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THE EFFECTS UPON READING COMPREHENSION OF PROVIDING DEFINED TECHNICAL TERMS WITHIN A READING PASSAGE TO VOCATIONAL EDUCATION CONSTRUCTION STUDENTS IN MACON, GEORGIA

The Ohio State University

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THE EFFECTS UPON READING COMPREHENSION OF PROVIDING DEFINED TECHNICAL TERMS WITHIN A READING PASSAGE TO VOCATIONAL EDUCATION CONSTRUCTION STUDENTS IN MACON, GEORGIA

Dissertation

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

by

John Edison Inman Jordan, III, B.S., M.Ed.

* * * * *

The Ohio State University
1981

Reading Committee: Dewey A. Adams
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Approved By: Dewey A. Adams
Adviser
College of Education
To my wife, Louise Olivia
and to my son, John, IV.
Love, peace, and forever happiness.
ACKNOWLEDGEMENTS

The author is sincerely grateful for the assistance and guidance of the many people in this research study. Special appreciation is extended to Professor Dewey A. Adams, Graduate Committee Chairman and the researcher's major adviser during the conduct of this investigation. Professor Adams, a person of high morals and fine character, has been a constant source of guidance, encouragement, and support.

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To my God, this year 1981, thank you, Amen.
VITA

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CHAPTER I

THE PROBLEM

Introduction

Student learning should be a teacher's primary concern in American education. Since the main body of information in student learning is ingested through reading, the selection of books, periodicals, and magazines is extremely important. However, teachers trying to choose good materials are faced with an extremely difficult task because of the many factors that influence readability and because of the range of student reading levels within a given class.

There is evidence that a multiplicity of reading abilities exists at every grade level of every school (Dickerson, 1925; Krantz, 1957; Brownrigg, 1962; and Walencik & Amatrudi, 1979). Congrue (1968), in a study at the University of Chicago High School where students' I.Q. scores average 128, reported that at each grade level a range in reading achievement of at least seven full years existed.

There are many reasons why students in the same grade read at varying levels. Dale (1965) suggested that
one cause is their different home situations. Students from privileged, average, and underprivileged homes generally read at different levels. (A child is considered underprivileged if the home environment does not provide books, periodicals, or discussions that reinforce the learning that takes place at school.) Another reason for the reading variance is the shifting English language itself. An article in the *Columbus Dispatch* July 14, 1978, revealed:

> English is changing so much in America that in 200 years, Americans and Britons won't be able to understand each other without the help of a translator. (p. C-12)

Just within the American culture, a fast-growing, ever-changing society, new developments create the need for new words. Robert Burchfield (1978), the chief editor of the Oxford English dictionaries, stated:

> Since 1776, American English and British English have been on a divergent course . . . they should end up being unintelligible to one another in another 200 years. (p. C-12)

There are also many English variations among sub-populations within America. Recent studies by Fasold and Wolfram (1970) and Dillard (1972) now support the proposition that black English is an identifiable language variety which differs systematically from the language of whites as well as from network standard English, as spoken
by national television newscasters. Presumably the languages of other American subcultures, such as Mexican-American or Indian-American, would differ as much as black English does from that of whites.

In summary, teachers are searching for ways to teach students from varied backgrounds who read at many different levels. This study should contribute to that search. The focus will be upon one approach to improving the readability of technical material in an industrial education setting.

Statement of the Problem

Legitimate questions can be raised about the apparent disparity between the reading levels of students and the rated readability levels of textbooks. Relatively few evaluative studies have been conducted to determine the appropriateness of instructional materials for the students these materials were intended to serve. Among the few are studies by Miller (1960), Brownrigg (1962), McKell (1970), and Paige (1978), which have all found that the instructional materials utilized in industrial education classrooms were written at a level of readability that was higher than the reading level of the students who were using the materials.

This research will be an attempt to provide an answer to the following question: Does providing a student with
defined technical terms within a reading passage increase
the level of comprehension of selected textbook materials?

Need for the Study

The importance of reading as a tool of learning in
secondary schools is recognized by almost everyone (Walters, 1975). The question is: "Who is responsible for teaching
those reading skills?" Considerable support exists for
the idea that teaching reading in the content areas results
in greater reading improvements than teaching reading in a
reading class. Reinforcing this, Walters (1975), quoting
Hasselriis and Sanders, described the content teacher as a
subject-matter specialist who is uniquely qualified to meet
the demands of that particular field. The content teacher
has the opportunity to demonstrate in a meaningful situa-
tion the application of specific reading skills. Herber
(1979) noted that even though educators are recommending
that reading instruction be provided in the content area
classrooms, this procedure is not widely practiced. Herber
suggested one reason for this paradox is that many teachers
lack the expertise to provide reading instruction. Re-
cognizing this problem, Austin (1961) recommended that a
basic reading instruction course be required of all pro-
spective secondary school teachers. Expressing this same
view, Strang (1962) reported that most high school teachers
have had little or no preparation for teaching reading, and urged that they be given assistance. In spite of the mounting evidence between 1961 and the present, most secondary content teachers continue to lack preparation in guiding the necessary development of reading and study skills (Walters, 1975).

What can we do as vocational, technical, and practical arts teachers to enhance reading instruction? In any content area such instruction must begin with a consideration of the specialized or technical vocabulary. In vocational, technical, and practical arts education, lists of vocabulary have already been accumulated along with methods to teach them.

For the development of technical vocabularies, Ferrerio (1960) discussed the use of charts, pictures of objects, word origin studies, vocabulary notebooks, and alphabetizing. To complement the work already done with vocabulary, vocational, technical, and practical arts educators must develop a system of reading comprehension. Stevens (1969) listed some of the skills needed for comprehension of technical material. They were: visualization, interpretation, critical reading, sequence, and interest.

Vocational experts Calhoun (1967), Waters (1975), and Walencik and Amatrudi (1979) concurred that the technical vocabularies required in vocational courses are
difficult for the student to master. The learning of vocational terminology is essential if the pupil is to perform in a satisfactory manner.

Vocational, technical, and practical arts courses are activity-oriented. Students who dislike reading tend to gravitate to these subjects in which reading is not stressed (Walencik & Amatrudi, 1979). The teachers do not usually have the expertise to conduct reading lessons. Therefore, a method that incorporates reading skill development and vocabulary skill development as part of the everyday classroom procedures is crucially needed.

The terminology used in vocational, technical, and practical arts education is literally a foreign language. Students are faced with the unique task of employing word processing skills if they are to function successfully on both cognitive and psychomotor levels. They must both comprehend the reading and do as it directs.

Aldridge (1978) stated that relevance of reading material and motivation to read have been identified as factors in any reading program. This research will examine a method of improving these reading skills in vocational trade and industrial education construction classes without the students' knowledge by making materials more relevant and easier to comprehend, hopefully resulting in higher motivation to read and better performance.
Objectives of the Study

1. To determine the effect upon reading comprehension of providing a student with defined technical terms within a reading passage.

2. To determine the effect upon reading comprehension of providing a student with a glossary of technical terms at the beginning of a reading passage.

3. To determine if interaction between treatments and levels of reading ability exists.

Assumptions

1. If the reading materials for students are beyond their reading level, students will become frustrated and avoid future contact with the material.

2. The more readable material is, the more students will be inclined to read it.

3. A student who has had previous experiences related to a technical reading will be more capable of comprehending that reading than a reader who has not had these experiences.

4. The cloze procedure accurately measures the level of reading comprehension.
## Definition of Terms

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<td>Cloze Procedure:</td>
<td>The cloze procedure is a method of taking away every nth word in a passage and replacing it with a standard-sized blank.</td>
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<td>Cloze Score:</td>
<td>A score on the cloze test that is a percentage of the number of possible correct responses.</td>
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<td>Concept:</td>
<td>A concept is an abstraction from observed events; it is a word that represents the similarities or common aspects of objects or events that are otherwise quite different from one another.</td>
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<td>Reading Achievement:</td>
<td>A subject's reading achievement that is measured by the Gates-MacGinitie Reading Test, Level F, Form 1. Chapter III, in the procedures selection, will explain how the scores from this test will be used to divide the subjects into a high, medium, and low reading achievement breakout.</td>
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<td>Reading Comprehension:</td>
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<td>Selected Textbook Reading:</td>
<td>Unit 3 of Modern Carpentry by Willis H. Wagner.</td>
</tr>
<tr>
<td>Technical Term/Phrase:</td>
<td>A word or phrase that is used only, or in a specific way, in a specialized branch of knowledge. These words and phrases will be identified by a panel of vocational, technical, and practical arts experts.</td>
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Limitations and Scope of the Study

This study is limited to students enrolled in high school vocational construction courses in one school system. Within the schools complete randomization will not be possible because of intact units.

This study will examine only the reading material used by vocational education construction classes. The reading material will consist of a selected chapter from the book *Modern Carpentry* by Willis H. Wagner. No attempt will be made to secure a reading analysis of other reading materials used in vocational education construction classes.

Because advanced students, third year students, may have an extended vocabulary of technical terms, only first and second year vocational education construction students will be used in this study. Also, since it is not possible to randomly select students and then randomly assign them to the experimental groups, intact classrooms will be used. Each student will randomly select one of the three treatments from a stack on the teacher's desk (alternately stacked A, B, C, A, B, C) to ensure random assignment of the instruments.

Because only one school system will be used in this study, the generalizability of the research findings are limited to this school system.
Statement of the Hypotheses

1. The level of reading comprehension of students who read the material with defined technical terms within a reading passage will be significantly higher than that of students who read the material without defined technical terms (Method C compared with Method A).

2. The level of reading comprehension of students who read the material with defined technical terms within a reading passage will be significantly higher than that of students who read the material with defined technical terms in a glossary on the front of the material (Method C compared with Method B).

3. The level of reading comprehension of students who read the material with defined technical terms in a glossary on the front of the material will be significantly higher than that of students who read the material without the defined technical terms (Method B compared with Method A).

4. There will be a significant interaction between treatments and reading levels.

The cloze test procedure will be used to measure the level of reading comprehension for the hypotheses stated above.
Summary

Chapter I included the introduction to the problem, the statement of the problem, the need for the study, the objectives of the study, the assumptions, the definition of terms, the limitations and scope of the study, and the statement of the hypotheses.

The problem of this study was to investigate the influence of defined technical terms upon reading comprehension. In addition, interaction of treatments and levels of reading ability were also examined.

Chapter II provides an examination of the empirical studies that relate to reading and readability of material in vocational, technical, and practical arts education.

Chapter III is a description of the research model, the results of the pilot study, the subjects used in the study, the instrument, and the procedures for the analysis of the data.

Chapter IV will include the results of the statistical analysis of the data.

Chapter V will include the summary, conclusions, and recommendations for practice and future research.
CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The literature abounds with studies dealing with the subject of reading. Instruction in reading begins in the elementary school and is the most important single branch of elementary education. The mistake has long been made in secondary education of assuming that pupils are not in need of post-elementary instruction in reading. Most secondary teachers know little or nothing about reading or readability of material.

The review of the literature for this research study is divided into six broad topics. The first area to be reviewed will be studies related to reading and readability of textbook material. The second area to be reviewed will be readability studies in industrial education. The third area to be reviewed will examine the techniques that are commonly used to measure reading comprehension. The fourth area to be reviewed will deal with the cloze test procedure as this will be the method of measuring reading comprehension in this study. The fifth area to be reviewed will examine technical vocabulary studies and the methods of
developing technical vocabulary. The sixth and final topic of the review of the literature will be the theoretical framework and model for this study.

Reading and Readability Studies

The ability to read, write, and to do basic arithmetic are unquestionably three of the most valuable skills that a person can acquire. In studies conducted by Dickerson (1925) and by Krantz (1957), it was pointed out that reading ability and level of comprehension are highly correlated with academic achievement in school.

A major concern of educators today is the inability of students to read materials at their present grade level. However, their problem is nothing new to those who have chosen to teach in the field of education in the past or present. Moore (1938) reported that approximately 15 percent of school-age youth had different levels of reading disabilities. Durrell (1940) and Betts (1957) supported Moore's estimates that the percentage of students who have reading handicaps was between 8 to 15 percent of all youth enrolled in elementary and secondary schools. Marksheffel (1965) estimated that as many as five million elementary and secondary school-age youth are handicapped in their reading ability. If reading is unquestionably one of the most valuable skills that a person can acquire,
could there possibly be a correlation between the apathy of today's youth in the classroom and their inability to read? Hansell (1974) addressed this issue when he stated, "Students can be frustrated, irritated, and demeaned by being required to attempt tasks at which they cannot hope to succeed" (p. 309).

