The Effect of Reward Structure and Group Ability Composition on a Problem-Solving Simulation in an Interactive Video Environment

Penelope Anne Nicholson

A Thesis

in

The Department

of Educational Technology

Presented in Partial Fulfillment of the Requirements
for the degree of Doctor of Philosophy at Concordia University
Montreal, Quebec, Canada

May 1993

National Library
of Canada

Acquisitions and
Bibliographic Services Branch

395 Wellington Street
Ottawa, Ontario
K1A 0N4

Bibliothèque nationale
du Canada

Direction des acquisitions et
des services bibliographiques

395, rue Wellington
Ottawa (Ontario)
K1A 0N4

Your file Votre référence

Our file Notre référence

ISBN 0-315-87324-8

Canada

ABSTRACT

The Effect of Reward Structure and Group Ability Composition on a Problem-Solving Simulation in an Interactive Video Environment

Penelope Anne Nicholson, Ph.D.
Concordia University, 1993

The present study examined the effects of group incentive structure, group composition, individual work, and ability level on 111 undergraduate students from the Faculty of Commerce working on an interactive video business simulation. Specifically, this study investigated the relationship between two levels of group incentive structure (cooperative and individualistic reward structures) and two types of group composition (homogeneous and heterogeneous for ability), with subjects of three ability levels (high, medium, and low ability as measured by the Comprehensive Ability Battery [CAB] pretest) on five dependent measures. All learners worked in dyads, except for the control group which consisted of individuals who completed the same task as the treatment groups but on their own. The dependent measures used were: achievement assessed by a multiple-choice and a case-study post-test, time-on-task in minutes tracked by the computer program, attitude measured by a 5-point Likert Scale, and sequence through the software determined by a 'tracking' program. Results show that low-ability subjects working with a partner outperformed low-ability subjects in the control group on the case-study measure. No significant differences were evident between low-ability subjects on the multiple-choice test. Medium and high-ability subjects were found to perform equally well, whether they worked individually (control group) or with a partner, on both the case study and multiple-choice measures. Low-ability subjects also took more time to complete the task than medium or high-ability subjects. Results from the online tracking program which recorded students' pathways through the interactive video program

revealed that the pathways of low-ability students working individually differed from that of medium and high-ability students working individually and from dyads, in some areas The difference was that the low-ability subjects working on their own made more unsuccessful attempts to gain a simulated bank-loan and when the loan was finally received, failed to look consistently at guidance functions. It is speculated that low-ability students working on their own may not have received the needed feedback to focus attention correctly and to detect and clarify misconceptions to help them modify their business plan sufficiently to obtain a bank loan, while paired low-ability students may have received this feedback and guidance from their partners. The quantitative and qualitative results of the study suggest that providing low-ability students with a partner may be a more effective instructional approach in increasing their performance than having them work alone at a computer simulation.

Acknowledgments

The author wishes to acknowledge that this project was partially funded by a J.W. McConnell Memorial Graduate Fellowship and a FCAR Scholarship. The author wishes to thank Ralph France from MITEC for all his help and support with The Business Disc program, and the Learning Lab at Concordia for their patience and assistance with this project. The author would also like to extend thanks to the members of the supervisory committee as well as the students, staff and faculty of Concordia's Management Department. Lastly the author would like to thank Timothy Ford for his continual patience and encouragement throughout this project.

Table of Contents

Figures

Tables

Appendices

Chapter One

Introduction

This study examined learners working either individually or in dyads on an interactive video simulation. Specifically, the study looked at how achievement in terms of recall and problem solving, time-on-task, attitude, and sequence through a simulation were affected by grouping, group composition, incentive structure, and ability level. Although past research has investigated group work, it has provided inconsistent guidance as to if or how students should be grouped in order to optimize their learning (Carrier & Sales 1987; Cartwright, 1972; Cox and Berger, 1985; Guntermann & Tovar, 1987; Johnson & Johnson. 1986, Mavarech, Stern & Levita, 1987, Okey & Majer, 1976, Trowbridge & Durnin, 1984; Webb, 1984). The present study explored various aspects of grouping in order to determine which conditions produce optimal group learning in an interactive video simulation.

The rationale for the present study is presented below in the following sections: (a) grouping (in general), (b) grouping and incentive structures, (c) group composition, (d) ability level, (e) interactive video simulations, and (f) the significance of the study.

Grouping

Not all researchers agree on whether working in a group effects learner's achievement over working individually Some researchers have stated that group work is equally productive to working individually (Carrier & Sales 1987, Cartwright, 1972, Guntermann & Tovar, 1987; Okey & Majer, 1976) Others have stated that group work is superior to individual work (Johnson & Johnson, 1986, Trowbridge & Durnin, 1984, Webb, 1984; Mevarech et al. 1987; Cox and Berger, 1985) The inconsistency of this research may stem from the type of tasks that past researchers have assigned to their subjects. Based on past research reports it can be speculated that group work may produce superior achievement only for problem solving tasks (Cox & Berger, 1985, Johnson & Johnson, 1986; Mevarech et al. 1987; Trowbridge & Durnin, 1984; Webb,

1984). Since grouping students for a task that promotes problem solving may be one technique that increases group member's achievement this study assigned a problem solving type task to dyads and individuals in order to add to our knowledge of this area. To determine if the findings of this study supported the findings of past research a comparison was conducted between the achievement of learners working in groups versus those working individually in a control group.

