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ABSTRACT

A study examined the retention of mathematical and reading comprehension skills for students enrolled in a learning-in-work environment (experience-based career education) and a traditional classroom learning environment. Academic achievement was measured using a twelve-month longitudinal design. Student performance in each environment was evaluated on the Comprehensive Test of Basic Skills administered at beginning and end of the junior year and beginning of the senior year. The learning interval was designated as the time between pre- and post-testing, and the retention interval as the time between post- and follow-up testing. The results indicated (1) differences in two areas--in reading skills versus math skills and in traditional learning environments versus learning-in-work environments; (2) math congnitive concepts causally related but not in the hierarchical order predicted by Bloom's taxonomy; (3) different causal processes in the acquisition of math concepts, depending upon placement in one of the two learning environments; (4) significant relationships between students' cognitive style and their math performance; and (5) moderate relationships between students' perceptions of complexity of learning environment and their math performance. An interference/assimilation model was proposed to interpret findings. (Technical information and appendixes are available as CE 027 943.) (YLB)

ED198293

LEARNING AND RETENTION

OF BASIC SKILLS

THROUGH WORK

Preliminary Investigation of the
Learning and Retention of Selected Reading
and Mathematical Concepts Resulting from
Student Enrollment in a Traditional Learning Environment
and in a Learning-in-Work Environment

Summary and Discussion

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FOREWORD

Learning-in-work is an integral part of Experienced-Based Career Education Programs, internships, cooperative and work-experience programs, and on-the-job components of vocational education. Since the early 1970s, there has been a movement in education to expand the education opportunities of all students to include "real world" learning experiences as part of the total educational experience. In an attempt to investigate the relationships of learning and work, the National Center for Research in Vocational Education has initiated a programmatic effort to conduct basic research of the phenomena. This study, supported by the National Institute of Education, reports the findings of a two-year exploratory examination of student retention of mathematical and reading skills resulting from student enrollment in a learning-in-work and in a traditional learning environment.

Suggestions for extending the first year's results were provided by David P. Ausubel, Distinguished Professor Emeritus, Ph.D. Program in Educational Psychology, Graduate School, City University of New York; Henry C. Ellis, Chairman, Department of Psychology, University of New Mexico; and Benton J. Underwood, Stanley G. Harris Professor of Social Science, Northwestern University. These scholars were commissioned to provide a perspective for investigating the psychological and pedagogical implications of learning and forgetting patterns in learning-in-work and traditional environments through extensions of their research and learning theories. While their suggestions are incorporated in the executive summary, their complete papers appear in the technical report.

Appreciation is extended to the Anoka-Hennepin School District No. 11, Anoka, Minnesota, for their cooperation and participation in the study. Don Anderson, Director of the Experience-Based Career Educaction Program, and Roger Giroux, Director of Research and Evaluation, were instrumental in providing support for the research staff in their investigation.

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in Vocational Education

ABSTRACT

The study examined the retention of mathematical and reading comprehension skills for students enrolled in a learning-in-work environment (Experience-Based Career Education) and a traditional classroom learning environment on a measure of academic achievement in a twelve-month longitudinal design. Student performance (n=27) in each environment was evaluated, using the Comprehensive Tests of Basic Skills, which was administered at the beginning and end of their junior year and at the beginning of their senior year. Thus, the learning interval was designated as the time between pre- and post-testing, and the retention interval, the time between post- and follow-up testing. The results indicated: (1) that students demonstrated significantly different learning/retention functions for math skills depending upon participation in one of the two learning environments: the learning and retention patterns of the students in the traditional learning environment conformed to the predictions from previous research--demonstrating increased performance during the instructional or learning interval and decreased performance during the summer break or retention interval, while the patterns of students in the learning-in-work environment deviated from predicted patterns--demonstrating decreased performance during the learning interval and increased performance during the retention interval; (2) that students in both learning environments demonstrated generally equivalent performance patterns for reading comprehension skills that increased linearly over both the learning and retention intervals; (3) that math cognitive concepts were causally related: for the traditional learning students, the causally-learned concepts did partially support the hierarchical order theorized by Bloom's taxonomy, while for the learning-in-work students, the causally-learned concepts did not support the hierarchical order theorized by Bloom's taxonomy; (4) that students who demonstrated greater cognitive complexity performed significantly higher on their acquisition of math skills; and (5) that students who perceived greater complexity in their learning environment generally performed lower on their acquisition of math skills. An interference/assimilation model was proposed to interpret the findings.

INTRODUCTION

This executive summary is a digest of information resulting from a preliminary two-year effort to investigate the patterns of learning and retention of basic skills in learning-in-work and traditional learning environments. In the spirit of a digest, salient points from the two technical reports (Crowe and Harvey 1979, 1980) are highlighted and discussed. The primary purpose is to communicate the findings, provide interpretations, and set forth a research agenda and recommendations in such a way that practitioners, decisionmakers, and policy analysts can use the information as a basis for designing, operating, and evaluating learning-in-work programs. Such topics as sampling and design considerations, instrument development and validation, analytical strategies, and statistical manipulations are briefly overviewed. For a thorough treatment of these topics, readers are referred to the technical reports.

Historically, learning-in-work programs have been a part of the tradition of alternative educational opportunities provided for young people. Our use of the phrase, however, refers to the more recently developed systems such as Experience-Based Career Education, Executive High School Internships Programs, and Career Intern Programs that were initially designed to meet the increasing demands for more relevant education and for career education. A common component of these programs is that youth learn experientially in work environments under the guidance of mentors from the work organization and the supervision of school personnel. Parenthetically, it is our view that, consciously or not, educators realized that the environment encountered after schooling was becoming more complex, while learning in the classroom environment was continuing to stress the invariant knowledge, rules, and processes for dealing with known and recurring problems. Since this mis-match was not compatible with the increased complexity required for problem solving and productivity in sophisticated technological work environments, more attention was directed to learning environments that would provide transitive contexts for youth entering the workplace.

Current legislative considerations for the youth initiatives emphasize employability development and programs designed to assist youth in acquiring employability competencies, not the least of which is a mastery of basic skills. Furthermore, not only do existing or proposed employability development programs include an experiential learning component in the workplace, but they also assume that learning can occur experientially, learning that is more productive than traditional classroom learning. While this position is appealing, it is a fact that experiential learning can also be accomplished within the classroom. Thus, when the underlying dimensions of learning-in-work environments were investigated, the following questions emerged. To what extent does learning experientially in a work environment enhance or suppress learning employability skills? More specifically, as related to this study, what are the patterns of learning and retention of the basic skills of mathematics and reading comprehension learned experientially in a work environment and learned traditionally in a classroom? Are the cognitive processing functions of learning and retention different for the two environments?

This investigation, which is only exploratory, is an initial effort to fill the gap between what is known from basic research (in laboratory settings with experimental designs) regarding cognitive processing and basic skill development and what is observed in naturalistic settings regarding the learning and retention of basic skills. Overall, it is designed as an heuristic study in that its purpose is to generate ideas, to encourage further inquiry of this type, and to open up new lines of investigation.

In the light of this overall purpose, the remainder of the executive summary is organized as follows:

- <u>The Problem</u>

  The line of inquiry and the heuristic model used for investigating student cognitive processes, and the research questions are discussed.

- <u>Methodological Considerations</u>

  The methodology is briefly described, including the research design, the instruments, and the data base.

- <u>Results</u>

  The findings related to the research questions are presented and briefly discussed.

- <u>Interpretation</u>

  The results are anchored to the theories of learning and retention.

- <u>Discussion and Recommendations</u>

  The research findings and interpretations are discussed and related to implications for continuing this line of inquiry.

THE PROBLEM

Overview

The growth of learning-in-work programs expands student learning opportunities to include workplace environments, and provides young people the option of choosing one learning environment over another (Crowe and Adams 1979). Allowing such a choice stems from a supposition that students in learning-in-work environments learn traditional subject-matter concepts as well as or better than those in the traditional classroom environment. Proponents of this theory believe that students in the learning-in-work environments are exploring real problems in the workplace that relate to subject matter disciplines, are learning under the guidance of a mentor who solves work-related problems, are having experiences that pair subject matter concepts and specific work tasks, are learning concepts in a concrete, "hands-on" manner, and presumably are forming cognitive structures for storing and retrieving concepts similar to those of the mentor at the workplace. This study is an initial investigation of these assumptions. Before proceeding with the theoretical considerations, a description of the learning-in-work program is provided.

Learning-in-Work Program Description

Briefly, the Experience-Based Career Education (EBCE) model is an academically oriented, community-based program. Students spend one day per week at the learning center with a learning coordinator, who supervises and directs their learning activities, and spend four days at a community worksite under the guidance and supervision of a resource person, the worksite mentor. They work at three to twelve sites per school year, depending on their career interests and academic needs. The program offers twenty-eight EBCE courses that are all related to traditional subject-matter disciplines. Students choose EBCE courses according to their assessment of (1) career interests and aptitudes (e.g., EBCE courses and occupations are related through the Dictionary of Occupational Titles worker trait groups) and (2) academic needs and interests (e.g., EBCE courses and traditional subject-matter concepts are related through an instructional matrix that sets the parameters for designing the learning activities).

Under the EBCE model, academic development is accomplished through the use of an activity sheet designed to guide students through a series of learning activities that relate subject-matter concepts and career objectives to experiences at the worksite. The activity sheets detail student tasks, estimate the time required to complete the activity, and furnish the basis for measuring progress. Students may be completing up to five or six activity sheets at any given time. Since activity-sheet assignments are expected to be completed at the worksite, there are no homework expectations for the students. After concluding work as outlined on the activity sheet, the students and coordinators (on a one-to-one basis) jointly evaluate the assignments. Students are given the opportunity to do additional work if they desire a better evaluation.

Research Related to Learning and Retention of Basic Skills in Alternative Learning Environments

The EBCE approach would seem to offer the benefits of frequent, meaningful, and prompt feedback on task performance for students. Research in academic learning and retention (Ausubel 1968, Boker 1974, La Porte and Voss 1975) would predict increased performance as a function of the above variables. Ausubel (1968) reported increased learning and retention of meaningful material as contrasted with rote-memorized material. Anderson and Biddle (1975) and Boker (1974) found a strong relationship between increased application (practice) of material and subsequent retention. Similarly, La Porte and Voss (1975) demonstrated superior retention as a result of usage of the information and response-contingent performance feedback.

While these factors are present to varying degrees within a classroom environment, we believe that the EBCE environment offers structurally-guided opportunities to encounter situations that emphasize these variables. For example, EBCE students complete tasks related to subject-matter concepts and complete them within the context of the workplace. They work with adults negotiating their work assignments and are required to meet the expectations of the learning coordinator, resource person, and coworkers employed by the organization. For us, these types of activities would seem to expand the number and variety of learning opportunities related to the above variables that learning-in-work students receive.