In attempting to alleviate the frustrations experienced by the unsuccessful reader, a good deal of research has been focused on the readability of written materials. Readable materials simply defined, are "those materials that can be read without great difficulty by a reader." Dale and Chall (1949a) identified three variables thought to affect the readability of a particular piece of material. They are:

1. The article or book itself--its format and organization; its subject matter and themes, and its expressional elements.

2. The reader--his general reading ability, his interest and purpose in reading, his general experiences and specific experiences along the lines of the book he is reading.

3. The criteria used to estimate readability--whether we use a measure of interest, comprehension or speed of reading; and the methods used to estimate these criteria. (p. 5)
Fries (1962) pointed out that the process of learning to read

. . .is not the learning of a new language code; it is not the learning of a new or different set of language signals. It is not the learning. . . of new grammatical structures. . . These are all matters of the language signals which he has on the whole already learned so well that he is not conscious of their use. (p. 120)

Therefore, successful reading ability is the application of a person's unconscious knowledge of the language code to the deciphering of the graphic symbolization of language. Since reading is in large measure dependent upon a person's knowledge of the underlying structure of the oral language, problems in decoding and comprehending may arise for any person if the language structure of the reading material differs to any great degree from the structure of the language patterns (Goodman, 1965; Weiner & Cromer, 1967).

The structure of a person's language, then, is an important variable in reading comprehension. Riddell (1965) and Tatham (1970) have shown, for example, that reading comprehension is higher for materials written in language patterns similar to one's oral patterns than for materials written in less frequently used oral patterns. Both concluded that reading comprehension is a function of the similarity between oral and written patterns of learning.
Recent theoretical descriptions of reading suggest that language processing is a central aspect of reading behavior (Goodman, 1970; Brown, 1970; Smith, 1971). The theorists have not explicated all of the features of the relationship between oral language and reading, but they have indicated that whatever ability a child has to handle linguistic structures will affect his reading. Evidence from the experimental research of Ruddell (1965) and Bougere (1969) has demonstrated that discrepancies between the vocabulary and syntax familiar to children orally and the language of written materials correlate with difficulties in reading.

The inability to read at one's grade level could possibly be the biggest problem facing contemporary education (Marksheffel, 1965). This inability to read on one's intellectual level severely handicaps a student's chance to succeed academically (Dickerson, 1925; Krantz, 1957).

Each year thousands of new educational materials are developed and deployed in classrooms throughout the country. Although all have been assigned a grade level which purports to indicate "the grade at which a book or article can be read with understanding," the level of comprehension is taken for granted.
In the attempt to address some of these problems in reading, research efforts have generally focused on the readability of materials. Dale and Chall (1949b) noted that most of the research on reading has focused on readability of written material. This is primarily due to the development of readability formulas. These two authors also noted that readability formulas have their shortcomings.

A readability formula is simply a mathematical equation derived by regression analysis. This procedure finds the equation which best expresses the relationship between two variables. The variables may be average sentence length and percentage of unfamiliar words or, expressed in another way, a measure of the difficulty experienced by people reading a given text and a measure of the linguistic characteristics of that text (McLaughlin, 1969).

Readability Studies in Industrial Education

The research literature in relation to readability of material in vocational, technical, and practical arts education is not extensive. The studies to be reviewed in this section of the review of the literature are Miller (1960), Brownrigg (1962), McKell (1970), Fields (1972), Rose (1966), and Paige (1978).
Miller (1960) conducted a readability study of five general shop textbooks using the Dale-Chall and Flesch readability formulas. A reading ability test was administered to a sample of 411 ninth grade industrial arts students. The mean reading ability of this group was found to be 8.3 grade level. From this, one would conclude that this group of students was reading below their grade level. To be exact, 70 percent of the 411 students who participated in this study were reading below the ninth grade reading level. Miller concluded that "large portions of four of the five general shop textbooks would be too difficult for the majority of the students to read effectively."

Brownrigg (1962) conducted a study that dealt with the readability of four drafting textbooks used in beginning college drafting courses. The Dale-Chall Formula was applied to four textbooks with the following results:

- Textbook A: upper twelfth grade
- Textbook B: upper twelfth grade
- Textbook C: middle twelfth grade
- Textbook D: upper twelfth grade

The reading ability of the 431 college drafting students sampled had a mean reading ability at the 13th grade level with a range from the 8th grade to 16th grade plus. Therefore, the majority of the students who participated in this study was capable of reading the textbooks examined. However, one should be reminded that these were
college drafting students enrolled in a major university (Missouri). One could conclude from this study that most college students are average to above average readers for this age group.

In a study related to vocational-technical education, McKell (1970) looked at the relationship between the reading abilities of trade and industrial education students and the readability of classroom textbooks. The California Reading Test was administered to determine the reading abilities of 388 eleventh and twelfth grade trade and industrial education students. The mean reading ability for the eleventh grade students was 10.8. The mean reading ability for the twelfth grade students was 11.1. The overall mean for both groups (388 students) was 11.0. McKell concluded from his study that reading grade level of students is a more important factor in determining the readability level for a textbook than the usual criterion of assigned grade level.

Another study related to vocational-technical education was conducted by Fields (1972). Fields examined the readability of textbooks used in high school vocational education classrooms. The Nelson-Denny Reading Test was used to measure the reading ability of the students, and the Dale-Chall Readability Formula was used to determine the readability level of the textbook. In this study,
nineteen textbooks were examined for their level of readability. Eighteen of the nineteen were found to be above the reading abilities of the students who were using them.

Rose (1976) examined twenty-two power mechanics textbooks used in industrial arts classrooms. He found that the twenty-two textbooks reviewed had readability levels from the upper tenth to the upper fourteenth grade levels using the Flesch Readability Formula. The Schrammel-Gray Reading Test was administered to 185 college seniors to determine their reading levels. The mean reading level of the students was 12.8. Rose concluded that only the most difficult parts of the books would present problems for the students.

Paige (1978) examined the readability of electricity and electronics textbook material. Two readings were selected from the book Electricity and Electronics by Howard Gerrish. Paige used the Fry Readability Graph and the Flesch Reading Ease Formula to determine the level of readability of the textbook material. The material selected was found to be written at the tenth to twelfth grade reading levels. After the readability level was determined, the material was rewritten at approximately the eighth grade readability level.

Paige also compared the reading comprehension of the students using the Gates-MacGinitie Survey F, Form 2M,
Comprehension Test. From this test Paige concluded that his subjects were representative of the group of subjects from which the national norms were developed. Paige concluded from his study that "lowering the level of readability of the textbook material substantially increased the level of reading comprehension." He further concluded that "there was a positive relationship between the level of reading comprehension and the level of reading achievement."

Instruments Used to Measure Comprehension

The next section of this review of the literature will focus on the techniques used to measure comprehension of written material. Researchers have used many devices for determining the relative comprehension difficulties of passages, ranging from obtaining the subjective judgments of subjects and experts to the use of subjects' responses on carefully constructed comprehension tests on the passages. Large (1939) pointed out that the difficulty of a test item can be altered greatly just by the way it is written. This makes it impossible to know how much of a test's difficulty is due to variations in a test writer's style and how much is due to the difficulty of the passage itself.
Brown (1914) published three criteria for reading measurement. They were:

1. Rate of reading,
2. Quantity of reproduction, and
3. Quality of reproduction (pp. 477-490).

The first reading comprehension test, published in 1916, was the Kansas Silent Reading Test devised by F. J. Kelly. Other reading comprehension tests were The Courtis Silent Reading Test, Monroe's Standardized Silent Reading Test and The Chapman Reading Comprehension Test. All of the above tests were published before 1921. The Kansas Silent Reading Test resembles many of our group verbal intelligence tests of today. The Courtis Silent Reading Test was a timed test in which a student was given three minutes to read as much as he/she could of a two-page story. A student was then given the same story but this time it was broken into a series of short paragraphs. A set of five yes-no questions followed each paragraph, and the student was given five minutes to answer as many of the questions as he/she could. The Monroe's Standardized Silent Reading Test was a four-minute timed test in which a student was to read a series of paragraphs. Following each paragraph was a list of five words. The student was to underline the correct word according to information contained in the paragraph. The Chapman Reading Comprehension
Test also consisted of paragraphs to be read. The student was told that the second half of each paragraph included one word which spoiled the meaning of the paragraph, and a line was to be drawn through the word.

The examples of early reading comprehension tests outlined above demonstrate that the first two of Brown's 1914 criteria were generally being adhered to. However, the Buros' 1938 Mental Measurements Yearbook had the following criterion of the various reading comprehension tests:

> A valuable feature of the test on reading comprehension is the effort to measure the pupils' ability to make inferences from the material read. However, portions of the test may measure intelligence rather than reading ability. (p. 131)

A procedure for measuring rate of reading comprehension very similar to Monroe's test is still used today. The speed and accuracy subtest of the Gates-MacGinitie Reading Test published in 1964 included a series of paragraphs which are read by the examinee. Following each paragraph are four words, and the examinee selects the word which answers a question related to the main idea of the paragraph.

From this review of the methods of measuring reading comprehension, one can see that there are many problems associated with the use of multiple-choice tests. The next section of the review of the literature will examine the
method chosen to measure reading comprehension for this study.

In order to avoid the problems and difficulties associated with the use of a multiple-choice comprehension test Taylor (1953; 1957), Bormuth (1962), Rankin (1966), Hafner (1966), Jongsm a (1970), Weber (1971), and Paige (1978) suggested that the cloze procedure be used to measure reading comprehension.

The Cloze Test Procedure

Wilson L. Taylor is credited with being the developer of the cloze procedure. In originating the cloze procedure, Taylor drew upon Miller's work in communication theory, Osgood's dispositional mechanisms, and the principles of statistical random sampling. The word "cloze" derives its name from the Gestalt concept of "Closure." This notion holds that a person presented with an incomplete figure will tend to make a "good figure" by mentally closing the gap.

Taylor (1953) defined the cloze procedure as:

A method of intercepting a message from a transmitter, mutilating its language patterns by deleting parts, and so administering it to receivers that their attempt to make the pattern whole again potentially yields a considerable number of cloze units. (p. 416)
The initial use of the cloze procedure (Taylor, 1953) was to determine the readability of passages. The number of correct responses to the mutilation in a particular passage gives an indication of the difficulty of the passage. In practice, the technique consists of systematically deleting every nth word of a written passage which is then presented to students with instructions to supply the missing words. If the cloze test is delivered to a group of subjects, and there is a significant difference between the mean number of correct closures of that passage and another passage delivered to the same or similar group of subjects, one can assume that the words which were not deleted in the more difficult passage did not give a sufficient amount of information to the reader to allow him/her to make the closure without making errors. Essentially then, at one word in five deletions, we are saying that eighty percent of the words in one passage contain less information regarding the total meaning of the passage than in another case.

An important question can be asked at this point in the review: Does it make any difference which words are deleted? Bormuth (1964) conducted a study which systematically deleted each one of the words in five different forms of a cloze procedure selection. The results indicated that there was no difference as a function of which words
are left out if the deletions are done in the systematic cloze procedure fashion. A further finding demonstrated that it was efficient to score only exact word matches. However, most researchers score misspellings as correct whenever there is reasonable assurance that the response is otherwise correct (Taylor, 1957; Rankin, 1959; and Bormuth, 1962). Miller and Coleman (1967) tested a weighted scoring system for giving credit for synonyms. The weighting system they used gave three points for exact replacement, two points for synonyms, and one point for the correct word class. The results of this study showed that the weighted cloze test correlated .99 with the ordinary cloze test using the exact replacement method. Miller and Coleman concluded that:

Unless one has a particular reason for being interested in synonyms, therefore one might as well use the simpler traditional system that ignores all insertions other than exact words.

(p. 853)

In summary, this review of the cloze procedure would support the hypothesis that the cloze procedure is a valid and reliable measure of readability. To support this hypothesis Taylor (1957) stated:

The more readable a piece of writing is, the better understood it will be even if some of the words are left out, and the better the writing is understood, the more likely it is that a reader can guess what words are missing. (p. 19)
Taylor goes on to say that if a passage is readable, it is also understandable, and the scores that measure readability should also measure comprehension. Hafner (1966) concurred, noting that "the ability to read with understanding can be measured rather well by the cloze procedure."

Most of the studies reviewed by this researcher favored the systematic deletion of every fifth word when preparing a cloze test. Jongsma (1970) stated in support of this that "the mechanical, every fifth word deletion rate has been the most widely used and accepted type of cloze procedure" (p. 8). Therefore this every fifth word deletion will be used for this research study.

Bormuth (1967a) has outlined specific guidelines for the construction and application of the cloze procedure. He suggested the following:

1. Delete every fifth word in the passage.
2. Replace the deletions with underlined blanks of standardized length.
3. Administer the test to subjects who have never read the passage.
4. Instruct the subjects to fill in the blanks with what they think the deleted words are.
5. Score exact replacements as correct.
6. The difficulty level of the passage will be the mean of all the subjects' percentage scores.