Grouping and Incentive Structures

Another main concern in group work is how to optimally group learners. Past research has suggested that providing incentive structures, that is giving learners reasons to help their partners, is one effective way to increase achievement (Johnson & Johnson, 1985; Slavin 1983). Cooperative incentives, where students are told that their success depends on the success of all group members, have been found to be the most successful incentives in increasing achievement, as learners belonging to these groups yield higher achievement than those in groups with individualistic incentives, or for those working alone (Johnson, Marayama, Johnson, Nelson, & Skon, 1981; Johnson & Johnson, 1985). This study introduced cooperative incentives into the learning environment in an attempt to optimize the achievement of group members. The study also introduced individualistic incentives, where students were not encouraged to help one another but merely work together. It was hoped that the introduction of the two incentive structures would suggest whether cooperative incentives were useful to optimize the group learning environment.

Cooperative learning research of the past has focused on the effects of cooperative learning on younger learners. Based on higher education literature, cooperative techniques with adult learners is a viable educational strategy (Cooper, Prescott, Mueck, Cook, Cuseo, & Smith, 1990; Dansereau, 1983). Past research has suggested that techniques, such as cooperative grouping, help to involve adult students in their university learning experience, thereby promoting their problem-solving abilities and

critical thinking more than traditional methods (Kulik & Kulik, 1979; Smith, 1977). To add to our knowledge of the effect of cooperative incentives on university level group work, undergraduate students were used in this study

Group Composition

Past research on group work also suggests that group composition should be carefully considered and based on learner's ability levels to create groups that are homogeneous or heterogeneous for ability (Slavin, 1987a; 1987b; Manning & Lucking, 1990). For example, in homogeneous ability groups learners work with same ability peers, while in heterogeneous ability groups learners work with different ability peers. Although there is an abundance of literature on the use of homogeneous and heterogeneous grouping in schools, controversy has arisen as to whether it is best to group learners homogeneously or heterogeneously for ability (Esposito, 1973; Slavin, 1987a; 1987b; Good & Marshall, 1984; Manning & Lucking, 1990; Dawson, 1987).

Ability

There is also uncertainty in past research as to whether learners of all ability levels (high, medium, and low) benefit equally from homogeneous and heterogeneous grouping (Johnson & Johnson, 1990; Slavin, 1989; Davidson, 1985; Webb, 1985; Hooper & Hannafin, 1988). Past research which investigated subjects working cooperatively in homogeneous and heterogeneous groups have found aptitude-treatment interactions (Webb, 1985; Hooper & Hannafin, 1988). To investigate the possible interaction between ability and group composition learners of varying abilities were placed in homogeneous and heterogeneous ability groups. To determine if and how ability level interacted with incentive structure learners were also placed in groups with cooperative and individualistic reward structures.

Interactive Video Simulations

The instructional medium used in the present study was an interactive video simulation. Simulations, simplified representations of real or alternate worlds, have been

used in classrooms where the real-life interaction may be difficult, dangerous, expensive or time consuming (Choi & Gennaro, 1987). The format of instructional simulations can range from written case studies to sophisticated multi-media packages (Raybould, 1990; de-Moura-Guimaraes & Dias, 1992). Interactive video simulations, teaching tools that combine computer and videodisc material, can stimulate problem solving, planning and decision making, and have the potential to promote higher level learning. Past research has suggested that one way to optimize the motivational variables of computer-assisted simulations is to allow students to work through the lessons in pairs or groups (Kearsley & Hillesohn, 1982; Rysavy & Sales, 1991). There is, however, a lack of sufficient research which investigates group work in terms of incentives and ability grouping, with interactive video simulations. A review of the literature revealed only two relevant studies (Vadas, 1986; Lookatch, 1990a, 1990b).

In order to further examine the effect of group incentives and ability grouping in an interactive video environment a tool was introduced into this study: an audience response tool in the form of online tracking. Audience response tools have been used in the past to assess viewers reactions to film and television, and their potential to provide the researcher with detailed formative and summative information has been illustrated by past studies (Baggaley, 1989; Nickerson, 1982). Audience-response type tools have also been used in computer-assisted-learning (CAL) and by intelligent tutoring systems (ITS) to help create computerized learning systems that are adaptive to students needs (Becker, 1988; Holt & Wood, 1990). A thorough review of past literature on interactive video instruction, however, revealed only one relevant study which attempted to track students' pathways through an interactive video program (Hoelscher, 1990). An online tracking program was used in the present study to provide insight into how learners from the different treatment groups: whether it be with incentive structures, ability grouping, or working alone, progressed through the interactive video simulation in an attempt to master the material The current study, with the use of this tracking data, planned to answer

questions such as why a particular group performed poorly or took more time to progress through the material with more certainty than just speculation.

Significance of the Study

When interactive video simulations are used in the classroom their potential to foster problem-solving and to motivate learners is significant as learners interact with dynamic material with individualized feedback and guidance. Research has suggested that one way to optimize the motivational variables of computer-assisted simulations is to allow students to work through the lessons in pairs or groups (Kearsley & Hillesohn, 1982; Rysavy & Sales, 1991). Working in groups can be a stimulating and enriching experience for students (Slavin, 1983; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). Grouping also reduces the monetary expenditure of purchasing numerous high cost computers and eliminates the logistic problem of finding sufficient space for these machines.

