, artistic models, statistical models, and evaluation models represented only a sample of the different contexts of the term found in the literature.

Snelbecker (1974), Snow (1973), and Brobeck (1963) pointed out that some authors use the word model synonymously with the term theory. Other writers, including Lange (1974), have used the words model and framework interchangeably. For the purpose of clarity in this study, the meaning of the term model was reviewed further.

In the textbook, An introduction to models in the Social sciences, Lave and March (1975) defined the term model as follows:

A model is a simplified picture of a part of the real world. It has some of the characteristics of the real world, but not all of them. It is a set of interrelated guesses about the world. Like all pictures, a model is simpler than the phenomena it is supposed to represent or explain. (p. 3)
Further insight into the definition of the term model was found in the literature. Snow (1973) defined models as:

Well-developed descriptive analogies used to help visualize, often in a simplified or miniature way, phenomena that cannot be easily or directly observed. Each model is thus a projection of a possible system of relationships among phenomena, realized in verbal, material, graphic, or symbolic terms. (p. 81)

The common element of these citations on the definition of the term model was the view that models are analogies of some complex system used for simplification and clarification.

Model builders utilize analogue devices for a variety of reasons. One of these reasons was given by Chapanis (1961):

Models describe and help us to understand complex systems or events. First and foremost, models describe complex systems or events in simple terms so that we can more easily understand them. They do this essentially by replacing intricate and complex systems with simpler and more familiar analogies. (p. 119)

Many different reasons for the employment of models in science and education were evident in the literature. Two additional reasons relevant to educational evaluation were given by Smith and Murray (1975):

Models may be chosen by researchers for their heuristic and conceptual features but used by administrators because of their monitoring and management capability. (p. 16)

The comments made by Smith and Murray (1975) concerning the double role of models have special significance for educational evaluation in general and this study in particular. An analogue model of the interrelationships of the procedures and
events included in educational evaluation serves not only researchers studying the process of educational evaluation, but also teachers and administrators conducting, monitoring, and managing the evaluation process. Any such model developed in the field of educational evaluation would be judged as Chapanis (1961) suggested: "A model is an analogy and no one expects an analogy to be completely accurate . . . . Models [are] judges by [their] usefulness" (p. 119).

Models used in educational evaluation should be judged by their usefulness in conducting research on the process of evaluation and by their usefulness in conducting, monitoring, and managing evaluation in the public schools. A well-developed educational evaluation model would meet the criteria of usefulness when it served to organize interrelated concepts and procedures of evaluation; when it predicted the flow of information and events during product planning, development, and assessment; and when it represented a viable system of evaluation for educational practitioners. The formative evaluation model presented in this chapter was developed and reported with these criteria in mind.

Replica and symbolic models

Two types of modeling techniques identified in the literature were replica models and symbolic models. Each of these modeling techniques was used to simplify complex phenomena into
simpler analogies, but they achieved this end through different means.

Replica models help people to visualize complex phenomena by tangible means. For example, a science teacher may employ replica models of molecules to help students visualize selected chemical structures that would be otherwise very difficult to study. Toy manufacturers produce plastic models of real-life items including cars, trucks, and people. That is, replica models are designed to look analogous to the phenomenon being modeled.

Symbolic models, more abstract than replica models, employ a system of numbers, words, and symbols to form a system analogue of the phenomenon being modeled. This concept of models was reported by Chapanis (1961) as follows:

Symbolic models . . . make use of ideas, concepts, and abstract symbols to represent the objects being modeled . . . . Lines and arrows are used to symbolize, by analogy, the flow of information from one element in the system to another. (p. 115)

Model Syntax

The modeling scheme employed in this study consisted of three major elements: (1) visually identifiable geometric shapes with verbal descriptions to represent major components of planning, development, and evaluation; (2) a point-numeric coding system to differentiate the sequence of procedures within the model; and (3) lines with arrows to indicate the path or flow of information and activities among the
interrelated elements of the model. The visual, numerical, and diagrammatical components of the modeling scheme were utilized to maximize the conceptual and procedural properties of the model developed.

The modeling scheme utilized was similar in content to the LOGOS language (Language for Optimizing Graphically Ordered Symbols) reported by Silvern (1969). An example of a model developed with LOGOS to simulate a counselor education system was published by Ryan (1969). Similar models developed with LOGOS, including Abedor (1971) and Carmichael (1974), incorporated a system of rectangles, words, numbers, and lines with arrows to produce flowchart analogies of the phenomena being modeled.

The point-numeric code or numbering system specified by LOGOS was adopted to differentiate the various functions and procedures within the model developed. In addition to the rectangular shape symbol utilized by LOGOS, several information processing symbols were adapted for the construction of the formative evaluation model. The information processing symbols used in this study are presented in Figure 15.

The symbols defined in Figure 15 were designed to form a visual analogy of specific types of activities or functions within the context of formative evaluation of educational products. Discrete, visually identifiable, function-related shapes were chosen to maximize the heuristic qualities of the
Figure 15. Analogue symbology used in model building

modeling scheme. An illustration of a hypothetical system of interrelated concepts and procedures was represented by the analogue model presented in Figure 16.

The total hypothetical system seen in Figure 16 was delineated by a horizontal envelope. Within the envelope, the access points and the individual subsystems or phases of the model were specified with the analogue symbology defined in Figure 15.
Figure 16. A hypothetical model at the second level of detail
The information processing symbol associated with input/output devices was selected to communicate the access points of the procedural model. Rhomboid parallelograms were employed to simulate the entry point and the exit point of the total system seen in Figure 16.

**Intrasubsystem symbolism**

Each subsystem or phase of the hypothetical system seen in Figure 16 was isolated and identified by a vertical envelope with a point-numeric code in the lower right-hand corner. Within each individual phase of the model, additional function-related symbols expanded the conceptual and procedural relationships of the system. The analogue symbology adapted for model building was designed to graphically represent the different components of formative evaluation including developmental, evaluative, and decision-making activities.

The smaller rectangular symbol was employed to indicate the entry point of each subsystem or phase of the model reported in this chapter. Within each phase, the header rectangle with a point-numeric code in the lower right-hand corner served to verbally and numberically identify the name and starting point of the individual phases of the model.

The six-sided polygon was used to identify developmental components of the formative evaluation model. Each developmental symbol communicated some activity associated with educational product development.
The elliptical symbol was utilized to simulate evaluative components of the model. Each evaluative symbol represented the utilization of assessment data prior to decision making.

The diamond symbol associated with information processing was selected to represent the decision-making component of the modeling scheme. Throughout the formative evaluation procedural model, the diamond symbol communicated decision points.

Lines and arrows were utilized to indicate the direction and flow of information and activities within each phase of the model. The combination of the path arrows and the point-numeric code formed the flowchart effect desired.

**Intersubsystem symbolism**

The information processing symbol associated with input/output devices was selected to communicate the access points of the model. Rhomboid parallelograms were employed to simulate the entry and exit points of the total system represented in Figure 16. However, entry within each individual phase of the model was accessed through the header rectangles. Movement from one interrelated phase to the next was indicated by lines, arrows, and circumscribed numbers. The exit point in each individual phase was either indicated by the access or connector symbol. Circumscribed numbers, following a decision component, were employed to direct the flowchart user to the next appropriate phase of the model.
An illustration of the intersubsystem movement was visualized in the hypothetical system modeled in Figure 16. In phase (1.0) of that system, the circumscribed 2.0 following the yes to decision 1.3 directed the flowchart user forward in the model to phase (2.0). The circumscribed 1.0 following the no to decision 2.1, in phase (2.0), directed the flowchart user back to the initial phase of the model.

The Formative Evaluation Model

The modeling schema described in the previous section of this chapter was used to produce two different types of models: a conceptual model and a procedural model. Both the conceptual and the procedural model were designed to simplify in visual form the components salient to formative evaluation of educational products. However, each model was advanced for a particular purpose. The conceptual model represented and communicated the broad constructs of the educational planning, development, and evaluation paradigm of formative evaluation of educational products. The conceptual model was designed to give the potential user a concise overview of the broad components of formative evaluation. This model was utilized to show the interrelated phases of formative evaluation and to aid educational planners and practitioners in the understanding of formative evaluation at a conceptual level.

The procedural model expanded the specificity of the developmental, evaluative, and decision-making components of
the formative evaluation conceptual model. The procedural model was designed to simulate the flow of information and activities needed to implement formative evaluation for the development, tryout, and revision of instructional materials in public school industrial arts education. This model was utilized to show not only the interrelated phases of formative evaluation, but also the specific activities and events within each individual phase.

The Conceptual Model of Formative Evaluation

The formative evaluation conceptual model designed in this study was similar in content to the evaluation "framework" reported by Sanders and Cunningham (1973, p. 217). However, in this study, a symbolic analogue modeling schema was used to help visualize and simplify the components of the formative evaluation paradigm.

Four phases of educational product development and evaluation were identified in the conceptual model. The symbolic representation of each phase includes a rectangle with a verbal description and a point-numeric code in the lower right-hand corner. The formative evaluation conceptual model is presented in Figure 17.

The formative evaluation conceptual model presented in Figure 17 represented a closed-loop, iterative design. Each of the four phases of the formative evaluation model were considered discrete but interrelated components of the total
Figure 17. The formative evaluation conceptual model

developmental-evaluative system. However, output information from one phase of the formative evaluation model was designed to serve as input information for another phase of the model.

The four phases of formative evaluation were identified as Phase (1.0), Identify and Order Goals; Phase (2.0), Identify and Operationalize Objectives; Phase (3.0), Develop Interim Materials; and Phase (4.0), Field Test Products. Each of these phases were graphically simulated with a rectangle and an evaluation-feedback loop. The first level of detail numbering system and lines with arrows indicated the order and path of the activities and information encountered when traversing the model.
Within each phase of the formative evaluation conceptual model, three components were visually represented. Each phase of the formative evaluation conceptual model incorporated a specific developmental activity, an evaluation component, and feedback input. The total model simulated the relationships among these components of the educational planning-developing-testing continuum.

The Procedural Model of Formative Evaluation

The formative evaluation conceptual model reported in Figure 17 was developed further, forming a procedural model for the implementation of formative evaluation of instructional materials produced from curriculum development efforts in public school industrial arts education. Each first level of detail rectangle, representing a phase of formative evaluation in the conceptual model, was extended to the second level of detail forming the procedural model presented in Figure 18.

The analogue symbology defined in Figure 15 was used to expand the specificity and the visual-heuristic quality of the formative evaluation model. As in the conceptual model, a rectangle with a point-numeric code in the lower right-hand corner was utilized to circumscribe and identify each of the four phases of the formative evaluation procedural model. Within each phase of the formative evaluation procedural model, the point-numeric code, analogue symbolism, and the lines with arrows were used to produce a flowchart effect.
Figure 18. The formative evaluation procedural model
The formative evaluation procedural model presented in Figure 18 used the flowchart design to simulate and communicate the activities and information salient to formative evaluation of curriculum development and improvement efforts in public school industrial arts education. However, the general concepts and procedures represented in the formative evaluation model were based upon a review of literature in educational product development and evaluation. The model represented a symbolic device designed to simplify and visually communicate the interrelated concepts and principles of product development and evaluation associated with authors including Scriven (1967), Cunningham (1973, 1974), Sanders and Cunningham (1973), and Lawson (1974).

Phase (1.0): Identify and order goals

Phase (1.0) of the formative evaluation procedural model represented the needs assessment intergrant of the educational material development and evaluation system. Needs assessment concepts and principles were reported in the literature by Campbell (1974), Krystal and Henrie (1972), Sweigert (1968), and Rose (1972). The needs assessment concepts and principles adapted for Phase (1.0) of the formative evaluation model consisted of three types of components: developmental, evaluative, and decision-making activities.

The initial symbol within Phase (1.0) indicated the presence of a logical question to be addressed prior to
subsequent efforts in curriculum development and evaluation. Sanders and Cunningham (1973) labeled this component "pre-developmental activities" in the context of their work in product development and evaluation (p. 221). Inspection of professional literature, survey of professional and lay opinion, and needs assessment techniques were sample procedures suggested in the literature to supply information for decision making on the need for initial or subsequent curriculum development. In this study, literature inspection and professional opinion served decisions on the need for curriculum development.

Goal identification included the development or identification of broad, general, educational goal statements. These educational goals served to give direction and purpose to subsequent instructional material development activities within the educational enterprise. Literature review and professional opinion were used to identify, glean, and adapt existing goal statements from parallel educational programs.

Goal ordering represented the initial "culling-out" process after the collection and development of the educational goals. Goal ordering activities entailed the use of professional opinion provided by a subject-matter expert and public school teacher/developers. Redundant goals were combined, unrealistic goals were deleted, and additional goals were written and placed into a tentative order of importance.
Evaluation of goals entailed the use of a panel of expert judges and teacher/developers to rate the goal statements in terms of the value, worth, and merit of each goal for public school industrial arts education. Weightings produced from rating the goal statements provided data needed to address the subsequent question on the establishment of developmental goals.

The second decision-making symbol of Phase (1.0) represented the examination of the ordered goals and the data produced from the evaluation of goals activities. Descriptive statistics were employed to rank the goals into priority order. The priority ranks were utilized by the subject-matter expert and the public school teacher/developers for decisions to revise, adapt, or adopt specific goal statements for further educational development. In essence a dichotomous question was addressed: Go on to the next phase of the model or recycle the existing phase of the model?

**Phase (2.0): Identify and operationalize objectives**

The design of Phase (2.0) of the formative evaluation model was influenced by publications of selected performance objective advocates associated with educational product development. Concepts and principles for development of educational objectives were reported in the literature by Bloom et al. (1956), Mager (1962), Krathwohl et al. (1964), and many other authors. The concepts and principles adapted for educational
objective development in Phase (2.0) of the formative evaluation procedural model included three components: developmental, evaluative, and decision-making activities.

The initial symbol within Phase (2.0) communicated the presence of a question concerning the disposition of the developmental priorities. This decision-making component acted as a feedback link to Phase (1.0) of the model, providing a mechanism for constant development, assessment, and revision of program goals.

Identifying educational objectives included the transformation of the broad, general, educational goal statements produced in Phase (1.0) into more specific statements of instructional intent. Review of literature and professional judgment were utilized to survey existing objectives from parallel educational materials. The objectives identified served to form criterion-references for subsequent educational material development, assessment, and revision.

The educational objective identified were organized into an overarching structure of interrelated objectives. This taxonomy served as a conceptual tool to relate the universe of technical content or subject matter of the developmental field to the goals and objectives identified by the public school teacher/developers. The overarching structure also served as a standard of comparison and selection of instructional materials during ensuing phases of the model.
The evaluation component of Phase (2.0) included the assessment of the educational objectives for worth and merit and for congruence with the priority goals. Evaluation-feedback data were collected from public school teacher/developers and a panel of subject matter/teaching methods experts to serve decisions on revision or use of the developmental objectives.

The additional decision-making symbol in Phase (2.0) simulated the examination of the developmental goals and objectives to determine if criteria for subsequent development emerged as a result of the first two phases of the model. The evaluation-feedback data were utilized to assess the need for further development of objectives prior to instructional material development.

Phase (3.0): Develop interim materials

Phase (3.0) of the formative evaluation model represented the instructional material development intergrant of the educational planning-developing-testing continuum. This phase incorporated the development of provisional, prototype instructional materials prior to field testing with public school students. Three types of activities were represented in Phase (3.0) including developmental, evaluative, and decision-making activities.

The initial symbol within Phase (3.0) simulated the use of a question regarding the status of the developmental objectives.
This decision-making component served as a feedback link to Phase (2.0) of the model, providing a mechanism for constant appraisal and refinement of instructional objectives.

The instructional material development component of Phase (3.0) of the formative evaluation model incorporated the transformation of priority goals and operationalized objectives from prior phases of the model into educational reality. Activities during this developmental component produced rough-draft prototype learning packages for public school industrial arts.

The edit/revise segment of Phase (3.0) represented the initial revising and reworking of the prototype instructional material prior to field testing. Revisions were based upon professional judgment of a subject matter expert and public school teacher/developers. Changes in format and content of the interim materials were made after intrinsic inspection of the learning packages.

The evaluation component of Phase (3.0) incorporated the formal assessment of the interim instructional materials by the public school teacher/developers. The assessment of interim materials produced data on the intrinsic quality of the instructional materials. Resulting data were used in decision making concerning material revision or subsequent field testing in the classroom.

The final symbol of Phase (3.0) represented the decision-making activity where the evaluation-feedback data were
utilized. A standard of comparison was specified for the use of data prior to decision making. Instructional materials failing to meet the standard were recycled to allow for revision. Interim materials that emerged as a result of Phase (3.0) were recommended for classroom tryout.

**Phase (4.0): Field test products**

Phase (4.0) of the formative evaluation model represented the concepts and principles associated with educational research and development and experimental research. The concepts and procedures within Phase (4.0) were derived from sources including Sanders and Cunningham (1973), Abedor (1971), Borg and Gall (1971), Campbell and Stanley (1963), and Siegel (1956). Phase (4.0) incorporated development, evaluation, and decision-making components.

The initial symbol of Phase (4.0) represents a logical question concerning the disposition of interim materials during field testing with public school students. The identification of major weaknesses in the field test materials necessitated recycling the instructional materials to Phase (3.0).

The intrinsic tryout component of the model incorporated the collection of process data from the teachers using the developmental materials in the classroom. The individual input of teachers trying the instructional materials concerning the procedural barriers, strengths, and weaknesses was recorded for subsequent evaluation and decision making.
The pay-off tryout component of Phase (4.0) included the collection of product data regarding the effect of the instructional materials on student learning. Intact experimental and control group data were collected for subsequent analysis during the evaluation component of the phase.

The evaluation of products component of Phase (4.0) included the statistical analysis of data resulting from both the intrinsic and pay-off tryout components. Data produced from these evaluative procedures were utilized in decision making regarding the ultimate disposition of the instructional materials developed and tested.

The second decision-making component of Phase (4.0) utilized the evaluative-feedback from the previous evaluation component to address the question of the ultimate disposition of the instructional material. Materials judged unworthy of large scale student use were recycled within the model. Materials meeting minimal tryout criteria were judged to be finished products.
CHAPTER IV. METHODOLOGY

The objective of this study was to investigate the feasibility of adopting or adapting a formative evaluation model for public school industrial arts teachers during the formative period of instructional material development. Specifically, the problem of this study was to design and test a formative evaluation model for the development, try-out, and assessment of curriculum materials in public school industrial arts education.

The twofold nature of the problem necessitated a two-part methodology for completing the study. Chapter IV reports the methodology salient to each element of the problem. Therefore, this chapter was divided into two major sections in which the methodology for designing the model and the methodology for testing the model are presented.

Designing the Model

The design element of the study was initiated through a review of selected literature. The investigation helped to identify concepts related to educational curriculum development, revision, and assessment. The literature review was directed toward finding information in the following categories:
1. industrial arts education,
2. curriculum development,
3. educational evaluation,
4. educational psychology,
5. measurement and evaluation, and
6. research methods.