Bormuth suggested that 50 deletions in a 250 word passage is sufficient in the construction of the test.

This section of the review deals with interpreting raw cloze scores. Bormuth (1967b) established criterion reference scores for interpreting cloze test scores in relation to conventional multiple-choice comprehension test scores. His results showed that a cloze score of 44 percent was comparable to a 75 percent comprehension score. A cloze score of 57 percent was comparable to a comprehension score of 90 percent. Rankin and Culhane (1969) replicated this study and obtained essentially the same results. Rankin and Culhane concluded that:

The results...tend to corroborate the validity of the comparable cloze and multiple-choice percentage scores found by Bormuth's...study which gave results for the two most commonly used reference points used in evaluating reading comprehension.

(p. 197)

In general, the studies reviewed of tests employing the cloze procedure seem to justify the following four statements. First, the cloze readability test provides a valid measure of a student's reading comprehension ability. Second, the cloze readability procedure provides a valid
method of measuring the comprehension difficulties of passages. Third, the procedure itself seems to incorporate both the most valid and the most economical of the possible alternatives for designing a cloze readability procedure. Finally, cloze readability scores can be used to judge the suitability of materials for any group.

**Technical Vocabulary Studies**

In this section of the review of the literature, technical vocabulary studies and the methods of developing a technical vocabulary will be examined. The American culture is a fast growing, everchanging society. New developments in technology create the need for new words.

There are many articles and studies that center around vocabulary in general. Dale (1973) identified ten journal articles that explain what an industrial education teacher could do to help students to understand the technical vocabulary. One method suggested was to teach the terms to the students before requiring them to read the technical material.

Randleman (1961) conducted a study to identify the relationship between the size of students' technical vocabularies and scholastic ability, and the amount and nature of industrial arts instruction and grade level. The results of this study showed a positive relationship
between the size of industrial arts students' technical vocabularies and their achievement on measures of intelligence and scholastic ability.

Marks et al. (1974) hypothesized that by varying the frequency of 15 percent of the words in elementary school reading materials, gains in the comprehension of the meaning of entire passages could be produced. According to these researchers' conception, reading comprehension involves more than knowledge about grammar, syntax, and the decoding of single words. Reading comprehension begins with a set of decoding skills which enable the reader to relate the printed words to their previously acquired vocabulary. Results of this study did support the hypothesis that by varying the frequency of 15 percent of the words, reading comprehension of the materials can be increased.

Karlin (1972) suggested five steps to help the industrial education teacher deal with technical terms:

The industrial education teacher can prepare students for reading in his field much the same way that other subject-matter teachers do. He can pull out of the text vocabulary whose meaning students are not likely to know and ideas that require clarification. He can guide students' reading by giving them a goal to achieve as well as by directing their reading step by step. He can help individual students overcome some word-identification and meaning difficulties and
provide opportunities for discussing
the material in terms of the groups' purpose for reading. He can arrange
demonstrations for which rereading of selected passages may be necessary.
Finally, he can provide opportunities that allow students to apply what they read. (p. 307)

Williams and Anderson (1952) also addressed the problem of technical terms for industrial arts students. They wrote:

Learning from the printed page is highly dependent on word understanding. In industrial arts, technical words not understood present a stumbling block to the student. A knowledge of certain technical words is necessary for reading text and reference books in this area. Because of this need, it becomes the responsibility of the shop instructor to teach a basic technical vocabulary in his area of instruction. (p. 12)

There are many ways that a shop teacher can help his/her students to build a working technical vocabulary. Weekly exercises in vocabulary skill building can be used by the teacher. The "word-a-week" method as described by Ruskin (1966) is also effective in vocabulary building.

By definition, most people do not know the meanings of words that are not common to them. However, most people are able to decode unfamiliar graphemes (sum of letters that equal a word) into their correct phonemes (sound of letters or groups of letters). Although people may be able to decode and pronounce individual words appearing in
print, comprehension often depends upon knowing the meanings of specific words in a sentence, words that have important, integral messages within themselves. Unfamiliar words, perhaps with only one such word in an entire sentence, may render meaningless an entire sentence, which may, in turn, limit the comprehension of the meaning of subsequent sentences in the same passage.

Most textbooks in industrial education provide a glossary of technical terms in the back of the book. A student is supposed to look up an unfamiliar word in this glossary. However, most people do not take the time to look up a word. Therefore, this research effort will shift the technical terms from the back of the book to the written passage. This way, the student has more information in front of him/her to help with the decoding and comprehending process.

Theoretical Framework and Model

This research is based upon the notion of learning concepts from definitions. A concept is "an abstraction from observed events; it is a word that represents the similarities or common aspects of objects or events that are otherwise quite different from one another" (Ary, Jacobs, & Razavieh, 1972:27).
Very few studies have been concerned with the investigation of the learning of concepts from definitions and explanations (Johnson & Stratton, 1966). Anderson and Kulhavy (1972) conducted a study to explore the extent to which people can learn concepts from exposure to definitions. In that study, subjects were required to select words that they did not know from the Thorndike-Lorge (1944) list of words that occur less frequently than once per million. One-sentence definitions of the words (concepts) were written with the aid of a dictionary. The results indicated that when subjects answered the test questions with the definitions in front of them, they did much better than when they responded without definitions. That indicated that most of the definitions contained information accessible to subjects and sufficient to answer the accompanying test questions. This would seem to fit Anderson's definition that a person has acquired a concept if he can identify instances of the concept and discriminate them from non-instances (Anderson, 1972).

Most concepts in vocational, technical, and practical arts education require the use of many of the student's senses to help with the discriminating process. The student can see the word and also touch the object the word relates to. In some cases, a student can hear and smell the concept. This type of associative experience makes
learning easier for students. The concept "spirit level" in vocational, technical, and practical arts education allows a student to see the object, if present, to touch the object, to watch the spirit move inside the glass case, to use the object, and even break the glass that holds the spirit to taste it or to smell it.

But, what happens when only the concept (written) is presented in a reading passage? Usually the rest of the words in the sentence will help to decode the meaning of the unfamiliar concept. If not, a student (reader) is supposed to look up the concept in the glossary of terms or the dictionary. This writer's argument, and a major assumption of this study, is that students do not often take the time to look up unfamiliar words. These unfamiliar words, perhaps only one per sentence, may render meaningless an entire sentence, which may in turn, limit the comprehension of the meaning of subsequent sentences in the same passage.

Sticth's (1971) study, using United States Air Force personnel, tried to determine how men in the services gained information through reading. Sticth reported that when the reading material was too difficult for the men to read, they either tried to watch someone else do what the reading passage was directing, or to ask questions about the passage from the men who seemed to understand what was going on.
In summary, definitions of words (technical terms; concepts) in a reading passage should enhance learning. A student will have more information in front of him/her and will not have to look in other places (dictionary, glossary of terms, bottom of the page, and/or the end of the chapter) for the meaning of a word that is unfamiliar.

A theoretical model for this study of reading comprehension is presented in Figure 1. For the purposes of this investigation, reading comprehension is defined operationally as a score on the cloze test procedure.

In the input stage of this model a wide range of intelligence, reading ability, vocabulary development, language factors, hygiene, and interest will be present. Based on a review of the literature related to reading comprehension, the above factors influence comprehension. Although this list of factors could go on and on, these factors were determined to be most significant for this study (Chester, 1975).

These six variables will be randomly distributed in the throughput stage into three levels of treatment. They are: (1) no defined technical terms, (2) defined technical terms in a glossary on the front of the material, and (3) defined technical terms in the reading passage. Also, each student will take a standard reading ability test to determine present reading achievement level.
FACTORS RELATED TO READING COMPREHENSION

Intelligence
Reading Ability
Vocabulary Development
Language Factors
Hygiene
Interest (reading)

TREATMENT LEVELS

Random Assignment to Different levels of the Treatment
No Defined Technical Terms
Defined Technical Terms in Glossary
Defined Technical Terms in the Reading Passage

EFFECT UPON READING COMPREHENSION

With Defined Technical Terms High Scores
Reading Comprehension
Without Defined Technical Terms Low Scores
Reading Achievement Level
High, Medium, Low

INPUT

THROUGHPUT

Fig. 1

OUTPUT

THEORETICAL MODEL
The output stage of this model is the effect upon reading comprehension as measured by the cloze test procedure. It is hypothesized that high, medium, and low ability students who have access to defined technical terms will all greatly increase their scores on the cloze test as compared to high, medium, and low ability students who are not provided with defined technical terms.

Summary

Chapter II included a review of the literature that relates to this study. The attempt was to focus on those studies that relate directly to vocational, technical, and practical arts education. Next, techniques used to measure reading comprehension were reviewed. An examination of the development and testing of the cloze procedure followed. Technical vocabulary studies were also reviewed and the chapter concluded with a discussion of the theoretical framework and model for this study.

From the review of the literature it was pointed out that the readability of written materials and the reading abilities of students often do not match. A problem in this area is that words often have different meanings in different contexts. In vocational, technical, and practical arts education, common words take on new meanings. Students are confused when this is the case and comprehension
of the material suffers. This study is designed to test the notion that providing defined technical terms will increase the level of comprehension of technical material.
CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Introduction

The purposes of the study were to determine the effects of providing defined technical terms on the level of reading comprehension and to determine if interaction between treatments and levels of reading ability exists. Undergirding theoretical considerations and a review of related literature were presented in the preceding chapter. In this chapter, the accessible population, the research design, the results of the pilot study, the instruments utilized for collecting data, the procedures for collection of data, and the method of data analysis are included.

Accessible Population

The subjects used in this study were high school vocational construction students enrolled in two high schools in Macon, Georgia. The two schools comprising the experimentally accessible population were chosen simply as a convenience sample.

A second factor that helped to determine the school system for this study was the concern of teachers. One
teacher felt that his students were not reading at grade level and needed help. Another teacher expressed a concern about vocabulary problems.

The last factor that helped to determine the school system for this study stems from the fact that this writer is a former student of this school system. Thus, it was felt that this writer could relate to the experience and background of these students.

**Research Design**

The design for this study is the treatments by levels design described by Lindquist (1956). There were 99 male subjects (40% black and 60% white) who participated in the study. The subjects' grade level included tenth, eleventh, and twelfth grades (first and second year students only). The students within each classroom were randomly assigned to one of three experimental groups. The experimental groups were:

- **Method A**—Standard Reading Passage—No defined terms.
- **Method B**—Standard Reading Passage with a glossary on the front of the material.
- **Method C**—Standard Reading Passage with a glossary built into the Reading Passage.

A treatments by levels design, 3 by 3 (3 x 3), was employed to study the independent effect of the independent variable on the dependent variable and to seek evidence of interaction between treatments and levels.
Reading achievement (blocking variable; treatments by levels) was measured by the Gates-MacGinitie Reading Test, Level F, Form I. The test was given to the subjects several weeks in advance of the experiment. From these data a student was assigned to a reading achievement level of high, medium, or low as explained in the procedure section to follow.

The manipulated independent variable, experimental treatment, was randomly assigned as explained in the procedures section.

The dependent variable is reading comprehension. A cloze test over the material was used to measure reading comprehension.

Pilot Study

A pilot study was conducted in late September, 1980, using students at the Southwest Career Center in Columbus, Ohio. The pilot study utilized a vocational education construction class and followed the methods and procedures that were to be used in the final study. The results of the pilot study led to one change in the coding of the three reading passages. Each of the three different reading passages had a big letter on the front to identify it (A, B, or C). The students picked this up right away.
Therefore, the three passages were re-coded with a smaller letter hidden on the cover sheet. The letters were used to help identify the three treatments.

The data derived from the pilot study cloze test provided the trend that was hypothesized. That is, those students with access to the defined technical terms scored higher than those students who did not have access to the defined terms.

Following the pilot study the three experimental treatments, the cloze test, and instructions were placed in final revised form, duplicated, and compiled for the final study which was conducted in late October, 1980.

Instrumentation

The instruments utilized for collecting data in this study were developed from the textbook titled Modern Carpentry by Willis H. Wagner. The selected reading was taken from Unit 3, which covers leveling instruments. This unit was chosen because the material is basic to the study of building construction and included information that was not covered as a regular part of the course content.

It was also important to select a reading passage that the subjects had not seen before. The textbook chosen was not used by this school system. Therefore, the study was not contaminated because the subjects had been exposed to the reading passage before hand.
Instrument Preparation

After the selection of the reading passage was made, it was very important that the technical terms and technical phrases be identified by experts in the field. It was equally important that once the terms and phrases were identified that the definitions of the terms and phrases be correct and appropriate for the material.