Though the potential advantages of grouping are important there is little past research done which details how to best group learners in an interactive video simulation environment, therefore, suggesting the best way to foster the problem-solving, planning and decision making that the simulation can provide. Grouping students on an interactive video simulation may be one technique which could be used to increase effectiveness and efficiency of interactive video instruction. Johnson and Johnson support this idea and state that: "The technology of computers and the interpersonal interaction promoted by cooperative learning provide complementary strengths" (1985, p. 12). With the introduction of sophisticated simulations into the classroom, such as those presented by interactive video, the issue of grouping becomes more critical as these systems are often very costly. The advantage of these systems is that they can present huge amounts of both text and audio-visual information to the learner.

Since it is possible for a teacher to assign tasks to individuals or groups and compose groups according to ability and incentive structure, generalizations about group

and individual performance have important and practical implications. With interactive video simulations, the question of how to structure groups so that they can effectively work independently of teacher intervention is an even more pressing issue

This present study created groups in terms of reward structure, ability grouping, and ability level and investigated how these variables functioned in an interactive video simulation environment. By investigating these variables in combination, the present study also hoped to clarify the differences and similarities in the terms 'cooperative', 'incentive structure', and 'ability grouping'. The need for clarification arises from several misinterpretations that were evident in the literature. Statements, evident in past research, that ability grouping may be an alternative to cooperative learning, that learners are always grouped heterogeneously in cooperative groups, or that working together in pairs automatically promotes 'cooperative learning' may mislead the researcher or educator (Morgan, 1989; Harp 1989; Lookatch, 1990b). By investigating incentive structure, along with groupings based on ability level, the study hoped to clarify the distinction and similarities between these variables.

The question of how interactive video simulations can best be used in education and training is an area of interest and needs to be further investigated. Research needs to explore what the optimum setting is for learners who posses varying characteristics to develop their thinking processes in interactive video simulation environments.

Chapter Two

Literature Review

The review of the literature has been organized into four distinct sections. The first section covers past literature on educational simulations ranging from paper and pencil type simulations to complex computerized systems such as interactive video simulations. The second section investigates group work as it compares to working individually, cooperative, competitive, and individualistic group incentives, and the area of ability grouping. The third section discusses interactive video. This section defines and discusses the effectiveness of this powerful tool, reports past research done in this area, and discusses how group work can be used to optimize the use of this medium The fourth section discusses the importance of investigating how groups and individuals approach and progress through material they are attempting to master. This section presents an overview and history of audience-response tools used in the past to determine how users respond to mediated material, and discusses how interactive video offers the ability to easily track the progress of learners through interactive video instruction.

Simulations

To prepare students to live in today's world educators must move away from a passive curriculum filled with lectures and rote-memorization to one which stresses critical thinking, understanding, application, synthesis, and problem solving. This can be partly achieved by introducing teaching methods into the classroom which shift the responsibility of learning from the teacher to the student by allowing students to test ideas, witness consequences, and discover answers for themselves. Simulations, simplified representations of real or alternate worlds, can be observed and altered to expand opportunities for active learning and can be used to change the role of the teacher

from that of a "fountain of wisdom" to that of a resource person or facilitator (Maclean, 1976; Storad, 1985).

Simulations of conceptual activities in the cognitive domain can stimulate problem solving, planning, and decision making tasks in which the learner can adopt the roles of the decision makers and planners (Romiszowski, 1987; Tennyson, Thurlow, & Breuer, 1987). Students can learn to trace their steps from the familiar to the new, from the fact or idea they possess to that which they wish to acquire. In other words the learner makes the journey in exploration and thought for himself (Birt, 1976). The concept of encouraging learners to discover answers by manipulating simulated environments is not new. As stated by Plato in the *Laws;* "the future builder must play at building, and the husband man at digging ... " (cited in Megarry, 1978, p. 187); and in the *Republic* Plato states, "... enforced learning will not stay in the mind. So avoid compulsion, and let your children's lessons take the form of play" (cited in Cornford, 1941, p. 252).

Educational simulations have been available for decades but it was not until the 1960s that researchers attempted to systematically determine their instructional effectiveness (Mitchell, 1982). In 1968, Tansey and Unwin presented a paper entitled *Simulation and Academic Gaming: Highly Motivational Teaching Technique* at the Association for Programmed Learning and Educational Technology (APLET), which attracted great interest (Megarry, 1978). Out of this interest rose NASAGA (North American Simulation and Gaming Society), and SAGSET (Society for Academic Gaming and Simulation in Education and Training) (Mitchell, 1982). Conference papers and symposiums followed which led to publications which in turn led to increased interest in the use of simulations in the classroom. Research was then carried out in an attempt to evaluate their usefulness as instructional tools.

The evaluation of simulations in terms of effectiveness, efficiency, retention, transfer, and attitude of learners has obtained mixed and unclear results (Shirts, 1976;

Hunter & Clark, 1977; Walker, 1978; Dekkers & Donatti, 1981; Foster, 1984). A review of the literature in 1977 by Hunter and Clark revealed that individual studies were considered to be of extremely poor quality and that all major reviews cited contradictory findings, used anecdotal evidence, and poor methodology.