**Initial investigation**

The initial sources of information pertinent to the design of the formative evaluation model were identified from the bibliographical entries and descriptors in selected publications. The search for primary sources and information of interest in the design element of the study was aided by utilizing the following research sources:

1. Educational Index,
2. Thesaurus of ERIC Descriptors,
3. Resources in Education,
4. Current Index to Journals in Education,
5. Abstracts of Research and Related Materials in Vocational Technical Education, and

Descriptors were identified, indices were searched, and publications were identified in pertinent categories. Additional sources were identified by conducting a computerized search of the ERIC system.
The review of literature served to identify evaluation concepts for developing the formative evaluation model. The initial sources and applicable concepts reviewed were:

1. Cronbach (1963a) Identified that evaluation is used for decision making in three areas: A) course improvement, B) decisions about individuals, and C) administrative regulation.

2. Scriven (1967) Identified that evaluation is to determine the worth and merit of any aspect of education. Distinctions in evaluation included: A) formative and summative evaluation, B) intrinsic versus pay-off evaluation, and C) comparative versus noncomparative evaluation.


4. Sanders and Cunningham (1973) Further delineated formative and summative evaluation as applied to the development and validation of educational products. Components included: A) a classification of information needed in formative evaluation, B) a structure for planning formative evaluation in product development, and C) a summary of techniques and procedures appropriate for formative evaluation.
The evaluation materials of Sanders and Cunningham (Appendix A) enhanced the substantiveness of the evaluation concepts identified as a result of the initial investigation and served as the initial heuristic device in the formulation of the formative evaluation model. Further investigation concerning evaluation theory and practices related to curriculum development, revision, and assessment was conducted. The evaluation model development was enhanced by the review of the following:

1. The evaluation theory and practices reported by Alkin at the Center for the Study of Evaluation, the University of California, Los Angeles.
2. The evaluation theory and practices reported by Provus resulting from research, curriculum development, and evaluation at the Pittsburgh public schools.
3. The evaluation theory and practices reported by Stake resulting in his association with the Center for Instructional Research and Curriculum Evaluation at the University of Illinois.
4. The evaluation theory and practices reported by Stufflebeam resulting from his work at the Evaluation Center of the Ohio State University and the Phi Delta Kappa National Study Committee on Evaluation.
5. The evaluation theory and practices reported by Hammond as a result of his field service and evaluation research at the EPIC Evaluation Center, Tucson, Arizona.

Each of the above sources contributed evaluation concepts and principles related to evaluation for course improvement during the formative period in curriculum development.

The formative evaluation conceptual model

After the review of literature pertaining to evaluation theory and practice was completed, common formative evaluation concepts were selected and graphically reorganized, producing the formative evaluation conceptual model. The model was identified to serve as a visual plan for curriculum development and improvement for public school industrial arts personnel. The formative evaluation conceptual model represented the broad elements of the curriculum development, assessment, and revision continuum as follows:

1. identifying and ordering goals,
2. identifying and operationalizing objectives,
3. developing interim materials, and
4. field testing products.

The formative evaluation conceptual model was advanced as a tool to communicate the major components of curriculum development and assessment at a conceptual level. The con-
ceptual model helped the researcher approach the topic of formative evaluation of public school industrial arts curriculum development and evaluation from a broad, non-procedural perspective. Thus, the conceptual model was employed to assist the communication and understanding process of formative evaluation by personnel with limited experience in evaluation theory and practice.

The initial assessment of the formative evaluation conceptual model included the presentation of the model to the individuals in selected groups familiar with curriculum development, evaluation, and industrial arts and the collection of informal feedback for revision. The model was discussed and reviewed in the following settings:

1. graduate seminars in educational research and evaluation,
2. graduate sections of evaluation in industrial education, and
3. informal discussions with public school personnel, graduate students, and faculty familiar with A) evaluation theory and practice, B) curriculum development, and C) industrial arts education.

Feedback input produced from these discussions was used to revise the conceptual model.
The formative evaluation procedural model

An additional review of literature was conducted related to modeling. As a review of the additional review, an analogue symbology was defined and used to expand the specificity of the conceptual model forming the formative evaluation procedural model.

The formative evaluation procedural model was designed to serve this research and to communicate activities needed to implement the formative evaluation model at a procedural level. The procedural model was advanced to specify the activities needed for each phase of the planning-developing-testing continuum associated with the educational enterprise. Thus, the procedural model assisted the researcher in structuring the sequence and flow of procedures and data associated with formative evaluation of educational products. The remainder of this chapter will report the methodology used in the process of testing the formative evaluation model.

Testing the Model

Rationale

The rationale employed in the testing of the model was adapted from an article entitled, "Men, machines, and models." In that publication, Chapanis (1961) stated:
A model is an analogy and no one expects an analogy to be completely accurate. . . . Theory, on the other hand, is a conceptual system which attempts to describe the real thing. . . . Models, in a word, are judged by criteria of usefulness; theories, by criteria of truthfulness. (p. 119)

Under this rationale of utility, an educational evaluation model is judged by its usefulness in conducting research on the process of evaluation and by its usefulness in conducting, monitoring, and managing evaluation in the public schools. Specifically, a well-developed educational evaluation model meets the criteria of usefulness when it serves to organize interrelated concepts and procedures of evaluation; when it predicts the flow of information and events during product planning, development, and assessment; and when it represents an effective system of evaluation for educational practitioners.\(^1\) Therefore, the testing of the formative evaluation model was addressed by a demonstration of the application of the concepts and procedures of each individual model phase using the curriculum development efforts of selected industrial arts teachers.

\(^1\)According to Stufflebeam (1967, p. 129) an effective evaluation system serves decision-making by supplying information that is "valid (suited to the variable of interest), reliable (reproducible), timely (available when the decision-maker needs it), credible (trusted by the decision-maker and those he must serve), and pervasive (available to all decision-makers who need it)."
Setting

The testing of the formative evaluation model was conducted during the summer sessions of 1976 and 1977 and the school year 1976-1977. The Graphic Communications Institute conducted at Iowa State University by the Department of Industrial Education served as the developmental setting for testing the model proposed in the study. The mission of the Institute included the identification, development, tryout, and revision of exemplary content and activities to help public school industrial arts teachers implement The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12 (1975).¹ The Graphic Communications Institute was chosen as the developmental setting for the testing of the formative evaluation model for the following reasons:

1. The Institute was one of the two formal efforts in Iowa specifically designed and charged with the development of curriculum materials under The Iowa Guide for industrial arts.

2. The mission of the Institute was suited for the utilization of formative evaluation procedures.

¹For the remainder of this chapter the publication will be referred to as The Iowa Guide.
3. The Institute consisted of a number of industrial arts teachers representing several different public school districts in Iowa.

4. The Institute planners, director, and participants were receptive towards using the formative evaluation procedures.

**Personnel**

Ten teachers were selected by the State Industrial Arts Cadre to participate as curriculum developers for the Graphic Communications Institute (Appendix B). The primary teaching responsibility distribution of the participants included three junior high school teachers, six senior high school teachers, and one collegiate instructor. The teacher/developers had an average of 7.3 years of teaching experience. Five participants had at least a Master's degree prior to the Institute.

The State Industrial Arts Cadre (Appendix B) was utilized where input data from a panel of industrial arts experts were needed. The Cadre had a natural evaluative relationship to this study because it is the intermediate governing body for industrial arts curriculum Institutes funded by the Iowa State Department of Public Instruction (DPI).

The teachers included in the field testing of developed materials were Institute participants. The student subjects
used in the field testing of developed materials were enrolled in industrial arts classes during the 1976-1977 school year.

Time plan

The development and evaluation activities of the Graphic Communications Institute were conducted during three time intervals. The Institute's schedule included:

2. School year 1976-1977: A) further developing and refining of instructional materials, and B) public school field testing.

During the summers of 1976 and 1977 the Institute met five days a week for four weeks. During the school year 1976-1977 five Saturday work sessions were conducted.

The interface between the Graphic Communications Institute schedule and the research schedule for testing the formative evaluation model was scheduled as illustrated in Figure 19.

The initial meetings of the Institute were devoted to introductions and orientation. The initial activities that took place were:
Figure 19. Time line interface between the Institute schedule and the model testing research

1. An orientation to the total concept of industrial arts curriculum development in the State of Iowa.
2. Distribution of and introduction to The Iowa Guide.
3. Identification of the mission of the Institute and discussion of its role in the curriculum development plan of the State.
4. Discussions and participant interaction concerning the new curriculum and subject matter concepts related to the mission of the Institute.
Phase (1.0): Identify and order goals

The developmental, evaluative, and decision-making components of Phase (1.0) are reported below. Each component was organized and numbered corresponding to the formative evaluation procedural model presented in Figure 18.

Decision point (1.1): Is development needed? The initial question in Phase (1.0) of the formative evaluation model was addressed prior to the first meeting of the Graphic Communications Institute. The actions of the Iowa Industrial Arts Cadre to organize and fund curriculum development institutes based on the rationale and concepts of The Iowa Guide were based upon prior literature review and professional judgment. In reviewing the Iowa Plan for Curriculum Improvement in Industrial Arts, Bro and Foelske (1976) explained:

The project proposal called for an assessment of further needs regarding the implementation of curriculum improvement, as well as the development of a new state curriculum guide. As a result of the assessment, the Project Committee determined that if the practitioners were to be successful in implementing the concepts and methodology presented in the guide, [teacher] in-service should accommodate the dissemination of the guide and the development of additional curriculum material would be necessary. (p. 183)

The development of the additional curriculum materials to help practicing teachers implement The Iowa Guide became the charge of curriculum institutes. Bro and Foelske (1976)
stated further:

These institutes will be held in the cluster areas of graphic communications, energy and power and production. Their purpose will be development of instructional competencies, preparation of teaching materials, and designing of student learning activities needed to facilitate implementation of the recommended program offerings and methodology [in the guide]. (p. 184)

Developmental component (1.2): Identify goals During the initial days of the Institute the activities centered around the identification of developmental goals. The definition of educational goals was adopted from Rose (1972), who wrote: an educational goal statement is "a statement of broad direction or intent which is not concerned with achievement within a specified time" (p. 1). The activities associated with goal identification were as follows:

1. Instruction was given on the writing and use of educational goal statements.

2. The suggested goals in The Iowa Guide for both industrial arts and graphic communications were identified.

3. Goal statements from selected publications including technical textbooks, parallel curriculum guides of other states, and professional journal articles were identified.

Participants used their individual teaching experience, subject matter expertise, and the rationale of career and
industrial-technical emphasis (The Iowa Guide, p. 13) in the initial identification and selection of goal statements.

**Developmental component (1.3): Order goals**

The identified goals were reviewed and debated in both informal and formal group work sessions. Redundant goals were combined, unrealistic goals were deleted, and additional goals were written and placed into a tentative order of importance resulting in the graphic communications developmental goals reported in Table 4.

Table 4. Graphic communications developmental goals prior to Phase (1.0) evaluation

<table>
<thead>
<tr>
<th>Goal statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To provide opportunities for students to broaden career awareness through exploration of graphic communications.</td>
</tr>
<tr>
<td>2. To provide opportunities for students to make tentative career choices.</td>
</tr>
<tr>
<td>3. To provide opportunities for students to explore graphic communications technology (materials and methods).</td>
</tr>
<tr>
<td>4. To provide opportunities for students to develop safe working habits in graphic communications.</td>
</tr>
<tr>
<td>5. To provide opportunities for students to improve problem solving and creative abilities through graphic communications.</td>
</tr>
<tr>
<td>6. To provide opportunities for students to understand the structure of the graphic communications industries.</td>
</tr>
<tr>
<td>7. To provide opportunities for students to understand the implications of graphic communications on society.</td>
</tr>
</tbody>
</table>
Evaluation component (1.4): Evaluation of goals  

The activities included in the evaluation component of Phase (1.0) included: A) the development of the instrumentation to rate the developmental goals, B) the administration of an assessment activity on education goals, and C) the analysis of resulting data. The activities of evaluation component (1.4) were:

1. A Phase (1.0) evaluation instrument (Appendix C) was developed using a five-point Likert-type scale. The purpose of the assessment of goals instrument was to collect data concerning the importance of each developmental goal in an exploratory course in graphic communications for junior high school industrial arts.

2. The evaluation instrument was administered to the graphic communications Institute teacher/developers and the State Industrial Arts Cadre members. The teacher/developers represented the public school teacher population. The Cadre represented a panel of industrial arts and teaching methods experts.

3. The data produced from administering the assessment of goals instrument were organized to facilitate subsequent decision making by the Institute concerning the educational goal statements.
The instrument was administered to the teacher/developer in the Institute and the Cadre. Summary statistics were employed in the analysis of the data produced from the administration of the assessment of goals instrument. The procedure for analyzing and organizing the resulting data was as follows:

1. The mean, standard deviation, and rank of each goal were computed for A) the teacher/developer ratings and B) the Cadre ratings.

2. Overall ratings resulting from the combination of the teacher/developer ratings and the Cadre ratings were produced for each goal statement.

3. The mean, standard deviation, and rank of the combined ratings were computed.

4. The data resulting from the evaluation of goals component were organized into a table for subsequent presentation to the Institute (Appendix C).

Decision component (1.5): Have priorities emerged?
An Institute session was conducted to decide the final arrangement of the graphic communications goals. The data produced from the administration of the assessment of goals instrument were presented to the Institute participants. The decisions of the Institute participants were as follows:
1. The overall ratings were the basis for the decision-making process.

2. Goals rated $\geq 4.0$ were retained and minor changes in goal wording made where needed.

3. The goals were rearranged into priority order using the ranks from the overall ratings.

As a result of completing Phase (1.0) a priority list of goals emerged from the development process. These goals are reported in Table 5.

Table 5. Priority rank order of graphic communications developmental goals after completing Phase (1.0)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Developmental goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To provide opportunities for students to broaden career awareness through exploration of graphic communications</td>
</tr>
<tr>
<td>2</td>
<td>To provide opportunities for students to explore graphic communications materials and processes</td>
</tr>
<tr>
<td>3</td>
<td>To provide opportunities for students to improve problem solving and creative abilities through graphic communications</td>
</tr>
<tr>
<td>4</td>
<td>To provide opportunities for students to develop safe working habits in graphic communications</td>
</tr>
<tr>
<td>5</td>
<td>To provide opportunities for students to understand the implications of graphic communications on society</td>
</tr>
<tr>
<td>6</td>
<td>To provide opportunities for students to understand the total structure of graphic communications technology</td>
</tr>
</tbody>
</table>
Phase (2.0): Identify and operationalize objectives

The developmental, evaluative, and decision-making components of Phase (2.0) are reported below. Each component was organized and numbered corresponding to the formative evaluation procedural model presented in Figure 18.

Decision point (2.1): Have priorities changed? The initial symbol of Phase (2.0) of the formative evaluation procedural model acted as a feedback link to Phase (1.0). Thus, a mechanism was provided for constant development, assessment, and revision of the developmental goals. In the application of the model to the graphic communications Institute, no change occurred in the priority goals once Phase (1.0) was completed.

Developmental component (2.2): Identify objectives
The activities and procedures in component (2.2) had considerable overlap with the activities in component (1.2). In component (2.2) instructional objectives were identified to implement each goal statement. The activities associated with the identification of objectives were as follows:

1. Instruction was given on the writing and use of instructional objectives using A) the Phi Delta Kappa materials entitled: A programmed course for the writing of performance objectives (Rose, 1972),

2. Concern was expressed for identifying input for the cognitive, affective, and psychomotor learning domains.

3. The suggested objectives for graphic communications in The Iowa Guide were reviewed.

4. Objectives identified in publications of parallel materials were reviewed.

5. A tentative list of instructional objectives for exploratory graphic communications was organized.

Developmental component (2.3): Operationalize objectives

The activities in this component of Phase (2.0) of the model produced an overarching structure to classify and organize the universe of technical content related to the graphic communications cluster. This taxonomy (Appendix D) expanded the conceptual base for industrial arts in The Iowa Guide (p. 9) by dividing the graphic communications cluster into a system of areas, sections, units, and activities. Other activities included in this component of the model were:

1. The categorizing of the graphic communications instructional objectives using the cluster, area, and unit divisions of the technical content taxonomy.
2. The informal assessment and revision of the list of objectives.

It became evident that duplication had taken place in the initial writing and organization of the objectives. Objectives originally written for each area and section division of the taxonomy (Appendix D) differed only slightly in wording within each area classification. Thus, writing objectives at the cluster, area, and section levels of Appendix D gave the teacher/developers little additional information. Therefore, the instructional objectives were synthesized for each goal, at the cluster level, forming the operationalized goals and objectives presented in Appendix D.

**Evaluation component (2.4): Evaluation of objectives**

The activities included in the evaluation component of Phase (2.0) included the development of an assessment of objectives instrument, the administration of the assessment instrument, and the analysis of resulting data. The specific procedures of this component were as follows:

1. A Phase (2.0) evaluation instrument (Appendix E) was developed using a five-point Likert-type scale to rate each graphic communications objective according to two criteria: A) the worth and merit of the objective for an exploratory course in graphic communications, and B) the degree of congruity or
agreement among the educational goal statement and accompanying objectives.

2. The evaluation instrument was administered to the Institute teacher/developers and the industrial arts Cadre.

3. The data produced from administering the instrument were analyzed and organized for subsequent Institute decision-making purposes.

Data produced from the assessment activity on instructional objectives were analyzed using the Statistical package for the social sciences (1975) condescriptive procedures (p. 186). Summary statistics were utilized to address the questions of worth and merit and the congruence of the objectives. The procedure for analyzing and organizing the data collected was as follows:

1. The mean, standard deviation, and rank of each objective were computed for the ratings of worth and congruence.

2. Overall ratings resulting from the combination of the teacher/developer ratings and the Cadre ratings were produced for each objective.

3. The overall ratings were ranked and objectives rated \( > 4.0 \) were identified.
4. The data resulting from the evaluation of objectives component were organized into tables for subsequent presentation to the Institute (Appendix E).

A summary of the evaluation of objectives data was organized into a decision-making matrix. That decision-making input is presented in Table 6.

Table 6. Summary of overall ratings of worth and congruence of instructional objectives by priority goal order

<table>
<thead>
<tr>
<th>Goal-Objective Number</th>
<th>Criteria of Worth</th>
<th>Criteria of Congruence</th>
<th>Objectives Emerge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>1.2</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>1.3</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>1.4</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>2.1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2.2</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2.3</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>2.4</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>3.1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>3.2</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>3.3</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>3.4</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>4.1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>4.2</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>4.3</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>4.4</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>5.1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>5.2</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>5.3</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>5.4</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>6.1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>6.2</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>6.3</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

Note: Criteria = Overall rating ≥ 4.0.
Decision point (2.5): Have criteria emerged? An Institute session was conducted to decide the final arrangement of the graphic communications instructional objectives. The data produced from the assessment of objectives were presented to the Institute participants. The decisions of the Institute were as follows:

1. Only the objectives rated at $\geq 4.0$ would be considered further.

2. The local schools should be given the flexibility to establish priorities for the individual objectives within each graphic communications goal. However, the objectives were placed into a priority order based on group consensus using the overall ranks for both worth and congruence.

3. The wording of specific objectives was revised. The revised objectives resulting in the completion of Phase (2.0) of the formative evaluation model are presented in Appendix E.

Phase (3.0): Develop interim materials

The developmental, evaluative, and decision-making components of Phase (3.0) are reported below. Each component was organized and numbered according to the formative evaluation procedural model seen in Figure 18.
Decision point (3.1): Have objectives changed? The initial symbol of Phase (3.0) of the formative evaluation procedural model acted as a feedback link to Phase (2.0). Thus, a mechanism was provided for constant development, assessment, and revision of the developmental objectives. In the application of the model to the graphic communications Institute, no change occurred in the objectives that emerged from completing Phase (2.0).