As stated, we believe that the learning environment an individual chooses (EBCE vs. traditional classroom instruction approach) is important with respect to its effect on academic learning and retention; however, research has indicated that person-related variables such as cognitive style interact with the environment, suggesting that the difference in environment alone cannot account for all differences in learning and retention. Davey (1976) concluded that the students' cognitive style, defined as stable preferences in individuals with respect to conceptual categorization and perceptual organization of the external environment, was a critical factor in maximizing performance. Hunt (1975) argued for future research directed at identifying the interactive nature of the personal and environmental characteristics of behavior. Cronbach and Snow (1977), maintaining that the traditional method of classroom instruction was not optimal for all students, advocated consideration of the interaction of instructional methods with individual characteristics. Schroder, Driver, and Steurfert (1967) found that more complex persons were less influenced by the environment than less complex persons. In the same vein, Staszkiewicy (1977) indicated more cognitively complex students scored higher than less complex students in situations characterized by less teacher direction. Consequently, a closer examination of the interaction between person variables (cognitive style) with learning environment (EBCE vs. traditional classroom instruction) in the present investigation seeks to examine the contributions of each with respect to academic learning and retention.

Orientation to Investigating Learning and Retention of Basic Skills in the Two Environments

Since past research using only a pre-test/post-test control group design has detected few statistical differences in students' achievements (Crowe and Adams 1979; Crowe and Walker 1977), it was of interest in the present investigation to test the assumption that demonstrable changes in student performance may occur sometime after students leave the program. Thus, a retention model design was proposed using repeated measures with the learning interval being the time students participated in the learning environment (nine months) and the retention interval, the summer recess (three months). In view of previous research on environmental contingencies as determinants of learning and retention (see Gagne 1978, for a review), it was predicted that students' exposure to different types of learning environments would affect performance on standardized tests of academic ability. The study examines performance in two learning environments longitudinally in order to detect changes in the retention of academic performance resulting from participation in one of the two environments during the learning interval.

Studying work and its effect on individuals and their performance is in itself a complex phenomenon. However, it becomes even more complex when students are expected to learn subject matter at the same time that they are assimilating the working role. Therefore, in order to study the processes underlying learning in a work environment, it becomes necessary to understand the student as both learner and worker, the dynamics of the environment, and the interaction of the student within the context of the work setting.

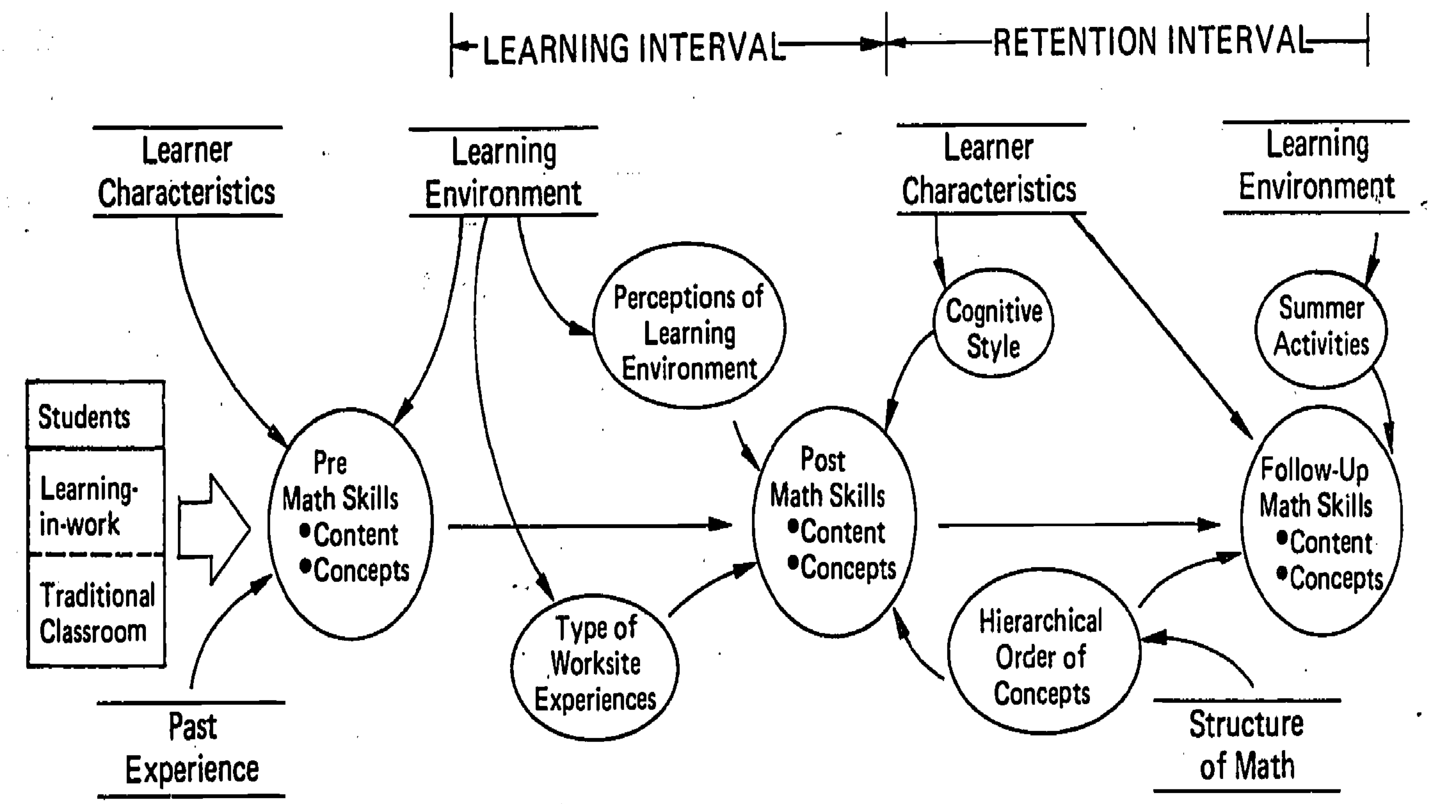
The environment in which subject matter is learned may shape the way students perceive the meaningfulness of the content and concepts associated with the discipline and therefore what they learn and remember. For example, it would seem to us that learning math in academically oriented classrooms has as its purpose the attainment of a level of proficiency to be manifested in students' ability to perform on teacher-made or standardized achievement tests. On the other hand, it may be that the purpose of learning math in a work setting is to help students become functionally competent and able to use subject matter in applying it to real-life situations. This would seem to imply that students in the workplace actively structure their subject matter to meet the requirements of doing work, while students in a traditional classroom, for the most part in a passive role, receive the subject matter as contained in textbooks and as presented by teachers trained in that discipline. Thus, the learning-in-work students may pick and choose subject matter content in a way that will enable them to perform work related to the goals of the worksite.

Studying the complexity of students' acquisition of subject matter in order that they may become functionally competent should include not only what is learned, but also the additional variables of what is retained and what content and concepts transfer from the classroom to the practical and productive performance of meaningful work. As a guide to the investigation of the learning and retention of basic skills acquired in the workplace, a heuristic model was developed. The purpose of this model was to synthesize the complexity of the problem, thereby enabling us to conceptualize the variables, to ask questions, and to permit the emergence of patterns of cognitive processes and possible causal relationships underlying student learning in a work environment.

The model, although neither complete nor comprehensive, realistically portrays the sequential nature of learning events and the availability of data within the pre-established conditions of the study. Although the model uses a notation borrowed from path-analytic literature, the nature of the data obtained for this study (e.g., small sample size, nonrandom assignment of students) precludes using techniques such as analysis of covariance or estimation of path coefficients. Nevertheless, the model, which follows, provides the logical foundation for the nature and type of research questions addressed in this study.

FIGURE 1

Heuristic Model for Investigating Student Cognitive Processes in Learning Environments



Key:

- possible causal relationships
- measured variables
- unmeasured variables
- student preselection of environments

Independent (Predictor) Variables
- Learning-in-work
- Traditional Learning Students

Dependent Variables
- Math Skills
- Reading Comprehension Skills

Explanatory Variables
- Hierarchical order of concepts
- Learning Environment (perception)
- Worksite Experience (type)
- Summer Activities
- Cognitive Style

Research Questions

The purpose was to determine the learning and retention patterns of math and reading skills for students in each learning environment and to investigate the moderating effects of explanatory variables on those observed patterns. In light of this overall purpose, the following questions were investigated.

- RETENTION OF BASIC SKILLS

  What is the retention pattern of subject matter associated with mathematical skills and reading comprehension skills acquired in learning-in-work and traditional learning environments?

- MODERATING RELATIONSHIPS

  Function of Learning Concepts Hierarchically (Bloom's Taxonomy)

  Did participation in either the learning-in-work or in the traditional learning environment correspond to an hierarchical achievement of cognitive concepts as theorized by Bloom's taxonomy and as measured by the achievement test?

  Function of Learning Environment (Environmental Complexity)

  To what extent did students perceive complexity in their learning environment and to what extent did these perceptions contribute to math performance?

  Effect of Type of Worksite Experiences

  Did learning-in-work students participation in worksite experiences as classified by the Worker Trait Group (from the Dictionary of Occupational Titles) contribute to math achievement?

  Effect of Summer Activity

  Did summer experiences of school or work contribute to math achievement at follow-up testing?

  Effect of Cognitive Style

  Did students' cognitive style contribute to math achievement?

METHODOLOGICAL CONSIDERATIONS

To provide technical information that meets the various needs of the readers, two charts summarize the methodology of the study. Readers with varying purposes may choose to read thoroughly or to skim those parts of interest to them. Figure 2 summarizes the conditions for the study including the design and student characteristics. Figure 3 displays the measures with their corresponding descriptions. The descriptions of the measures are organized to correspond with the variables listed in figure 1 (i.e., independent, dependent, and explanatory).