A meta-analysis conducted by Dekkers and Donatti in 1981 on 93 research studies revealed that simulation as an instructional strategy did not improve cognitive development or retention over the lecture method but was more effective for attitude formation. This type of comparative evaluation, which tries to evaluate the supposed advantages that simulations hold over traditional teaching evaluates only those tasks where the simulation replicates a traditional method in seeking objectives that are already well established (Walker, 1978). Simulations, however, are tools for presenting open-ended material and research should investigate not how these tools compare to traditional instruction but when and how to best use this powerful teaching tool to create an optimal learning environment. This later type of research offers the potential to provide a clearer understanding of when it is best to use simulated material and how to create optimal environments for learners with varying characteristics.

Simulations have been used in science, mathematics, and social science where the real-life interaction may be difficult, dangerous, expensive, or too time consuming (Choi & Gennaro, 1987). They have also been used in history , geography , business, and management situations where, because of the enormous amount of time needed to complete the real-life situation, simulations are used to cover information in relatively short hours, weeks, or months (Birt, 1976; Stopp, 1976; Walker, 1978; Evans & Sculli, 1984). The premise of simulations is that by reducing the overwhelming complex interactions that exist in the real world, behavior options become manageable, and learners can develop deeper insight into the working mechanisms of the simulated situation (Hansen, 1989).

The format of simulations can vary from simple paper and pencil case studies to computer-monitored simulations (i e., MAIS*), to complex computerized simulated systems. Well-designed simulations have been seen to motivate, capture, and maintain the interest of learners while achieving their intended objectives (Mitchell, 1982; Ladousse; 1982). Some teachers, however, remain reluctant to use even the most simple paper and pencil simulations in their classrooms.

Teacher reluctance to use paper and pencil simulations in the classroom may be caused by their fear of managing a large number of artifacts or pieces of paper and the related fear of giving up the control of the classroom to the simulation. It may also be difficult for these teachers to repress their instincts to help while students struggle to solve simulation problems and to avoid the temptation of interpreting and explaining the meaning of the simulated experience to the students (Shirts, 1976). These difficulties have been partly alleviated by the introduction of kits, cassettes, and computer programs which help make the introduction of simulations into the curriculum easier for educators.

One powerful tool, the computer, has greatly improved the organization and accessibility of simulated material because of its unique data collection, storage, and retrieval capabilities. The computer has been used to simulate many situations which just a few years ago were not possible to teach as a complex whole instead of as successive parts. The computer can provide sound, colour, light, and graphics, which foster cognitive curiosity by producing an uncertain environment that sometimes fails to meet the anticipation's or expectations of the user (Andersen, 1983). Because computer simulations allow students to make choices, observe, and act on the consequences of their choices, they provide students with a way to study cause and effect, which in turn allows the student to test hypotheses and draw conclusions. It is this practice that allows

* MAIS - Minnesota Adaptive Instructional System - A computer based research tool which monitors simulations with the student doing most of the learning activities with resources other than the computer. (Tennyson, Thurlow, & Breuer, 1988)

learners to solve problems at a higher level of thinking in logical, mathematical, or symbolic simulations.

The computer's capabilities help the simulation to resemble reality. However, the complexity of the reality may make the implementation of a realistic computer simulation overwhelming for classroom use. Highly realistic and structured simulations called "simulators", used as aircraft and helicopter piloting simulations have been used to certify users for civilian and military aviation. Simulators, however, are rarely used in the classroom as teaching aids mainly because of their high cost and the time and difficulty in the construction and use of such systems. The simulator's overpowering complexity, as very realistic simulations, often makes them unsuitable for pedagogic intentions (Stopp, 1976).

Presently, there is increased interest in the area of multi-media and the introduction of such tools as hypermedia (including interactive video), expert systems, and telecommunications into the area of educational simulations (Raybould, 1990; de-Moura-Guimaraes & Dias, 1992). The question of how these sophisticated computer simulations can best be used in teaching and training needs to be further investigated. The current study is specifically interested in the introduction of interactive video simulations into the classroom environment.

Grouping

Group work versus individual achievement. Researchers have investigated whether working in groups is superior to working individually in a computer-assisted (CAI) environment in terms of achievement (Carrier & Sales, 1987; Cartwright, 1972; Cox & Berger, 1985; Guntermann & Tovar, 1987; Johnson and Johnson, 1986; Okey & Majer, 1976; Mevarech et al. 1987; Trowbridge & Durnin, 1984; Webb, 1984).

In a study conducted by Cartwright (1972) 282 McGill University students were selected and placed into one of four treatment groups: a control group with individuals

and three remaining treatments working in groups of two, three, and four. Cartwright found no significant differences in the group means of the four treatments and concluded that students work equally well whether they work in groups or individually. In a similar study conducted by Carrier and Sales (1987) 36 college juniors were assigned to one of two treatment groups, individual or paired, and asked to complete a task. It was concluded that although pairing students to complete a task did not lead to higher achievement scores it did not decrease their performance. Guntermann and Tovar (1987) also concluded, after studying 10-year-olds working in groups and individually with LOGO, that there were no differences between individuals and groups in terms of productivity. Okey and Majer (1976) similarly concluded that no differences in either cognitive achievement or attitude were evident in students who studied alone, in pairs, or in groups at a CAI terminal. A significant difference in time-on-task, however, was evident with groups of three and four students being superior.