Developmental component (3.2): Develop prototype materials The activities and procedures in Phase (3.0) were built upon the foundation provided by completing the two prior phases of the formative evaluation model. During this component of Phase (3.0) instructional packages were developed to serve as resource materials for public school teachers implementing graphic communications in industrial arts.

The Institute participants avoided a "cookbook" approach that would specify exact teaching strategy, content, and sequence to be used by individual public school teachers. The packages developed were designed to serve as samples and examples of possible student-learning activities for implementation and further development at the local school level. The rationale of The Iowa Guide encourages flexibility for meeting the needs of local industrial arts programs, students,
and teachers.

Institute participants worked individually and in small groups to identify and develop ideas for the packages. Where possible, independent activities were designed to allow schools to utilize the materials separately. The packages were developed to achieve the goals under the four graphic communications areas of image generation, image reproduction, image processing, and image management. After the concepts of each package were identified, rough draft copies were prepared using the format presented in Figure 20.

![Figure 20. Activity package format](image-url)
Developmental component (3.3): Edit/revise prototype
This component of Phase (3.0) included the initial editing and revising of the developmental instructional packages based on informal intrinsic inspection. The Institute participants inspected, discussed, and appraised the prototype packages applying individual teaching experience and subject matter expertise as a basis for the decision-making process. At the completion of the summer 1976 session, 45 prototype instructional packages were produced.

Evaluation component (3.4): Evaluation of interim materials
The evaluation component of Phase (3.0) included:

1. the development of an interim material assessment strategy,
2. the development of the evaluation instrumentation,
3. the collection of data, and
4. the analysis of evaluation data.

Since 45 instructional packages were written by the end of the 1976 summer session, a strategy was needed to delimit the number of packages to be evaluated in the process of testing the formative evaluation model. Therefore, all packages were reviewed and only the materials that were judged ready and most complete for classroom tryout were included in the testing of the remainder of the formative evaluation
model. Sixteen packages were identified for further evaluation during the 1976-1977 school year. The remaining packages were identified for subsequent revision at a later time in the Institute schedule.

The evaluation of interim materials scheme utilized an interview of the teacher/developers to assess the major components of the instructional packages developed. The Institute participants were employed to rate the materials because they represented the public school teachers who had teaching experience and would ultimately implement graphic communications at the local school level using the newly developed instructional packages. The procedures used in the testing and administration of the evaluation interviews were as follows:

1. A phase (3.0) evaluation instrument (Appendix F) was developed using a series of five-point Likert-type scales to assess each major component of the interim materials.

2. Each individual scale was typed on a 3 x 5 card and an interview tally sheet was prepared.

3. A plan was developed for the assignment of packages to each evaluator. Eight participants were available for the assessment activity. Each package was evaluated by three different teacher/developers.
A total of 16 interim instructional packages were assigned as seen in Table 7.

Table 7. Sampling strategy for assessment activity on prototype materials

<table>
<thead>
<tr>
<th>Teacher/Developer</th>
<th>Learning packages to be assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 9 2 10 3 11</td>
</tr>
<tr>
<td>B</td>
<td>2 10 3 11 4 12</td>
</tr>
<tr>
<td>C</td>
<td>3 11 4 12 5 13</td>
</tr>
<tr>
<td>D</td>
<td>4 12 5 13 6 14</td>
</tr>
<tr>
<td>E</td>
<td>5 13 6 14 7 15</td>
</tr>
<tr>
<td>F</td>
<td>6 14 7 15 8 16</td>
</tr>
<tr>
<td>G</td>
<td>7 15 8 16 9 1</td>
</tr>
<tr>
<td>H</td>
<td>8 16 9 1 10 2</td>
</tr>
</tbody>
</table>

**Note:** 8 participants assessed 6 packages each for a total of 16 packages evaluated with 3 replications per package.

The evaluation of interim materials interviews was conducted during two Saturday work sessions during the school year. Each teacher/developer was provided time to reread the instructional packages, one at a time. The raters were asked to consider the following criteria:
1. Could you teach the specified area of graphic communications using the activity package as it presently is?
2. Is the activity package ready for classroom tryout with your junior high school students?
3. Is the activity package ready for classroom tryout with your junior high school aged son or daughter?

At each point where a rating of < 4.0 was given, the interviewer asked the participants to give further evaluation input. The teacher/developers were asked: A) How would you improve the instructional materials? and B) How would you revise the package if you were to use it in your school? A tape recorder was used to record all evaluation discussions. Each package took approximately 12 minutes to evaluate. After all interviews were conducted, the researcher tabulated the ratings for each package and summarized the recorded comments using the feedback summary form presented in Appendix F.

The data resulting from the administration of the assessment activity on prototype materials were analyzed and summarized for subsequent decision making of the Institute. The procedures used were as follows:

1. A group assessment was determined for each package by calculating the mean rating for each individual component of the 16 instructional packages.
2. Activity packages rated $\geq 4.0$ were identified.
3. The resulting data were organized into a table for subsequent decision making (Appendix F).

**Decision point (3.5): Have interim materials emerged?**

An Institute session was conducted to decide the arrangement of the instructional packages assessed. The data produced from the interim materials assessment instrument were presented to the Institute participants. The decisions resulting from the session were as follows:

1. Materials rated $\geq 4.0$ were ready for field testing with public school students.
2. Materials rated $< 4.0$ in one category were identified for minor revisions during subsequent meetings of the Institute.
3. Materials rated $< 4.0$ in more than one category were identified for more extensive revisions during the summer of 1977.

As a result of the Phase (3.0) activities, four instructional packages were judged ready for field testing with public school students; four packages were assigned for minor revision, and eight packages were assigned to be recycled to the beginning of Phase (3.0). These decision-making activities are summarized in Table 8. For the purpose of this research only the top four packages meeting the stipulated rating
Table 8. Results of Phase (3.0) decision-making

<table>
<thead>
<tr>
<th>Learning package number</th>
<th>Have interim materials emerged?</th>
<th>Yes proceed to field testing</th>
<th>No needs minor revisions</th>
<th>No needs more extensive revisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>626 (6)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>629 (9)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>630 (5)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>635 (16)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>603 (3)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>527 (15)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>528 (4)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>642 (7)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>608 (8)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>609 (1)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>610 (10)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>613 (13)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>616 (2)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>631 (14)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>633 (11)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>636 (12)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
specified for Phase (3.0) were considered in the testing of the remainder of the formative evaluation model.

Phase (4.0): Field test products

The activities and procedures in Phase (4.0) of the formative evaluation model assessed the instructional packages which were developed as a result of completing the three previous phases of the model. During Phase (4.0) instructional packages were field tested using public school industrial arts students. The field testing included intrinsic and pay-off evaluation components. All materials tested were still considered to be revisable throughout Phase (4.0).

The instructional packages chosen for field testing were limited to the four top packages resulting from the Phase (3.0) evaluation activities. Other packages were field tested in the public schools by individual Institute participants, but those materials were not considered in this research. Field test activities took place from March through May of the 1976-1977 school year.

Decision point (4.1): Are major revisions needed?

The initial symbol of Phase (4.0) of the formative evaluation procedural model, seen in Figure 18, served as a feedback link to Phase (3.0). In the application of the model, no change occurred in the status of the interim materials from the time that Phase (3.0) activities ended and the Phase (4.0)
Developmental component (4.2): Intrinsic tryout

This component of Phase (4.0) served the curriculum development, assessment, and revision process by collecting feedback data from public school teachers concerning the internal and procedural characteristics of the instructional packages (Appendix G). An intrinsic tryout instrument (Appendix H) was designed to collect information in the following categories:

1. major components of the instructional package format,
2. problems encountered in carrying out the activity,
3. attitudes of the students using the tryout packages, and
4. reactions of the teacher concerning the revision and ultimate usefulness of the package.

The selected teachers were given the intrinsic instrument prior to field testing the packages. The instruments were completed after the packages were used in the public school classroom. The feedback instrument on tryout materials (Appendix H) was used to summarize the intrinsic tryout information collected for presentation to the Institute.
Selection criteria

Three public school industrial arts programs were chosen to serve as the target population in the field testing activities of Phase (4.0) of the evaluation model. The criteria used for the selection of test sites were as follows:

1. The school planned to implement the graphic communications developmental materials during the 1976-1977 school year.

2. The industrial arts teacher was an Institute participant. Thus, the teacher was familiar with the concepts and content in graphic communications.

3. The industrial arts teacher expressed willingness to test instructional materials with students and provide feedback data.

4. The March through May testing period coincided with the individual school's tryout plans.

Activity package assignment

Two schools were assigned to field test one package each and one school was assigned to two activity packages. The activity package assignments are seen in Table 9.
Table 9. Field test packages and schools

<table>
<thead>
<tr>
<th>Activity Package Number</th>
<th>Test Site Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>626</td>
<td>Design of a logo for individual students</td>
</tr>
<tr>
<td>629</td>
<td>Printing negatives with flair</td>
</tr>
<tr>
<td>630</td>
<td>Developing film</td>
</tr>
<tr>
<td>635</td>
<td>Chronological filing</td>
</tr>
</tbody>
</table>

See Appendix G for activity packages.

See Appendix H for test site information.

Developmental component (4.3): Pay-off tryout

This component of Phase (4.0) served the curriculum development, assessment, and revision process by collecting feedback data based on student tryout of the instructional materials. Activities included the development and administration of individual pay-off tryout instruments for each package tested. The procedures used in the development of the pay-off tryout instruments were as follows:

1. The activity objectives, student activities, and evaluation statements of each package were reviewed.

2. Activity objectives specifying psychomotor student activities resulted in the development of a practical test component.
3. Activity objectives specify cognitive student learning resulted in the development of a paper and pencil test component.

4. Rough draft versions of the tests were prepared and reviewed by selected Institute participants. The tests developed were compared to the objective, activity, and evaluation statement of the instructional packages.

5. The test instruments were revised, duplicated, and assembled for use. (Pay-off tryout instruments are presented in Appendix I.)

Selecting field test students Each participating public school industrial arts teacher was asked to select two parallel classes for the field test activity. This instruction was based on the comments concerning independent samples made by Siegel (1956). Siegel stated:

Although the merits of using two related samples in a research design are great, to do so is frequently impractical. . . . It may also be impossible to design a study which uses matched pairs, perhaps because of the researcher's ignorance of useful matching variables, or because of his inability to obtain adequate measures (to use in selecting matched pairs) of some variable known to be relevant, or finally because good "matches" are simply unavailable.

When the use of two related samples is impractical or inappropriate, one may use two independent samples. In this design the two samples may be obtained by either of two methods: (a) they may each be drawn at random
from two populations, or (b) they may arise from the assignment at random of two treatments to the members of some sample whose origins are arbitrary. In either case it is not necessary that the two samples be of the same size. (p. 95)

The method used to identify the students at each test site was an application of method (b) of Siegel's illustration. The students in the two classes identified by each participating teacher represented independent samples; inasmuch as neither repeated measures nor formal student matching between the two classes was used. In the application of this design, student differences resulting from the field test packages must be interpreted with caution.

In each case, however, efforts were made to insure that the classes included students at the same grade level and with the same general course background.

Administrating the field tests Each participating teacher identified two classes: one to receive instruction with the newly developed package and one to receive no instruction. At all test sites, instruction was given to the class using the package by the participating local industrial arts teacher. Between one and three weeks after instruction, the pay-off tryout instruments were administered to both the experimental and control class students. The instructional packages tested and the pay-off field test instruments are reported in Appendix G and Appendix H, respectively.
The design employed in administering the field tests represented an application of the "pre-experimental designs" discussed by Campbell and Stanley (1963). In the interpretation of data resulting from the application of this design, the sources of invalidity reported by Campbell and Stanley (1963, p. 178) were considered. The weak factors of this design are:

1. selection,
2. mortality,
3. interaction of selection and mortality, and
4. interaction of selection and x [treatment].

However, the factors that are controlled by the application of this design are:

1. history,
2. testing,
3. instrumentation, and

The sources of invalidity of the "pre-experimental designs" would be intolerable in the decision-making process associated with summative evaluation. However, the model of concern in this study was formative evaluation not summative evaluation. In formative evaluation, the pay-off field testing is only one source of evaluative feedback concerning the developmental materials. Interpretations of the experi-
mental and control group data produced from the design were approached with caution.

**Evaluation component (4.4): Evaluation of products**

The activities of this component of Phase (4.0) included the analysis and organization of the data produced from the intrinsic and pay-off tryouts for subsequent presentation to the Institute. The data produced from the intrinsic tryouts were intended to give feedback to the curriculum developers concerning the procedural barriers, strengths, and weaknesses of the instructional materials tested. The data produced from the pay-off tryouts were intended to give feedback on student achievement resulting from the use of the instructional packages.

**Data analysis**

The pay-off instruments developed in this study represent ordinal measurement. Therefore, the analysis of the pay-off tryout data was restricted to descriptive and nonparametric statistics. The descriptive statistics for the practical and written component of each pay-off tryout were organized as in Table 10.

The descriptive data for each field test package are reported in Appendix J. Additional analysis activities were conducted based on the procedures published in the textbook *Nonparametric statistics for the behavioral sciences*. In
Table 10. Descriptive data format

<table>
<thead>
<tr>
<th>Package 000</th>
<th>Written Test&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students instructed with package</td>
<td>Students not receiving package instruction</td>
</tr>
<tr>
<td>n = exclusive range =</td>
<td>n = exclusive range =</td>
</tr>
<tr>
<td>high score =</td>
<td>high score =</td>
</tr>
<tr>
<td>low score =</td>
<td>low score =</td>
</tr>
<tr>
<td>median&lt;sup&gt;b&lt;/sup&gt; =</td>
<td>median&lt;sup&gt;b&lt;/sup&gt; =</td>
</tr>
<tr>
<td>100% score =</td>
<td>100% score =</td>
</tr>
</tbody>
</table>

<sup>a</sup>The practical tryout data followed the same format.

<sup>b</sup>The median was computed according to Glass and Stanley (1970, p. 60).

that text, Siegel (1956) explained:

When at least ordinal measurement has been achieved, the Mann-Whitney U test may be used to test whether two independent groups have been drawn from the same population. This is one of the most powerful of the nonparametric tests, and it is a most useful alternative to the parametric t test when the researcher wishes to avoid the t test's assumptions, or when the measurement in the research is weaker than interval scaling. (p. 116)

The general application of the Mann-Whitney U test as used in this study was to determine if the bulk of the scores of the students receiving instruction (A) was larger than the bulk of the scores of the students not receiving
Statistical hypothesis

The Mann-Whitney U statistic was used to evaluate the following statistical hypothesis of each component of the intrinsic tryouts. The general form of the statistical hypothesis was:

\[ H_0: \quad p(a>b) = \frac{1}{2} \]

\[ H_1: \quad p(a>b) > \frac{1}{2} \quad \alpha = .05 \]

The rationale for the application of this procedure was given by Siegel:

Suppose we have samples from two populations, population A and population B. The null hypothesis is that A and B have the same distribution. The alternative hypothesis, \( H_1 \), against which we test \( H_0 \), is that A is stochastically larger than B, a directional hypothesis. We may reject \( H_1 \) if the probability that a score from A is larger than a score from B is greater than one-half. That is, if \( a \) is one observation from population A, and \( b \) is one observation from population B, then \( H_1 \) is that \( p(a>b)>1/2 \). If the evidence supports \( H_1 \), this implies that the "bulk" of population A is higher than bulk of population B. (p. 116)

As applied in this study, accepting \( H_0 \) would indicate that the two independent samples were drawn from the same population. Accepting \( H_1 \) would indicate that the independent samples were not drawn from the same population. If the classes used in the field testing were parallel, A represents the students receiving instruction, and B represents
the students not receiving instruction, accepting \( H_1 \) gives support for labeling the field test packages "successful".

**Calculating U**  

The procedures used to determine whether the null hypothesis or the alternative hypothesis was applicable to the data were determined by the size of \( n_1 \) and \( n_2 \) in each tryout. In the tryouts where \( n_2 \) (the larger of the two independent samples) was between 9 and 20, the following procedure was followed:

1. Determine the value of \( n_1 \) and \( n_2 \). \( n_1 \) = the number of cases in the smaller group; \( n_2 \) = the number of cases in the larger group.

2. Rank together the scores for both groups, assigning the rank of 1 to the score which is algebraically lowest. Ranks range from 1 to \( N = n_1 + n_2 \). Assign tied observations the average of the tied ranks.

3. Determine the value of \( U \) by using formula (5) or (6). (The smaller value is \( U \) and the larger value is \( U' \).)

4. Compare the calculated \( U \) value with the critical \( U \) value for the desired \( \alpha \) from Table K (Siegel, 1956, p. 277).

5. Reject \( H_0 \) when the observed \( U \) is equal to or less than the \( U \) value in the table.
The formula for calculating U was given by Siegel (1956, p. 120) as:

\[ U = n_1 n_2 + \frac{n_1 (n_1 + 1)}{2} - R_1 \]  

or, equivalently,

\[ U = n_1 n_2 + \frac{n_2 (n_2 + 1)}{2} - R_2 \]  

where

- \( R_1 \) = sum of the ranks assigned to group of size \( n_1 \)
- \( R_2 \) = sum of the ranks assigned to group of size \( n_2 \)

In tryouts where \( n_2 \) was greater than 20, additional computations were required. A value of U was calculated as in the procedure of the smaller group outlined above. The additional procedures included:

1. Calculate a value of \( z \) using formula (7) using either \( U \) or \( U' \). (The only difference will be in the sign of \( z \).)

2. Compare the computed value of \( z \) with the tabular \( z \) value. (In this case Table A, Siegel, 1956, p. 247.)

3. Where the observed \( z \) has a one-tailed \( p < \alpha \), reject \( H_0 \).

The formula for calculating \( z \) was given by Siegel (1956, p. 121) as follows:


\[
z = \frac{U - \mu_u}{\sigma_u} = \frac{U - \frac{n_1n_2}{2}}{(n_1)(n_2)(n_1+n_2+1)} \frac{1}{12}
\]  

(7)

The data resulting from the completion of the Phase (4.0) pay-off tryout evaluation are presented in Table 11. The data in Table 11 and the intrinsic tryout summary forms (Appendix J) were presented to the Institute for subsequent decision-making.

**Decision point (4.5): Have products emerged?** An Institute session was conducted to decide the final arrangement of the instructional packages field tested. The data produced from the administration and evaluation of the intrinsic and pay-off tryouts were presented to the Institute. Recommendations were made for minor changes in format. The packages tested were judged to be finished products, ready for use in implementing graphic communications in industrial arts.