FIGURE 2

Methodological Conditions for Conducting the Study

DESIGN

The design for this investigation is probably best described as quasi-experimental, since the students were not randomly assigned to participate in the EBCE program. Pictorially, the design is depicted below:

Group	Events
Learning-in-Work	0_1 X_1 0_2 X_3 0_3
Traditional Learning	0_1 X_2 0_2 X_3 0_3

The design is a repeated-measures one where the nature of the treatments and observations is defined as follows:

Treatment

- X_1 Learning-in-Work Environment
- X_2 Traditional Learning Environment
- X_3 Summer Recess

Observation

- 0_1 Pre-test - September 1978 (comparability of groups)
- 0_2 Post-test - May 1979 (concepts achieved)
- 0_3 Follow-up test - September 1979 (concepts retained)
- $0_2 - 0_1$ 9 months (learning interval)
- $0_3 - 0_2$ 3 months (retention interval)

SUBJECTS

Juniors from a suburban school district in Minnesota were selected to participate in the study. This district was chosen by virtue of having both a traditional learning environment (classroom instruction) and learning-in-work environment (EBCE program) in operation. Twenty-seven students who volunteered for the EBCE program were successfully followed over the observation period. Eleven students in the original EBCE sample of thirty-eight were dropped due to missing data at one or more of the subsequent testings. Control students in a traditional environment were selected at random from a pool of students to match the EBCE students on sex, school membership, and GPA. Twenty-seven control students were successfully followed over the observation period, while fifteen students were lost due to missing test data.

PROCEDURES

The Comprehensive Tests of Basic Skills (CTBS) were group administered on three occasions to students from both programs who were assembled at their home schools for testing which proceeded according to CTBS guidelines. Therefore, testing conditions and times were identical for both groups of students for each home high school. Additionally, a Learning Environment Questionnaire (LEQ) and the Paragraph Completion Test (PCT) were administered at the post-testing and interview data was gathered the week prior to the post-testing. A make-up session, following the above procedure, was held for each observation to ensure maximum number of respondents. Testing time required about an hour.

GENERALIZABILITY

The fact that random assignment was not used to place students in the learning-in-work program places limitations on the extent to which generalizations of the observed results of the EBCE program can be made to other samples populations of students who would participate in an EBCE program. Because the students were "self-selected" for membership in the learning-in-work program, we do not know the extent to which they are atypical of the "average" high school students. Overall, it would not be prudent to state that our obtained observations can be expected for a group randomly assigned to the program. Essentially, for the learning-in-work group, we can only describe the way things were for our sample but not predict for a larger population with any substantial degree of confidence.

FIGURE 3

Description of the Measures

INDEPENDENT (PREDICTOR) VARIABLES

- **Student Participation**
  Students who participated in the EBCE program were designated as those in the learning-in-work environment, while students who participated in classroom instruction were designated as those in the traditional learning environment.

DEPENDENT VARIABLES

- **Comprehensive Tests of Basic Skills (CTBS)**
  The CTBS Expanded Edition, Level 4, Form S was used at all testings. Of the total test battery, Test 2 (Reading Comprehension) and Test 7 (Mathematics Concepts and Applications) were selected for administration due to constraints on testing. According to the *Test Coordinator's Handbook* (1976, p. 5), the CTBS is described as a measuring instrument thus:

> Measurement of the basic skills and abilities cannot be divorced entirely from the measurement of knowledge acquired through schooling, but it is not the intent of CTBS to measure this knowledge directly. The emphasis . . . is on measurement of the grasp of broad concepts and abstractions as developed by all curricula and on the facility in the skills that are required for effective use of language and number . . . .

Of importance to this study is the CTBS classification scheme whereby both content and process dimensions are provided. According to CTBS literature, the categories in the content dimension (e.g., measurement, sets, problem solving) vary according to the type of content considered appropriate to students of the grades for which it was intended. The categories for the process dimension follows essentially the approach presented in Bloom's *Taxonomy of Educational Objectives* in that the classification scheme is hierarchical in nature. Thus, as the level increases, more of the complex processes are used with a greater frequency. For the process dimension the categories measure knowledge of ways and means of dealing with concepts and principles as reflected in the application of rules and processes. For the two sub-tests used in this study, the content and process dimensions are as follows:

Dimension	Mathematics	Reading Comprehsnsion
	Scale Name	Scale Name
Content	1. Concepts 2. Application	1. Comprehension
Process/ Concepts	3. Recognition 4. Translation 5. Interpretation 6. Analysis	2. Recognition 3. Translation 4. Interpretation 5. Analysis

Thus, the CTBS not only measures mathematical and reading comprehension content, but also the cognitivo processes or concepts underlying learning.

EXPLANATORY VARIABLES

- **Hierarchical Order of Concepts**
  As described above, the math concepts are the process scales of the CTBS that were developed to correspond to an hierarchical order theorized in Bloom's *Taxonomy*.

(Figure 3, continued)

- **Learning Environment**
  A Learning Environment Questionnaire (LEQ), developed by project staff, was composed of thirteen items measuring the degree to which students perceived the environment as providing feedback, offering a variety of tasks, and giving direction to complete tasks. Factor analysis of the scales resulted in three identifiable factors. While the results from the LEQ are discussed later, the factors and their corresponding items are presented in figure 4.

- **Worksite Experiences**
  The worksite experiences of the Learning-in-work Students were classified by the Worker Trait Groups of the *Dictionary of Occupational Titles.*

- **Summer Activities**
  Students were asked to indicate which activities they were engaged in over the summer. Students could choose from summer school, part-time paid work, full-time paid work, or indicate other activities.

- **Cognitive Style—Paragraph Completion Test (PCT)**
  The PCT derived from the work of Schroder, Driver, and Streyfert (1967) represents an approach to the content-free measurement of cognitive style. The approach involves a projective technique of stem completion. The PCT presents the student with five stems requiring three sentences to be written for each stem. The integrative or cognitive complexity score used for this study was the mean of the four most abstract responses after each stem had been scored on a seven-point scale. An example of a stem used for this study was:
  Your friend: Rules! How do you feel about rules?
  Your answer: Rules . . . (complete the sentence and write two more).

FIGURE 4

Learning Environment Questionnaire

Learning Environment Questionnaire (LEQ)*

Factor I: Opportunity for generating concepts

4 In my program I was able to ask many questions about the work.
8 The work that I did offered me many different things to do.
10 In my program I was encouraged to come up with my own ideas.
11 (The adult)**provided me with opportunities to do meaningful work or solve problems.
13 (The adult)**encouraged me to decide for myself how I was going to do my work.
5 The results of what I did had meaning, I felt the results were important.

Factor II: Structure that permits learning with adults

3 (The adult)** taught me what I needed to know.
6 (The adults)** described the way they wanted me to do my work.
9 (The adult)** gave me the right way to do the work.
12 (The adult)** showed me what was required of me.

Factor III: Gratification for initiating and carrying out work.

1 In my program I felt encouraged to find things out for myself.
2 I was able to tell by myself if I was doing a good job.
7 In my program I had opportunities to try things out for myself.

* Responses ranged from 1-strongly disagree to 5-strongly agree.

** The learning-in-work students responded to two items, one for the program coordinator, the other for the resource person. The traditional environment students responded to a single item with the adult being the teacher.

RESULTS

This section contains a concise statement of the problem followed by a discussion of the results for each research question. As far as possible, the results are displayed or described in nontechnical ways. We have chosen this approach, in part, because the summary is derived from two technical reports that carefully detail the research hypotheses, analyses, and findings and because the primary focus is on the interpretations and recommendations which we consider exciting and provocative.

The primary purpose is to examine the retention of mathematical and reading concepts for students enrolled in a learning-in-work environment (EBCE) and a traditional classroom environment on a measure of academic achievement in a twelve-month longitudinal design. Students' performance (n=27) in each environment is evaluated using the CTBS, which was administered at the beginning and end of their junior year and at the beginning of their senior year. Thus, the learning interval is designated as the time between pre- and post-testing, and the retention interval, the time between post- and follow-up testing. The secondary purpose is to investigate the possible cognitive processes and causal patterns among environmental characteristics, personal characteristics, and performance effects that underlie student learning in one of the two learning environments.

Retention of Basic Skills

> What is the retention pattern of subject matter associated with mathematical skills and reading comprehension skills acquired in a learning-in-work and a traditional learning environment?

Since the purpose of the investigation was to identify areas for future in-depth examination of the data, repeated-measures analysis of variance techniques were used to evaluate the results of the math and reading CTBS scores. Since the sample size was relatively small, an attempt was made in all analyses to use the smallest number of variables possible to allow higher statistical power to detect effects that may have been present. Thus, analyses of CTBS math and reading scores were performed using a two (programs--learning-in-work and traditional) by three (tests--observations at T_1, T_2, and T_3) design to permit increased power in detecting effects. The dependent or response variables representing math and reading skills were those measured by the six CTBS math scales and the five CTBS reading scales.

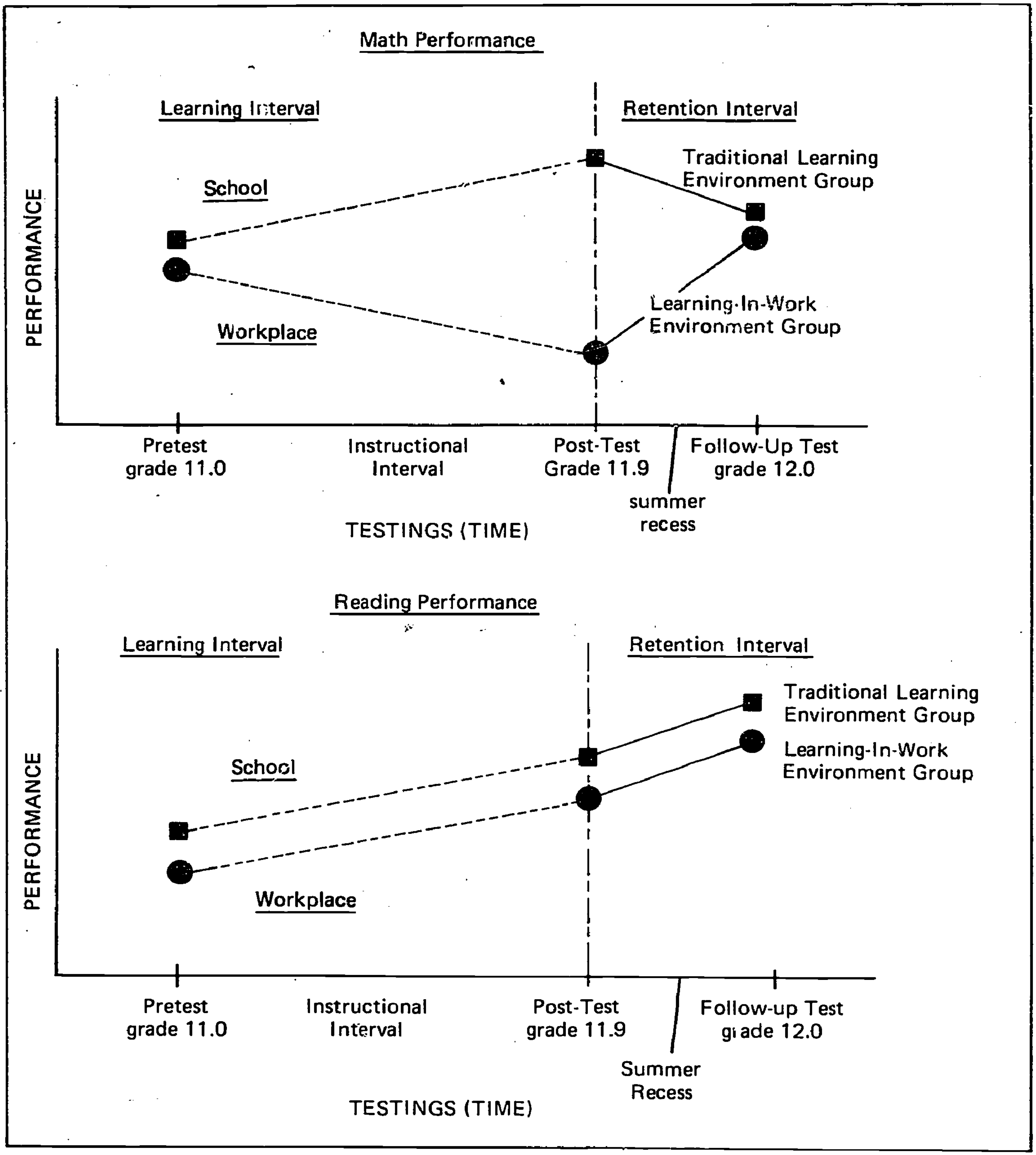
What was the effect of the two environments on standardized scholastic achievement performance? Figure 5 displays the overall composite form of the relationship across math and reading concepts.