Other studies, however, have concluded that group CAI is superior in terms of performance to that of working individually. Trowbridge and Durnin (1984) investigated the question of grouping by placing students in groups ranging from individuals to groups of four. They concluded that small groups had the advantage over individuals in using the computers and that groups interpreted the task as the authors of the material had intended.

Webb (1984) studied students learning LOGO for a one week period. She found that the verbal interaction in the group seemed to influence the learning of the basic commands although it did not seem to influence higher order learning, interpreting, and generating graphics programs; the primary focus of instruction. In another study by Webb, Ender & Lewis (1986) it was concluded that the group setting had significant positive effects on the individual student's behavior and learning. Mevarech et al. (1987) found significantly positive results and concluded that students working in small CAI

groups improved prosocial orientation and tended to score higher on the achievement test than those who worked individually.

It is apparent that the research is not conclusive as not all researchers agree if or how group work effects learners performance. Some researchers state that group work is equally productive to working individually (Cartwright, 1972; Carrier & Sales 1987; Guntermann & Tovar, 1987; Okey & Majer, 1976). Others state that group work is superior to individual work (Johnson & Johnson, 1986; Trowbridge & Durnin, 1984; Webb, 1984; Webb et al. 1986; Mevarech et al 1987; Cox and Berger, 1985)

There is a possible explanation for the differences in results and conclusions of past research which investigated the effect of group work on learner's achievement. With the exception of Guntermann and Tovar (1987), it appears that the researchers who found no significant differences assigned drill and practice type tasks to the subjects, while the ones that found a significant positive difference assigned more problem solving tasks. In illustration, Cartwright (1972) asked his subjects to simply type in the word or phrase required by presented frames, and Carrier and Sales (1987) provided subjects with descriptions and best examples of concepts and asked them to simply identify the concept represented. Okey and Majer (1976) asked students to learn low level objectives taught in a drill and practice procedure. All three studies failed to find significant differences for achievement. Mevarech et al. (1987), however, found a marginally positive, significant difference when students were asked to identify terms, classify words, and demonstrate knowledge and application of rules.

Johnson and Johnson (1986) found significantly positive differences for achievement when problem-solving tasks were assigned to students in cooperative groups. Trowbridge and Durnin (1984) likewise assigned problem-solving tasks and asked subjects to manipulate pictures of batteries, bulbs, and wires on the computer screen to perform experiments with simple DC circuits The purpose of this task was for the subjects to discover the idea of current flow through a complete circuit. Webb

(1984) and Cox and Berger (1985), who also found significant positive differences assigned problem-solving type tasks by presenting LOGO and BASIC to the participants or had students complete problem-solving puzzles.

This research suggests that for problem oriented tasks, group work may be more beneficial. Classroom organization which is often set up for whole class or individual work, will therefore have to be re-examined if group work is to be encouraged (Taylor, 1989). To understand how to create optimal learning groups, research will need to investigate the way learners interact when placed in problem-solving groups and the effects groups have on learners achievement, attitude, and instructional efficiency.

Cooperative, competitive and individualistic groups. There are three basic ways in which individuals can work together in groups. They can compete, work individually on their own goal without paying attention to the success of other group members, or they can work cooperatively with a vested interest in each others learning as well as their own (Johnson & Johnson, 1985). Working cooperatively in small groups in which members are expected to help one another learn, understand the concepts presented, and solve the problems involved has been found to increase achievement, (Slavin, 1983; Johnson et al., 1981; Dalton, Hannafin & Hooper, 1989; Hooper & Hannafin, 1991). It has also been found to facilitate the development of higher level processing skills, deeper understanding, critical thinking, and long term retention (Litchfield, 1990; Johnson & Johnson, 1990). Cooperative efforts have also been seen to result in "more frequent process gains and collective induction and higher performance on subsequent tests taken individually (group-to-individual transfer) than did competitive or individualistic efforts" (Johnson & Johnson, 1990, p. 33). Researchers have also found that individuals in cooperative groups use elaboration and metacognitive strategies more frequently, and thus perform better, than individuals working competitively or individualistically (Spurlin, Dansereau, Larson, & Brooks, 1984). Evaluations of cooperative classroom strategies such as Jigsaw, Teams-Games-Tournaments (TGT), and Student Teams and Academic

Division (STAD) have indicated that cooperative techniques not only improve academic achievement but also improve social and affective variables such as race relations and mutual concern (McDonald, Larson, Dansereau & Spurlin, 1985; Sharan, 1980).

A meta-analysis conducted by Johnson et al. (1981) reviewed 121 studies which dealt with cooperative group learning versus individualistic or competitive learning. The overwhelming conclusion from the cooperative, competitive, and individualistic goal structures on achievement was that cooperative groups are superior to the competitive and individualistic goal structures on achievement.