**Model assessment**

After completion of the formative evaluation activities a model assessment session was held. Each Institute teacher/developer participating for both the 1976 and 1977 summer sessions and the 1976-1977 school year was interviewed using
Table 11. Results of Phase (4.0) pay-off tryout evaluation activities

<table>
<thead>
<tr>
<th>Package</th>
<th>Observed U</th>
<th>Tabular^a U</th>
<th>z Score</th>
<th>p</th>
<th>Reject H₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package 626 Cognitive</td>
<td>324.5</td>
<td>NA</td>
<td>4.39</td>
<td>&lt;.00003</td>
<td>yes</td>
</tr>
<tr>
<td>Package 626 Psychomotor</td>
<td>240.5</td>
<td>NA</td>
<td>1.91</td>
<td>.0281</td>
<td>yes</td>
</tr>
<tr>
<td>Package 629 Cognitive</td>
<td>40</td>
<td>65</td>
<td>NA</td>
<td>.05</td>
<td>yes</td>
</tr>
<tr>
<td>Package 629 Psychomotor</td>
<td>2</td>
<td>60</td>
<td>NA</td>
<td>.05</td>
<td>yes</td>
</tr>
<tr>
<td>Package 630 Cognitive</td>
<td>29</td>
<td>65</td>
<td>NA</td>
<td>.05</td>
<td>yes</td>
</tr>
<tr>
<td>Package 630 Psychomotor</td>
<td>6.5</td>
<td>65</td>
<td>NA</td>
<td>.05</td>
<td>yes</td>
</tr>
<tr>
<td>Package 635 Psychomotor</td>
<td>25</td>
<td>34</td>
<td>NA</td>
<td>.05</td>
<td>yes</td>
</tr>
</tbody>
</table>

^aTable K (Siegel, 1956, p. 277).

the instrument presented in Appendix K.

The interview instrument was designed to collect data on the attitude of Institute participants concerning the process of curriculum development, revision, and improvement. A five-point Likert-type scale was constructed to assess the participants' attitude concerning:

1. identifying and ordering goals,
2. identifying and operationalizing objectives,
3. developing interim materials, and
4. field testing products.

Each participant was asked to supply feedback on the formative evaluation model. The findings resulting from the interviews are presented in Chapter V.
CHAPTER V. FINDINGS

The objective of this study was to investigate the feasibility of adopting or adapting a formative evaluation model to facilitate the collection and utilization of feedback data for public school industrial arts teachers during the formative period of instructional material development. Specifically, the problem of this study was to design and test a formative evaluation model for the development, tryout, and assessment of curriculum materials in public school industrial arts education.

**Designing the model:**

Question 1.1. What information-gathering activities produce evaluation feedback for public school industrial arts curriculum developers?

Question 2.1. What evaluation data sources provide evaluation feedback for public school industrial arts curriculum developers?

**Testing the model:**

Question 2.1. What effect does the use of a formative evaluation model have on the goals, objectives, and interim versions of materials developed by public school industrial arts teachers?
Question 2.2. What effect does the use of a formative evaluation model have on the attitude of teachers involved in the process of curriculum development, revision, and improvement?

Designing the Model

The questions concerning the design of the formative evaluation model were initially addressed through a review of literature associated with evaluation theory and practice. As a result of the review the following schools of evaluation were identified:

1. evaluation as measurement,
2. performance-objective congruence, and
3. professional judgment.

A further review of literature associated with evaluation theory and practice resulted in the identification of four contemporary evaluation models that expanded upon the theory associated with the schools of evaluation. The theory and practice of evaluation associated with each model were:

1. Methodology of Evaluation by Scriven which includes formative and summative evaluation.
2. Countenance of Evaluation by Stake which includes the organization of descriptive data concerning program antecedents, transactions, and outcomes.
3. Total Program Evaluation by Stufflebeam which includes context, input, process, and product evaluation components.

4. Discrepancy Evaluation by Provus which includes program design, installation, process, and product evaluation components.

Elements of the above models were used in the design and selection of information-gathering activities for producing evaluation feedback in public school industrial arts curriculum development. The classification of information needed in formative evaluation published by Sanders and Cunningham (Appendix A) gave the initial direction to the design and selection of data sources for providing evaluation feedback to curriculum developers. The specific sources suggested by Sanders and Cunningham (1973) were:

Critical Appraisal:
1. author (developer),
2. experts (subject matter, media, psychologists, etc.),
3. students using the materials, and
4. relevant others.

The findings related to the design of the model were organized under each research question. Each question was subdivided to represent the phases of the formative evaluation model.
Question 1.1: What information-gathering activities produce evaluation feedback for public school industrial arts curriculum developers?

The information-gathering activities that were designed to produce evaluation feedback were identified in each phase of the formative evaluation model. The findings related to this question are reported in Table 12.

Table 12. Information-gathering activities for evaluation feedback

<table>
<thead>
<tr>
<th>Formative Evaluation Model Phase</th>
<th>Information-Gathering Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase (1.0): Identify and Order Goals</td>
<td>Rate identified goals using Likert-type scale</td>
</tr>
<tr>
<td></td>
<td>Criteria: Worth and merit of goal</td>
</tr>
<tr>
<td>Phase (2.0): Identify and Operationalize Objectives</td>
<td>Rate identified objectives using Likert-type scale</td>
</tr>
<tr>
<td></td>
<td>Criteria: A) Worth and merit of objective, B) congruence with goals</td>
</tr>
<tr>
<td>Phase (3.0): Develop Interim Materials</td>
<td>Rate individual components of interim materials using Likert-type scale</td>
</tr>
<tr>
<td></td>
<td>Criteria: Completeness and usability of materials</td>
</tr>
<tr>
<td>Phase (4.0): Field Test Products</td>
<td>Intrinsic tryout. Critique components of product, procedural characteristics, strengths and weaknesses</td>
</tr>
<tr>
<td></td>
<td>Pay-off Tryout. Pre-experimental design</td>
</tr>
</tbody>
</table>
Question 1.2: What information data sources provide evaluation feedback for public school industrial arts curriculum developers?

Information data sources were designed to meet the needs of the curriculum development and evaluation components in each phase of the formative evaluation model. The findings related to this question are reported in Table 13.

Table 13. Data sources for evaluation feedback

<table>
<thead>
<tr>
<th>Formative Evaluation Model Phase</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase (1.0): Identify and Order Goals</td>
<td>1. Author/Developer(s)</td>
</tr>
<tr>
<td></td>
<td>2. Experts</td>
</tr>
<tr>
<td>Phase (2.0): Identify and Operationalize Objectives</td>
<td>1. Author/Developer(s)</td>
</tr>
<tr>
<td></td>
<td>2. Experts</td>
</tr>
<tr>
<td>Phase (3.0): Develop Interim Materials</td>
<td>1. Author/Developer(s)</td>
</tr>
<tr>
<td>Phase (4.0): Field Test Products</td>
<td>1. Teachers using developed materials</td>
</tr>
<tr>
<td></td>
<td>2. Students using developed materials</td>
</tr>
<tr>
<td></td>
<td>3. Students not using developed materials</td>
</tr>
</tbody>
</table>
Testing the Model

The testing of the formative evaluation model represented a demonstration of the application of the concepts and procedures of each individual model phase using the curriculum development efforts of selected industrial arts teachers. The findings related to the testing of the formative evaluation model were organized under each research question. Each question was subdivided to represent the phases of the formative evaluation model.

**Question 2.1:** What effect does the use of a formative evaluation model have on the goals, objectives, and interim versions of materials developed by public school industrial arts teachers?

**Phase (1.0): Identify and order goals**
As a result of completing Phase (1.0) educational goals emerged. The results of the curriculum development, assessment, and revision effort associated with education goals are presented in Table 14.

**Phase (2.0): Identify and operationalize objectives**
As a result of completing Phase (2.0) criteria for subsequent curriculum development emerged. The results of the curriculum development, assessment, and revision effort concerning objectives are presented in Table 15.
### Table 14. Effect of formative evaluation on goals

<table>
<thead>
<tr>
<th>Original Goal Rank</th>
<th>Priority Goal Rank</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>none</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>dropped</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>moved up</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>none</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>moved up</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>none</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>moved up</td>
</tr>
</tbody>
</table>

*a*Table 4.  
*b*Table 5.

### Table 15. Effect of formative evaluation on objectives

<table>
<thead>
<tr>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal/Objective No. Prior to Evaluation</td>
<td>Evaluate Objectives (Criteria)</td>
<td>Goal/Objective No. After Evaluation</td>
</tr>
<tr>
<td></td>
<td>Worth</td>
<td>Congruence</td>
</tr>
<tr>
<td>1.1</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>1.2</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>1.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.1</td>
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<td>yes</td>
</tr>
<tr>
<td>2.2</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.4</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*a*Appendix E.  
*b*Table 6.
Table 15 (Continued)

<table>
<thead>
<tr>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal/Objective No. Prior to Evaluation</td>
<td>Evaluate Objectives (Criteria)</td>
<td>(Objectives)</td>
</tr>
<tr>
<td></td>
<td>Worth</td>
<td>Congruence</td>
</tr>
<tr>
<td>3.1</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>3.2</td>
<td>-</td>
<td>yes</td>
</tr>
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<td>yes</td>
</tr>
<tr>
<td>3.4</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>4.1</td>
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<td>yes</td>
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<tr>
<td>4.2</td>
<td>-</td>
<td>-</td>
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<td>yes</td>
</tr>
<tr>
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</tr>
<tr>
<td>5.2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5.3</td>
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</tr>
<tr>
<td>5.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.1</td>
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<td>yes</td>
</tr>
<tr>
<td>6.2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.3</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Phase (3.0): Develop interim materials  
As a result of completing Phase (3.0) interim materials emerged from the curriculum development process. The results of the curriculum development, assessment, and revision process associated with this phase are presented in Table 16.
Table 16. Effect of formative evaluation on interim materials

<table>
<thead>
<tr>
<th>Packages Evaluated</th>
<th>Identified for Field Testing</th>
<th>Identified for Revision</th>
<th>Identified to be Recycled</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>100%</td>
<td>25%</td>
<td>25%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Phase (4.0): Field test products As a result of completing Phase (4.0) products emerged from the curriculum development process. The four instructional packages field tested were judged to be finished and satisfied the formative evaluation sequence.

Question 2.2: What effect does the use of a formative evaluation model have on the attitude of teachers involved in the process of curriculum development, revision, and improvement?

Data resulting from the model assessment interviews and discussions were organized by model phase to address question (2.2). The number of teachers interviewed did not justify the use of a statistical test of the prior-to-Institute participation/after-Institute participation rating differences. Therefore, the data related to the teachers' attitude were restricted to a descriptive summary for each model phase as follows:
Phase (1.0): Identify and order goals

The results of completing the interviews concerning the teachers' attitude about identifying and using educational goals in the curriculum development process are presented in Table 17.

Table 17. Attitude of teacher/developers towards developing and using goals

<table>
<thead>
<tr>
<th>Responses</th>
<th>Very Important</th>
<th>Important</th>
<th>Necessary</th>
<th>Unimportant</th>
<th>Very Unimportant</th>
<th>No Prior Experience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Institute Participation</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>After Institute Participation</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

Only two teachers rated their prior to Institute feeling about identifying and using goals in the curriculum development process as important or very important. Six of the seven teachers interviewed after Institute participation indicated that development and use of goals were at least important in the curriculum development process.
Phase (2.0): Identify and operationalize objectives

The results of completing the interviews concerning the teachers' attitude about the development and use of objectives as part of the curriculum development process are presented in Table 18.

Table 18. Attitude of teacher/developers towards developing and using objectives

<table>
<thead>
<tr>
<th></th>
<th>Very Important</th>
<th>Important</th>
<th>Necessary</th>
<th>Unimportant Unimportant</th>
<th>No Prior Experience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Institute Participation</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>After Institute Participation</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Three teachers rated their prior to Institute feeling about identifying and using objectives in the curriculum development process as important or very important. Five of the seven teachers interviewed after Institute participation indicated that development and use of objectives were at least important in the curriculum development process.
Phase (3.0): Development interim materials

The results of completing the interviews concerning the teachers' attitude about the process of developing new instruction materials are presented in Table 19.

Table 19. Attitude of teacher/developers towards developing new instructional materials

<table>
<thead>
<tr>
<th>Responses</th>
<th>Very Positive</th>
<th>Generally Positive</th>
<th>Neutral</th>
<th>Generally Negative</th>
<th>Very Negative</th>
<th>No Prior Experience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Institute Participation</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>After Institute Participation</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

Five teachers rated their prior to Institute feelings about developing new instructional materials as generally positive or very positive. All seven teachers indicated they felt at least positive about developing new instructional materials after Institute participation.
Phase (4.0): Field test products The results of completing the interviews concerning the teachers' attitude about testing new instructional materials prior to making decisions on their ultimate use are presented in Table 20.

Table 20. Attitude of teacher/developers towards field testing new instructional materials

<table>
<thead>
<tr>
<th>Responses</th>
<th>Essential</th>
<th>Very Helpful</th>
<th>Helpful</th>
<th>Helpless</th>
<th>Irrelevant</th>
<th>No Prior Experience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Institute Participation</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td>After Institute Participation</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

Four teachers rated their prior to Institute feelings about field testing new instructional materials as very helpful or essential. All seven teachers indicated they felt field testing new instructional materials prior to final decision-making was at least a very helpful component of the curriculum development process after Institute participation.
Chapter Summary

This chapter presented the findings relevant to the questions of this study. The information-gathering activities and data sources that provided evaluation feedback for public school industrial arts curriculum developers were reported. The effect of the formative evaluation model on the goals, objectives, and interim versions of materials developed by public school industrial arts teachers was reported. The effect of the formative evaluation model on the attitude of teachers involved in the process of curriculum development, revision, and improvement was presented.

Teacher/developer comments concerning the utility of the formative evaluation model are reported in Appendix K. Those comments and the results of this study are discussed in Chapter VI.
CHAPTER VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The first five chapters of this study presented the scope of the research project, literature review related to educational evaluation, definition and discussion of the formative evaluation model, and findings related to the design and testing of the evaluation model. This chapter will summarize the study, present conclusions, and list recommendations.

Summary

In summary, a brief review of the preceding chapters is presented. This summary is facilitated by the restatement of the problem and purpose of this research.

Restatement of the problem

The problem of this study was to design and test a formative evaluation model for the development, tryout, and assessment of curriculum materials in public school industrial arts education.

Restatement of the purpose

The purposes of this study were to:

1. expand upon the existing body of knowledge in the field of educational evaluation;
2. help the industrial arts profession understand the goals, roles, and procedures of formative evaluation; and

3. assist the industrial arts profession to identify activities and information sources that can be utilized to evaluate efforts for curriculum development, tryout, and assessment.

Developing the foundation

A review of literature provided the theoretical insights which helped to formulate a systematic foundation for the study. Three schools of evaluation were defined, reviewed, and compared. The three schools of evaluation were:

1. Evaluation as Measurement,
2. Performance-Objective Congruence, and

Four contemporary evaluation models that build upon the theory and practices under the three schools of evaluation were identified, reviewed, and compared. The four contemporary evaluation models were:

1. The Methodology of Evaluation Model (Scriven),
2. The Countenance of Evaluation Model (Stake),
3. The CIPP Evaluation Model (Stufflebeam), and
4. The Discrepancy Evaluation Model (Provus).
Developing the model

A model was developed resulting from a synthesis of concepts selected from the above schools of evaluation and contemporary evaluation models. The model developed in this study was intended to represent the broad concepts associated with evaluation during the formative period in curriculum development. The formative evaluation conceptual model identified four broad components in the educational planning-developing-testing continuum. The four broad components were:

1. identifying and ordering goals,
2. identifying and operationalizing objectives which reflect the priority goals,
3. developing instructional materials and programs to implement the goals and objectives, and
4. field testing the developed materials to provide evaluative feedback to developers.

Suggested in the formative evaluation conceptual model were four different functions of evaluation. The functions included:

1. assessment of the worth and merit of the identified goals,
2. assessment of the operationalized objectives for validation,
3. assessment of the interim developmental materials for validity and congruence with both the goals and objectives, and
4. assessment of the educational products as applied in the classroom.

A further review of literature was conducted which related to modeling. An analogue symbology was defined and used to expand the specificity and the heuristic quality of the conceptual model producing the formative evaluation procedural model. Both the conceptual and the procedural model were designed to simplify in visual form the components needed to formatively evaluate educational products. However, the two mentioned versions of the formative evaluation model have different purposes and intents.

The conceptual model was designed to give the potential user a concise overview of the broad components of formative evaluation. Thus, that model was utilized to show the interrelated phases of formative evaluation and to aid educational planners and practitioners in the understanding of formative evaluation at a conceptual level.

The procedural model was designed to simulate the flow of information and activities needed to implement formative evaluation for the development, tryout, and revision of instructional materials. This model was utilized to show
not only the interrelated phases of formative evaluation, but also the specific activities and events within each individual phase of the curriculum planning-developing-testing continuum.

**Field testing the model**

The formative evaluation model was field tested during the summer sessions of 1976 and 1977 and during the school year 1976-1977. The Graphic Communications Institute, conducted at Iowa State University by the Department of Industrial Education, served as the developmental setting. The mission of the Institute included the identification, development, tryout, and revision of exemplary curriculum materials to implement *The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12* (1975).

The personnel involved in the field testing of the formative evaluation model included the teacher/developers participating in the Institute during both summers and the members of the Iowa Industrial Arts Cadre.

The developmental and evaluative components of Phase (1.0) of the model were employed to identify, order, and evaluate educational goals for exploratory graphic communications. The data produced from the administration of an assessment activity on educational goals served as the basis for subsequent decision making concerning the arrange-
ment of the developmental goals. As a result of completing
the Phase (1.0) activities goal priorities emerged.

The developmental and evaluative components of Phase
(2.0) were employed to identify, operationalize, and evalu­
ate objectives to further clarify the educational goals
developed in Phase (1.0). The data produced from the ad­
ministration of an assessment activity on instructional ob­jectives served as the basis for subsequent decision making
concerning the inclusion of the instructional objective. As
a result of completing the Phase (2.0) activities, criteria
for subsequent curriculum development emerged.

The developmental and evaluative components of Phase
(3.0) were employed to develop, edit/revise, and evaluate
instructional packages designed to implement exploratory
graphic communications. As a result of completing the
Phase (3.0) activities, interim materials emerged from the
curriculum development process.

The developmental and evaluative components of Phase
(4.0) were employed to field test the instructional packages.
The intrinsic and pay-off tryouts were considered to be de­velopment components because the instructional packages were
still in the formative stage and could be revised based
on the field-test data feedback.

Four instructional packages were field tested in the
public school industrial arts classes of selected Institute
participants during the winter and spring terms of the 1976-1977 school year. Participating teachers completed an evaluation of tryout materials instrument to collect feedback data concerning the internal and procedural characteristics of the instructional packages.

Each participating field-test teacher identified two parallel intact classes to serve as the experimental and control groups in the pay-off tryout design. The students in the two intact classes represented independent samples. Posttest data were collected from the experimental and control classes for both the cognitive and psychomotor objectives of the instructional packages. Descriptive and nonparametric statistics were employed to organize data for subsequent decision making on the usefulness of the field test packages. As a result of completing the Phase (4.0) activities, instructional products emerged from the formative sequence.

Findings

The findings of the study were addressed and presented in terms of the specific research questions. The findings of the study were:

Question 1.1: What information-gathering activities produce evaluation feedback for public school industrial arts curriculum developers?
Findings  It was found that the information-gathering activities identified in each phase of the formative evaluation model produced evaluation feedback for public school industrial arts curriculum developers. Scale instruments were found to be useful in assessing educational goals, objectives, and instructional materials developed in the study. Intrinsic tryout and pay-off tryout activities also produced evaluation feedback to the industrial arts curriculum developers. These findings are supported by evaluation literature including Sanders and Cunningham (1973), Cunningham (1973), and Scriven (1967). The information-gathering activities on goals, objectives, interim materials, and instructional products identified in the formative evaluation model were helpful tools for public school industrial arts teachers involved in the process of developing, revising, and testing new instructional materials.