The panel of consultants (experts) chosen were:

Mr. Willie Wilkerson
Teacher, Vocational Construction
Fulton County School System
Atlanta, Georgia

Dr. Willis H. Wagner
Professor, Industrial Technology
University of Northern Iowa
Cedar Falls, Iowa

Dr. Roy Butler
Senior Research Associate
The National Center for Research in
Vocational Education
Columbus, Ohio

These members were chosen because they are vocational education curriculum experts: teacher, textbook writer, and researcher.

First each member was asked to review the reading passage and identify all technical terms and phrases. With the aid of a dictionary, the glossary of terms in the back of the textbook (Modern Carpentry), and a technical dictionary by Gerrish (1968), definitions were developed. The
panel members were then asked to review the list of definitions to assure that the definitions were correct and appropriate for the material.

Following this review, it was then necessary to decide how best to place the definition within the reading passage. A second decision, should all terms be defined each time they appeared in the passage, also had to be made.

It was decided, with the help of Professor Richard C. Anderson, Professor of Educational Psychology at the University of Illinois, to place the definitions in parentheses right after the technical term or phrase. It was also decided to define the term or phrase when it first appeared in text and any other time that it was felt that a definition would make a sentence clearer to the reader.

Following these decisions, the next step was to subject the standard reading to the cloze procedure. This procedure was accomplished by removing every fifth word from the text and replacing it with a standard-sized blank.

A total of 50 deletions were made from the beginning, middle, and latter portions of the reading. Bormuth (1967) suggested that the deletions not begin until the second paragraph. This is to help lead the reader into the material.

With the cloze procedure completed, the instruments (the three treatments), and instructions sheets were
printed, and compiled. The three experimental methods and cloze test were:

First Reading

1. Method A--Standard reading passage, no defined terms.

2. Method B--Standard reading passage with a glossary on the front of the material.

3. Method C--Standard reading passage with the glossary built into the reading passage.

Second Reading

4. Cloze test applied to the standard reading passage (this reading passage was the same as Method A, but a cloze test was applied to it this time).

The instruments (the three treatments) were then alternately stacked (i.e. A, B, C, A, B, C, etc.) to insure random assignment of the instruments to the students. A student read one of the three readings (Method A, B, or C) and then completed a cloze test. All students took the same cloze test.

Procedures

Each student randomly selected one of three treatments (methods) from the stack on the teacher's desk. Each student then returned to his seat (all males) and proceeded to read the instructions on the packet. The students were
given forty minutes to read the material. All students finished the reading in less than the forty minutes given.

After reading one of the three treatments (Method A, B, or C), each student then turned in his packet and took a second packet (the cloze test) from the teacher's desk. The second packet was the same reading material except this reading had the cloze test procedure applied (there were no technical terms defined in this reading). Each student read the material and filled out the cloze test at his own rate.

In early October, 1980, each student took the Gates-MacGinitie Reading Test. The comprehension section of Level F, Form I measures the student's ability to read prose passages with understanding.

The results from this test were used to determine a student's present reading achievement level. The decision was made, with the help of Dr. Victor Rentel, Professor, Academic Faculty of Humanities Education, The Ohio State University, to use a natural grouping breakout of high, medium, and low abilities. Since the generalizability of the research findings are limited to the school system in Macon, Georgia, this researcher accepted the natural categories in this hypothetical population. Table 1 provides the data related to the Gates-MacGinitie Reading Test, (comprehension section, Level F, Form 1). The mean raw
score for this group of students was 24.84. This raw score mean converted into a grade equivalent mean of 7.9. From the standardized mean it would appear that the major portion of the sample selected for this investigation was reading considerably below grade level. The group as a whole did exactly as planned. There was a break between the low and the medium group as well as between the medium and high group. Therefore, this natural grouping breakout was used to separate the students into high, medium, and low reading comprehension achievement levels, as shown in Table 1.

Table 1
Gates-MacGinitie Reading Test Scores by Ability Levels High, Medium, Low

<table>
<thead>
<tr>
<th>Level</th>
<th>N</th>
<th>Score Range</th>
<th>$\bar{X}^a$</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>28</td>
<td>30 - 43</td>
<td>35.17</td>
<td>4.3</td>
</tr>
<tr>
<td>Medium</td>
<td>33</td>
<td>22 - 28</td>
<td>24.09</td>
<td>1.5</td>
</tr>
<tr>
<td>Low</td>
<td>38</td>
<td>0 - 20</td>
<td>15.28</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Note: Maximum Score = 43

a A score of 35 is equal to a reading grade level 12+
A score of 24 is equal to a reading grade level 7.6
A score of 15 is equal to a reading grade level 4.9.
(Houghton Mifflin Company, 1978, p. 63)

Results of the Scheffe' Test for multiple comparisons revealed statistically significant differences among the three levels of reading ability, as shown in Table 2. A
contrast between the levels (High Ability and Medium Ability, High Ability and Low Ability, and Medium Ability and Low Ability) revealed statistically significant differences at the alpha level of .05 for each comparison.

Table 2

Summary of One-Way Analysis of Variance of Gates-MacGinitie Test Scores

<table>
<thead>
<tr>
<th>Sources</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>2</td>
<td>5692.4930</td>
<td>2846.2463</td>
<td>147.057*</td>
</tr>
<tr>
<td>Within groups</td>
<td>96</td>
<td>1858.0569</td>
<td>19.3548</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at the alpha level of .001

Analysis of Data

The completed cloze tests were scored by this researcher and one other person (as a reliability check). Since there were 50 deletions, the number of correct word replacements were totaled and divided by 50 to obtain a percentage score.

The data were then coded and placed on IBM data cards and an analysis of variance (ANOVA) was conducted to examine the differences among the three groups in the study. The alpha level was set at $p < .05$.

The results of this analysis, as it relates to Hypotheses 1 through 4, are reported in Chapter IV.
Summary

In this chapter the purposes of the study were restated in the introduction. The subjects, the methods, and the techniques for the study were also provided. In addition, the selection of the research instruments, the independent variable, the blocking variable, the dependent variable, and the method of data analysis were provided.

The Gates-MacGinitie Reading Test was administered by the vocational education counselor in each school. The results from this test served as the measure of reading comprehension achievement of students enrolled in vocational construction. From these data, a student was assigned to an ability level of high, medium, or low reading comprehension achievement level. There were 99 male subjects involved in this study.
CHAPTER IV

ANALYSIS OF THE DATA

Introduction

The data derived from the study will be provided and analyzed in this chapter. Reported are the overall findings related to the effects of the independent variable (mode of presentation), the level of reading ability (blocking variable), and the dependent variable, reading comprehension (measured by the cloze test).

The purposes of this research study were to: (1) determine the effects of providing defined technical terms within a reading passage on the level of reading comprehension (2) to determine if interaction between treatments and level of reading ability exists and (3) to determine the effects of providing a glossary of technical terms at the beginning of a reading passage, on the level of reading comprehension.

The data from the cloze test, which were used to measure the subjects' level of comprehension, were subjected to an analysis of variance (ANOVA) to determine the main effects and to determine the interaction, if any, of the independent variable and blocking variable.
Number of Subjects

Table 3 provides the data related to the number of subjects who participated in the study. Of the total convenience sample available, 99 subjects were involved. Five potential subjects were absent from school the day of the test. It might be mentioned that two of the students who were absent were described by the teachers as being teenage alcoholics. The other three students were absent because of sickness.

Table 3
Subjects Participating in the Study by Grade Level and by School

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Northeast</th>
<th>School</th>
<th>Southwest</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>11</td>
<td>19</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>35</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

Test Validity

Studies by Ruddell (1963), Jongsma (1970), Webber (1971), and Simons (1971) give support to the notion that the cloze procedure is a better (valid) method of measuring reading comprehension then traditional multiple-choice test. The cloze test procedure is a better measure of
reading comprehension than the traditional test procedure because it appears to measure fewer of the extraneous aspects of student functioning (Simons, 1971). The procedure of deleting every nth word makes the test more objective and less subject to the despotic discretion of the test constructor. The cloze test is a direct measure of reading comprehension which is easy to construct and score, making it quite appealing as a substitute for the conventional multiple-choice test of comprehension.

Rankin (1966) concluded his review of research relating to the cloze procedure by noting that, "The cloze procedure appears to be a highly valid measure of the specific comprehension of a particular message" (p. 136). Thus, the cloze procedure was chosen as the measure of reading comprehension for this study.

Test Reliability Estimate

Test reliability was estimated using the Kuder-Richardson Formula #20. The reliability estimate was .89 for the cloze test. Judging from the size of the reliability coefficient, it would appear that the cloze test served as a reliable measuring instrument in this investigation. With the reliability of the cloze test confirmed, attention was directed to testing for the main effects and for any interaction of the treatment and blocking variables.
Analysis and Interpretation of Data

The results of the 3 x 3 treatments by levels design are provided in the ANOVA summary table. The data indicated that there was a main effect for method (treatment) and a main effect for reading level (blocking variable). Interaction was not significant, as shown in Table 4.

Table 4
Analysis of Variance Summary Table for the Cloze Test by Method and by Reading Level

<table>
<thead>
<tr>
<th>Sources</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method (A)</td>
<td>2</td>
<td>1132.685</td>
<td>566.343</td>
</tr>
<tr>
<td>Reading Level (B)</td>
<td>2</td>
<td>506.344</td>
<td>253.172</td>
</tr>
<tr>
<td>Method x Reading Level (A x B)</td>
<td>4</td>
<td>123.752</td>
<td>30.938</td>
</tr>
<tr>
<td>Residual</td>
<td>90</td>
<td>6555.133</td>
<td>72.835</td>
</tr>
</tbody>
</table>

** Significant at the alpha level .001
* Significant at the alpha level .05

Post hoc procedures were performed using the Scheffe' Test for multiple comparison to test for significant differences among the means of Treatment Methods A, B, and C.

Hypothesis I

The first hypothesis of the study as stated in Chapter I was:
The level of reading comprehension of students who read the material with defined technical terms within a reading passage will be significantly higher than that of students who read the material without the defined technical terms (Method C > Method A).

Hypothesis I when stated in the statistical null form is:

There will be no significant difference in the level of reading comprehension of students who read the material with defined technical terms within a reading passage and that of students who read the material without the defined technical terms (Method C = Method A).

The resulting means and associated standard deviations of the cloze test scores as they relate to this hypothesis are provided in Table 5.

Table 5

Means and Standard Deviations of Cloze Test Scores for the Group Not Provided With Defined Technical Terms and for the Group Provided With Defined Technical Terms Within a Reading Passage

<table>
<thead>
<tr>
<th>Groups</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method A</td>
<td></td>
</tr>
<tr>
<td>Group not provided with Defined Tech-</td>
<td>Mean 15.83</td>
</tr>
<tr>
<td>nical Terms</td>
<td>SD 9.3</td>
</tr>
<tr>
<td></td>
<td>N 35</td>
</tr>
<tr>
<td>Method C</td>
<td></td>
</tr>
<tr>
<td>Group Provided with Defined Technical</td>
<td>Mean 22.88</td>
</tr>
<tr>
<td>Terms Within a Reading Passage</td>
<td>SD 8.8</td>
</tr>
<tr>
<td></td>
<td>N 34</td>
</tr>
</tbody>
</table>
An examination of the data in Table 5 shows that the overall mean for the group (Method C) that read the material with the defined technical terms within a reading passage is higher than the mean for the group (Method A) that read the material without the defined technical terms.

Results of the Scheffe' Test for multiple comparisons revealed statistically significant differences among the three methods. Findings were statistically significant at the alpha level of .05 when the following groups were compared: Method A, no defined technical terms, Method B, defined technical terms in a glossary on the front of the material, and Method C, defined technical terms within the reading passage. Table 6 provides the results of the one-way analysis of variance.

Table 6

Summary of Analysis of Variance of Cloze Test Scores of Methods A, B, and C

<table>
<thead>
<tr>
<th>Sources</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2</td>
<td>998.9913</td>
<td>499.4956</td>
<td>6.694**</td>
</tr>
<tr>
<td>Within Groups</td>
<td>96</td>
<td>7163.1899</td>
<td>74.6166</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at the alpha level of .001

A contrast coefficient matrix between Method A and Method C revealed statistically significant differences between
the methods at the alpha level of .05. Table 7 provides the results of the contrast.