Johnson, Johnson, and Stanne (1985) investigated cooperative computer-assisted-instruction and reported that working alone at a computer limits the amount of divergent thinking and creativity. They claim that the technology of the computer and the interpersonal interaction promoted by cooperative learning provide complementary strengths (Johnson & Johnson, 1985). Their findings of cooperative learning in CAI suggested that:

> ...computer-assisted cooperative learning promoted greater quantity and quality of daily achievement, more successful problem solving, and higher performance on factual recognition, application, and problem-solving test items than did computer-assisted competitive and individualistic learning. (Johnson & Johnson, 1986, p. 15)

The most predominant ways in which cooperative learning has been encouraged is through:

1. Group Study With Group Reward for Individual Learning - students work as a group to complete a single task, are assessed individually, and group members scores are summed to form group scores

2. Group Study With Group Reward for Group Product - students work as a group to complete a single task and are praised and rewarded as a group.

3. Group Study With Individual Reward - students work as a group to complete a single task with no group rewards. Students are graded solely on the basis of their own work.

4. Task Specialization With Group Reward for Group Product - students are given a subtask within the group topic and group rewards are based on a single group product or report.

Although cooperative techniques employed by research have not been consistent across studies, Slavin (1983) concluded that "only methods that provide group rewards based on group member's individual learning consistently increase student achievement more than control methods " (p. 429). Slavin also found that, overall, the effects of cooperative learning were positive. Of 46 studies, 29 (63%) showed cooperative learning methods to have significantly positive (or, in one case, marginally positive) effects on student achievement, 15 (33%) found no differences, and 2 (4%) found significantly higher achievement for a control group than for a cooperative group (1983, p. 434). When one investigates group reward for individual learning, however, the percentages are higher: (a) 89% positive for group study without task specialization, and (b) 100% for group study with task specialization. Slavin (1989) therefore concluded that cooperative learning can be an effective means of increasing student achievement if group goals and individual accountability are incorporated into the cooperative methods.

When students are grouped with group goals and rewards, positive interdependence should also be encouraged (Johnson & Johnson, 1990). According to Johnson and Johnson (1990) "positive interdependence exists when one perceives that one is linked with others in a way so that one cannot succeed unless they do, and/or that one must coordinate one's efforts with the efforts of others to complete a task" (p. 27). They further suggest that positive interdependence is the most important factor in making a group cooperative and if group members do not perceive that they are interlinked then the motivation for group success is not present and there is no reason to expect them to outperform other groups or individuals.

While research on learning in cooperative groups has increased during the past several years most of the research has focused on learners in grades 2-9 and some research

with learners in grades 10-12 or higher (Sherman & Thomas 1986; Slavin, 1990). Based on higher education literature, cooperative techniques with adult learners is a viable educational strategy (Cooper, Prescott, Mueck, Cook, Cuseo, & Smith, 1990, Dansereau, 1983). Past research has suggested that techniques, such as cooperative grouping, help to involve adult students in their university learning experience, thereby promoting their problem solving abilities and critical thinking more than traditional methods (Kulik & Kulik, 1979; Smith, 1977).

For example, research with college students in peer-monitoring programs, which fostered peer tutoring, resulted in improved performance (Fraser, Beaman, Diener, & Kelem, 1977; Beaman, Diener, Fraser & Endresen, 1977). Though peer monitoring resembles cooperative learning it is not synonymous. The group work used in these studies was an additional separate component and not a controlled treatment. It is not clear, therefore, if it was the peer tutoring which improved achievement or simply that these students were required to spend extra time with a peer on the information they were attempting to master. As a result, generalizations to other cooperative learning environments should be made with caution

Slavin's (1983) extensive review of the literature did not include studies with college level learners and it is not clear how group rewards function at college level as conclusions from studies with younger learners cannot be safely generalized to older learners. More research, therefore, is badly needed in this area

Group ability composition. The way in which students are encouraged to work in groups, whether with cooperative or other incentives, continues to be an area of interest in the research but the issue of ability grouping is also of particular educational significance (Slavin, 1987a; 1987b; 1990; Dawson, 1987; Manning & Lucking, 1990). Ability grouping is a term that has many meanings but it generally refers to grouping students for instruction by ability or achievement so as to reduce heterogeneity (Slavin, 1987a; 1987b). Its use was first reported in 1867 in St. Louis, Missouri and today it continues to exist but

in many different forms (Manning & Lucking, 1990, p. 254). The premise of ability grouping is that by reducing the heterogeneity of the class the teacher is better able to provide an optimal pace and level of instruction for most students.

According to Slavin (1987b) there are various grouping plans which are currently used in education. These plans group students on the basis of their ability for selected subjects such as reading (e.g., Joplin Plan) and mathematics, creating special classes or groups for high and low achievers. This grouping can either be done across grade levels or within intact classes. Most teachers today use some form of within-class ability grouping in their classrooms to create small groups which can work on "different materials at rates unique to their needs and abilities" (Slavin, 1987b, p. 296). Within-class ability grouping, in which students are taught in ability-homogeneous subgroups within a heterogeneous classroom, has been used successfully in math and reading instruction in elementary schools (Kagan, 1989; Slavin & Karweit, 1985; Slavin, 1987a; 1987b). Educators and researchers do not agree, however, whether homogeneous grouping should be the sole grouping technique used when attempting to improve achievement, attitude, and/or instructional efficiency.