Question 1.2: What evaluation data sources provide evaluation feedback for public school industrial arts curriculum developers?

Findings  It was found that selected data sources provided evaluation feedback for public school industrial arts curriculum developers. It was found that participating teacher/developers and a panel of subject matter and teaching methods experts provided evaluative feedback, enabling decision making concerning educational goals and objectives.
The teacher/developers provided evaluative data for feedback enabling decision making concerning the interim versions of the instructional packages. Participating field test teachers and students provided evaluative data for feedback enabling decision making concerning the final versions of the instructional products. These findings are supported by the literature associated with curriculum development and evaluation applied to education in general. Collecting information from teachers developing instructional materials, from a panel of experts, from field test teachers, and from experimental and control class students is not a new idea. However, the organization of the above elements into a useful model adds a unique aid to the individual interested in pursuing the challenge of formative evaluation for curriculum development, revision, and improvement.

**Question 2.1:** What effect does the use of a formative evaluation model have on the goals, objectives, and interim versions of materials developed by public school industrial arts teachers?

**Findings**

It was found that employment of a formative evaluation model facilitates the development, assessment, and revision of educational goals, objectives, interim materials, and instructional products. The use of the formative evaluation model facilitated informed decision making by the Institute participants at appropriate points in the
curriculum development-assessment-revision continuum. The application of the formative evaluation model by the Graphic Communications Institute served to organize the interrelated concepts and procedures of evaluation; to predict the flow of information and events during product planning, development, and assessment, and to represent a useful system of evaluation for the participating industrial arts practitioners.

**Question 2.2:** What effect does the use of a formative evaluation model have on the attitude of teachers involved in the process of curriculum development, revision, and improvement?

**Findings** It was found that the employment of the formative evaluation model increased the participating teachers' degree of positive attitude towards identifying and using goals, developing and using objectives, developing new instructional materials, and field testing instructional materials prior to final decision making. It was found that the use of the model had a positive effect on the attitude of the teachers involved in the process of curriculum development, revision, and improvement.

Two concerns come to mind in the evaluation of the findings related to Question 2.2: 1) The cause for this positive attitude could be explained because the teachers participating in the Institute represented the more motivated
teachers in the field. 2) The increase in the individual ratings of attitude towards the components of the curriculum development process represented the presence of the phenomenon of experimental mortality. That is, the improved rating of attitude may have resulted because unmotivated or negative Institute participants did not return for the second year of the curriculum development process. These findings must be evaluated in the light of the two above considerations. However, it is held that teachers who participate in the process of developing, testing, and revising new instructional materials are the more motivated individuals from the total teacher population.

As a result of the model assessment interviews, minor revision in the formative evaluation conceptual model occurred. Two path arrows were added to the conceptual model: one arrow to show the entry point and another arrow to show the exit point in the formative evaluation sequence. The revised model is presented in Figure 21.

Conclusions

The objective of this study was to investigate the feasibility of adopting or adapting a formative evaluation model to facilitate collection and use of evaluation data
Figure 21. The revised formative evaluation conceptual model
during the formative period in the development, revision, and
improvement of industrial arts curriculum at the public
school level. The conclusions of this study are based on
the findings related to the research questions. The
conclusions are confined to the problem and purpose of the
study as follows:

1. A formative evaluation model can be developed to
facilitate the development, tryout, and assessment
of curriculum materials in public school industrial
arts education.
2. A formative evaluation conceptual model can be adopted to facilitate collection and use of evaluative data for feedback to industrial arts curriculum developers enabling informed decision making during the curriculum development, assessment, and revision process.

3. A formative evaluation conceptual model is a useful tool for communicating and promoting the understanding of the goals, roles, and procedures of formative evaluation in public school industrial arts.

4. The application of the formative evaluation model can assist the industrial arts curriculum developer to identify the activities and information sources that can be utilized to evaluate efforts for curriculum development, tryout, and assessment.

5. The formative evaluation procedural model can be adapted for organizing and conducting curriculum development, assessment, and revision in public school industrial arts.

The application of the formative evaluation procedural model must be approached with caution in any curriculum development and evaluation setting different from the setting in this study. Each curriculum development under-
taking is similar in nature with respect to the basic components of the formative evaluation procedural model. That is, most curriculum development projects will identify goals, identify objectives, develop interim materials, and test the materials in the classroom. However, the specific activities within each phase of the procedural model should be evaluated and redesigned to meet the specific needs of each situational application. This conclusion is supported by Wenig (1974):

In the long run, it is better that each individual develop his own model with his own terminology and his own application techniques. When the individual has achieved this, he can begin to achieve the true significance of total program evaluation models in assisting him to gather information that is necessary to make informed judgments. (p. 59)

The conceptual model developed in this study can serve as the basis for predevelopment design in subsequent curriculum development and evaluation undertakings. However, the specific terminology, techniques, and applications of the procedural model should be considered individually by each potential user.

Recommendations

The recommendations resulting from the completion of this study are based upon the finding and conclusions reported. The recommendations are organized in two categories.
The first list of recommendations pertain to the replications and improvement of the research on the curriculum development, tryout, and assessment process. The second list of recommendations pertain to the application of the formative evaluation model.

The recommendations for replication and improvement of the research are:

1. The formative evaluation model designed and tested in this study should be replicated in other developmental settings to investigate additional information-gathering activities and additional data sources for providing evaluative feedback for public school curriculum developers.

2. Further study is recommended to investigate and report additional techniques that analyze data resulting from each phase of the formative evaluation model.

3. Further research is recommended to investigate and report the effects of the application of a formative evaluation model on additional individuals and groups within the educational enterprise.

The recommendations for application of the formative evaluation model are:
1. It is recommended that the formative evaluation conceptual model be adopted as an organizational tool to communicate and facilitate the development, tryout, and assessment of curriculum materials in public school industrial arts education.

2. It is recommended that the formative evaluation procedural model be adapted to meet the specific needs of curriculum development, revision, and improvement efforts in public school industrial arts education.

3. It is recommended that innovative curriculum materials for industrial arts (K-12) be developed, assessed, and revised using the formative evaluation model.

4. It is recommended that a summative evaluation model to facilitate the collection and use of evaluation data during the summative period in the testing, comparing, adapting, and disseminating of curriculum improvement materials for public school industrial arts be developed and combined with the formative evaluation model presented in this study.
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To my mother Ruth, thank you for your love, support, and help throughout my life.

To my dearest wife Janice, thank you for your love, sacrifice, understanding, and help in all my endeavors.
Date of Birth: May 28, 1947
Place of Birth: Hackensack, New Jersey
Marital Status: Married
Family: Wife: Janice E.
Child: Lila Beth

Education:

Teaching Experience:
1973-1977 Industrial Education Instructor. Iowa State University.

Publications:
Matched molding of fiberglass products. Industrial Education, 1975, 64, 40-41.

APPENDIX A:
SANDERS AND CUNNINGHAM
FORMATIVE EVALUATION MATERIALS
I. Internal Information
   
   A. Descriptive Information
      1. Physical specifications
      2. Rationale, goals, and objectives
      3. Content
      4. Other

   B. Critical Appraisal
      1. Author (developer)
      2. Experts (subject matter, media, psychologists, etc.)
      3. Students using the materials
      4. Teachers using the materials
      5. Relevant others

II. External Information

   A. Assessment of the effects of the materials on student behavior
      1. Achievement
      2. Attitude
      3. Skill
      4. Interest
      5. Commitment
      6. Other

   B. Assessment of the effects of the materials on teacher behavior
      1. Attitude
      2. Interest
      3. Commitment
      4. Competency
      5. Teaching strategy
      6. Other

   C. Assessment of the effects of the materials on the behavior of relevant others
      1. Parents
      2. Administrators
      3. Teachers not using the materials
      4. Students not using the materials
      5. The community
      6. Others

III. Contextual Information

   A. Student Characteristics
   B. Teacher Characteristics
   C. School Characteristics
   D. Community Characteristics
   E. Curricular Characteristics
   F. Other Relevant Elements in the Learning Environment

Figure 22. A classification of information needed in formative evaluation (Sanders and Cunningham, 1973, p. 219)
I. Pre-Developmental Activities
   A. Needs Assessment
   B. Evaluation of Needs

II. Evaluation of Objectives
   A. Logical Analyses
      1. Cogency of rationales for objectives
      2. Consequences of reaching objectives
      3. Appeals to higher values
   B. Empirical Analysis
      1. Evaluation by relevant groups
      2. Evaluation by specialists
      3. Appeals to written documents

III. Formative Interim Evaluation
   A. Formal
      1. Pay-off evaluation
      2. Intrinsic evaluation
      3. Evaluation of programs operations
   B. Informal (unobtrusive)

IV. Formative Product Evaluation
   A. Validation Studies
   B. Cost Analyses
   C. Descriptive Analyses
   D. Goal Free Evaluation

Figure 23. A structure for planning formative evaluation in product development (Sanders and Cunningham, 1973, p. 218)
Table 21. Summary of techniques and procedures appropriate for formative evaluation (Sanders and Cunningham, 1973, p. 220)

<table>
<thead>
<tr>
<th>FORMATIVE EVALUATION ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRE-DEVELOPMENTAL</strong></td>
</tr>
<tr>
<td>Logical analyses of needs:</td>
</tr>
<tr>
<td>1. cogency</td>
</tr>
<tr>
<td>2. consequences</td>
</tr>
<tr>
<td>3. higher order value</td>
</tr>
<tr>
<td>Empirical analyses of needs:</td>
</tr>
<tr>
<td>1. group data: surveys</td>
</tr>
<tr>
<td>2. observation and expert opinion</td>
</tr>
<tr>
<td>unobtrusive measures</td>
</tr>
<tr>
<td>accreditation procedures</td>
</tr>
<tr>
<td>category systems</td>
</tr>
<tr>
<td>3. analysis of documents</td>
</tr>
<tr>
<td>unobtrusive measures</td>
</tr>
<tr>
<td>content analysis</td>
</tr>
<tr>
<td>operationalization of objectives</td>
</tr>
<tr>
<td>experimental tryout of goal statements</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Needs assessment</td>
</tr>
<tr>
<td>(if no needs assessment results available)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B:
STUDY PERSONNEL
1. Mike Bartlett  
   Industrial Arts Instructor  
   Ballard High School  
   Box 307  
   Huxley, IA 50124

2. Harold Berryhill  
   Consultant DPI  
   Grimes State Office Bldg.  
   Des Moines, IA 50319

3. Ronald Bro  
   Teacher Educator  
   University of Northern Iowa  
   Cedar Falls, IA 50613

4. Donald Davis  
   Consultant-AEA #16  
   305 Avenue F  
   Fort Madison, IA 52627

5. Roger Foelske  
   Consultant DPI  
   Grimes State Office Bldg.  
   Des Moines, IA 50319

6. Richard Gabriel  
   Career Ed. Representative  
   1800 Grand Avenue  
   Des Moines, IA 50307

7. Robert Gelina  
   Teacher Educator  
   Iowa State University  
   Ames, IA 50011

8. Ted Nunebaker  
   Industrial Arts Instructor  
   Springville Community Schools  
   Springville, IA 52336

9. William Strilich  
   Industrial Arts Instructor  
   Harding Junior High School  
   Cedar Rapids, IA 52402

Figure 24. Iowa Industrial Arts Cadre participants
1. Tom Baughman  
   Adel-Desoto Schools  
   Adel, IA
2. Robert Brown  
   Indianola Community Schools  
   Indianola, IA
3. Larry Card  
   McCombs Junior High School  
   Des Moines, IA
4. Dwight Crow  
   Indianola Community Schools  
   Indianola, IA
5. Michael Foley  
   Fort Madison Senior High School  
   Fort Madison, IA
6. Vernard Foster  
   Hoyt Middle School  
   Des Moines, IA
7. Kirk Geist  
   Jefferson Junior High School  
   Jefferson, IA
8. Michael Hiydon  
   Lewis Central High School  
   Council Bluffs, IA
9. Denise Keller  
   Iowa State University  
   Ames, IA
10. Eugene Lane  
    Durant Community Schools  
    Durant, IA

Dr. Ray D. Loyd, Institute Director  
Iowa State University  
Ames, IA

Figure 25. Institute personnel participating in the study
APPENDIX C:
PHASE (1.0) EVALUATION
INSTRUMENT AND DATA
THE IOWA GUIDE FOR CURRICULUM IMPROVEMENT IN EXPLORATORY GRAPHIC COMMUNICATIONS

Assessment Activity on Educational Goals

Rater's Name

Instructions: This questionnaire is being administered to ascertain your opinion of the developmental goal statements listed below. Please read each goal carefully and circle the rating corresponding to your assessment of the goal's importance in an exploratory course in graphic communications for junior high school industrial arts.

Goal Rating Scale:
(5) Very Important
(4) Important
(3) Neutral
(2) Unimportant
(1) Very Unimportant

Graphic Communications Developmental Goals:

1. To provide opportunities for students to broaden career awareness through exploration of graphic communications.

2. To provide opportunities for students to make tentative career choices.

3. To provide opportunities for students to explore graphic communications technology (materials and methods).

4. To provide opportunities for students to develop safe working habits in graphic communications.

5. To provide opportunities for students to improve problem solving and creative abilities through graphic communications.

6. To provide opportunities for students to understand the structure of the graphic communications industries.

7. To provide opportunities for students to understand the implications of graphic communications on society.
Table 22. Mean, standard deviation, and priority rank order of ratings for graphic communications developmental goals

<table>
<thead>
<tr>
<th>No.</th>
<th>Teacher/Developer Ratings (n=10)</th>
<th>Cadre Ratings (n=7)</th>
<th>Overall Ratings (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{X}$</td>
<td>$s$</td>
<td>Rank</td>
</tr>
<tr>
<td>1</td>
<td>4.50</td>
<td>0.71</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3.40</td>
<td>0.84</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>4.50</td>
<td>0.53</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4.20</td>
<td>0.63</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>4.40</td>
<td>0.52</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>4.10</td>
<td>0.74</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>4.00</td>
<td>0.67</td>
<td>6</td>
</tr>
</tbody>
</table>

Note. Rating of 5= Very Important, 4= Important, 3=neutral, 2= Unimportant, 1= Very Unimportant.
APPENDIX D:

GRAPHIC COMMUNICATIONS TECHNICAL CONTENT
TAXONOMY, DEFINITIONS, AND OBJECTIVES PRIOR TO EVALUATION
Figure 26. Graphic communications technical content taxonomy
Graphic Communications  The graphic communications cluster involves the study of personnel, systems, and techniques in communicating ideas, knowledge, and information for the producing and servicing of industrial goods. Graphic communications encompasses all the content of four areas: graphic image generation, graphic image reproduction, graphic image processing, and graphic image management. The graphic communications cluster represents one form of communication.

Area  An area is a generalized component of the graphic communications cluster which deals with related phases of the total production process. Each area may be comprised of several sections.

Section  A section is a component of an area which deals with specific phases of the total graphic production process.

Unit  A unit is a component of a section which deals with specific subject matter within a given section. A unit may entail several activities.

Activities  Activities are student oriented supportive components of units and deal with specific processes, equipment, materials, methodology, and technology.

Instructional Package  An instructional package is a collection of materials dealing with any or all content and methodology from the activities, units, sections, areas, or cluster and is a complete step by step procedural package of specific production processes. These packages may include any materials appropriate to the attainment of goals and objectives of an exploratory graphic communications program.

Figure 27. Definition of terms
Table 23. Developmental goals and objectives prior to Phase (2.0) assessment

<table>
<thead>
<tr>
<th>Goal Number</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>To provide opportunities for students to broaden career awareness through exploration of graphic communications.</td>
</tr>
<tr>
<td></td>
<td><strong>Objectives</strong></td>
</tr>
<tr>
<td>1.1</td>
<td>The student will explore a wide variety of careers related to graphic image generation, reproduction, processing, and management.</td>
</tr>
<tr>
<td>1.2</td>
<td>The student will explore the interrelationships among graphic communications careers.</td>
</tr>
<tr>
<td>1.3</td>
<td>The student will identify requisite abilities, knowledges, training, etc., of select careers related to the graphic communications cluster.</td>
</tr>
<tr>
<td>1.4</td>
<td>The student will pursue social factors (salary, prestige, working conditions, mobility, etc.) of select graphic communications careers.</td>
</tr>
<tr>
<td>2.0</td>
<td>To provide opportunities for students to explore graphic communications materials and processes.</td>
</tr>
<tr>
<td></td>
<td><strong>Objectives</strong></td>
</tr>
<tr>
<td>2.1</td>
<td>The student will identify the materials, equipment, tools, etc., related to the graphic communications cluster.</td>
</tr>
<tr>
<td>2.2</td>
<td>The student will identify processes from the areas of graphic communications including: graphic image generation, graphic image reproduction, graphic image processing, and graphic image management.</td>
</tr>
<tr>
<td>2.3</td>
<td>The student will utilize a wide variety of graphic communications materials and processes.</td>
</tr>
<tr>
<td>2.4</td>
<td>The student will explore the relationships that exist among the various materials and processes of the graphic communications cluster.</td>
</tr>
<tr>
<td>Goal Number</td>
<td>Objectives</td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>3.0</td>
<td>To provide opportunities for students to improve his/her problem-solving and creative abilities through graphic communications.</td>
</tr>
<tr>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>The student will become familiar with problem-solving techniques in graphic communications.</td>
</tr>
<tr>
<td>3.2</td>
<td>The student will utilize problem-solving techniques in solving unique problems.</td>
</tr>
<tr>
<td>3.3</td>
<td>The student will begin to develop creative abilities through graphic communications experiences.</td>
</tr>
<tr>
<td>3.4</td>
<td>The student will apply creative abilities through innovative ideas and unique solutions to problems.</td>
</tr>
<tr>
<td>Goal 4.0</td>
<td>To provide opportunities for students to develop safe working habits on graphic communications.</td>
</tr>
<tr>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>The student will explore safety in all aspects of graphic communications.</td>
</tr>
<tr>
<td>4.2</td>
<td>The student will be familiar with industrial laws and codes concerning graphic communications related safety.</td>
</tr>
<tr>
<td>4.3</td>
<td>The student will be acquainted with laboratory safety practices including tools, equipment, personnel, etc.</td>
</tr>
<tr>
<td>4.4</td>
<td>The student will exemplify safe working habits in all graphic communications activities.</td>
</tr>
</tbody>
</table>
Table 23 (Continued)

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 To provide opportunities for students to understand the implications of graphic communications on society.</td>
<td></td>
</tr>
</tbody>
</table>

   **Objectives**

   5.1 The student will explore ways graphic communications has affected society (products, methods, materials, etc.).

   5.2 The student will explore limitations society puts on areas of graphic communications.

   5.3 The student will pursue the historical aspects and developments of graphic communications.

   5.4 The student will become familiar with other social aspects/effects of graphic communications (quality control, economics, occupations, etc.).

   **Goal 6.0** To provide opportunities for students to understand the total structure of graphic communications technology.