Inspection of the math scores revealed a different pattern for the learning-in-work and traditional learning group. Three of the six math scales revealed significant interactions of the groups by tests, indicating significantly nonparallel learning/retention functions. Additionally, the two groups differed significantly at the end of the school year but were nonsignificantly different at the start of their junior year and at the start of their senior year. Thus, groups were equivalent at the point where they were split into different learning environments, but the students in the traditional learning environment increased in performance up to the end of the year, while the learning-in-work students showed a decrease in performance on the post-test. This effect was manifest in two scales at $p<.05$, while three other scales showed trends in this direction. The groups subsequently reversed this direction of change over the summer: the learning of students in the traditional learning environment decreased from post- to follow-up test, while that of the learning-in-work students increased over the summer.

Results of reading scores in general, showed both groups demonstrating equal performance that increased linearly for four reading scales over the learning interval (pretest to post-test) and over the retention interval (post-test to follow-up). Significant mean increases were seen only for two reading scales when pretest scores were compared to follow-up. The learning-in-work and traditional learning groups did not differ significantly at any observation, on any reading scale, indicating a similar level of performance on these measures.

FIGURE 5

Composite Functions for Math and Reading Skills



Moderating Relationships

Because of the unanticipated results of math performance, the following research questions focus on explaining the different math learning and retention functions for the two groups of students.

Function of Learning Concepts Hierarchically (Bloom's Taxonomy)

> Did participation in either the learning-in-work or in the traditional learning environment correspond to an hierarchical achievement of cognitive concepts (at post- or follow-up testing) as theorized by Bloom's taxonomy and as measured by CTBS?

The second area of inquiry was aimed at further exploring the unusual patterns of performance exhibited on the mathematics scales of the CTBS. As illustrated above, the patterns of learning/retention, when broken down by program, suggested that different processes were involved for the two different learning environments. Thus, did enrollment in one of the two learning environments cause students during the learning or retention intervals to learn or retain math skills hierarchically as theorized by Bloom's taxonomy and as measured by the CTBS? The CTBS process scales of Recognition (R), Translation (T), Interpretation (I), and Analysis (A) were hierarchically developed along the lines of Bloom's Taxonomy; therefore, it was hypothesized that students would learn the concepts in such a way that, for example, a mastery of the cognitive skill of Recognition at pretest would increase the students' performance in the skill of Translation at the post-test.

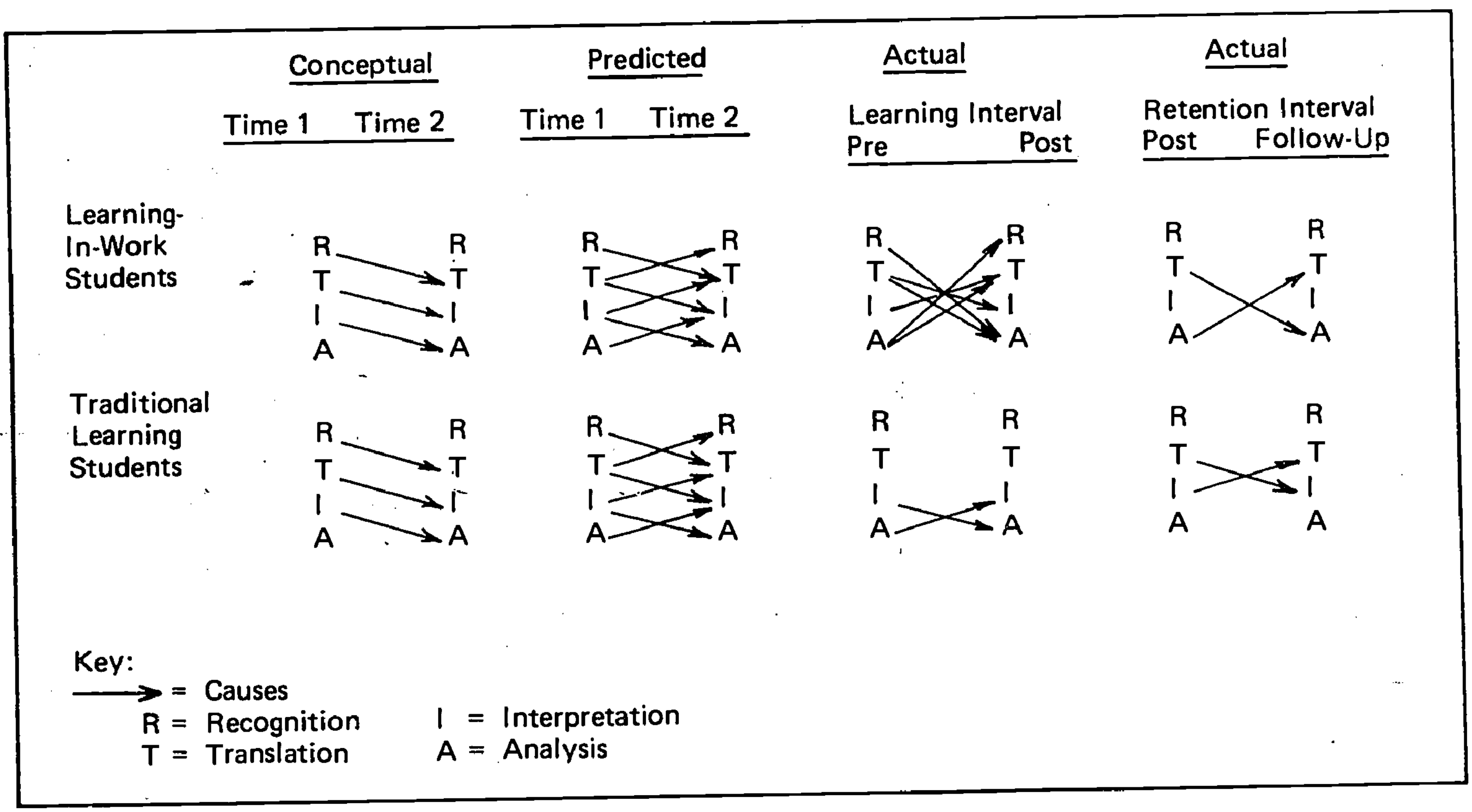
One technique for assessing the validity of the above hypothesis of different causal processes for each group is cross-lagged panel correlation (CLPC). For the purpose of our analyses of the CTBS math performance, CLPC techniques were used according to the procedures outlined by Kenny (1979). Briefly, CLPC is a statistical method that attempts to rule out alternative hypotheses to a causal effect between two variables. The primary alternative hypothesis in these cases is that of spuriousness, i.e., one variable does not cause the other; instead, they are related by virtue of a common relationship to a third (unmeasured) variable. For example, the correlation between height and math achievement may not be due to a causal relationship; instead, they may be related because increases in both are caused by maturation.

The usefulness of CLPC lies in its ability to provide support for the existence (and form) of a causal relationship between variables by ruling out the alternative hypothesis of spuriousness. Therefore, the purpose of these analyses is not to "prove" the existence of specific causal relationships in the CTBS scales/concepts; rather, it is to discover significant differences in the crosslags or nonsymmetric patterns. These differences or patterns would be seen as offering support to the hypothesis that different causal processes were operative in the two learning environments, insofar as the variables represented by our observed variables are concerned. Thus, the CLPC techniques will be used as suggested by Kenny (1979), in that significant crosslag differences will be seen only as indicators of a potential causal relationship between the variables (CTBS process scales), and not as "proof" of causation.

The predicted and actual patterns of learning cognitive skills in the two learning environments are depicted in figure 6. Crosslag differences of $p < .10$ are reported.

FIGURE 6

Predicted and Actual Causal Relationships between Cognitive Concepts for Students in the Two Learning Environments



These results suggest that for the learning-in-work students the cognitive concepts for math were causally related but not in the hierarchical order theorized by Bloom's taxonomy as interpreted and measured by CTBS. That is, with regard to the predictions generated from Bloom's taxonomy, the signs of the crosslag differentials (on significant pairs) were not consistent with the notion that lower-order concepts should cause higher-level concepts. Furthermore, the results would indicate that different causal processes were operating in the two environments as manifested by the number and type of relationships. The learning interval for the learning-in-work students showed the greatest number of potential causal relationships. During the retention interval both groups showed relationships between two variables, but for different cognitive concepts. Overall these results are consistent with the hypothesis that there are different causal processes operating for learning math concepts as a result of enrollment in one of the two learning environments.

Function of Learning Environment (Environmental Complexity)

To what extent did students perceive complexity in their learning environment?

Because the investigation is concerned with learning and retention in two learning environments, a measure to assess student perceptions of the complexity of the environment was developed.

Environmental complexity was considered in terms of the two types of environments, one in which concepts are generated and the other in which concepts are presented. Concept-generating environments may include opportunities to observe, ask questions, experiment, develop ideas, and evolve alternative problem solutions. Indicators such as these are characteristic of an open environment where individuals are supported and encouraged by the environment to achieve goals. On the other hand, concept-presenting environments may include those in which learners are told what to do, are taught the correct or acceptable way to handle a situation, and are given relatively little encouragement to be creative in solving problems. Indicators such as these are characteristic of a closed environment where individuals may perceive the environment as nonsupportive of achievement of individual goals. A concept-generating environment may be considered more complex than a concept-giving environment, in part because decisions must be made without the benefit of readily available rules and predetermined consequences. Thus, individuals in such environments may have to consider more dimensions and make more judgments with finer discriminations in deciding how to solve problems.