**Table 7**

Cloze Test Mean of Method A, No Defined Technical Terms, Compared to Cloze Test Mean of Method C, Defined Technical Terms Within a Reading Passage

<table>
<thead>
<tr>
<th>Source</th>
<th>Cloze Test Mean ($\bar{X}$)</th>
<th>SD</th>
<th>df</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method A</td>
<td>15.83</td>
<td>9.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method C</td>
<td>22.88</td>
<td>8.83</td>
<td>67</td>
<td>3.23*</td>
</tr>
</tbody>
</table>

* Significant at alpha level .01

The results of the preceding comparisons, using the 't' test, were significant at the alpha level .05. In view of the significant 't' value, the null hypothesis which stated that there will be no significant difference in the level of reading comprehension between two methods (Method A and Method C) was rejected. Thus, it would appear that the higher cloze test scores obtained by the students who had access to the defined technical terms understood the reading significantly better than a comparable group of students who did not have access to the defined technical terms.
**Hypothesis II**

The second hypothesis of the study as stated in Chapter I was:

The level of reading comprehension of students who read the material with defined technical terms within a reading passage will be significantly higher than that of students who read the material with defined technical terms in a glossary on the front of the material (Method C > Method B).

Hypothesis II when stated in the statistical null form is:

There will be no significant difference in the level of reading comprehension of students who read the material with defined technical terms within a reading passage and that of students who read the material with defined technical terms in a glossary on the front of the material (Method C = Method B).

The resulting means and associated standard deviations of the cloze test scores as they relate to this hypothesis are provided in Table 8.

An examination of the data in Table 8 shows that the overall mean for the group (Method C) that read the material with defined technical terms within a reading passage is higher than the mean for the group (Method B) that read the material with the glossary on the front of the material.
Table 8

Means and Standard Deviations of Cloze Test Scores for the Group Provided with Defined Technical Terms in a Glossary and the Group Provided with Defined Technical Terms Within a Reading Passage

<table>
<thead>
<tr>
<th>Groups</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Method B</td>
<td></td>
</tr>
<tr>
<td>Group Provided with Defined Technical Terms in a Glossary</td>
<td>Mean: 21.90, SD: 7.4, N: 30</td>
</tr>
<tr>
<td>Method C</td>
<td></td>
</tr>
<tr>
<td>Group Provided with Defined Technical Terms Within a Reading Passage</td>
<td>Mean: 22.88, SD: 8.8, N: 34</td>
</tr>
</tbody>
</table>

Although the means of the two groups (Method B and Method C) are different, a contrast coefficient matrix between Method B and Method C revealed no statistically significant difference at the alpha level of .05. Table 9 provides the results of the contrast.

Table 9

Cloze Test Mean of Method B, the Glossary Group, Compared to Cloze Test Mean of Method C, the Group with Defined Technical Terms Within a Reading Passage

<table>
<thead>
<tr>
<th>Source</th>
<th>Cloze Test Mean</th>
<th>SD</th>
<th>df</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method B</td>
<td>21.90</td>
<td>7.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method C</td>
<td>22.88</td>
<td>8.8</td>
<td>62</td>
<td>.481</td>
</tr>
</tbody>
</table>
The results of the preceding comparisons, using the 't' test, pointed out that the means of Method B and Method C were not statistically different. In view of this non-statistically significant difference, the null hypothesis is tenable.

Hypothesis III

The third hypothesis of the study as stated in Chapter I was:

The level of reading comprehension of students who read the material with defined technical terms in a glossary on the front of the material will be significantly higher than that of students who read the material without the defined technical terms (Method B > Method A).

Hypothesis III when stated in the statistical null form is:

There will be no significant difference in the level of reading comprehension of students who read the material with defined technical terms in a glossary on the front of the material and that of students who read the material without the defined technical terms (Method B = Method A).

The resulting means and associated standard deviations of the cloze test scores as they relate to this hypothesis are provided in Table 10.
Table 10

Means and Standard Deviations of Cloze Test Scores for the Group not Provided with Defined Technical Terms and for the Group Provided with Defined Technical Terms in a Glossary

<table>
<thead>
<tr>
<th>Groups</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Method A</td>
</tr>
<tr>
<td>Group Not Provided with Defined Technical Terms</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>SD</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Method B</td>
</tr>
<tr>
<td>Group Provided with Defined Technical Terms in a Glossary</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>SD</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
</tbody>
</table>

An examination of the data in Table 10 shows that the overall mean for the group (Method B) that read the material with defined technical terms in a glossary on the front of the material is higher than the mean for the group (Method A) that read the material without the defined technical terms.

A contrast coefficient matrix between Method A and Method B revealed statistically significant differences between the methods at the alpha level of .05. Table 11 provides the results of the contrast.
Table 11

Cloze Test Mean of Method A, No Defined Technical Terms, Compared to Cloze Test Mean of Method B, Defined Technical Terms in a Glossary

<table>
<thead>
<tr>
<th>Source</th>
<th>Cloze Test Mean</th>
<th>SD</th>
<th>df</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method A</td>
<td>15.83</td>
<td>9.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method B</td>
<td>21.90</td>
<td>7.4</td>
<td>63</td>
<td>2.90*</td>
</tr>
</tbody>
</table>

* Significant at the alpha level .01

The results of the preceding comparisons, using the 't' test, were significant at the alpha level .05. In view of the significant 't' value, the null hypothesis which stated that there will be no significant difference in the level of reading comprehension between two methods (Method A and Method B) was rejected. Again, it would appear that the higher cloze test scores obtained by the students who had access to the defined technical terms understood the reading significantly better than a comparable group of students who did not have access to the defined technical terms.

**Hypothesis IV**

The fourth hypothesis of the study as stated in Chapter I was:

There will be a significant interaction between treatments and reading levels.
Hypothesis IV when stated in the statistical null form is:

There will be no significant interaction between treatments and reading levels.

The analysis of variance summary table indicated that interaction was not statistically significant at the .05 alpha level ($F = .425; \text{df} = 4/90; \text{ns}$) as shown earlier in Table 4. Therefore, the null form of Hypothesis IV is tenable.

Summary

This chapter provided information related to the number of subjects participating in the experiment, test validity concerning the cloze test procedure, the reliability of the test instrument used in the study, and the statistical data used to reject or fail to reject the null hypotheses.

It was found that the reliability coefficient associated with the cloze test used in this study was fairly high. This high reliability coefficient is consistent with the results of other studies which have found the cloze procedure to be a reliable and valid measure of reading comprehension.

The results of the overall analysis of variance procedure were then provided. From this summary table, a
main effect for method and a main effect for reading level are reported. This summary table also provides information about the interaction of methods and reading levels. Interaction is shown not to be statistically significant at the .05 alpha level. The main effect for method was significant at the alpha level .001. The main effect for reading level was significant at the alpha level .05, as shown in Table 3.

Post hoc procedures were then performed using the Scheffe' Test for multiple comparisons to test the significance of the F-ratio for Method. No post hoc procedures were performed for interaction of method and reading level because interaction was not statistically significant at the .05 alpha level. No post hoc procedures were performed for reading level because this blocking variable was not a primary concern in this investigation.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The investigation of technical terms and phrases in relation to reading comprehension has been a substantial omission in vocational, technical, and practical arts education. When students are faced with common words in technical readings and these common words have new and completely different meanings, from their everyday use, understanding (comprehension) of the material suffers.

This study examined methods of presenting defined technical terms (as related to the technical material being read) to students to test their effects upon reading comprehension. This was accomplished by (1) not providing defined technical terms with a passage, (2) providing defined technical terms in a glossary on the front of the passage, and (3) providing defined technical terms within the passage.

Included in this chapter is a brief summary of the problem, the procedures utilized for this research and the findings. The conclusions of this study are presented next followed by recommendations for the educator and the researcher.
The Problem

Technical terms and phrases in vocational, technical, and practical arts education textbooks can cause confusion for the students when reading technical material. This is especially true when these terms or phrases have other meanings outside the content area.

This research study attempted to provide an answer to the following question: Does providing a student with defined technical terms increase the level of comprehension of selected textbook materials? Specifically, the purposes of this study were to: (1) determine the effects of providing defined technical terms within a reading passage on the level of comprehension, (2) determine if any interaction between treatments and levels of reading ability exists, and (3) determine the effects of providing a glossary of technical terms at the beginning of a reading passage, on the level of comprehension.

Procedures

The procedures used in this study involved formulating hypotheses based upon a review of the literature. The hypotheses were stated in a directional form and then in a null form to facilitate testing. Literature relating
to studies of the readability of technical materials was reviewed. From this review of the literature, it was pointed out that technical materials (readings) were being used in classrooms where the rated readability of the material was higher than the reading grade level of the students they were intended to serve. Next, the instruments used to measure the level of reading comprehension and the cloze test procedure were reviewed. From this review, the cloze test procedure was described as being a more valid measure of reading comprehension than traditional methods. Literature relating to technical vocabulary was also reviewed. The theoretical framework with a model was presented to provide the principles upon which this study is based.

The instruments (the three methods and the cloze test) that were to be used in this study were developed, and a pilot study (using students enrolled in vocational construction at the Southwest Career Center, Columbus, Ohio) was conducted to gain insight as to how the defined technical terms would affect reading comprehension. The final study was conducted in October, 1980 in Macon, Georgia.

The instruments were scored, and a check of reliability was conducted using the Kuder-Richardson Formula #20. The data were then subjected to an analysis of variance (ANOVA) to determine the overall significance of
the findings. The Scheffe' Tests for multiple comparisons were used to test the significance of F-ratios among the groups. Results revealed statistically significant differences among certain groups.

**Findings**

The one-way analysis of variance was used to test the equality of mean scores among the three methods (mode of presentation). The F-ratio calculated for method was significant at the alpha level .001.

Scheffe' Tests for multiple comparisons revealed statistically significant differences among the three methods. Method A, no defined terms, was statistically different from Method B, defined terms in a glossary on the front of the material, and Method C, defined technical terms within the reading passage, at the alpha level .001.

The major findings are based on the analysis of the data in relation to the four hypotheses.

1. The first hypothesis stated that the level of reading comprehension of students who read the material with defined technical terms within a reading passage will be significantly higher than that of students who read the material without defined technical terms (Method C > Method A). The data of the study supported this hypothesis.
2. The second hypothesis stated that the level of reading comprehension of students who read the material with defined technical terms within a reading passage will be significantly higher than that of students who read the material with defined technical terms in a glossary on the front of the material (Method C > Method B). The data of the study did not support this hypothesis. However, the mean of Method C was slightly higher than the mean of Method B.

3. The third hypothesis stated that the level of reading comprehension of students who read the material with defined technical terms in a glossary on the front of the material will be significantly higher than that of students who read the material without the defined terms (Method B > Method A). The data of the study supported this hypothesis.

4. The fourth hypothesis stated that there will be a significant interaction between treatments and reading levels. The data of the study did not support this hypothesis.

Two other observations concerning this study are:

5. Most of the subjects utilized in this study were reading below grade level.
6. The reliability estimate of the cloze test (.89) was consistent with other reliability estimates of cloze tests.

Conclusions

Based on the review of the literature, the analysis of the data, and the findings of this study, the following conclusions were made.

1. Technical terms and phrases do affect the readability of technical material. Based upon the results of this study, technical terms and phrases, when defined for the students, make the reading of technical material more readable. That is, the definitions help with the script elaboration process (to expand, connect, and apply associative experiences). Therefore, it may be concluded that defined technical terms and phrases do help students comprehend technical material.

2. The placement of defined technical terms (as presented in this study) apparently did not assist any one type of reader over another.

3. The placement of defined technical terms and phrases, in a glossary or within the reading passage, did not make a difference in this
study. That is, if the students had access to the definitions (in this study the glossary was placed on the front of the material, which means the students more than likely read through the definitions before beginning the reading passage) they made use of them.

**Recommendations**

The following recommendations are made on the basis of the findings and conclusions of this study and the experience gained from conducting this experiment.

**Recommendations to the Educator**

1. Educators should study the literature and apply the suggested methods that help to increase or to expand technical vocabularies for students.

2. Educators, when selecting textbooks, should select books that contain a glossary of technical terms.

3. Educators should provide reference books, and other related materials, for the students to use. Instructions should be provided, by the teachers, on how to use these materials.

4. The cloze test procedure should be used by educators in the classroom to determine how well students are comprehending the material being utilized.
Recommendations to the Researcher

1. It is recommended that this study be replicated, using materials from other technical areas as well as the technical area of construction. Doing so would help increase our understanding of the process of learning concepts from definitions.

2. Further research should be conducted using a glossary in the back of a reading passage. This study placed the glossary in the front of the reading passage.

3. Research should be conducted to determine the most appropriate structural format of technical material. That is, should more pictures, illustrations, and charts be used in place of words?

4. Research should be conducted to determine how best to teach technical vocabulary to students. Perhaps the reading comprehension of technical material could be improved by teaching vocabulary first.

5. Research should be conducted to determine if actual experiences with a particular subject helps a reader to better understand written material related to that subject.

6. Further research is needed in determining the most efficient and precise method of estimating
the level of readability of technical materials. The problem is that technical terms and phrases often have different meanings outside the content area. A passage may be readable, but comprehension depends upon knowing the meanings of words as they relate to the topic being studied.
APPENDIX A
Methods A, B, and C
STUDENT'S INSTRUCTIONS FOR THIS PACKET.