   **Objectives**

   6.1 The student will explore the interrelationships among the areas of graphic communications.

   6.2 The student will identify the areas and sections of the graphic communications cluster.

   6.3 The student will comprehend the working relationships between each section of the four areas of graphic communications.
APPENDIX E:
PHASE (2.0) EVALUATION
INSTRUMENT, DATA, AND RESULTS
Introduction

The purpose of this assessment activity is to collect feedback data on the instructional objectives developed for the implementation of The Iowa Guide for Curriculum Improvement in Exploratory Graphic Communications. Six educational goals developed from The Iowa Guide for Curriculum Improvement in Industrial Arts K-12 have been previously rated for the graphic communications cluster. The six goals for exploratory graphic communications are listed in this instrument in priority order (1.0 was highest priority). Please take the time to provide further evaluative feedback to the graphic communications curriculum workshop participants concerning the objectives listed under each goal.

Directions

(1) Rate the worth and merit of each educational objective for an exploratory graphic communications cluster course for junior high school industrial arts.

Scale

[5] extremely important
[4] very important
[3] important
[2] not too important
[1] not important

(2) Rate the congruity or degree of agreement among the educational goal and the educational objective for exploratory graphic communications.

Scale

[a] complete agreement
[b] considerable agreement
[c] some agreement
[d] little agreement
[e] no agreement

Please feel free to write in comments concerning the goals and objectives.
GRAPHIC COMMUNICATIONS AREA DEFINITIONS

**Graphic Image Generation:** Graphic image generation is the area of graphic communications beginning with an idea conception and following through to a copy ready message. All products and all layouts must first be designed and carried through the copy preparation stage.

**Graphic Image Reproduction:** Graphic image reproduction is an area of graphic communications which involves the techniques of image carrier preparation and image transfer methods. Image carriers are produced by: manual, mechanical, and chemical processes. Image transfers are produced by stencil, relief, gravure, planographic, and photographic methods.

**Graphic Image Processing:** Graphic image processing is the area of graphic communications which involves the processes of assembly, finishing, and packaging operations. Because the nature and purpose of the product usually determines the operations that must be performed, these operations are generally established during the message analysis stage of product development.

**Graphic Image Management:** Graphic image management is the area of graphic communications which involves the techniques of storage and retrieval of graphic images. The graphic image management area includes the storage and retrieval by paper, electronics (computer, video tape), and microform means.
Junior High School Industrial Arts
Exploratory Graphic Communications
Goals and Objectives

Goals are listed in priority order.
Please CIRCLE RESPONSES.

Goal
1.0 To provide opportunities for students to broaden career awareness through exploration of graphic communications.

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>1.1 The student will explore a wide variety of careers related to graphic image generation, reproduction, processing, and management.</td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>1.2 The student will explore the interrelationships among graphic communications careers.</td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>1.3 The student will identify requisite abilities, knowledges, training, etc., of select careers related to the graphic communications cluster.</td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>1.4 The student will pursue social factors (salary, prestige, working conditions, mobility, etc.) of select graphic communications careers.</td>
</tr>
</tbody>
</table>

Please write in comments or additional objectives for goal 1.0.
Goal
2.0 To provide opportunities for students to explore graphic communications materials and processes.

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>2.1 The student will identify the materials, equipment, tools, etc., related to the graphic communications cluster.</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>2.2 The student will identify processes from the areas of graphic communications including: graphic image generation, graphic image reproduction, graphic image processing, and graphic image management.</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>2.3 The student will utilize a wide variety of graphic communications materials and processes.</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>2.4 The student will explore the relationships that exist among the various materials and processes of the graphic communications cluster.</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
</tbody>
</table>

Please write in comments or additional objectives for goal 2.0.
Goal

3.0 To provide opportunities for students to improve his/her problem-solving and creative abilities through graphic communications.

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5]</td>
<td>3.1 The student will become familiar with problem solving techniques in graphic communications.</td>
</tr>
<tr>
<td>[a]</td>
<td>3.2 The student will utilize problem solving techniques in solving unique problems.</td>
</tr>
<tr>
<td>[b]</td>
<td>3.3 The student will begin to develop creative abilities through graphic communications experiences.</td>
</tr>
<tr>
<td>[c]</td>
<td>3.4 The student will apply creative abilities through innovative ideas and unique solutions to problems.</td>
</tr>
<tr>
<td>[d]</td>
<td></td>
</tr>
<tr>
<td>[e]</td>
<td></td>
</tr>
</tbody>
</table>

Please write in comments or additional objectives for goal 3.0.
### Goal 4.0

To provide opportunities for students to develop safe working habits in graphic communications.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[a]</td>
<td>[b]</td>
<td>[c]</td>
<td>[d]</td>
<td>[e]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives</th>
<th>4.1</th>
<th>The student will explore safety in all aspects of graphic communications.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.2</td>
<td>The student will be familiar with industrial laws and codes concerning graphic communications related safety.</td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td>The student will be acquainted with laboratory safety practices including tools, equipment, personnel, etc.</td>
</tr>
<tr>
<td></td>
<td>4.4</td>
<td>The student will exemplify safe working habits in all graphic communications activities.</td>
</tr>
</tbody>
</table>

Please write in comments or additional objectives for goal 4.0.
### Goal
5.0 To provide opportunities for students to understand the implications of graphic communications on society.

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>5.1 The student will explore ways graphic communications has affected society (products, methods, materials, etc.).</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>5.2 The student will explore limitations society puts on areas of graphic communications.</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>5.3 The student will pursue the historical aspects and developments of graphic communications.</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>5.4 The student will become familiar with other social aspects/effects of graphic communications (quality control, economics, occupations, etc.).</td>
</tr>
<tr>
<td>[a] [b] [c] [d] [e]</td>
<td></td>
</tr>
</tbody>
</table>

Please write in comments or additional objectives for goal 5.0.
Goal
6.0 To provide opportunities for students to understand the total structure of graphic communications technology.

Objectives

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>6.1 The student will explore the interrelationships among the areas of graphic communications.</td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>6.2 The student will identify the areas and sections of the graphic communications cluster.</td>
</tr>
<tr>
<td>[5] [4] [3] [2] [1]</td>
<td>6.3 The student will comprehend the working relationships between each section of the four areas of graphic communications.</td>
</tr>
</tbody>
</table>

Please write in comments or additional objectives for goal 6.0.
Table 24. Mean, standard deviation, and overall rank order of ratings of worth of developmental objectives for graphic communications

<table>
<thead>
<tr>
<th>Goal/objective number</th>
<th>Developer Ratings</th>
<th>Cadre Ratings</th>
<th>Overall Ratings</th>
<th>Rank</th>
<th>Criteria Met?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>$\bar{X}$</td>
<td>$s$</td>
<td>$\bar{X}$</td>
<td>$s$</td>
<td>$\bar{X}$</td>
</tr>
<tr>
<td>1.1</td>
<td>4.80</td>
<td>0.42</td>
<td>4.50</td>
<td>0.55</td>
<td>4.69</td>
</tr>
<tr>
<td>1.2</td>
<td>4.20</td>
<td>0.92</td>
<td>4.33</td>
<td>0.52</td>
<td>4.25</td>
</tr>
<tr>
<td>1.3</td>
<td>3.50</td>
<td>0.97</td>
<td>4.33</td>
<td>0.82</td>
<td>3.81</td>
</tr>
<tr>
<td>1.4</td>
<td>3.30</td>
<td>0.95</td>
<td>3.83</td>
<td>1.16</td>
<td>3.50</td>
</tr>
<tr>
<td>2.1</td>
<td>4.20</td>
<td>0.79</td>
<td>4.33</td>
<td>0.82</td>
<td>4.25</td>
</tr>
<tr>
<td>2.2</td>
<td>4.40</td>
<td>0.70</td>
<td>4.33</td>
<td>0.82</td>
<td>4.37</td>
</tr>
<tr>
<td>2.3</td>
<td>3.40</td>
<td>0.70</td>
<td>4.50</td>
<td>0.84</td>
<td>3.81</td>
</tr>
<tr>
<td>2.4</td>
<td>3.80</td>
<td>0.92</td>
<td>3.67</td>
<td>1.37</td>
<td>3.75</td>
</tr>
<tr>
<td>3.1</td>
<td>4.40</td>
<td>0.97</td>
<td>4.67</td>
<td>0.52</td>
<td>4.50</td>
</tr>
<tr>
<td>3.2</td>
<td>3.60</td>
<td>1.17</td>
<td>4.50</td>
<td>0.84</td>
<td>3.94</td>
</tr>
<tr>
<td>3.3</td>
<td>4.20</td>
<td>0.63</td>
<td>4.00</td>
<td>0.89</td>
<td>4.12</td>
</tr>
<tr>
<td>3.4</td>
<td>4.10</td>
<td>0.57</td>
<td>4.17</td>
<td>0.98</td>
<td>4.12</td>
</tr>
<tr>
<td>4.1</td>
<td>4.60</td>
<td>0.70</td>
<td>3.00</td>
<td>1.09</td>
<td>4.00</td>
</tr>
<tr>
<td>4.2</td>
<td>3.00</td>
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Note. Ratings of 5= Extremely Important, 4= Very Important, 3= Important, 2= Not Too Important, 1= Not Important. Developer n= 10; Cadre n= 6; Criteria= Overall Rating $\geq$ 4.0.
Table 25. Mean, standard deviation, and overall rank order of ratings of congruence among developmental goals and objectives for graphic communications

<table>
<thead>
<tr>
<th>Goal/objective number</th>
<th>Developer Ratings</th>
<th>Cadre Ratings</th>
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<th>Criteria Met?</th>
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<td>1.34</td>
<td>4.33</td>
<td>0.52</td>
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</tbody>
</table>

Note. Ratings of 5= Complete Agreement, 4= Considerable Agreement, 3= Some Agreement, 2= Little Agreement, 1= No Agreement.
Developer n= 10; Cadre n= 6; Criteria= Overall Rating ≥ 4.0.
Table 26. Instructional objectives resulting from Phase (2.0)

Developmental Goals in Priority Rank Order

Goal
1.0 To provide opportunities for students to broaden career awareness through exploration of graphic communications.

Objectives
1.1 The student will explore a wide variety of careers related to graphic image generation, graphic image reproduction, graphic image processing, and graphic image management.

1.2 The student will explore the interrelationships among graphic communications careers.

Goal
2.0 To provide opportunities for students to explore graphic communications materials and processes.

Objectives
2.1 The student will identify and utilize processes from the areas of graphic communications including: graphic image generation, graphic image reproduction, graphic image processing, and graphic image management.

2.2 The student will identify and utilize the materials, equipment, tools etc., related to the graphic communications cluster.

Goal
3.0 To provide opportunities for students to improve problem-solving and creative abilities through graphic communications.

Objectives
3.1 The student will begin to develop creative abilities through graphic communications experiences.

3.2 The student will become familiar with problem solving techniques in graphic communications.

3.3 The student will apply creative abilities through innovative ideas and unique solutions to problems.
Goal
4.0 To provide opportunities for students to develop safe working habits in graphic communications.

Objective
4.1 The student will be acquainted with laboratory safety practices including tools, equipment, personnel, etc.
4.2 The student will exemplify safe working habits in all graphic communications activities.
4.3 The student will explore safety in all aspects of graphic communications.

Goal
5.0 To provide opportunities for students to understand the implications of graphic communications on society.

Objective
5.1 The student will explore ways graphic communications has affected society (products, methods, materials, etc.).

Goal
6.0 To provide opportunities for students to understand the total structure of graphic communications technology.

Objective
6.1 The student will explore the interrelationships among the areas of graphic communications.
APPENDIX F:
PHASE (3.0) EVALUATION
INSTRUMENT, SUMMARY FORM, AND DATA
THE IOWA GUIDE FOR
CURRICULUM IMPROVEMENT IN
EXPLORATORY GRAPHIC COMMUNICATIONS

ASSESSMENT ACTIVITY ON PROTOTYPE MATERIALS

Introduction
The purpose of this activity is to collect information needed to assess the instructional materials developed to implement the Graphic Communications Cluster for junior high school industrial arts in the State of Iowa. Previously, educational goals and objectives, derived from The Iowa Guide for Curriculum Improvement in Industrial Arts K-12 specifically for Exploratory Graphic Communications, were rated and evaluated. This assessment activity will collect feedback data needed for subsequent field testing and/or revision of the instructional materials.

Directions
You are being interviewed to evaluate the prototype instructional packages for exploratory graphic communications for junior high school industrial arts. Please evaluate the following instructional package using the following criteria.

1. Could you teach the specified area of graphic communications using the activity package as it presently is?

2. Is the activity package ready for classroom tryout with your junior high school students?

3. Is the activity package ready for classroom tryout with your junior high school aged son or daughter?
<table>
<thead>
<tr>
<th>INSTRUCTIONAL PACKAGE Number</th>
<th>Participant 1</th>
<th>Participant 2</th>
<th>Participant 3</th>
<th>Participant 4</th>
<th>Participant 5</th>
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</table>

5 COMPLETELY APPROPRIATE
4 ACCEPTABLE
3 NEEDS SOME REVISION
2 TOO GENERAL
1 UNACCEPTABLE
5 EXCELLENT
4 GOOD
3 FAIR
2 POOR
1 UNACCEPTABLE
5 LOGICAL & ADEQUATE
4 CONTAINS ADEQUATE DETAIL
3 BARELY ACCEPTABLE
2 NEEDS MORE DETAIL
1 NOT USABLE
5 EXCELLENT
4 GOOD
3 USABLE
2 TOO SKETCHY
1 UNACCEPTABLE
5 EXCELLENT
4 ADEQUATE TO MEASURE OBJECTIVE
3 NEEDS SOME REVISION
2 UNRELATED TO OBJECTIVE(S)
1 INADEQUATE
5 RIGHT ON TARGET
4 VERY GOOD MATERIAL
3 NEEDS MORE MATERIAL
2 DOESN'T MAKE IT
1 HOPELESS
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<td>642</td>
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**Note.** 8 participants assessed 6 packages each for a total of 16 packages evaluated with 3 replications per package.

*a* Scale: 5= Completely Appropriate, 4= Acceptable, 3= Needs Some Revision, 2= Too General, 1= Unacceptable.

*b* Scale: 5=Excellent, 4= Good, 3= Fair, 2= Poor, 1= Unacceptable.

*c* Scale: 5= Logical & Adequate, 4= Contains Adequate Detail, 3= Barely Acceptable, 2= Needs More Detail. 1= Not Usable.

*d* Scale: 5=Excellent, 4= Good, 3= Usable, 2= Too Sketchy, 1= Unacceptable.

*e* Scale: 5= Excellent, 4= Adequate to Measure Objective(s), 3= Needs Some Revision, 2= Unrelated to Objective(s), 1= Inadequate.

*f* Scale: 5= Right On Target, 4= Very Good Material, 3= Needs More Work, 2= Doesn't Make it, 1= Hopeless.

*g* Criteria: All components rated ≥ 4.0
APPENDIX G:
INSTRUCTIONAL PACKAGES
TITLE: Design of a Logo for Individual Students

AREA COVERED: Graphic Image Generation

GOALS: To provide opportunities for students to broaden career awareness through exploration of graphic communications.

To provide opportunities for students to explore graphic communications materials and processes.

To provide opportunities for students to improve problem-solving and creative abilities through graphic communications.

To provide opportunities for students to develop safe working habits in graphic communications.

ACTIVITY

OBJECTIVE: The student will know and be able to use design processes, elements, and principles to produce a mechanical layout of an individual logo.

TIME: Is dependent on resources available (i.e., class size, equipment) but in most instances this package is for three to four class periods.

PREREQUISITE: None

OVERVIEW: This package is constructed to teach some of the basic concepts of design. The package will result in a final product of individual origin for each student. Logos and trademarks confront us everywhere and from the student's logo they may go on to investigate different ways to reproduce, process, and manage their products.

MATERIALS, EQUIPMENT, SUPPLIES:

- Drawing area
- T-square
- Triangles
- Straight edge, rule
- Colored pencils
- Rubber cement
- Ink
- Grid paper
- Type samples (art supplier cat.)
- Scissors
- Tracing paper

ACTIVITY:

Procedure

1. Students are to design their own logo using their name, initials, nickname, etc. Several examples of logos should be shown.
2. The students will be given a sheet of drawing paper 9" x 12". They then divide the sheet into 9 equal parts, each part being 3" x 4" which is the size limit of the final logo design.

   Note: Do not discourage mistakes, simply move to another block during the following sequence. Emphasize final logo will be cut from sheet.

3. Instructor shows example of thumbnail sketches (straight lines for type, balloon figures, position).

4. Students then do their own thumbnail sketches using a minimum of three boxes for unique ideas.

5. Instructor then shows examples of rough layout. Rough layout can be a refinement of one or more of the thumbnail sketches.

6. Students then proceed to rough layouts of their own with hand lettering and exact sizes blocked in.

7. Instructor gives examples of comprehensive layout showing colors, lettering in exact position, copy attached, photos blocked in. Comprehensive layout also has an overlay sheet which indicates the ink color, margins, type style and size, paper, and if possible the reproduction process.

8. Students then take their rough layout and construct a comprehensive layout with all the features mentioned in #7.

9. Instructor shows examples of mechanical layout (camera ready copy). This is the final copy with all markings, notes, etc., removed.

10. Students then finish their final product the mechanical layout. This copy is letter-perfect using the exact style and size of lettering, colors and all features making up the final logo. The final copy will be cut out to exact 3" x 4" size.

Definitions

   Logo
   Thumbnail sketch
   Rough layout
   Comprehensive layout
   Mechanical layout (camera ready)

Reading

None
Vocabulary Review

INTRODUCTORY LECTURE - DEMONSTRATION TO DESIGN (Instructor should use part or all of this outline).

1. Areas: Graphic
   Product
   Architecture
   Structure
   Others

2. Processes: Identification of problem
   Preliminary ideas
   Refinement
   Analysis
   Decision
   Implementation

3. Elements: Line
   Value
   Shape
   Color
   Texture
   Proportion
   Direction

4. Principles: Dominance
   Harmony
   Contrast
   Repetition
   Unity
   Balance

ENRICHMENT: Background information on type development and history.
   Point and pica system for type.
   Color wheel and color harmony.
   Visit or report from local advertising art company on logo development.

HOMEWORK: Clip out and bring in four examples of logos.

EVALUATION: The 9" x 12" sheet with all steps involved will be handed in and evaluated by the instructor. Look at (time, effort, creativity, etc.).

Have students identify the design process, elements, and principles needed to produce a mechanical layout.


TITLE: Printing Negatives with Flair

AREA COVERED: Graphic Image Generation

GOALS: To provide opportunities for students to broaden career awareness through exploration of graphic communications.

To provide opportunities for students to explore graphic communications materials and processes.

To provide opportunities for students to develop safe working habits in graphic communications.

ACTIVITY

OBJECTIVE: Given a properly developed negative, the necessary chemicals, and either an enlarger or glass sandwich, the learner will expose and develop photographic paper with typically acceptable quality.

Given an enlarger, the learner will identify the basic parts (head, lens, negative carrier, easel).

TIME: Two class periods

PREREQUISITES: Developing Film

OVERVIEW: The final step of basic photography - using developed negatives to make a print - is covered. Students study and participate in the photographic printing process.

MATERIALS, EQUIPMENT AND SUPPLIES:

If you have a darkroom... If you don't have a darkroom...

developed negatives developed negatives
Kodabrome RC paper Studio Proof Paper
Dektol developer glass sandwiches
stop bath fixer
fixer running water
running water sunlight or desk lamp

ACTIVITY:

Procedure

1. A lecture/demonstration on enlarging and developing photographic paper including:
   a. parts and operation of the enlarger;
   b. darkroom techniques;
   c. the mechanics of paper development;
   d. papers, chemicals, processes, etc.