A Learning Environment Questionnaire (LEQ) was developed to assess the environmental factors discussed above (figure 4). Initial analysis of the LEQ as a dependent or outcome measure (t-tests between groups) showed that the learning-in-work students had significantly higher means on ten of the thirteen items ($p<.05$). These results seemed to indicate that students in the learning-in-work environment perceived (1) a greater chance to make discoveries on their own (autonomy), (2) more support from instructors for developing their own ideas, (3) more feedback on their performance (self-generated), (4) more variety in their learning tasks, and (5) more meaning in their activities. These characteristics are similar to those identified by research on learning and retention. Overall they seem to lead to increased performance and thereby to favor the learning-in-work environment as an effective vehicle for academic learning and retention.

In order to examine the underlying structure of the perceptions of the learning environment, as reflected in the items of the LEQ, factor-analytic techniques were used. This procedure resulted in three identifiable factors. Although the LEQ requires additional research for validation, the analysis suggests that it does discriminate between student perceptions of learning-in-work and traditional learning environments. The three factors indicate that students see the learning-in-work environment as providing (1) an opportunity for generating concepts or engaging in a variety of experiences, (2) a structure that permits learning and negotiating with adults who are responsible for guiding the learning, and (3) sufficient gratification (feeling of self-confidence) to enable them to initiate and carry out work. Environmental complexity is suggested when higher levels of the factors are perceived to be present in the environment. That is, an environment that is perceived as having more opportunities for generating concepts is more complex than one that is perceived as having fewer opportunities. When this interpretation of the LEQ was applied to the two groups of students in the study, the learning-in-work students, when compared to the traditional learning students, perceived their environment as providing (1) greater opportunity to generate concepts, (2) more structure for negotiating work, and (3) more gratification for initiating and completing work. Thus, on the basis of this measure (LEQ) and the current sample of students, the learning-in-work students appeared to perceive a more complex environment for learning than the traditional learning students perceived. Additional information on the use of the LEQ as a predictor of math performance is presented in the final research question.

Effect of Type of Worksite Experiences

> Did learning-in-work students participation in worksite experiences as classified by Worker Trait Group (from Dictionary of Occupation Titles) contribute to math achievement?

In the course of their program activities, the students in the learning-in-work group chose placements at various sites in the community, where their "hands on" experiences took place. It was of interest in the present analyses to examine whether differences occurred in the math performance of the students as a function of the differences in their site placements. Specifically, were there differences between students who had at least one exposure to one of the twelve worker trait group classified job clusters and those who did not have that exposure? If these clusters were valid for the purpose of classifying the characteristics of a given site and if some of these characteristics had an impact on the acquisition of math skills, then it would be expected that there would be differences (on post-test and/or follow-up CTBS scores) between participants and nonparticipants in those worker trait groups (WTG), differences that affected math skill acquisition. While this type of analysis could certainly not address the issue of what caused what (i.e., Did the WTG classification experience cause later math achievement?), the discovery of differences as a function of placement would tend to contribute support to the EBCE hypothesis that the type of site characteristics has an impact on what is learned at the site. In addition to the fact that the students self-selected themselves into the sites, the presence of differences could also be attributed to an interactive effect of the self-selection and the characteristics of the site. This alternative explanation, however, could not be addressed in this analysis.

The analyses consisted of using simultaneous regression analyses wherein the predictor variables were the WTGs (for those students who participated in sites with that WTG classification) and the dependent or outcome measures, the two CTBS content scales of concepts and application. The results showed differences between the participants and nonparticipants at post-test for the WTG classifications of 1 (artistic) and 11 (social) on the math scale of concepts and for the WTG 11 on the math scale of application. While this result would tend to suggest an effect for the classifications, the results also showed that patterns similar to the post-test differences were present at pretest before exposure to the sites. Thus, the presence of these initial differences before the experience casts strong doubt on the efficacy of the WTG classifications as causal agents in this sample.

Effect of Summer Activity

Did summer experiences of school or work contribute to math achievement at follow-up testing?

The research question addressed by this section concerned student activities during the summer break (i.e., between post-test and follow-up test) and their relation to math achievement. Specifically, these analyses addressed the issue of whether distinctions (1) between summer school and no summer school, (2) between work and no work, and (3) between learning-in-work and traditional programs would account for significant amounts of CTBS score variance.

An alternative explanation of the increase in scores following the summer recess could be that this increase was an artifact, resulting from greater exposure to learning situations (i.e., summer school). If the students had worked during the summer, a similar increase in performance might have been expected due to the opportunity to practice skills learned during the school year (provided that such an opportunity existed). Another alternative explanation to significant differences between students on the summer-work and summer-school variables could be that these differences represented pre-existing differences; thus, a hypothetical finding that students in summer school scored higher at the follow-up test could be due to their superiority at pre- and post-test, rather than to the extra classwork.

To address these issues, simultaneous regression analyses were conducted at all testing periods. The effect of summer school attendance and a summer job was examined on CTBS math performance, while the effect of the program variable was held constant (i.e., partialled from each). Summer activities did not help much in explaining CTBS score variance, independent of program effects: none of the multiple correlations were significant at $p = .05$, and only summer school participation showed strong effects (on math content, at post-test and follow-up test). The general pattern was that students who went to summer school showed lower mean math scores at all testings, while students who worked showed generally higher mean scores. Thus, summer activity, as measured by this study, does not seem to explain the learning-in-work or traditional learning environment differences observed for math performance during the retention interval.

Effect of Cognitive Style

Did students' cognitive style contribute to math performance?

The position of the authors (and supported by the literature) is that the relationship of person, environment, and performance (as measured by the CTBS) is interactive. In this sample, optimum performance is predicted for students who perceive a more complex environment, as indicated by higher LEQ scores and who exhibit greater integrative complexity as measured by the PCT. Thus, when the level of environmental complexity is controlled, the performance of students is predicted to be uniformly higher as a function of increased integrative complexity or cognitive style. Accordingly, a significant relationship or "main effect" for the cognitive style variable is predicted, together with a significant interaction effect when performance is predicted from perceived environmental complexity and cognitive style. Overall, the hypothesis is that performance is maximized when the students' level of cognitive style is matched with similar levels of perceived environmental complexity and that performance is minimized when there is a "mismatch" between the two variables (e.g., when students with less integrative complexity are placed in an environment perceived as complex).

To assess the predictions regarding the environmental and cognitive complexity interaction, hierarchical regression analyses were used. While membership in either of the two environments could conceivably have been used as an "objective" measure of environmental complexity, this approach was rejected at this stage, since it was felt that individual differences in perceptions would constitute more meaningful information than the "program" variable. The results indicated that no interactive relationship was present for the cognitive style and environmental complexity variables.

In an attempt to discover the person-by-environment interaction through a different conceptualization of the "environment" construct, variables representing other aspects of the environment were added to the model: (1) summer activities, consisting of summer school attendance and employment; and (2) program, whether enrolled in the learning-in-work or traditional learning environment. It was reasoned that the inclusion of the above variables would perhaps provide a more complete representation of salient environmental characteristics, and therefore a more accurate test of the person-by-environment hypothesis. The analyses were replicated. The results of using summer activities and the program classification were the same as found for using the LEQ scales alone in that the main effect variance and the interaction of PCT-by-environmental variables produced no significant increase in explained variance beyond that explained by the main effect variables.

In both analyses, however, a main effect or relationship was observed for cognitive style as measured by the PCT and for perceived environmental complexity as measured by the LEQ. That is, higher cognitive style scores were associated with higher achievement for both the learning and retention intervals across all levels of perceived environmental complexity. Although weak, a reverse relationship was generally observed for the perceived environmental complexity in that an increase in LEQ scores was associated with small decreases in math performance. Overall, the cognitive style variable exhibited uniform effects on math performance; the environmental perceptions (LEQ) showed a smaller, less consistent effect; and the predicted person-by-environment interaction failed to materialize.

Summary of Findings

The findings from this study are summarized below.

Retention of Basic Skills

- Math Performance:
  During the learning interval, the learning-in-work students decreased in performance and the traditional learning students increased, while during the retention interval, the learning-in-work students increased in performance and the traditional learning students decreased.

- Reading Comprehension Performance:
  Overall, both groups demonstrated similar increasing performance for the learning and retention intervals.

Moderating Relationships

- Function of Learning Math Concepts Hierarchically:
  For the learning-in-work students, the concepts learned were not hierarchically related as theorized by Bloom's taxonomy and as measured by CTBS.

  Each group showed different causal concept patterns for the learning and retention intervals.

- Function of Learning Environment:
  As measured by the LEQ, the learning-in-work students perceived their environment as providing greater opportunity to generate concepts, more structure for negotiating work, and more gratification that enabled them to initiate and complete work than the traditional learning students perceived.

- Effect of Type of Worksite Experiences:
  For learning-in-work students, the decrease in math performance during the learning interval could not be explained by the different worksite experiences as classified by the Worker Trait Groups.

- Effect of Summer Activity:
  Summer-school attendance or summer work could not account for math performance of either learning group during the retention interval.

- Effect of Cognitive Style:
  Students who demonstrated greater cognitive complexity performed significantly higher on their acquisition of math skills for both the learning and retention intervals.