Name__________________________________________________________
School________________________________________________________
Your Grade____________________________________________________
Your Age Today_______________________________________________
Your Sex_______________________________________________________
Your Class Period______________________________________________
Your Father's Occupation________________________________________
Your Mother's Occupation________________________________________
Do You Have A Part Time Job? Yes _____ No _____
   If Yes, What Do You Do________________________________________
Is This Your First Class In Construction? Yes _____ No _____
   If No, How Many Semesters _________(including this semester)

DID YOU FILL IN ALL THE BLANKS ABOVE? IF NOT PLEASE DO IT NOW!

On the next page(s) you will be asked to read a passage about LEVELING INSTRUMENTS. Read the material very carefully. When you have finished reading, turn in this packet to your teacher. Your teacher will then give you another packet to read. You may start.
Unit 3

LEVELING INSTRUMENTS

In building construction it is important that footings and foundation walls be level, square, and the correct size.

For small structures, the carpenters' level, framing square, and rule can be used to lay out and check the foundation work. As the size increases in residential construction and in commercial and institutional buildings, special leveling instruments must be used if accuracy and efficiency are to be maintained.

Leveling Instruments

The level and level-transit are commonly used in laying out and checking construction work. These instruments can also be used for surveying and other space and land-layout jobs. When the job is too large for the chalk line, straightedge, level, and square; leveling instruments should be used. The instruments include an optical device which operates on the basic principle that a LINE OF SIGHT is a straight line that neither dips, sags or curves. Any point along a level line of sight will be the same height as any other point. In the use of these instruments, the line of sight replaces the chalk line and straightedge.

The builders' level (also called a dumpy level) is shown in Fig. 3-1. It consists of an accurate spirit level and telescope assembly that is attached to a circular base. Leveling screws are used to adjust the base after it has been mounted on the tripod. The telescope can be rotated on the base and any angle in a horizontal plane can be laid out or measured.
The level-transit, Fig. 3-2, works like the builders' level with an additional feature that permits the telescope to be pivoted up.

Fig. 3-3. Parts of a level-transit. This instrument can be used to lay out or check level and plumb lines. It can also be used to measure angles in either horizontal or vertical planes.
and down in a vertical plane. This makes it possible to accurately measure vertical angles or to determine if a wall is perfectly plumb (vertical). The vertical movement simplifies the operation of aligning a row of stakes, especially when they vary in height.

In use, both the builders' level and level-transit are mounted on tripods, Fig. 3-3. Some models, like the one shown, have adjustable legs that make it easier to set them up on sloping ground. This feature also permits the legs to be retracted for handling and storing.

Fig. 3-3. Parts of a tripod. The legs hinge at the top for carrying and storing.
When it is necessary to sight over long distances, a leveling rod is used. See Fig. 3-4. It is designed so that differences in the elevation between the position of the level and various positions where the rod is held can be easily read. The rod is especially useful for surveying work. Readings can be made by the person operating the level (the levelman), or the target can be adjusted up and down to the line of sight and then the rodman (man holding the rod) can make the reading. The rod shown has graduations in feet and inches. However, for regular surveying work, the graduations are usually based on the foot and decimal parts of a foot.

When sighting short distances (100 feet or less) a regular folding rule can be held against a wood strip and read through the
instrument. This procedure will be satisfactory for jobs such as setting grade stakes for a footing. Always be sure to hold the strip and rule in a vertical position.

For measurements and layouts involving long distances, steel tapes (called measuring tapes) may be used. They are contained on winding reels such as the one shown in Fig. 3-5, and are available in lengths from 50 to 300 feet. Various types or graduations may be obtained, Fig. 3-6. The carpenter will usually select one that is graduated in feet, inches and eighths like two that are shown. Surveying requires a tape that is graduated in feet and decimal parts of a foot.
Setting Up Instrument

Set up the tripod in a firm and stable position. Make sure the points are well into the ground. On hard surfaces, be sure the points will not slip. Check the tripod wing nuts and see that they are securely tightened. The legs should have a spread of about 3-1/2 feet and be adjusted so the tripod head appears to be level.

Lift the instrument carefully from its case by the base plate. Screw it firmly onto the tripod head. On some instruments the leveling screws may need to be turned up so the mounting screw can be threaded all the way into the tripod head. If the instrument is to be located over an exact point, this should be done before the final leveling.

Leveling is a very important operation in preparing the instrument for use. None of the readings taken or levels sighted will be accurate unless the instrument is level throughout the work. First, release the horizontal clamp screw and turn the telescope so it is directly over a pair of the leveling screws. Grasp the screws between the thumb and forefinger as shown in Fig. 3-7. Turn both screws uniformly with

![Fig. 3-7. Adjusting the leveling screws.](image)

your thumbs moving toward each other or away from each other. Center the bubble of the spirit level carefully between the graduations. You will find that on most instruments the BUBBLE WILL TRAVEL IN THE
DIRECTION THAT YOUR LEFT THUMB MOVES. See Fig. 3-8. Leveling screws should bear firmly on the base plate. Never tighten the screws so much they will bind.

![Fig. 3-8. The bubble of the spirit level moves in the same direction as the left thumb.](image)

When the bubble is centered, turn the telescope 90 deg. so it is over the other set of leveling screws and repeat the operation. Now check and recheck the instrument over each pair of screws. When the instrument is level, it will be possible to turn the telescope in a complete circle without any change in the bubble.

**Sighting**

The telescope will magnify or enlarge the image (object sighted). Most builders' levels have a telescope with a power of about 20X which means that the object will appear to be only one-twentieth of its actual distance. First, line up the telescope by sighting along the barrel and then look into the eyepiece, Fig. 3-9, and adjust the focusing knob until the image is clear and sharp. When the cross hairs are in
approximate position on the object, Fig. 3-10, tighten the horizontal-motion clamp and make the final alignment by turning the tangent screw.

**Leveling**

Finding the difference in the grade level between several points or transferring the same level from one point to another is called leveling. With the instrument level, the line of sight will be level and the readings shown in Fig. 3-11 can be used to calculate the
Leveling Instruments

Using a level-transit to plumb (make vertical) a column in a steel frame structure. The horizontal clamp screw is locked and the telescope rotated in a vertical arc. Also see Fig. 3-19. (David White Instruments, Div. of Reoist, Inc.)

Builder adjusts focusing knob on a level-transit. The telescope has a power of 26X. At a distance of 100 ft. it provides a field of view of 1 3/4 ft. (100 m/1.7 m). Total weight of the instrument, less tripod, is 9 3/4 lb. (4.4 kg).

(David White Instruments, Div. of Reoist, Inc.)

NOTE: When sighting through a telescope, keep both eyes open. This eliminates squinting, provides the best view and reduces eye strain.
difference in elevation. When there is a great amount of slope, the instrument can be set up between the points. The reading is taken with the rod in one position and then the instrument is carefully rotated to secure the reading at a second position.

When setting grade stakes for a footing or erecting batter boards, the instrument should be set in a central location as shown in Fig. 3-12.

The distances will be about equal and it will reduce the need for changing focus on each corner. An elevation established at one corner can be quickly transferred to other corners or points in between.
Grade stakes for footings are usually set to the approximate level by "eye" judgment. They are then carefully checked with the rod and level as they are driven deeper until the top of each stake is at the required elevation. Sometimes reference lines are drawn on construction members or stakes near the work and then transferred to the forms with a carpenters' level and rule.

There may be situations where the existing grade will not permit the setting of a stake or reference mark at the actual level of the required grade. In such cases a mark is made on the stake with the added notation of its position in relation to the required grade elevation. The letters C and F, standing for cut and fill, are generally used.

When laying out sloping building plots or "carrying" a benchmark (an officially established elevation) to the building site, it will likely be necessary to set up the instrument in several locations. Fig. 3-14 shows how reading from two positions is used to calculate or establish grade levels.
Fig. 3-14. When there is a great amount of slope or long distances are involved, the instrument will need to be set up at two or more locations.
STUDENT'S INSTRUCTIONS FOR THIS PACKET.

Name________________________________________________

School________________________________________________

Your Grade___________________________________________

Your Age Today________________________________________

Your Sex_____________________________________________

Your Class Period_____________________________________

Your Father's Occupation________________________________

Your Mother's Occupation________________________________

Do You Have A Part Time Job?    Yes _____ No _____

   If Yes, What Do You Do______________________________

Is This Your First Class In Construction?    Yes _____ No _____

   If No, How Many Semesters ________(including this semester)

DID YOU FILL IN ALL THE BLANKS ABOVE?  IF NOT PLEASE DO IT NOW!

On the next page(s) you will be asked to read a passage about LEVELING INSTRUMENTS. Read the material very carefully. When you have finished reading, turn in this packet to your teacher. Your teacher will then give you another packet to read. You may start.
TECHNICAL TERMS

BATTER BOARDS. Framework used in locating corners when laying out a foundation.

BEAR. To rest upon.

BENCHMARK. An officially established elevation.

BIND. To jam; too tight.

CHALK LINE. A mark or line made with chalk on a string.

COMMERCIAL BUILDINGS. Used by businesses.

FOOTINGS. The base or bottom of a foundation.

FOUNDATION WALLS. The supporting portion of a structure (building) below and/or above ground.

HORIZONTAL. Straight across.

IMAGE. Object sighted through a scope.

INSTITUTIONAL BUILDINGS. Schools, churches, mental homes.

LAND-LAYOUTS. Arrangement of land according to plan.

LAYOUT. To arrange according to plan; place in order.

LEVELING ROD. A pole or stick with a movable marker, target.

PLOTS. A measured area of land.

READINGS. Information indicated by a gauge or scale.

REFERENCE LINE. A mark or line used to point out a certain location; a guide.

RESIDENTIAL CONSTRUCTION. Family homes.

SIGHT. Aim or observe; through a scope.

SPIRIT. The liquid solution (with bubble) in a level.

STAKES. Wood or metal sticks used as markers; driven in ground.

SURVEYING. To determine boundaries, to mark off land.

TRIPOD. A three-legged stand.
In building construction it is important that footings and foundation walls be level, square, and the correct size.

For small structures, the carpenters' level, framing square, and rule can be used to lay out and check the foundation work. As the size increases in residential construction and in commercial and institutional buildings, special leveling instruments must be used if accuracy and efficiency are to be maintained.

Leveling Instruments

The level and level-transit are commonly used in laying out and checking construction work. These instruments can also be used for surveying and other space and land-layout jobs. When the job is too large for the chalk line, straightedge, level, and square; leveling instruments should be used. The instruments include an optical device which operates on the basic principle that a LINE OF SIGHT is a straight line that neither dips, sags or curves. Any point along a level line of sight will be the same height as any other point. In the use of these instruments, the line of sight replaces the chalk line and straightedge.

The builders' level (also called a dumpy level) is shown in Fig. 3-1. It consists of an accurate spirit level and telescope assembly that is attached to a circular base. Leveling screws are used to adjust the base after it has been mounted on the tripod. The telescope can be rotated on the base and any angle in a horizontal plane can be laid out or measured.
The level-transit, Fig. 3-2, works like the builders' level with an additional feature that permits the telescope to be pivoted up.

Fig. 3-2. Parts of a level-transit. This instrument can be used to lay out or check level and plumb lines. It can also be used to measure angles in either horizontal or vertical planes.
and down in a vertical plane. This makes it possible to accurately measure vertical angles or to determine if a wall is perfectly plumb (vertical). The vertical movement simplifies the operation of aligning a row of stakes, especially when they vary in height.

In use, both the builders' level and level-transit are mounted on tripods, Fig. 3-3. Some models, like the one shown, have adjustable legs that make it easier to set them up on sloping ground. This feature also permits the legs to be retracted for handling and storing.
When it is necessary to sight over long distances, a leveling rod is used. See Fig. 3-4. It is designed so that differences in the elevation between the position of the level and various positions where the rod is held can be easily read. The rod is especially useful for surveying work. Readings can be made by the person operating the level (the levelman), or the target can be adjusted up and down to the line of sight and then the rodman (man holding the rod) can make the reading. The rod shown has graduations in feet and inches. However, for regular surveying work, the graduations are usually based on the foot and decimal parts of a foot.

When sighting short distances (100 feet or less) a regular folding rule can be held against a wood strip and read through the
instrument. This procedure will be satisfactory for jobs such as setting grade stakes for a footing. Always be sure to hold the strip and rule in a vertical position.