Proponents of homogeneous grouping state that it takes individual differences into account by allowing students to work with similar ability peers, thereby advancing at their own pace with others of similar ability (Noddings, 1989). Noddings states:

> It seems reasonable that groups organized for higher-order tasks (application, analysis and synthesis) should be relatively homogeneous both in achievement and on a measure of sociability so that all members can participate freely and equally. (1989, p. 615)

Proponents of heterogeneous ability grouping argue that homogeneous grouping does not create an optimal learning environment for all students (Espositio, 1973; Slavin 1987a; 1987b; Good & Marshall, 1984).

Esposito (1973) summarized the literature and stated that though ability grouping research differs in terms of treatments, group size and so on:

> ...[homogeneous] ability grouping as currently and generally practiced produces: (a) conflicting evidence in promoting scholastic achievement in the relatively high or superior groups; (b) almost uniformly unfavorable evidence for promoting scholastic achievement in average groups; and (c) almost uniformly unfavorable evidence for promoting scholastic achievement in relatively low ability groups. (p. 167)

Other researchers and educators fear that homogeneous ability grouping is not only ineffective, it is undemocratic and affects the self-concept and self-esteem of young learners, placing a stigma on low achievers and inflated sense of self-worth on high achievers (Manning & Lucking, 1990; Dawson 1987). These researchers and educators feel that being labeled and assigned to a low ability group communicates low expectations for low achievers which may be a self-fulfilling, and also fear that low achievers may experience a slower pace and quality of instruction than needed (Good & Marshall, 1984). Homogeneous ability grouping has also been criticized for segregating children not only on ability but also along class, race, ethnic, and socio-economic lines (Rosenbaum, 1980).

Slavin's (1987a; 1990) recent "best evidence syntheses" on the effect of ability grouping on elementary and secondary school children provides some guidance in effective ability grouping . Slavin states that between-class ability grouping has few if any benefits for school children but that grouping students homogeneously for a specific skill or subject while students still remain in heterogeneous classrooms may be beneficial and eliminate some of the fears expressed above.

Within the debate of whether to group learners homogeneously or heterogeneously in terms of ability, is the disagreement of whether high, medium, and low-ability students benefit equally from participating in these groups. Researchers who support heterogeneous ability grouping state that it has important advantages for all ability groups. Their studies have found that high, medium, and low-ability students working

cooperatively in heterogeneous groups outperformed their counterparts working alone or competitively (Johnson & Johnson, 1986; Slavin, 1989). High-ability individuals working with medium and low-ability peers developed higher reasoning skills than their counterparts working individually or competitively (Johnson & Johnson, 1986; Slavin, 1989). In addition, there is research which found that students collaborating with peers of discrepant learning abilities learn more than collaborating with same ability peers for some learners (Webb 1985; Hooper & Hannafin, 1988).

Webb (cited in Davidson, 1985) investigated subjects working in homogeneous and heterogeneous four-person groups working cooperatively at a task. She concluded that the best to worst conditions in terms of achievement were: heterogeneous ability grouping, individual learning, and homogeneous ability grouping. Webb (cited in Davidson 1985), however, found an aptitude-treatment interaction with the preceding order holding for low-ability subjects but reversed for medium-ability subjects. High-ability groups performed less well in homogeneous-ability groups than in other conditions.

Peterson, Janicki, and Swing (1981), and Swing and Peterson's (1982) research results also indicated aptitude-treatment interactions (ATI) in small mixed-ability groups. Their results suggested task-related interaction in small group work enhanced the achievement and retention of information for high and low-ability students but not for medium students even though medium students did not engage in less interaction than did high and low-ability students. Hooper and Hannafin (1988) also found an ATI, with low-ability subjects achievement being improved more than 50%, when grouped heterogeneously, over low-ability subjects working homogeneously, while not affecting the achievement of high-ability subjects.

Research in the area of group composition has continued in an attempt to understand why learners perform differently when groups are composed of same ability or mixed ability peers. Webb (1985) investigated intra-group interactions and examined the difference in the effect of giving and receiving information within a group. She found that

giving explanations to peers was beneficial to achievement while giving only information to peers without explanation was not related to achievement. On the other hand receiving information without explanation or receiving no help when it is needed were both detrimental to achievement. Webb found that in relationship to achievement:

> ... high-ability students gave more explanations in mixed ability groups than in uniform-ability groups; low-ability students received more explanations in mixed-ability groups than in uniform-ability groups; and medium-ability students gave more and received more explanations in uniform-ability groups than in mixed-ability groups. (1985, p. 165)

Webb (1985) also found that three and four member heterogeneous groups with students from two ability levels were beneficial for all learners while groups composed of three ability levels were beneficial for students with high and low ability but not medium ability.