INTERPRETATION

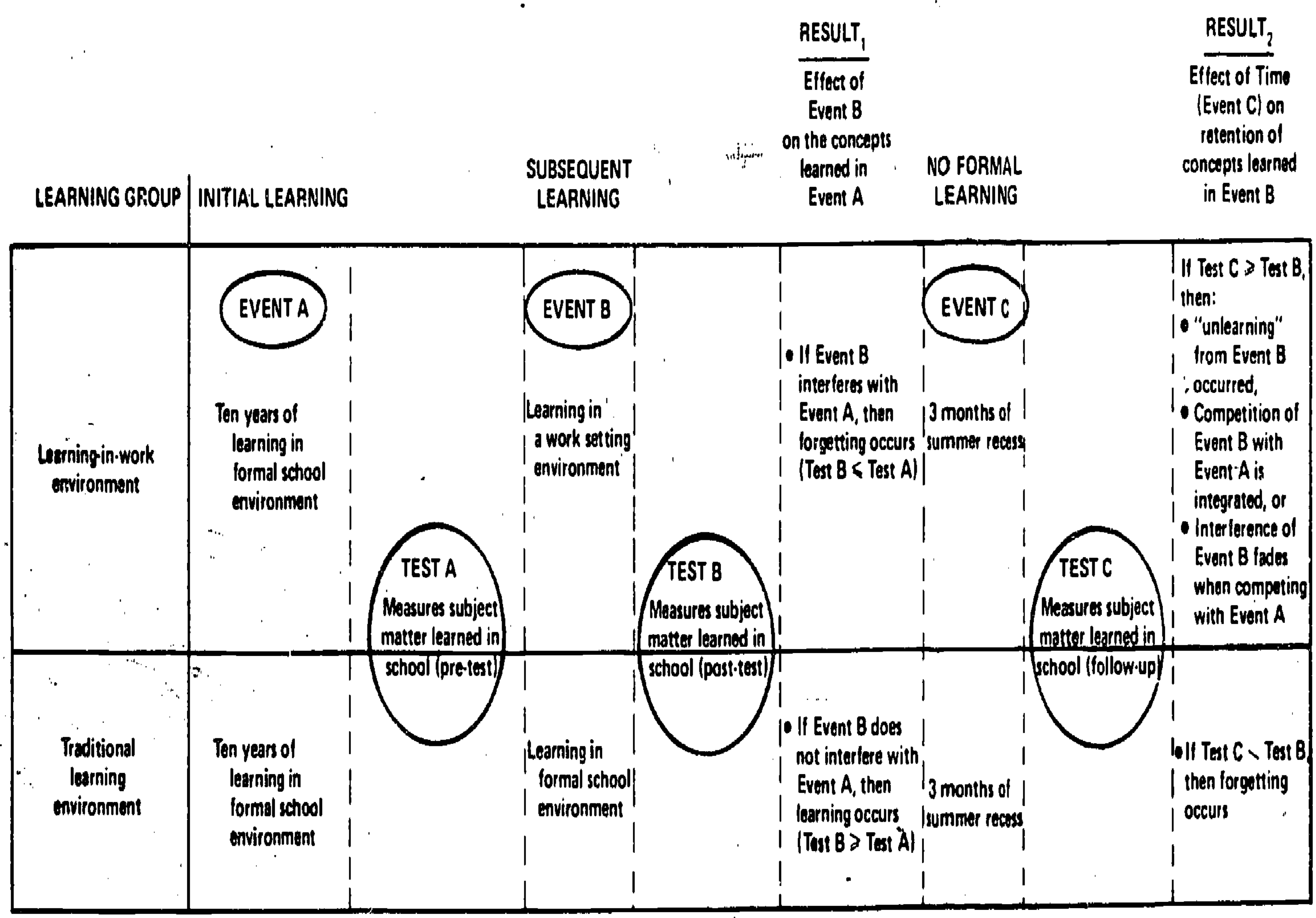
The patterns of math performance were not predicted from previous research, which would have suggested an increase for both groups during the instructional period and a "forgetting" gradient over the summer (Ebbinghaus 1964). Alternative post hoc explanations for these results were considered by the authors, which centered on uncontrolled effects of student selection for the learning-in-work program. While it was deemed possible, that due to nonrandom assignment of students to the EBCE program, subjects may have systematically differed on a variable that could interact with the repeated testings, this explanation was not favored in view of the lack of differences between groups at the start of the study. Additionally, a mechanism would be necessary to account for the unequal effect of such a confounded selection, such that for math performance it would have no effect at test 1, would produce a significant decrement at test 2, and would then increase performance for the EBCE students at the same time that traditional students (in the same environment) were decreasing over the summer. The mechanism would also have to take into consideration the generally equal performance of both groups at all three testings for reading performance. This necessarily unparsimonious approach was rejected in interpreting the results of the math performance.

Interference and Assimilation Model

A model was proposed to account for the unequal learning and retention of CTBS math skills, a model that emphasized two constructs: interference due to previous learning (retroactive interference) and assimilation of information. This model is displayed in figure 7. The researchers hypothesize that students in the learning-in-work environment were learning different things than the students in a traditional setting. Specifically, it was postulated that EBCE students were learning new "rules" for learning how to learn math in a work environment. These rules for learning how to learn were seen to be different than those typically measured by academic tests of achievement (e.g., CTBS). The paradigm is as follows: (1) students in both groups had similar learning histories up to the first testing, which emphasized traditional, nonapplied use of math constructs; (2) students placed in the learning-in-work environment were then forced to use or generate constructs in an applied setting and to generalize from abstract math concepts to applied math usage on the jobs; (3) traditionally learned math skills were not being practiced on the job, and new ways to use math were being learned that did not necessarily overlap with previous learning; (4) these new rules for learning were not assimilated into the previous math framework or structure learned in class, thereby constituting a retroactive inhibitor to the retrieval of the CTBS measured math skills which emerged as a function of dissimilarities for the two ways of learning math (measures at T_2); and

FIGURE 7

Interpretation of Results From A Retroactive Design Perspective



(5) follow-up performance on CTBS depended on the extent to which new ways to use math were assimilated into the previous framework or structure of math knowledge. That is, CTBS performance should increase according to how well students could relate the new rules for using math to the way math is measured by the CTBS. Conversely, it was predicted that the use of a performance-based math test (content-valid for applied settings) would reveal that learning-in-work students were not "losing information" but were learning new rules for learning how to learn, rules which were not manifest on the CTBS until they could be assimilated into the previously developed traditional structure for remembering math concepts.

Supporting Evidence

Other findings can be used as possible supporting evidence for the interference hypothesis. For example, while we cannot say that the environments caused the observed patterns of cross-lag correlations for math concepts, the results do suggest (1) that for the learning-in-work group, the causal patterns were not hierarchically related, as would be theorized by Bloom's taxonomy and (2) that the learning-in-work group demonstrated a more diverse pattern of causal relationships during the learning interval than the traditional learning group demonstrated. Thus, while not providing "proof," this finding does add support that some type of interference may have been present for the learning-in-work group during the learning interval, as manifested by the nonhierarchical nature and the greater number of causally related math concepts.

Another event that could counter the interference factor and explain the decreased math performance of the learning-in-work students during the learning interval could be their unequal exposure to worksites that required use and practice of math concepts. However, our analyses suggest that exposure to worksites as classified by the WTGs did not affect math performance.

Also, the interference hypothesis may be supported by the students' perceptions of the complexity of the learning environments. As measured by the LEQ, the learning-in-work students perceived their environments as providing greater opportunity to generate concepts, more structure for negotiating work, and more gratification that enabled them to initiate and complete work than the traditional learning students perceived. Thus, if more of these factors are present in the learning-in-work environment than in the traditional learning environment (if this is the students' first formal exposure to a work experience, they have had little or no experience with these factors) then the factors may behave as interference-type variables to the acquisition of math concepts. That is, these environmental factors in some unknown way may interfere with the transfer of math learned in a classroom environment to math used or required in a work environment. There is some evidence in our sample that this interference occurs, as students who scored high on the LEQ generally showed significant statistical decreases (although moderate) on math performance. Thus, while these factors are not unique to the learning-in-work environment, they nevertheless seem to be negatively related to--or to interfere with--the acquisition of mathematical concepts.

An event that could counter the assimilation factor and explain the increased math performance of the learning-in-work students during the retention interval or the decreased math performance of the traditional learning students during the retention interval could be their summer activities of school or work and the resultant practice or nonpractice on math concepts. However, the analyses suggest that summer activities, as measured in this study, did not contribute to the math score variance at the follow-up testing.

Limitations of the Model

It should also be noted that the interference/assimilation model is hypothesized only for math concepts and not for reading comprehension concepts. It would appear from our sample that whatever reading is, it does seem to transfer from prior school learning to learning-in-work environments. Whether this is due to the structure or content of reading or to the fact that work-site mentors require students to be able to read prior to worksite placement was not investigated as part of this study.

While the interference/assimilation model can explain the observed math performance patterns, there are, at this stage of development of the study, theoretical limitations to the explanation. As Henry Ellis (1980) points out in his review of the first-year results, it is possible that the forgetting occurring during the learning interval could be due to other nonspecific interference and not to learning specific interference rules or concepts. It is also possible that there was no interference if one assumes that the skills and knowledge learned in a learning-in-work environment represent an independent system that neither interferes with nor reinforces prior school learning. Thus, forgetting may occur because of insufficient practice to maintain the level of knowledge exhibited nine months earlier. This explanation, however, seems unable to furnish an adequate explanation for the increase in performance over the summer when there was also no formal practice or learning of math concepts.

The explanatory construct of assimilation, while intuitively appealing, may also possess some limitations as noted by Ellis (1980). One is that it may not be required because empirical findings show that as time increases for the retention interval, retroactive inhibition tends to decrease. Thus, continued improvement in performance may be due to the fading of the retroactive interference and not to assimilation of information. A second limitation centers on the two-process construct itself.

That is, when, in the learning process, does the interference end and assimilation begin? Would we, for example, have found interference (or decreased scores) for reading comprehension if measurements had been taken more frequently during the learning interval. Similarly, would greater decreases in math performance have been found earlier if more frequent observations were made? For the interference/assimilation construct to be valid, this research needs to be replicated with different students and criteria measures, and with multiple observations.

Summary

In summary, we propose or hypothesize an interference/assimilation model to interpret the patterns of math performance. Retroactive interference is used to explain the loss of math performance during the instructional or learning interval. It is assumed that students in the learning-in-work environment were acquiring new skills and concepts that interfered with prior learning acquired in a traditional learning environment. During the summer retention interval, the learning-in-work students assimilated the new rules and concepts learned during the instructional interval with their existing knowledge structures. This assimilation led to a new cognitive structure which in turn led to enhanced performance on the retention test.

DISCUSSION AND RECOMMENDATIONS

No longer is formal schooling limited to learning in a classroom environment. Not only do youth have the opportunity to choose their learning environments, but educators concentrate on designing and implementing alternative environments that seem likely to promote and maximize student learning. The preliminary research from this two-year effort has resulted in findings that support different patterns of learning and retention of basic skills as a result of experience in one of two learning environments. At this stage of the research effort, we prefer to consider our research exploratory--providing for an initial line of inquiry.

To implement this line of inquiry, this section relates the implications of the research findings and interpretations of the study to research designs and measurement concerns and to the substance or research variables that should be examined in future efforts. Thus, the section addresses two specific areas: research design and measurement considerations; and research variables related to a study of the learning, forgetting, and retention of basic skills in learning-in-work environments. Specific recommendations are made regarding the extension of this line of inquiry. It should be noted that the discussion draws upon the suggestions and ideas generated by the three scholars commissioned to review the first-year results.