For measurements and layouts involving long distances, steel tapes (called measuring tapes) may be used. They are contained on winding reels such as the one shown in Fig. 3-5, and are available in lengths from 50 to 300 feet. Various types or graduations may be obtained, Fig. 3-6. The carpenter will usually select one that is graduated in feet, inches and eighths like two that are shown. Surveying requires a tape that is graduated in feet and decimal parts of a foot.
Setting Up Instrument

Set up the tripod in a firm and stable position. Make sure the points are well into the ground. On hard surfaces, be sure the points will not slip. Check the tripod wing nuts and see that they are securely tightened. The legs should have a spread of about 3-1/2 feet and be adjusted so the tripod head appears to be level.

Lift the instrument carefully from its case by the base plate. Screw it firmly onto the tripod head. On some instruments the leveling screws may need to be turned up so the mounting screw can be threaded all the way into the tripod head. If the instrument is to be located over an exact point, this should be done before the final leveling.

Leveling is a very important operation in preparing the instrument for use. None of the readings taken or levels sighted will be accurate unless the instrument is level throughout the work. First, release the horizontal clamp screw and turn the telescope so it is directly over a pair of the leveling screws. Grasp the screws between the thumb and forefinger as shown in Fig. 3-7. Turn both screws uniformly with your thumbs moving toward each other or away from each other. Center the bubble of the spirit level carefully between the graduations. You will find that on most instruments the BUBBLE WILL TRAVEL IN THE
DIRECTION THAT YOUR LEFT THUMB MOVES. See Fig. 3-8. Leveling screws should bear firmly on the base plate. Never tighten the screws so much they will bind.

![Figure 3-8](image)

*Fig. 3-8. The bubble of the spirit level moves in the same direction as the left thumb.*

When the bubble is centered, turn the telescope 90 deg. so it is over the other set of leveling screws and repeat the operation. Now check and recheck the instrument over each pair of screws. When the instrument is level, it will be possible to turn the telescope in a complete circle without any change in the bubble.

**Sighting**

The telescope will magnify or enlarge the image (object sighted). Most builders' levels have a telescope with a power of about 20X which means that the object will appear to be only one-twentieth of its actual distance. First, line up the telescope by sighting along the barrel and then look into the eyepiece, Fig. 3-9, and adjust the focusing knob until the image is clear and sharp. When the cross hairs are in
approximate position on the object, Fig. 3-10, tighten the horizontal-motion clamp and make the final alignment by turning the tangent screw.

Fig. 3-10. View through the telescope. Left. Cross hairs. Right. Object in view.

Leveling

Finding the difference in the grade level between several points or transferring the same level from one point to another is called leveling. With the instrument level, the line of sight will be level and the readings shown in Fig. 3-11 can be used to calculate the
Leveling Instruments

Using a level-transit to plumb (make vertical) a column in a steel-frame structure. The horizontal clamp screw is locked and the telescope rotated in a vertical arc. Also see Fig. 3-19. (David White Instruments, Div. of Reoellis, Inc.)

Builder adjusts focusing knob on a level-transit. The telescope has a power of 20X. At a distance of 100 ft. it provides a field of view of 1 3/8 ft. (100 m/1.7 m). Total weight of the instrument, less tripod, is 9 3/4 lb. (4.4 kg).
(David White Instruments, Div. of Reoellis, Inc.)

NOTE: When sighting through a telescope, keep both eyes open. This eliminates squinting, provides the best view and reduces eye strain.
difference in elevation. When there is a great amount of slope, the instrument can be set up between the points. The reading is taken with the rod in one position and then the instrument is carefully rotated to secure the reading at a second position.

When setting grade stakes for a footing or erecting batter boards, the instrument should be set in a central location as shown in Fig. 3-12.

The distances will be about equal and it will reduce the need for changing focus on each corner. An elevation established at one corner can be quickly transferred to other corners or points in between.
Grade stakes for footings are usually set to the approximate level by "eye" judgment. They are then carefully checked with the rod and level as they are driven deeper until the top of each stake is at the required elevation. Sometimes reference lines are drawn on construction members or stakes near the work and then transferred to the forms with a carpenters' level and rule.

There may be situations where the existing grade will not permit the setting of a stake or reference mark at the actual level of the required grade. In such cases a mark is made on the stake with the added notation of its position in relation to the required grade elevation. The letters C and F, standing for cut and fill, are generally used.

Fig. 3-13.

When laying out sloping building plots or "carrying" a benchmark (an officially established elevation) to the building site, it will likely be necessary to set up the instrument in several locations. Fig. 3-14 shows how reading from two positions is used to calculate or establish grade levels.
Fig. 3-14. When there is a great amount of slope or long distances are involved, the instrument will need to be set up at two or more locations.
STUDENT'S INSTRUCTIONS FOR THIS PACKET.

Name__________________________________________
School__________________________________________
Your Grade_____________________________________
Your Age Today_______________________________
Your Sex_______________________________________
Your Class Period_______________________________
Your Father's Occupation_________________________
Your Mother's Occupation_________________________
Do You Have A Part Time Job? Yes _____ No _____
   If Yes, What Do You Do_______________________
Is This Your First Class In Construction? Yes _____ No _____
   If No, How Many Semesters ________ (including this semester)

DID YOU FILL IN ALL THE BLANKS ABOVE? IF NOT PLEASE DO IT NOW!

On the next page(s) you will be asked to read a passage about LEVELING INSTRUMENTS. Read the material very carefully. When you have finished reading, turn in this packet to your teacher. Your teacher will then give you another packet to read. You may start.
Unit 3
LEVELING INSTRUMENTS
(used to find the differences in height of land)

In building construction it is important that footings (BASE OR BOTTOM OF A FOUNDATION) and foundation walls (SUPPORTING PORTION OF A STRUCTURE BELOW AND/OR ABOVE THE GROUND LEVEL) be level, square, and the correct size.

For small structures, the carpenters' level, framing square, and rule can be used to lay out (TO ARRANGE ACCORDING TO PLAN; PLACE IN ORDER) and check the foundation work. As the size increases in residential construction (FAMILY HOMES) and in commercial buildings (USED BY BUSINESSES) and institutional buildings (SCHOOLS, CHURCHES), special leveling instruments must be used if accuracy and efficiency are to be maintained.

Leveling Instruments

The level and level-transit are commonly used in laying out and checking construction work. These instruments can also be used for surveying (TO DETERMINE BOUNDARIES) and other space and land-layout (ARRANGEMENT OF LAND ACCORDING TO PLAN) jobs. When the job is too large for the chalk line (A MARK OR LINE MADE WITH CHALK ON A STRING), straightedge, level, and square; leveling instruments should be used. The instruments include an optical device (DESIGNED TO ASSIST SIGHT) which operates on the basic principle that a LINE OF SIGHT is a straight line that neither dips, sags, or curves. Any point along a level line of sight will be the same height as any other point. In the use of
these instruments, the line of sight replaces the chalk line and straight-edge.

The builders' level (also called a dumpy level; dumpy for short in size) is shown in Fig. 3-1. It consists of an accurate spirit (THE LIQUID SOLUTION, WITH BUBBLE) level and telescope assembly that is attached to a circular base. Leveling screws are used to adjust the base after it has been mounted on the tripod (THREE-LEGGED STAND). The telescope can be rotated on the base and any angle in a horizontal plane (STRAIGHT ACROSS) can be laid out or measured.

![Fig. 3-1. Builders' level which is used to sight level lines and lay out or measure horizontal angles. (David White Instruments, Div. of Realist, Inc.)](image)

The level-transit, Fig. 3-2, works like the builders' level with an additional feature that permits the telescope to be pivoted up and down in a vertical plane. This makes it possible to accurately measure vertical angles or to determine if a wall is perfectly plumb.
(VERTICAL; UP AND DOWN). The vertical movement simplifies the operation of aligning a row of stakes, especially when they vary in height.

In use, both the builders' level and level-transit are mounted on tripods, Fig. 3-3. Some models, like the one shown, have adjustable legs that make it easier to set them up on sloping ground (TO SLANT UPWARD OR DOWNWARD). This feature also permits the legs to be retracted (TO DRAW BACK) for handling and storing.
When it is necessary to sight (AIM OR OBSERVE) over long distances, a leveling rod (A POLE OR STICK WITH A MOVABLE MARKER, TARGET) is used. See Fig. 3-4. It is designed so that differences in the
elevation (TO RAISE; HEIGHT) between the position of the level and various positions where the rod is held can be easily read. The rod is especially useful for surveying work (TO DETERMINE BOUNDARIES). Readings (INFORMATION INDICATED BY A GAUGE OR SCALE) can be made by the person operating the level (THE LEVELMAN), or the target (ON THE LEVELING ROD, OR STICK) can be adjusted up and down to the line of sight and the rodman (MAN HOLDING THE ROD) can make the reading. The rod shown has graduations (SCALES, ORDERED MARKS) in feet and decimal parts of a foot.

When sighting short distances (100 feet or less) a regular folding rule can be held against a wood strip and read through the instruments (BUILDERS' LEVEL OR LEVEL TRANSIT). This procedure will be satisfactory for job suchs as setting grade stakes (WOOD OR METAL DRIVEN INTO THE GROUND AS A MARKER; PEG) for a footing. Always be sure to hold the strip and rule in a vertical position.

For measurements and layouts involving long distances, steel tapes (CALLED MEASURING TAPES) may be used. They are contained on winding reels such as the one shown in Fig. 3-5, and are available in

![Fig. 3-5. Measuring tape. Graduations in feet, inches and eighths. (Roundel and Essex Co.)](image-url)
lengths from 50 to 300 feet. Various types or graduations may be obtained, Fig. 3-6. The carpenter will usually select one that is graduated in feet, inches and eighths like two that are shown. Surveying requires a tape that is graduated in feet and decimal parts of a foot.

Setting Up Instrument

Set up the tripod in a firm and stable position. Make sure the points (ON EACH LEG) are well into the ground. On hard surfaces, be sure the points will not slip. Check the tripod wing nuts (THUMB NUT, A NUT WITH WING LIKE ENDS) and see that they are securely tightened. The legs should have a spread of about 3-1/2 feet and be adjusted so the tripod head appears to be level.

Lift the instrument carefully from its case by the base plate (BOTTOM). Screw it firmly onto the tripod head. On some instruments the leveling screws (ON BOTTOM OF BASE PLATE, USED TO LEVEL INSTRUMENT) may need to be turned up so the mounting screw can be threaded (SCREWED) all the way into the tripod head. If the instrument is to be located over an exact point, this should be done before the final leveling.
Leveling is a very important operation in preparing the instrument for use. None of the readings taken or levels sighted will be accurate unless the instrument is level throughout the work.

First, release the horizontal clamp screw and turn the telescope so it is directly over a pair of the leveling screws. Grasp the screws between the thumb and forefinger as shown in Fig. 3-7. Turn both screws uniformly with your thumbs moving toward each other or away from each other. Center the bubble of the spirit level carefully between the graduations. You will find on most instruments the BUBBLE WILL TRAVEL IN THE DIRECTION THAT YOUR LEFT THUMB MOVES. See Fig. 3-8. Leveling screws should bear (REST) firmly on the base plate. Never tighten the screws so much they will bind (JAM; TOO TIGHT).

Fig. 3-8. The bubble of the spirit level moves in the same direction as the left thumb.
When the bubble is centered, turn the telescope 90 deg. so it is over the other set of leveling screws and repeat the operation. Now check and recheck the instrument over each pair of screws. When the instrument is level, it will be possible to turn the telescope in a complete circle without any change in the bubble.

Sighting

The telescope will magnify or enlarge the image (object sighted). Most builders' levels have a telescope with a power of about 20X which means that the object will appear to be only one-twentieth of its actual distance. First, line up the telescope by sighting along the barrel and then look into the eyepiece, Fig. 3-9, and adjust the focusing knob until the image is clear and sharp. When the cross hairs are in approximate position on the object, Fig. 3-10, tighten the horizontal-motion clamp and make the final alignment by turning the tangent screw.
Finding the difference in the grade level between several points or transferring the same level from one point to another is called leveling. With the instrument level, the line of sight will be level and the readings (INFORMATION INDICATED BY A GAUGE OR SCALE) shown in Fig. 3-11 can be used to calculate the difference in elevation. When there is a great amount of slope (IN THE LAND), the instrument can be set up between the points. The reading is taken with the rod in one position and then the instrument is carefully rotated to secure (MAKE, DETERMINE) the reading at a second position.
Leveling Instruments

Using a level-transit to plumb (make vertical) a column in a steel frame structure. The horizontal clamp screw is locked and the telescope rotated in a vertical axe. Also see Fig. 3-19. (David White Instruments, Dir. of Realist, Inc.)

Builder adjusts focusing knob on a level-transit. The telescope has a power of 24X. At a distance of 100 ft. it provides a field of view of 3 3/4 ft. (100 m/2.3 m). Total weight of the instrument, less tripod, is 9 3/6 lb. (4.4 kg). (David White Instruments, Dir. of Realist, Inc.)