Lectures can be enhanced through the use of:
   a. realia - enlargers, papers, etc.
   b. appropriate transparencies and handouts.
Content of lectures and explanations should be general in nature, but superficially geared to equipment and processes students will be using: i.e., darkroom processes as opposed to using Studio Proof Paper processes.

2. Items to discuss:
   a. enlarging as a means of reproduction.
   b. the safe handling of chemicals.
   c. working effectively in a darkroom.
   d. quality control in enlarging and printing.

   If you have a darkroom:
   enlarging the negatives; and developing the prints.

   If you don't have a darkroom:
   making contact prints with studio proof paper.

Definitions
See Vocabulary

Reading
None

Vocabulary Review
enlarger
darkroom
easel
emulsion
light sensitive

ENRICHMENT: None

HOMEWORK: None

EVALUATION: Proper identification of enlarger parts
Prints made by students

ENLARGING AND DEVELOPING PRINTS ON KODABROME RC PAPER

**Enlarging:**

1. Mix the needed chemicals and have them immediately available;
   a) Deutol developer
   b) Stop bath
   c) Fixer
   d) Running water

2. Place your developed negative in the carrier of the enlarger. The emulsion or dull side of the negative should be facing down.

3. Adjust the size of your print by raising or lowering the enlarger head. Have the enlarger light on while completing this step.

4. Adjust the focus until the image is sharp on the easel.

5. Turn the enlarger light off! For the remaining steps, only the darkroom safelight should be on!

6. Place a test strip of RC paper on the easel. Make sure the emulsion side is up.

7. Turn on the enlarger, and make a test strip.

8. Develop this test strip (using the following processes). Select the best exposure.

9. Place a full piece of RC paper on the easel. Again, be certain the emulsion side is up.

10. Expose your paper using the time and lens opening you selected.

**Developing:**

1. Develop your exposed print in the Deutol developer for 1½ minutes.
   This time is constant and should not change! Only change exposure times!

2. Now quickly dip your print in the stop bath solution for 5-10 seconds, use tongs to do this!
3. Next, put your print in the fixer, agitating for about 10 seconds. Leave your print in the fixer for 2-3 minutes, agitating occasionally.

4. Wash your prints thoroughly in running water, about 10-12 minutes!

5. Kodabrome RC paper will not curl when it dries, unlike some other photographic papers. So all you need to do now is completely air dry your print!

**Always handle photographic negatives and prints carefully! They damage easily!**
CONTACT PRINTING ON STUDIO PROOF PAPER

STUDIO PROOF PAPER IS A SPECIAL TYPE OF PHOTOGRAPHIC PAPER. UNLIKE OTHER PHOTOGRAPHIC PAPERS, STUDIO PROOF PAPER DOES NOT NEED A CHEMICAL DEVELOPER. IT DEVELOPS RIGHT BEFORE YOUR EYES IN SUNLIGHT!

1. PLACE A SMALL SHEET OF STUDIO PROOF PAPER ON A PIECE OF CARDBOARD (EMULSION SIDE UP).

2. ON TOP OF THAT, PLACE YOUR NEGATIVE, SHINY SIDE UP.

3. NOW, "SANDWICH" ALL THIS WITH A PIECE OF GLASS. SEE THE DIAGRAM BELOW.

   GLASS

   NEGATIVE

   STUDIO PROOF PAPER

   CARDBOARD

4. CAREFULLY PLACE THIS STACK OF NEGATIVE, PAPER, ETC. IN THE SUNLIGHT. IN JUST SECONDS YOUR PICTURE WILL BEGIN TO APPEAR. LET THE PAPER TURN DEEP PURPLE!

5. NOW QUICKLY TAKE THE DEVELOPED STUDIO PROOF PAPER AND SWISH IT IN THE FIXER FOR 3-5 SECONDS. IT SHOULD TURN BROWN IN THIS STEP!

6. WASH YOUR CONTACT PRINT FOR 10-15 MINUTES IN RUNNING WATER. ALL YOU HAVE LEFT TO DO NOW, IS LET YOUR PRINTS AIR DRY!
a typical enlarger for use in the darkroom
TITLE: Developing Film

AREAS COVERED: Graphic Image Generation, Graphic Image Reproduction

GOALS: To provide opportunities for students to broaden career awareness through exploration of graphic communications.
To provide opportunities for students to explore graphic communications materials and processes.
To provide opportunities for students to develop safe working habits in graphic communications.

ACTIVITY

OBJECTIVES: Given the procedures for developing film, the learner will arrange the procedures in sequential order.

Given an exposed roll of film and the necessary chemicals, the learner will develop the film to make printable negatives.

TIME: Two class periods

PREREQUISITES: Using a camera effectively

OVERVIEW: The student will learn about and participate in the technique of developing film. Specific processes (times, chemicals) are unique to types of film, and should be noted.

MATERIALS, EQUIPMENT AND SUPPLIES:

If you have a darkroom...        If you don't have a darkroom...
developing tank and apron         you also need a changing can opener
developer                          bag!
fixer
running water
exposed film

ACTIVITY:

Procedure

1. A procedural lecture on developing film. An easy-to-read and easy-to-follow handout would be appropriate for junior high students.

2. Items to discuss:
   a. The safe handling of chemicals.
   b. Working effectively in a darkroom; or how to use a changing bag.
   c. Quality control in developing film.
   d. Where and when film is developed.
3. Hands-on activity developing exposed film.

Definitions

See Vocabulary

Reading

None

Vocabulary Review

developer  stop bath
photo-flo  emulsion
fixer      darkroom
           agitating

ENRICHMENT: Activities in photography can be tied to other units or activities, such as preparing layouts, advertising design, etc. The more a teacher integrates these activities, one with the other, the more the learner will comprehend the interwoven nature of graphic communications.

HOMEWORK: None

EVALUATION: Successful film development to make printable negatives. Arrangement of developing procedures in correct sequence.


A FEW REMINDERS ON FILM PROCESSING

1. MIX THE NEEDED CHEMICALS AND HAVE THEM IMMEDIATELY AVAILABLE:
   A. DEVELOPER
   B. STOP BATH
   C. RAPID FIXER
   D. PHOTO-FLO

2. LOAD YOUR FILM INTO THE DEVELOPING TANK.
   A) IF YOU HAVE ACCESS TO A DARKROOM, FILM CAN BE LOADED DIRECTLY INTO THE TANK. MAKE SURE NO ONE ACCIDENTLY TURNS ON THE LIGHTS!

   OR

   B) IF YOU DO NOT HAVE ACCESS TO A DARKROOM, YOU WILL NEED A CHANGING BAG TO LOAD YOUR FILM INTO THE DEVELOPING TANK. BEFORE YOU START, MAKE CERTAIN EVERYTHING YOU NEED IS ALREADY IN THE BAG: FILM CANNISTER (EXPOSED), CAN OPENER, DEVELOPING TANK AND LID, APRON, AND WEIGHT.

   Use a bottle opener to remove 35mm film from the cannister. If you are using Instamatic 126 film cartridges, twist them until they break open; then remove the film carefully!

3. TURN ON THE LIGHTS OR REMOVE THE DEVELOPING TANK FROM THE CHANGING BAG. CHECK THE TABLE (NEXT PAGE) FOR TIMES AND TEMPERATURES, AND POUR IN THE DEVELOPER. KEEP TRACK OF THE TIME! BE ACCURATE!

4. POUR OUT THE DEVELOPER AND RINSE THE TANK WITH WATER. THEN ADD STOP BATH FOR APPROXIMATELY 30 SECONDS.

5. POUR OUT THE STOP BATH (SAVE!) AND ADD THE FIXER FOR THESE TIMES:
   1-2 MINS. FOR PAN-X FILM
   2-4 MINS FOR PLUS-X FILM
   2-4 MINS. FOR TRI-X FILM
6. Pour out the fixer (SAVE!), open the tank and flush the film with water for approximately 20 minutes.

7. Dip the film in Photo-Flo.

8. Very carefully! Blot the film, removing excess water. Then hang the film up to dry.

TIMES AND TEMPERATURE TABLES
FOR D-76 DEVELOPER

<table>
<thead>
<tr>
<th>FILM</th>
<th>TEMPERATURE</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65</td>
<td>11</td>
</tr>
<tr>
<td>Pan-X</td>
<td>68</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>72</td>
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<td>6</td>
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<tr>
<td></td>
<td>65</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td>7</td>
</tr>
<tr>
<td>Plus-X</td>
<td>70</td>
<td>6½</td>
</tr>
<tr>
<td></td>
<td>72</td>
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</tr>
<tr>
<td></td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>11</td>
</tr>
<tr>
<td>Tri-X</td>
<td>68</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>9½</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>8</td>
</tr>
</tbody>
</table>
APPENDIX H:
INTRINSIC TRYOUT
TEST SITE LOCATIONS,
INSTRUMENT, AND SUMMARY FORM
Test Site I  Jefferson Junior High School
           Jefferson, Ia

Test Site II  Adel-Desoto Schools
            Adel, Ia

Test Site III  Durant Community Schools

Figure 28. Field test locations
THE IOWA GUIDE FOR
CURRICULUM IMPROVEMENT IN
EXPLORATORY GRAPHIC COMMUNICATIONS

ASSESSMENT ACTIVITY ON TRYCUT MATERIALS

Introduction
The purpose of this activity is to collect information needed to assess the instructional materials developed to implement the Graphic Communications Cluster for junior high school industrial arts in the state of Iowa. Previously, educational goals and objectives, derived from The Iowa Guide for Curriculum Improvement in Industrial Arts K-12 were rated and evaluated. Prototype instructional materials designed to teach selected goals and objectives were evaluated and revised based upon professional judgments. This assessment activity will collect feedback data based upon classroom tryout to be used in subsequent decision making concerning the need for further development and field testing of the instructional materials.

Directions
Field test school teachers are being asked to provide two types of information on each instructional package tested. (1) Intrinsic information concerns the internal, procedural characteristics of the instructional materials. (2) Pay-off information concerns the effect of the instructional materials on student learning. Please complete both the Intrinsic and the Pay-off assessment activities for the instructional packages field tested.
Intrinsic Evaluation of Tryout Materials

Participant

Instructional Package

Directions: Please record your reaction to the instructional materials field tested in your classes. Your comments on any procedural problems, methods to improve the package, or teaching tips on how to successfully teach and use the materials will be extremely helpful in the future development and use of the materials. Please circle the appropriate response and supply additional information where appropriate.

1. Were the OBJECTIVES of the instructional package realistic? Yes No If no, what changes do you recommend in the OBJECTIVES of the package?

2. Was the planned class TIME adequate? Yes No If no, how much TIME was needed?

3. Should there be a change in the PREREQUISITES? Yes No If yes, please list changes.

4. Did you find the OVERVIEW adequate to describe the activity? Yes No If no, what changes in the OVERVIEW do you recommend?

5. Are additional MATERIALS, EQUIPMENT, AND SUPPLIES needed to complete the activity? Yes No If yes, please list additions you found helpful.

6. Should any changes be made in the ENRICHMENT section? Yes No If yes, what changes do you suggest?

7. Did you use the HOMEWORK assignment? Yes No Did you change or add to the HOMEWORK section? Yes No If yes, what changes or additions were made?
8. Were additional REFERENCES used to successfully teach the activity? Yes No What other references would you recommend to others using the package?

9. Did you find the EVALUATION section adequate to assess the activity's objectives? Yes No If no, what changes did you make?

10. (a) What problems did you encounter using the PROCEDURES of the instructional package? (b) Did you add or delete any of the content suggested in the package? (c) What hints or teaching aids would you suggest to other teachers using these materials?
   (a)
   (b)
   (c)

11. What was the reaction and attitude of your students using the materials?

12. (a) What is your overall reaction and attitude regarding the usefulness of the materials used? (b) Would you use the materials in your future teaching as is? Yes No (c) What major changes would you like to see in subsequent versions of the learning package used?
   (a)
   (b)
   (c)

13. Please write down any additional comments, reactions, or judgments toward the instructional materials field tested in your class.
THE IOWA GUIDE FOR CURRICULUM IMPROVEMENT
in
EXPLORATORY GRAPHIC COMMUNICATIONS
Feedback Information on Tryout Materials

Instructional Package: [Blank]
Date Evaluated: [Blank]

Summary of teacher comments: [Blank]
APPENDIX I:
PAY-OFF TRYOUT INSTRUMENTS
Participant

Pay-Off Evaluation of Tryout Materials

Directions: Each field test school is asked to complete the student learning assessment for each instructional package tried. Please follow the guidelines provided for the assignment of the experimental class (the class receiving instruction) and the control class (the class not receiving instruction).

In most cases the student learning assessment instrument includes both a pencil and paper component and a practical "hands-on" component. Please ask each student to do as well as possible. However, stress that this evaluation activity is for the evaluation of the instructional package.

Please collect all student learning assessment materials by class, keeping both the hands-on and written test together for each student. These materials will be used by the curriculum developers to evaluate the need for revisions in the instructional materials. Thank you for your help.

<table>
<thead>
<tr>
<th>Instructional Package to be Tested</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
Design of a Logo:
Graphic Image Generation

As a worker in a graphic design studio, you are to design and produce a camera ready logo for a customer. You would use a series of steps in the design process to produce the customer's logo. Place the letter of the design process steps in Column B into the correct order in Column A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order of Steps</td>
<td>Design Process</td>
</tr>
<tr>
<td>1. ________</td>
<td>A. Analysis</td>
</tr>
<tr>
<td>2. ________</td>
<td>B. Decision</td>
</tr>
<tr>
<td>3. ________</td>
<td>C. Identify problem</td>
</tr>
<tr>
<td>4. ________</td>
<td>D. Implementation</td>
</tr>
<tr>
<td>5. ________</td>
<td>E. Preliminary idea</td>
</tr>
<tr>
<td>6. ________</td>
<td>F. Refinement</td>
</tr>
</tbody>
</table>

MULTIPLE CHOICE: Circle the letter of the best answer.

7. In placing your ideas on paper in the design of your logo a thumbnail sketch would be done. A thumbnail sketch:
   a. shows exact size of the finished product
   b. shows ideas and approximate location of the product
   c. shows color, photographs, words and paper size
   d. shows logo as camera ready copy

8. You produced a design showing color, lettering, copy, photos, margins, type style and size, paper, and printing process to be used. This design is called a:
   a. Comprehensive layout
   b. Idea
   c. Rough layout
   d. Thumbnail sketch
9. After talking to your customer, a decision is made on the final design to be printed. Your letter-perfect design that is "camera ready" with all markings and notes removed is called a:
   a. Comprehensive layout
   b. Mechanical layout
   c. Rough layout
   d. Thumbnail sketch

10. If all elements of a design are woven together, according to some well developed plan, the design is said to have...
   a. Balance
   b. Color
   c. Dominance
   d. Unity

11. A designer emphasizes a portion of an advertisement using color or bold shapes. The designer used what design principle?
   a. Contrast
   b. Texture
   c. Unity
   d. Value

12. A printer folded a paper in half to check if a design had equal amounts of each major unit on either side of the fold. The printer is checking for...
   a. Balance
   b. Direction
   c. Repetition
   d. Shape

13. The light reflective ability of a surface ranging from white (much reflection) to black (little reflection) is called...
   a. Color
   b. Contrast
   c. Proportion
   d. Value
14. If a design has a pattern of contrasts in its surface, the design is said to have...
   a. Direction
   b. Harmony
   c. Texture
   d. Repetition

15. If a designer added contrast and interest to a design by mixing and blending pigments, the designer used what design element?
   a. Balance
   b. Color
   c. Shape
   d. Texture

Assessment of student learning on design process.

Have students complete three thumbnails and a rough layout of the school name in twenty minutes. Use paper provided.

Evaluation: The student will be evaluated as follows:

Thumbnails

Ideas were expressed excellent 5 : 4 : 3 : 2 : 1 poor
Alternatives were tried

Rough Layout

Showed evidence of design principles and elements excellent 5 : 4 : 3 : 2 : 1 poor

Overall Evaluation

0 Student could not comprehend the activity
5 Student did sketches to show some ideas
10 Student did several sketches and refined ideas
15 Student refined ideas incorporated into the rough layout
20 Rough layout showed good use of design elements and principles
Student Assessment Procedure:

1. Administer written test to the class receiving instruction (experimental class) and a parallel class of students not receiving instruction (control class).

2. Based on the answers of the control class students to questions 15 and 16, identify control class students with previous experience in the process of making photographic prints.

3. Schedule a dark room for all experimental class students and the selected control class students. (30 minutes each)

4. Have dark room ready including the negative to be used, instruction sheets for processing time and temperature, enlarger, trays, timer, and chemicals.

5. Teacher/tester will stay in the dark room with each student.

6. Have the student enlarge and process the print.

7. Give the student reinforcement and help as needed. The student should be successful in making a print within 2 tries.

8. Rate the students' work using the evaluation scale.

9. Keep the print for future quality check.
Printing Negatives

Student’s Name ___________________ Date ___________________

School Name ___________________ Class ___________________

(629)

In your hobby photographic studio you have an enlarger for making prints from black and white film. The diagram shown is a typical darkroom enlarger. Match the name of its parts in Column B with the number of the part in Column A.

<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number (from diagram)</td>
<td>Enlarger Part</td>
</tr>
</tbody>
</table>

Parts 1-4
1. ___ A. Base Board
2. ___ B. Bellows Unit
3. ___ C. Filter Unit
4. ___ D. Focusing Mechanism
      E. Head Assembly

Parts 5-8
5. ___ A. Adjusting Column
6. ___ B. Basel
7. ___ C. Lens
8. ___ D. Light Source
      E. Negative Carrier

Multiple Choice. Circle the letter of the best answer.

9. The part of an enlarger that changes the distance between the lens and the negative by adjusting the bellows is the -
   A. Base Board
   B. Focusing Knob
   C. Hand Crank
   D. Lifting Lever
10. The part of the enlarger that projects the image onto the photographic paper is the -
   A. Condenser
   B. Film Carrier
   C. Filter
   D. Lens

11. The ____ is placed between the lens and the photographic paper for special set-ups and special effects.
   A. Bellows
   B. Easel
   C. Filter
   D. Lamphouse

12. The flat surface for positioning the photographic easel is the -
   A. Base Board
   B. Film Carrier
   C. Hand Crank
   D. Photographic Paper

13. The four required processing baths needed to develop enlarged images on photographic paper are (correct sequence from left to right) -
   A. Stop bath, fixer, developer, running water
   B. Fixer, stop bath, running water, developer
   C. Developer, fixer, stop bath, running water
   D. Developer, stop bath, fixer, running water

14. The recommended developing temperature for most black and white film is between (temperature in °F) -
   A. 65° and 68°
   B. 68° and 70°
   C. 68° and 72°
   D. 72° and 76°

15. Before taking this class I have used a photographic enlarger.
   A. Yes
   B. No

16. Before taking this class I have developed black and white photographic prints.
   A. Yes
   B. No
STUDENT ASSESSMENT
Fringing Negatives (629)

EVALUATION SCALE
5 Completed on own
4 Needed some reinforcement
3 Needed minor corrections
2 Needed major corrections
1 Couldn't complete on own within 2 tries

<table>
<thead>
<tr>
<th>STUDENTS' NAMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<td>12.</td>
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<td>14.</td>
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<td>15.</td>
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<td>16.</td>
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<tr>
<td>17.</td>
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<tr>
<td>18.</td>
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<tr>
<td>19.</td>
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<tr>
<td>20.</td>
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<tr>
<td>21.</td>
</tr>
<tr>
<td>22.</td>
</tr>
</tbody>
</table>

PRODUCT QUALITY

---

Product Quality is sum of all other ratings. 100% = 35 points.
Student Assessment Procedure:

1. Administer written test to the class receiving instruction (experimental class) and a parallel class of students not receiving instruction (control class).