Research Design and Measurement Considerations

Design Considerations

It goes without saying that the study should be replicated. Although confidence in the current findings is limited to a great degree by the quasi-experimental nature of the research, confidence in similar findings in a replicated study could be enhanced by a multivariate research design approach. Reviewers of this research have noted that the findings may be due to such factors as the Hawthorne effect, the impreciseness and ambiguity inherent in the global nature of the "traditional" and "learning-in-work" variables, and to the cuing effect of the post-testing on follow-up observations. While acknowledging the value of a multivariate design to identify precisely and measure both learning and retention effects attributable to the independent variables and their interactions, we also realize the burdens placed on students and the costs associated with implementing such a design in a school setting.

The purpose of exploratory studies of this type is to develop research ideas by observing learning phenomena in its more or less natural state. In this way major effort can be diverted from methodological problems and directed to substantive patterns of human behavior. By pressing the methodological considerations too far, and too fast, we may inhibit the emergence of potential-durable factors associated with learning and retention of basic skills in different environments. Thus, it is our opinion and recommendation that further investigation is required before a multivariate design is implemented, an investigation that would identify significant variables and increase understanding of the learning process.

With this recommendation we propose that on-going evaluations in school districts be used as the vehicle for data collection but that (1) additional data observations and (2) additional comparison groups be included. The inclusion of more data observations during the learning and retention interval should provide a more accurate description of the learning and retention functions. The proposed interference/assimilation model assumes that at some point interference stops and assimilation begins. With additional observations, it may be possible to determine more precisely the "true" dimensions of these functions. Whereas a decrease in math performance was observed for the learning-in-work students, with additional observations the interference could be manifested at earlier stages, meaning that what was observed was actually part of the assimilation process. Likewise, would earlier observations of reading performance have resulted in detection of "interference" via decreased scores? More observations would enable us to address such questions. However, since more observations increase the risk of interaction between testing and treatment, we recommend the inclusion of more comparison groups. In the current study, the possible effect of the post-test as a cue for the follow-up observation could be isolated if an additional comparison group received only the pre- and follow-up tests.

Another factor related to design considerations is that the interpretation of the findings is anchored to the classical framework of learning and retention. Most classical studies use shorter time frames for the learning and retention intervals with precise control over the learning task within experimental research designs. In effect for this study, group data and macro time intervals were overlayed on the micro cognitive processes studied in classical learning and retention paradigms. Thus, there is the problem of separating nonschool from school effects in the presence of the two types of effects especially in non-experimental designs. This problem occurs because our interest is in studying how learning and long-term retention processes operate in naturally occurring learning environments. However, classical learning theory says little about learning and long-term retention in natural settings, and experimental designs require manipulation of the independent variables as part of the treatment. Since the environment we want to study occurs naturally, the manipulation of the independent variables to accommodate the experimental design would change the treatment under study. To some extent, multiple observations would provide the frequency of data generally associated with classical learning studies, a procedure, that reinforces the need for multiple comparison groups. Thus, we recommend that research is needed on ways to apply learning theories (classical or contemporary) and research designs to study alternative learning environments if we are to understand the trade-offs of the learning and retention of basic skills.

Measurement Considerations

For this study, increased achievement of math and reading comprehension skills on a standardized achievement test was the learning criterion. As discussed earlier, this criterion is appropriate for the traditional classroom learning environment. However, the mere lack of increased scores for the learning-in-work students may not imply that learning did not occur, but rather that participation in the work environment, because of its perceived complexity and therefore its potential for interference, could lead to decreased test scores but at the same time could produce increases in other outcomes not measured in this study. Thus, the criterion of increased cognitive knowledge may not be an appropriate learning criterion for a work environment. Additionally, the use of a standardized achievement test may not be an appropriate outcome measure, either in terms of the content to be learned (since it is curriculum bound) or its psychometric properties. For example, the test items may maximize the discrimination among student populations at a given time rather than measuring change in performance over a period of time.

With regard to measurement considerations we propose two approaches: (1) the use of tests appropriate to both environments and (2) the use of systematic observations by trained observers. Although the performance of the learning-in-work students was lower at post-test, it may be that even though they possessed the basic knowledge needed to solve the test item, they may have had difficulties remembering the needed "rule," since that rule (although taught in the classroom) was not required to perform effectively at the workplace. Thus, the use of a performance-based math test (content-valid for applied settings) could reveal a reverse in the findings for the two groups (with the performance of traditional indicating a relative decrease at post-test). We recommend that performance-based math items, appropriate for both groups of students, be used in future data collections. Furthermore, we recommend that math items from National Assessment of Educational Progress (NAEP) be considered for initial use, since they were developed for more applied situations and provide for interpretations different from those obtained from standardized achievement test items. In addition to multiple observations of test data, we recommend that systematic observations be used to supplement these data. If conducted in a rigorous and scientific way, the observations from on-site visits cannot only be used to provide accurate descriptions of the learning process (thus providing initial precision) but also can be "triangulated" with the test data to provide a more powerful interpretation of the results.

Recommendations

In summary, we suggest the following recommendations:

- Continue the line of inquiry with additional exploratory investigations.

- Employ on-going school evaluations with the inclusion of more observations and additional comparison groups.

- Administer tests (such as NAEP) appropriate to both learning environments.

- Conduct systemmatic observations of the learning process at the worksite and in the classroom.

In line with our original concerns for data collection at reasonable costs and within the parameters tolerated by school policy, these recommendations would be feasible for most school programs.

Considerations Related to the Study of the Learning and Retention of Basic Skills in Work Settings

Since the process for extending our line of inquiry was discussed in the preceding section, the factors related to the learning, forgetting, and retention of basic skills in learning-in-work environments is the focus of this section. Earlier in the report, we suggested that in order to study the processes related to learning in a work environment, it is necessary to study the student as both learner and worker, the dynamics of the environment, the interaction of the student within the context of the work setting, and the content variables (in this study math and reading skills and concepts). This framework provides the organizing structure for this section. We will begin with the content variables, follow with the dynamics of the learning environment, and finally discuss the characteristics of the learner. Although the topics cannot be investigated in a linear fashion, the sequential order of the topics parallels the priority which we would assign to future investigations. Although we believe that the interaction of the learner within the context of the work setting is probably the most powerful predictor of performance, this type of relationship can most profitably be addressed statistically only after the associated variables have been reliably identified and precisely measured.

Content Variables

Evidence from this study suggests, even with methodological reservations, that math skills learned in a learning-in-work environment are different from those learned in a traditional environment and that they may be learned and retained in different ways (see figure 5). Furthermore, evidence from the crosslag correlations of the math process variables (figure 6) suggests that the decrement observed at post-test for the learning-in-work students may be due to different causal cognitive processes that operate in the two environments. With regard to reading comprehension skills the evidence suggests that student performance is almost equivalent in either environment.

Cognitive or conceptual skills. In addition to the basic skill outcomes discussed above, we recommend investigating the cognitive or conceptual skills that seem to be present in learning-in-work environments. As described by Harold Schroder in correspondence with the project staff, these skills include (1) the ability to generate conceptual complexity to a level that matches the complexity of the environment and (2) the ability to use multiple conceptions in information processing. More specifically, the first skill entails concept learning, the ability to discover concepts others use to make judgments; and reality testing, the ability to determine "correctness" of the assumption for making judgments. The second skill requires concept transmission, the ability to share one's own concepts with others; and concept projection, the ability to project one's concepts to new situations. Based on the interview data from the learning-in-work program, it would appear that students in this environment have the opportunity to practice these kinds of conceptual skills.

Structure of math. The analysis of math concepts as measured by the CTBS suggests that math concepts are related differently for students in the two environments. Most notably, the math concepts learned by students in the learning-in-work environment were not hierarchically related while those math concepts learned by students in the traditional environment approached a hierarchical order as theorized by Bloom's taxonomy. This finding leads us to suggest that participation in a learning-in-work environment may shape the students' psychological structure of math in such a way that it appears different from the logical structure as it is derived from experts and conveyed in textbooks. Thus, a hierarchical structure of concepts as theorized by Bloom may not be appropriate when applied to learning concepts in an actual work setting. Our reasoning is as follows: in the traditional environment, we would expect a hierarchical order of learned concepts because students were presented the logical structure through the textbook (concepts in textbooks are presumed to be organized hierarchically). In the learning-in-work environment, we would not necessarily expect a hierarchical order of learned concepts because students had to figure out the structure as a function of completing work (concepts encountered in work are presumed not to be organized hierarchically). Students in both environments would perceive their learning to be meaningful.

This finding, if replicated, could have implications for curriculum development in that disciplines such as math, when taught in learning-in-work programs, should be structured to assist students to understand the relationships between their own psychological structure and the logical structure of the discipline. Another possibility is to reorganize math curriculum for classroom instruction to reflect the psychological structure involved in math to perform work. Such reorganization would be designed to increase the efficiency of students in applying the basic skill to solving problems encountered in the workplace. We recommend that an examination and analysis of the concepts related to learning and retaining different subject matter disciplines in the workplace be initiated. The goal of such an effort would be to understand the relationships between the psychological structure of the students and the logical structure of the discipline in order to increase the productivity of learners who use and apply math concepts in a work setting.

Dynamics of the Learning Environment

For us, the workplace as a learning environment provides exciting and dynamic opportunities for youth. Not only do they have the opportunity to learn traditional subject matter, but they also are able to participate actively in solving problems that result in real consequences, in negotiating work tasks, in initiating action to complete tasks, and in practicing social or coping skills to relate to a variety of workers. The multiplicity of these characteristics highlights the need to classify and study learning environments.

Environmental complexity. To furnish a measure of environmental complexity for the two environments in this study, the Learning Environment Questionnaire (LEQ) was developed. Analysis of this instrument suggests three factors related to student perception of the learning environment: (1) an opportunity for generating concepts or engaging in a variety of experiences, (2) a structure that permits learning and negotiating with adults, and (3) gratification (feeling of self-confidence) that enables students to initiate and carry out work. Environmental complexity is suggested when high levels of the factors are present (or perceived) in the environment.

Data from this study suggested that the learning-in-work students perceived greater environmental complexity (as determined by higher test scores) than students in the traditional environment perceived. They also suggested that student perceptions of environmental complexity affected math performance at post- and follow-up testings. Overall, since higher levels of perceived environmental complexity resulted in slightly lower math performance and since these environmental characteristics are present in work environments for this study, math achievement (as currently structured and measured) may be better acquired in those environments not emphasizing factors measured by the LEQ.