NOTE: When sighting through a telescope, keep both eyes open. This eliminates squinting, provides the best view and reduces eye strain.
When setting grade stakes (WOOD OR METAL DRIVEN INTO THE GROUND AS A MARKER; PEG) for a footing or erecting batter boards (FRAMEWORK USED IN LOCATING CORNERS WHEN LAYING OUT A FOUNDATION), the instruments should be set in a central location as shown in Fig. 3-12. The distance will be about equal and it will reduce the need for changing focus on each corner. An elevation established at one corner can be quickly transferred to other corners or points in between.

Grade stakes (MARKERS) for footings (BASE OF FOUNDATION) are usually set to the approximate level by "eye" judgement. They are then carefully checked with the rod and level as they are driven deeper until the top of each stake is at the required elevation. Sometimes reference lines (A MARK OR LINE USED TO POINT OUT A CERTAIN LOCATION) are drawn on construction members or stakes near the work and then transferred to the forms (SUPPORTING FRAME TO SET CONCRETE) with a carpenters' level and rule.

There may be situations where the existing grade (SHAPE OF LAND) will not permit the setting of a stake or reference mark at the actual level of the required grade (FINISHED SHAPE OF THE LAND). In such cases a mark is made on the stake with the notation of its position in
relation to the required grade elevation. The letters C and F, standing for cut and fill, are generally used, Fig. 3-13 (LAND TOO HIGH OR TOO LOW).

When laying out (TO ORDER) sloping building plots (A MEASURED PIECE OF LAND) or "carrying" a benchmark (AN OFFICIALLY ESTABLISHED ELEVATION) to the building site, it will likely be necessary to set up the instrument in several locations. Fig. 3-14 shows how reading from two positions is used to calculate or establish grade levels (CUT AND/OR FILL LAND FOR REQUIRED SHAPE).
APPENDIX B
The Cloze Test
NAME __________________________

STUDENT'S INSTRUCTIONS FOR THIS PACKET.

In this packet is another reading passage for you to read. It is the same material as you read before. As you read you will notice that some words have been left out. In place of these words you will find a blank space. You are to try and guess what words have been left out. For example, try and guess what words go in the following two blanks:

Dewey used scissors to ________ the paper.
This process ________ called separating.

The word "cut" was left out of the first blank and the word "is" was left out of the second. Notice the blanks are the same size. The left out word may be long or short. Use only one word in each blank. Some words will be easy to fill in while others will be hard. Don't be afraid to guess. This test will in no way affect your grade in class. Do your best to fill in every blank. You may start.
In building construction it is important that footings and foundation walls be level, square, and the correct size.

For small structures, the carpenters' level, framing square, and rule can be used to lay out and check the foundation work. As the size increases in residential construction and in commercial and institutional buildings, special leveling instruments must be used if accuracy and efficiency are to be maintained.

Leveling Instruments

The _______ and level-transit are ________ used in laying out ________ checking construction work. These ________ can also be used ________ surveying and other space ________ land-layout jobs. When ________ job is too large ________, the chalk line, straightedge, ________, and square; leveling instruments ________ be used. The instruments ________ an optical device which ________ on the basic principle ________ a LINE OF SIGHT ________ a straight line that ________ dips, sags or curves. ________ point along a level ________ of sight will be ________ same height as any ________ point.

In the use ________ these instruments, the line ________ sight replaces the chalk ________ and straightedge.

The builders' level (also called a dumpy level) is shown in Fig. 3-1. It consists of an accurate spirit level and telescope assembly that is attached to a circular base. Leveling screws are used to adjust
the base after it has been mounted on the tripod. The telescope can be rotated on the base and any angle in a horizontal plane can be laid out or measured.

The level-transit, Fig. 3-2, works like the builders' level with an additional feature that permits the telescope to be pivoted up and
down in a vertical plane. This makes it possible to accurately measure vertical angles or to determine if a wall is perfectly plumb (vertical). The vertical movement simplifies the operation of aligning a row of stakes, especially when they vary in height.

In use, both the builders' level and level-transit are mounted on tripods, Fig. 3-3. Some models, like the one shown, have adjustable legs that make it easier to set them up on sloping ground. This feature also permits the legs to be retracted for handling and storing.

Fig. 3-3. Parts of a tripod. The legs hinge at the top for carrying and storing.
When __________ is necessary to sight __________ long distances, a leveling __________ is used. See Fig. __________. It is designed so __________ differences in the elevation __________ the position of the __________ and various positions where __________ rod is held can __________ easily read. The rod __________ especially useful for surveying __________. Readings can be made __________ the person operating the __________ (the levelman), or the __________ can be adjusted up __________ down to the line __________ sight and then the __________ (man holding the rod) can make the reading. The rod shown has graduations in feet and inches. However, for regular surveying work, the graduations are usually based on the foot and decimal parts of a foot.

**Fig. 3-4. Leveling rod. Consists of two sections that can be extended to a height of 12 feet.**

When sighting short distances (100 feet or less) a regular folding rule can be held against a wood strip and read through the instrument. This procedure will be satisfactory for jobs such as setting
grade stakes for a footing. Always be sure to hold the strip and rule in a vertical position.

For measurements and layouts involving long distances, steel tapes (called measuring tapes) may be used. They are contained on winding reels such as the one shown in Fig. 3-5, and are available in lengths from 50 to 300 feet. Various types or graduations may be obtained, Fig. 3-6. The carpenter will usually select one that is graduated in feet, inches and eighths like two that are shown. Surveying requires a tape that is graduated in feet and decimal parts of a foot.
Setting Up Instrument

Set the tripod in a and stable position. Make the points are well the ground. On hard, be sure the points not slip. Check the wing nuts and see they are securely tightened. legs should have a of about 3-1/2 feet be adjusted so the tripod head appears to be level.

Lift the instrument carefully from its case by the base plate. Screw it firmly onto the tripod head. On some instruments the leveling screws may need to be turned up so the mounting screw can be threaded all the way into the tripod head. If the instrument is to be located over an exact point, this should be done before the final leveling.

Leveling is a very important operation in preparing the instrument for use. None of the readings taken or levels sighted will be accurate unless the instrument is level throughout the work. First, release the horizontal clamp screw and turn the telescope so it is directly over a pair of the leveling screws. Grasp the screws between the thumb and forefinger as shown in Fig. 3-7. Turn both screws

Fig. 3-7. Adjusting the leveling screws.
uniformly with your thumbs moving toward each other or away from each other. Center the bubble of the spirit level carefully between the graduations. You will find that on most instruments the BUBBLE WILL TRAVEL IN THE DIRECTION THAT YOUR LEFT THUMB MOVES. See Fig. 3-8. Leveling screws should bear firmly on the base plate. Never tighten the screws so much they will bind.

Fig. 3-8. The bubble of the spirit level moves in the same direction as the left thumb.

When the bubble is centered, turn the telescope 90 deg. so it is over the other set of leveling screws and repeat the operation. Now check and recheck the instrument over each pair of screws. When the instrument is level, it will be possible to turn the telescope in a complete circle without any change in the bubble.

Sighting

The telescope will magnify or enlarge the image (object sighted). Most builders' levels have a telescope with a power of about 20X which means that the object will appear to be only one-twentieth of its actual distance. First, line up the telescope by sighting along the barrel and then look into the eyepiece, Fig. 3-9, and adjust the focusing
knob until the image is clear and sharp. When the cross hairs are in approximate position on the object, Fig. 3-10, tighten the horizontal-motion clamp and make the final alignment by turning the tangent screw.

Leveling

Finding the difference in the grade level between several points or transferring the same level from one point to another is called leveling. With the instrument level, the line of sight will be level and the readings shown in Fig. 3-11 can be used to calculate the difference in elevation. When there is a great amount of slope, the instrument can be set up between the points. The reading is taken with
Leveling Instruments

Using a level-transit to plumb (make vertical) a column in a steel frame structure. The horizontal clamp screw is locked and the telescope rotated in a vertical arc. Also see Fig. 3-19. (David White Instruments, Div. of Reelist, Inc.)

Builder adjusts focusing knob on a level-transit. The telescope has a power of 26X. At a distance of 100 ft, it provides a field of view of 3 3/4 ft. (100 m/7.7 m). Total weight of the instrument, less tripod, is 9 3/4 lb. (4.4 kg). (David White Instruments, Div. of Reelist, Inc.)

NOTE: When sighting through a telescope, keep both eyes open. This eliminates squinting, provides the best view and reduces eye strain.
the rod in one position and then the instrument is carefully rotated to secure the reading at a second position.

When setting grade stakes for a footing or erecting batter boards, the instrument should be set in a central location as shown in Fig. 3-12.

The distances will be about equal and it will reduce the need for changing focus on each corner. An elevation established at one corner can be quickly transferred to other corners or points in between.

Grade stakes for footings are usually set to the approximate level by "eye" judgment. They are then carefully checked with the rod and level as they are driven deeper until the top of each stake is at
the required elevation. Sometimes reference lines are drawn on construction members or stakes near the work and then transferred to the forms with a carpenters' level and rule.

There may be situations where the existing grade will not permit the setting of a stake or reference mark at the actual level of the required grade. In such cases a mark is made on the stake with the added notation of its position in relation to the required grade elevation. The letters C and F, standing for cut and fill, are generally used, Fig. 3-13.

When laying out sloping building plots or "carrying" a benchmark (an officially established elevation) to the building site, it will likely be necessary to set up the instrument in several locations. Fig. 3-14 shows how reading from two positions is used to calculate or establish grade levels.
Fig. 3-14. When there is a great amount of slope or long distances are involved, the instrument will need to be set up at two or more locations.
APPENDIX C

Letter to the Deputy Superintendent
August 28, 1980

Mr. Robert Williams
Deputy Superintendent
Bibb County School System
P.O. Box 6157
Macon, Georgia 31213

Dear Mr. Williams:

I am a graduate student at The Ohio State University in Columbus, Ohio, working toward the degree Doctor of Philosophy in Vocational-Technical Education. As part of the degree requirements, I will need to conduct a research study related to vocational education.

I would like to conduct this research study in the Bibb County School System using vocational education construction students enrolled at the secondary level. The use of first and second year vocational education construction students will be required for this study.

Briefly, the study is described below:

A. This study is a reading evaluation.

B. First and second year students enrolled in vocational education programs will be required for this study.

C. Each student will be administered a national standard reading test to determine student reading ability level. This test will take about one hour to administer.

D. Each student will be administered a second test constructed by me to test if increased comprehension can be obtained through the manipulation of technical terms within a reading passage. This test will take about one hour to administer.

E. Confidentiality of the data will be insured by assigning case numbers to the test data once the data have been matched.

F. Participation in this study will be strictly voluntary. A parent/student consent form will be provided and collected from each student.

College of Education
G. So as not to disturb the normal school activities too much the teachers of the various classes of vocational education construction will be asked to administer the two tests in the classrooms. The teachers will be fully briefed by me before any testing begins.

H. I would like to test the students in early October, 1980.

Two copies of the prospectus (that fully describe this proposed study) are enclosed. If there are additional questions concerning this study, please feel free to call me at 1-800-848-4815 anytime Monday through Friday from 9:00 A.M. to 4:00 P.M..

Thank you for your attention to this matter and for your assistance in this study.

Sincerely,

John E. Jordan, III
Doctoral Candidate

Authorized by:

Dr. Dewey A. Adams, Chairperson
Student's Graduate Committee

Enclosures:
APPENDIX D

Letter from the Deputy Superintendent
Bibb County Public Schools

CENTRAL ADMINISTRATIVE OFFICES
September 9, 1980

Mr. John Jordan, III
1781 Willowy Circle North
Columbus, Georgia 43220

Dear Mr. Jordan:

This is in reply to your letter dated August 28, 1980 requesting permission to conduct a research study of our system's first and second year construction cluster students. My understanding is that this request is in connection with degree requirements of a program of study in which you are enrolled at the Ohio State University.

We are most happy and eager to accommodate you. I have caused the appropriate building principals and vocational staff to be contacted relative to your request. They have given their permission and expressed a willingness to assist you in any way necessary. Mr. Aaron Cook will make the necessary arrangements relative to the specific dates and time you wish to conduct your study. Please contact Mr. Cook directly at the address and/or telephone number of our central office.

There are presently one hundred and five (105) students enrolled in our construction cluster. Ninety-three (93) are first year students and twelve are second year students. They are enrolled in grade levels ten through twelve. We are in position to provide you a more detailed breakdown of this population upon request.

If I can be of further assistance, please do not hesitate to contact me.

Very truly yours,

Robert J. Williams
Deputy Superintendent

RJW/AC/bc
CC: Dr. W. C. Whitley
    Mr. E. O. McDowell
    Mr. Melton Palmer
    Mr. Aaron Cook

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