2. Based on the answers of the control class students to the last question, identify control class students with previous experience in film developing.

3. Schedule a dark room for all experimental class students and the selected control class students. (30 minutes each)

4. Have 35 mm reusable cannisters loaded with exposed film ready for developing.

5. Have dark room ready including film developing tank, timer, and chemicals.

6. Teacher/tester will stay in dark room with each student.

7. Have the student open cannister, load developing tank, and process the film.

8. Give the student reinforcement and help as needed. The student should be successful in the development process.

9. Rate the students' work using the evaluation scale.

10. Keep developed film for future quality check.
As a worker in a photographic processing house, you are to prepare the materials and processes needed to develop black and white film. You have a dark room and the exposed film is in 35 mm canisters. Place the processing steps in Column B into the proper sequence in Column A.

<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence of Steps</td>
<td>Processes</td>
</tr>
</tbody>
</table>

1-4 Getting set up

1. ____
2. ____
3. ____
4. ____

A. Load the film into the developing tank.
B. Mix the needed chemical and have available.
C. Open film canister.
D. Turn off dark room lights.

5-8 Processing Film

5. ____
6. ____
7. ____
8. ____

A. Agitate (stir) chemicals and develop film.
B. Pour chemicals out of the developing tank.
C. Pour developer into the developing tank.
D. Turn the dark room light on.
<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence of Steps</td>
<td>Processes</td>
</tr>
<tr>
<td>9-12 <strong>Further Processing</strong></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>A. Add fixer, agitate, pour fixer out.</td>
</tr>
<tr>
<td>10.</td>
<td>B. Add stop bath, agitate, pour stop bath out.</td>
</tr>
<tr>
<td>11.</td>
<td>C. Open developing tank.</td>
</tr>
<tr>
<td>12.</td>
<td>D. Rinse developing tank with water.</td>
</tr>
<tr>
<td>13-16 <strong>Finishing the Job</strong></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>A. Blot film, remove excess water.</td>
</tr>
<tr>
<td>14.</td>
<td>B. Cut film to length.</td>
</tr>
<tr>
<td>15.</td>
<td>C. Dip film into photo-flow.</td>
</tr>
<tr>
<td>16.</td>
<td>D. Flush film and developing tank with water.</td>
</tr>
<tr>
<td></td>
<td>E. Hang the film up to dry.</td>
</tr>
</tbody>
</table>

Please check one of the following.

Before taking this class, I have developed black and white photographic film using a dark room.

- [ ] Yes
- [ ] No
STUDENT ASSESSMENT
Developing Film (630)

EVALUATION SCALE

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Completed on own</td>
</tr>
<tr>
<td>4</td>
<td>Needed some reinforcement</td>
</tr>
<tr>
<td>3</td>
<td>Needed minor corrections</td>
</tr>
<tr>
<td>2</td>
<td>Needed major corrections</td>
</tr>
<tr>
<td>1</td>
<td>Couldn't complete on own</td>
</tr>
</tbody>
</table>

STUDENTS' NAMES

1. 
2. 
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\[ \text{Product Quality is sum of all other ratings. } 100\% = 35 \text{ points} \]
Chronological Filing (635)

Student Assessment Procedure:

1. Administer procedure to the class receiving instruction (experimental class) and a parallel class of students not receiving instruction (control class).

2. Have packages of $7\frac{1}{2}\times 6\frac{3}{4}$ card stock and ample material for 12 glue-on tabs for each student prepared.

3. Have packages of 35 check facsimilies prepared.

4. Give students instruction and materials needed to fold card stock into a file system for a fiscal year (July to June).

5. Give students glue-on tabs. Have the students label the file system. File set-up takes 35 minutes.

6. Give students the checks. Instruct the students to file the checks chronologically (by month and date). Limit check filing to 10 minutes.

7. Collect file systems and evaluate using the following Scales:

Rate the file folder system for

1. All months included . Perfect 5:4:3:2:1 Numerous Errors
2. Fiscal year in order . . . . . 5:4:3:2:1

Rate the filed checks for

1. Months in order . . . Perfect 5:4:3:2:1 numerous errors
2. Dates in order . . . . . 5:4:3:2:1

100% rating = 20 points
APPENDIX J:
PHASE (4.0) EVALUATION
PAY-OFF TRYOUT DATA
Table 28. Package 626 pay-off tryout written test descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n= 22</td>
<td>n=16</td>
</tr>
<tr>
<td>Range = 9</td>
<td>Range = 7</td>
</tr>
<tr>
<td>High Score= 12</td>
<td>High Score= 7</td>
</tr>
<tr>
<td>Low Score= 3</td>
<td>Low Score= 1</td>
</tr>
<tr>
<td>Median= 8.5</td>
<td>Median=4.5</td>
</tr>
<tr>
<td>100% Score= 15</td>
<td></td>
</tr>
</tbody>
</table>

Table 29. Package 626 pay-off tryout practical test descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=22</td>
<td>n=16</td>
</tr>
<tr>
<td>Range=21</td>
<td>Range= 9</td>
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<tr>
<td>High Score=28</td>
<td>High Score=17</td>
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<tr>
<td>Low Score= 7</td>
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<tr>
<td>Median= 15.83</td>
<td>Median=12.5</td>
</tr>
<tr>
<td>100% Score= 30</td>
<td></td>
</tr>
</tbody>
</table>
Table 30. Package 629 pay-off tryout written test descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n= 13</td>
<td>n= 16</td>
</tr>
<tr>
<td>Range= 10</td>
<td>Range= 14</td>
</tr>
<tr>
<td>High Score= 14</td>
<td>High Score= 14</td>
</tr>
<tr>
<td>Low Score= 4</td>
<td>Low Score= 0</td>
</tr>
<tr>
<td>Median= 12</td>
<td>Median= 8</td>
</tr>
<tr>
<td>100% Score= 14</td>
<td></td>
</tr>
</tbody>
</table>

Table 31. Package 629 pay-off tryout practical test Descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n= 12</td>
<td>n= 16</td>
</tr>
<tr>
<td>Range= 24</td>
<td>Range= 22</td>
</tr>
<tr>
<td>High Score= 35</td>
<td>High Score= 22</td>
</tr>
<tr>
<td>Low Score= 11</td>
<td>Low Score= 0</td>
</tr>
<tr>
<td>Median= 27.5</td>
<td>Median= 3.2</td>
</tr>
<tr>
<td>100% Score= 35</td>
<td></td>
</tr>
</tbody>
</table>
Table 32. Package 630 pay-off tryout written test descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n= 13</td>
<td>n= 16</td>
</tr>
<tr>
<td>Range= 14</td>
<td>Range= 9</td>
</tr>
<tr>
<td>High Score= 16</td>
<td>High Score= 11</td>
</tr>
<tr>
<td>Low Score= 2</td>
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<tr>
<td>Median= 10.75</td>
<td>Median= 4.5</td>
</tr>
<tr>
<td>100% Score= 16</td>
<td></td>
</tr>
</tbody>
</table>

Table 33. Package 630 pay-off tryout practical test descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n= 13</td>
<td>n= 16</td>
</tr>
<tr>
<td>Range= 28</td>
<td>Range= 29</td>
</tr>
<tr>
<td>High Score= 35</td>
<td>High Score= 29</td>
</tr>
<tr>
<td>Low Score= 7</td>
<td>Low Score= 0</td>
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<tr>
<td>Median= 30.75</td>
<td>Median= 3.2</td>
</tr>
<tr>
<td>100% Score= 35</td>
<td></td>
</tr>
</tbody>
</table>
Table 34. Package 635 pay-off tryout practical test descriptive data

<table>
<thead>
<tr>
<th>Students Receiving Package Instruction</th>
<th>Students not Receiving Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>n= 11</td>
<td>n= 11</td>
</tr>
<tr>
<td>Range= 2</td>
<td>Range= 8</td>
</tr>
<tr>
<td>High Score= 20</td>
<td>High Score= 20</td>
</tr>
<tr>
<td>Low Score= 18</td>
<td>Low Score= 12</td>
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<tr>
<td>Median= 19.7</td>
<td>Median= 18</td>
</tr>
<tr>
<td>100% Score= 20</td>
<td></td>
</tr>
</tbody>
</table>
Table 35. Mann-Whitney U test (Package 626 written test)\(^a\)

<table>
<thead>
<tr>
<th>Raw Scores</th>
<th>Rank</th>
<th>Raw Scores</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students Not Receiving Package (n(_1)=16)</td>
<td></td>
<td>Students Receiving Package Instruction (n(_2)=22)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>19.5</td>
<td>12</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td>19.5</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>7</td>
<td>19.5</td>
<td>10</td>
<td>35.5</td>
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<tr>
<td>6</td>
<td>15.5</td>
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<td>35.5</td>
</tr>
<tr>
<td>6</td>
<td>15.5</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>4</td>
<td>9.5</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>3</td>
<td>7.5</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>8</td>
<td>24.5</td>
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<tr>
<td>2</td>
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<td>24.5</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>8</td>
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<tr>
<td>1</td>
<td>2</td>
<td>8</td>
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<td>1</td>
<td>2</td>
<td>8</td>
<td>24.5</td>
</tr>
<tr>
<td>(R_1=163.5)</td>
<td></td>
<td>(R_2=577.5)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)\(U = 324.5, Z \geq 4.39, P < .00003.\)
Table 36. Mann-Whitney U test (Package 626 practical test)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Students Not Receiving Package ($n_1 = 16$)</th>
<th>Students Receiving Package Instruction ($n_2 = 22$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Scores</td>
<td>Rank</td>
</tr>
<tr>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>17</td>
<td>28</td>
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<td>17</td>
<td>28</td>
</tr>
<tr>
<td>15</td>
<td>22</td>
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<tr>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>14</td>
<td>20</td>
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<tr>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>13</td>
<td>18</td>
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<tr>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>11.5</td>
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<tr>
<td>11</td>
<td>11.5</td>
</tr>
<tr>
<td>11</td>
<td>11.5</td>
</tr>
<tr>
<td>8</td>
<td>3.5</td>
</tr>
<tr>
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<td>3.5</td>
</tr>
<tr>
<td>8</td>
<td>3.5</td>
</tr>
<tr>
<td>8</td>
<td>3.5</td>
</tr>
</tbody>
</table>

\(R_1 = 247.5\)

<table>
<thead>
<tr>
<th>Raw Scores</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
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<td>7</td>
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<tr>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

\(R_2 = 493.5\)

\(U = 240.5, Z > 1.91, p < .0281.\)
<table>
<thead>
<tr>
<th>Students Not Receiving Package (n=16)</th>
<th>Students Receiving Package Instruction (n=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Scores</td>
<td>Rank</td>
</tr>
<tr>
<td>14</td>
<td>28.5</td>
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<tr>
<td>12</td>
<td>21.5</td>
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<td>11</td>
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<td>8</td>
<td>9.5</td>
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</tr>
<tr>
<td>2</td>
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</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

\(a\) \(U = 40^*, \alpha = .05, \text{Table K (Siegel, 1956, p. 277).}\)
Table 38. Mann-Whitney U test (Package 629 practical test)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Students Not Receiving Package (n\textsubscript{2}=16)</th>
<th>Students Receiving Package Instruction (n\textsubscript{1}=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>Rank</td>
</tr>
<tr>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>14.5</td>
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<td>7</td>
<td>14.5</td>
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<td>7</td>
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<tr>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>0</td>
<td>(R\textsubscript{2}=138)</td>
</tr>
</tbody>
</table>

\textsuperscript{a}U = 2*, \(a = 0.5\), Table K (Siegel, 1956, p. 277).
Table 39. Mann-Whitney U test (Package 630 written test)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Students Not Receiving Package (n\textsubscript{2}=16)</th>
<th>Students Receiving Package Instruction (n\textsubscript{1}=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>Rank</td>
</tr>
<tr>
<td>11</td>
<td>22.5</td>
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<tr>
<td>11</td>
<td>22.5</td>
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<td>9</td>
<td>16.5</td>
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<td>8</td>
<td>14.5</td>
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<tr>
<td>7</td>
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<tr>
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<td>7</td>
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<tr>
<td>5</td>
<td>10</td>
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<tr>
<td>4</td>
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<td>4</td>
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<tr>
<td>4</td>
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<td>2</td>
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<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>R\textsubscript{2}=165</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a}U = 29\textsuperscript{*}, \( \alpha = .05 \), Table K (Siegel, 1956, p. 277).
Table 40. Mann-Whitney U test (Package 630 practical test)\(^a\)

<table>
<thead>
<tr>
<th>Raw Score</th>
<th>Students Not Receiving Instruction (n(_2)=16)</th>
<th>Students Receiving Package Instruction (n(_1)=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Raw Score</td>
</tr>
<tr>
<td>29</td>
<td>20.5</td>
<td>35</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>34</td>
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<tr>
<td>10</td>
<td>15</td>
<td>34</td>
</tr>
<tr>
<td>0</td>
<td>7</td>
<td>33</td>
</tr>
<tr>
<td>0</td>
<td>7</td>
<td>33</td>
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<tr>
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<tr>
<td>0</td>
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<td>31</td>
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<tr>
<td>0</td>
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<td>29</td>
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<tr>
<td>0</td>
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<td>7</td>
<td>19</td>
</tr>
<tr>
<td>0</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

\(R_1=292.5\)

\(R_2=142.5\)

\(^a\)U = 6.5*, \(\alpha = .05\), Table K (Siegel, 1956, p. 277).
Table 41. Mann-Whitney U test (Package 635 practical test)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Raw Scores</th>
<th>Rank</th>
<th>Raw Scores</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>18</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>20</td>
<td>18</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>19</td>
<td>11</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>19</td>
<td>11</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>19</td>
<td>11</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>18</td>
<td>7</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>17</td>
<td>5</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>15</td>
<td>2.5</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>15</td>
<td>2.5</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>18</td>
<td>7</td>
</tr>
</tbody>
</table>

\[ R_1 = 91 \quad R_2 = 162 \]

\textsuperscript{a}U = 25, \( \alpha = 0.05 \), Table K (Siegel, 1956, p. 277).
APPENDIX K:
MODEL ASSESSMENT
INSTRUMENT AND DATA
Purpose of Interview: The purpose of this activity is to collect information concerning the attitude of the participating teacher/developers from the Graphic Communications Institute towards the process of curriculum development and evaluation. The information provided will be helpful in the assessment of a Formative Evaluation Model developed and used in the process of producing instructional materials by the Graphic Communications Institute. All information will be confidential. No attempt will be made to identify respondents individually. Thank you for participating.

Interview Procedure: The model assessment interviews are to be conducted on an individual basis. The purpose of the interview and each individual question are types on 3 x 5 cards. The interviewer will tally each response and record all additional evaluative comments.

Procedure:
1. Identify participants that completed all phases of the formative evaluation model.
2. Schedule interviews. (25 minutes each)
3. Explain the purpose of the interview.
4. Assess each individual question using the 3 x 5 cards.
5. Show participant the conceptual model.
6. Discuss the conceptual model.
7. Show participant the procedural model.
8. Discuss the procedural model.
9. Record all comments.
10. Tabulate results.
Interview Questions

1.0 Identify and Order Goals

1.1 Prior to participating in the Institute, how did you feel about identifying and using educational goals in the curriculum development process? Educational goals were:

[ ] Very Important  [ ] Unimportant
[ ] Important  [ ] Very Unimportant
[ ] Necessary  [ ] I had no previous experience with educational goals.

1.2 After participation in the Institute, how do you now feel about identifying and using educational goals in the curriculum development process? Educational goals are:

[ ] Very Important  [ ] Unimportant
[ ] Important  [ ] Very Unimportant
[ ] Necessary

2.0 Identify and Operationalize Objectives.

2.1 Prior to participating in the Institute, how did you feel about the development and use of objectives to further clarify educational goals as part of the curriculum development process? Educational objectives were:

[ ] Very Important  [ ] Unimportant
[ ] Important  [ ] Very Unimportant
[ ] Necessary  [ ] I had no previous experience with educational objectives

2.2 After participation in the Institute, how do you now feel about the development and use of objectives to further clarify educational goals as part of the curriculum development process? Educational objectives are:

[ ] Very Important  [ ] Unimportant
[ ] Important  [ ] Very Unimportant
[ ] Necessary
Interview Questions

3.0 Develop Interim Materials

3.1 Prior to participating in the Institute, how did you feel about the process of developing new instructional materials? I felt:

- [ ] Very Positive
- [ ] Generally Positive
- [ ] Neutral
- [ ] Generally Negative
- [ ] Very Negative
- [ ] I had no previous experience in developing new materials.

3.2 After participation in the Institute, how do you now feel about the process of developing new instructional materials? I feel:

- [ ] Very Positive
- [ ] Generally Positive
- [ ] Neutral
- [ ] Generally Negative
- [ ] Very Negative

4.0 Field Test Products

4.1 Prior to participating in the Institute, how did you feel about testing new instructional materials prior to making decisions on the ultimate use? Field testing was a (an) __________ component of the curriculum development process.

- [ ] Essential
- [ ] Very Helpful
- [ ] Helpful
- [ ] I had no previous experience in testing materials.
- [ ] Helpless
- [ ] Irrelevant

4.2 After participation in the Institute, how do you now feel about testing new instructional materials prior to making decisions on their ultimate use? Field testing is a (an) __________ component of the curriculum development process.

- [ ] Essential
- [ ] Very Helpful
- [ ] Helpful
- [ ] Helpless
- [ ] Irrelevant

Table 42. Model assessment raw data

<table>
<thead>
<tr>
<th>Teacher/Developer</th>
<th>Goals Before</th>
<th>Goals After</th>
<th>Objectives Before</th>
<th>Objectives After</th>
<th>Material Development Before</th>
<th>Material Development After</th>
<th>Field Testing Before</th>
<th>Field Testing After</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>5</td>
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<tr>
<td>B</td>
<td>5</td>
<td>5</td>
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<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
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Note: 5 = High Rating, 1 = Low Rating, 0 = No Experience.
POSITIVE COMMENTS

1. "Very impressed"
2. "When will some of this be available?"
3. "Having the model will help in motivation during the curriculum development process."
4. "The model helps in judging where we are and where we are going."
5. "Very helpful"
6. "Looks good"
7. "The model would help me get started."
8. "It gives direction."
9. "It helps in showing where we are."

NEGATIVE COMMENTS

1. "Model is not helpful."
2. "Tended to get bored with objectives."
3. "Goals and objectives should be developed together with materials."

MODEL REVISION COMMENTS

1. "Can't see where you exit from the curriculum development process in the conceptual model."
2. "It is not clear when a product is finished in the conceptual model."

Figure 29. Model assessment interview feedback