Process of learning. David Ausubel (1980) suggests that the process of learning be classified along experiential and didactic dimensions. This conceptual framework, presented in figure 8, suggests a way to classify learning environments more closely related to the cognitive psychologists view of learning. This approach illustrated the need to determine the extent to which reception or discovery learning actually occurs in either environment. The assumption for this study was that the learning-in-work environment emphasized experiential and discovery learning, while the traditional environment emphasized didactic and reception learning. To validate this assumption, we recommend an examination of the learning environments to determine the proportions of experiential and didactic learning for each.

FIGURE 8

Reception-Discovery and Rote-Meaningful Dimensions of Learning

Environments	Process of Learning	
	Experiential Reception / Discovery	Didactic Reception / Discovery
Worksite	Rote or Meaningful Learning	Rote or Meaningful Learning
Learning Center	Rote or Meaningful Learning	Rote or Meaningful Learning
Classroom	Rote Meaningful Learning	Rote or Meaningful Learning

DEFINITIONS (Ausubel, 1980, p. 9)

Reception Learning — the principal content of the material to be learned is presented to the learner in a more or less final form and he/she need only integrate it into his/her cognitive structure for the purposes of retention and transfer to new learning experiences.

Discovery Learning —the principal content of what is to be learned (i.e., new successful problems-solving proposition) must first be discovered by transforming relevant background knowledge (previously acquired concepts, facts) in such a way as to constitute a means to the end specified in a problem-setting proposition. Once an acceptable problem-solving proposition is discovered, it is then internalized in precisely the same way as in reception learning.

Meaningful Learning — (1) that which occurs if the student employs a meaningful learning set to his/her existing structure of knowledge and (2) that which occurs if the learning task itself is potentially meaningful

Variables that effect acquisition and retention of content. Variables that produce marked differences in learning may have no effect on the rate of forgetting. Benton Underwood in his review of the first-year results (1980) pointed out that it is important to distinguish between independent variables that influence the rate of forgetting and those that do not. Those variables that influence the rate of forgetting include the level of learning achieved before the retention interval, spaced practice, the learning of two or three tasks simultaneously, the learning of interfering tasks, and the length of the retention interval. Variables that have an effect on learning but not the rate of forgetting include meaningfulness of the task variables, depth-of-processing procedures, and individual differences. These variables should be considered for future research on learning and retention of concepts in alternative learning environments. We recommend an analysis of learning-in-work environments to determine the presence or absence of these variables. It is conceivable that these environments may possess factors that contribute more to reducing the rate of forgetting than to increasing the differences in learning.

Initial thinking regarding environmental characteristics that can affect performance centered on the contrast between environments that "generate concepts" and those that "give concepts." In "concept-generating" environments, according to our view, students learn to search for information, generate ideas, try them out, and receive feedback. The hypothesis was that "concept-generating" environments develop skills that later help students acquire knowledge. The results of the LEQ suggest that these factors are perceived by learning-in-work students. In Henry Ellis' commissioned paper he called attention to the generation effect in recall (Slamecka and Graf 1978). The basic finding was that if subjects have to generate an answer rather than simply to remember one, recall is substantially improved. Also, Jacoby (1978) reported that if subjects have to solve a problem rather than remember a solution, recall is enhanced. The research conducted by Ellis and associates suggests that the variability effect, seeing information to be remembered in varied fashion, aided recall. As Ellis suggests, (1980, p. 7), these findings support the concept of learning-by-discovery and would appear to be operative in a learning-in-work environment. To some extent the generation effect appears to be similar to our notion of "concept-generating" environments.

Because students in the learning-in-work environment are bringing ten years of past school knowledge and learning processes to the workplace, the concept of transfer is an important issue. While we cannot be certain, one possible explanation for the decrement in the math scores of these students at post-test may be attributable to interference from past school learning. Thus, for students who are making the transition to the workplace as well as for those who are experiencing other alternative environments, transfer variables not present in the classroom environment may be operating in such a way as to interfere with math performance at post-testing. Two such variables suggested by Henry Ellis (1980, p. 9) are depth of processing and cognitive effort. For example, due to the nature of learning activities, students in the learning-in-work environment may not process the information they have learned at the same depth or at the same intensity as students in the classroom. Thus, while increased performance (higher math achievement) is important in classroom learning, learning at a workplace may require less depth of processing or cognitive effort for student success, thereby resulting in lower math achievement at post-testing. If such mediating cognitive variables are operating in worksite environments but not in other learning environments, then they should be identified for studying basic-skill acquisition and retention.

Learner Characteristics

Individual difference variables must be included in any study of learning and retention of basic skills in learning-in-work environments.

For this study, the personal characteristic of cognitive style was measured by the Paragraph Completion Test (PCT), which yields an integrative complexity score for the individual's ability to generate ideas and to organize ideas or concepts in a hierarchical system. Results showed that higher integrative complexity scores were associated with higher math achievement at post- and follow-up testings for students in both learning environments.

The major recommendation for studying learner characters is that a theoretical template needs to be conceptualized that systematically relates individual differences, environmental parameters, and criteria measures. Advice from the consultants to the project have indicated that the following individual difference variables appear to be good candidates: cognitive style variables such as cognitive complexity, internal/external control, and field dependence; aptitude variables such as general intelligence, primary mental abilities, and dimensions of cognitive style affecting both reception and discovery learning; motivational factors such as intrinsic versus extrinsic, task-oriented versus ego-oriented, and cognitive drive; personality variables such as dogmatism, closed- versus open-mindedness, and tolerance for ambiguity; and knowledge in content area.

Recommendations

The above discussion illustrates the complexity of studying the factors related to learning and retention of basic skills in work settings. The primary recommendation is that multiple research strategies which emphasize interview and observational techniques be employed to identify and to describe the factors associated with the content variables, environmental variables and learner characteristics. For example, a factor such as the generation effect has been demonstrated to enhance recall in laboratory settings. We propose that this type of factor be operationalized and used as part of an observational schedule to detect its presence in learning environments. Furthermore, if test data were also available, then factors observed in work settings could be used as part of an overall analyses. The second recommendation is to conduct content analysis of curriculum for learning-in-work and traditional learning environments. The analysis should focus on identifying the logical structure of subject matter disciplines and the psychological structure resulting from participation in work settings. If differences exist, then we recommend that curriculum be organized to reflect the differences. In this way students should be more productive in the workplace when applying subject matter concepts.

APPENDIX A

TABLE OF CONTENTS FOR TECHNICAL INFORMATION AND APPENDICES REPORT

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REFERENCE LIST

Anderson, R.C., and Biddle, W.B. "On Asking People Questions about What They Are Reading." Psychology of Learning and Motivation 9. Edited by G. Bower. New York: Academic Press, 1975.

Ausubel, D.P. Educational Psychology: A Cognitive View. New York: Holt, Rinehart, and Winston, 1968.

Ausubel, D.P. "Relationships between Didactic and Experiential Learning." Paper prepared for The National Center for Research in Vocational Education Symposium on Learning-in-Work, Washington, D.C., October 1980.

Bloom, B.S., ed. Taxonomy of Educational Objectives. Handbook I: Cognitive Domain. New York: McKay, 1956.

Boker, J.R. "Immediate and Delayed Retention Effects of Interspersing Questions in Written Instructional Passages." Journal of Educational Psychology 66 (1974):96-98.

Cronbach, L.J., and Snow, R.E. Aptitudes and Instructional Methods. New York: Irvington, 1977.

Crowe, M.R., and Adams, K.A. The Current Status of Assessing Experiential Education Programs. Columbus, Ohio: The National Center for Research in Vocational Education, 1979.

Crowe, M.R., and Harvey, R.J. Learning and Retention of Basic Skills in Alternative Environments: Preliminary Investigation of the Retention of Selected Reading and Mathematical Concepts Resulting from Students Enrolled in a Traditional Learning Environment and in a Learning-in-Work Environment, Technical Information and Appendices. Columbus, Ohio: The National Center for Research in Vocational Education, 1980.

Crowe, M.R., and Harvey, R.J. Retention of Concepts Resulting from Learning by Experience. Columbus, Ohio: The National Center for Research in Vocational Education, 1979.

Crowe, M.R., and Harvey, R.J. Retention of Concepts Resulting from Learning by Experience: A Preliminary Investigation of the Retention of Selected Reading and Mathematical Concepts Resulting from Students Enrolled in a Traditional Learning Environment and in a Learning-in-Work Environment, Technical Information and Appendices. Columbus, Ohio: The National Center for Research in Vocational Education, 1979.

Crowe, M.R., and Walker, J.P. Evaluation of the Executive High School Internships Program: Executive Summary. Columbus, Ohio: The National Center for Research in Vocational Education, 1977.

Davey, B. "Cognitive Styles and Reading Achievement." Journal of Reading 20 (1976):113-120.

Ebbinghaus, H. Uber das bedachtnis Leipyiz-Duncker and Humbolt, 1885. Translated by H.A. Ruger and C.E. Bussenius. New York: Teachers College, Columbia, 1913. Revised New York: Dover, 1964.

Ellis, H.C. "An Analysis of Retention of Concepts Resulting from Learning by Experience." Paper prepared for the National Center for Research in Vocational Education Symposium on Learning-in-Work, Washington, D.C., October 1980.

Gagne, E.D. "Long-Term Retention of Information following Learning from Prose." Review of Educational Research 48 (1978): 629-665.

Hunt, D.E. "Person-Environment Interaction: A Challenge Found Wanting Before It Was Tried." Review of Educational Research 45, no. 2 (1975):209-230.

Jacoby, L.L. "On Interpretating the Effects of Repetition: Solving a Problem versus Remembering a Solution." Journal of Verbal Learning and Verbal Behavior 17 (1978):649-667.

Kenny, D. Correlation and Causality. New York: Wiley, 1979.

La Porte, R.E., and Voss, I.F. "Retention of Prose Materials as a Function of Post-Acquisition Testing." Journal of Educational Psychology 67 (1975):259-266.

Schroder, H.M.; Driver, M.J.; and Streufert, S. Human Information Processing. New York: Holt, Rinehart, and Winston, 1967.

Slamecka, N.J., and Graf, P. "The Generation Effect: Delineation of a Phenomenon." Journal of Experimental Psychology: Human Learning and Memory 4 (1978):592-604.

Staszkiewicy, M.I. "The Effect of Learner's Cognitive Style and Classroom Climate on Student Achievement and Attitudes in First-Year Algebra." Unpublished doctoral dissertation, University of Cincinnati, 1977.

Test Coordinator's Handbook, Comprehensive Tests of Basic Skills, Expanded edition. Monterey, California: CTB/McGraw-Hill, 1976.

Underwood, B.J. "Forgetting: Some Perspectives." Paper prepared for The National Center for Research in Vocational Education Symposium on Learning-in-Work, Washington, D.C., October 1980.

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