Laughlin, Branch, and Johnson (1969) investigated learners working in homogeneous and heterogeneous three-person groups In general, they concluded that group performance was proportional to the number of high ability learners in the groups and that high-ability subjects performed best working in groups with comparable high ability partners, while medium and low ability subjects did not benefit by working with comparable partners. In a later study Laughlin and Branch (1972) studied four-person groups and found consistent results in that performance was again proportional to the number of high-ability students in the group Interestingly, not only did low ability members not contribute to the group but the presence of two or three low ability members actually hindered the performance of high ability students relative to what they could have been achieved working individually. Laughlin and Branch (1972) also found that homogeneous high-ability group members performed better than they would have if they worked alone, medium-ability members performed somewhat better, and low ability

members did not differ from low ability subjects working on their own. Consistent findings were found in a later study done by Laughlin and his associates (Laughlin, 1978).

Recent research suggests that low achievers grouped heterogeneously for ability increased their achievement and efficiency over homogeneously paired lows but that high-ability students excelled in homogeneous grouping compared to their heterogeneously grouped counterparts (Hooper & Hannafin, 1988; 1991).

Past literature, therefore, provides researchers and educators with conflicting guidance as to how to group learners with varying abilities for optimal achievement. Despite this uncertainty, in cooperative learning groups, learners of all abilities are often grouped heterogeneously by ability (Johnson & Johnson, 1982; 1985; 1986; 1990). Johnson and Johnson strongly feel that heterogeneity "leads to potential controversy, and to more diverse interaction pattern and resources for achievement and problem solving" (p. 101). Perhaps because of Johnson and Johnson's strong influence in this area (1982; 1985; 1986; 1990), some researchers have considered that learners are always grouped heterogeneously in cooperative groups. Because of this misinterpretation some research findings should be interpreted with caution as researchers make statements such as 'ability grouping may be an alternative to cooperative learning' (Morgan, 1989, Harp, 1989). Research, such as the present study, which investigated cooperative techniques with homogeneous and heterogeneous ability grouping hopefully helped to clarify some of these misconceptions.

Interactive Video

Grouping and interactive video Interactive video is a relatively new medium which combines the power of the information handling capabilities of the computer with the illustrative capabilities of full motion video. It allows learners to move through material using feedback, embedded questions, and guidance functions. Its premise is that since the medium is interactive it has the potential to increase attention, involvement, and subsequent learning. Users are required to progress through the program by constantly moving between the active mode within the computer-driven part and a receptive mode as they watch video (Laurillard, 1984). At first glance interactive video appears to be a powerful new tool, however, the component technologies of interactive video need to be carefully considered as there may be "the temptation to show off the technical power of the medium rather than to pursue the instructional goal with the least cost, effort, and fanfare" (Braden, 1986, p. 20).

The technology of interactive video is powerful as it allows one to present pictorial, print, and audio information in many combinations. The designer, therefore, has the opportunity to match information and present it in the most optimal fashion (Nugent & Stone, 1980). Furthermore, with the vast information resources that can be placed on one disc, and the number of ways information can be put together and utilized, the researcher can aid the designer in clearly delineating the effects of the many diverse elements of a videodisc production (Nugent & Stone, 1980) While the technology of interactive video processes characteristics that are unlike any of its parent technologies (i e., television and computers), it seems unlikely that interactive video differs radically from allied technologies in terms of learning or cognition (Hannafin, 1985).

A recent meta-analysis of 63 studies concluded that interactive video is an effective instructional method for increasing achievement (McNeil & Nelson, 1991) Previous studies have investigated the relationship between interactive video and instructional control (Hannafin & Phillips, 1987, Hannifin & Calamaio, 1987), orienting

activities (Hannafin & Hughes, 1986, Hannafin; 1987) as well as presentation, sequence, encoding, and retrieval (Anderson & Lorch, 1983; Goetzfried & Hannafin, 1985; Tennyson, 1980; Hannafin & Phillips, 1987).

Past research on interactive video has investigated learners working predominantly individually (e.g., Goetzfried & Hannafin, 1985; Hannafin, 1984; Ross, 1984; Steinberg, 1977). Interactive video systems can also be utilized by groups of learners (Cockayne, 1991), however, a review of the research indicated only two comparative studies which investigated grouping in an interactive video environment (Vadas, 1986, Lookatch, 1990a, 1990b).

Vadas (1986) investigated grouping with interactive video by looking at four treatment groups. These were individuals (one-on-one), small groups with 5 students (one-on-few), and facilitated groups with 8 to 12 students assigned to a facilitated classroom structure (one-on-many). She also included a comparison to a traditional lecture-based classroom version of the program. Vadas (1986) concluded that students in the interactive video based treatments collectively outperformed those in the traditional classroom (lecture-based) treatment but because of a small sample size in the one-on-one treatment no conclusion could be drawn between individual and group work with interactive video. Vadas's research should encourage future research in the area of individual work versus grouping in an interactive video environment in an attempt to determine if there should be groups and, if so what size of group is optimal in terms of effectiveness and efficiency.

Lookatch (1990a, 1990b) looked at similar treatment groups within the context of achievement and critical thinking skills in an interactive video environment. He concluded that the cooperative and facilitated treatment conditions resulted in more critical thinking skill gains than the individual treatment and favored the cooperative treatment with respect to instructional efficiency. In terms of achievement, however, subjects receiving the individual treatment outperformed the cooperative and facilitated groups. Lookatch noted

that results of his study were contrary to those found by other cooperative studies and stated that since no other study had investigated cooperative learning and interactive video it appeared that:

> "subjects anticipated differing needs of their partners, they elected in advance when, individually, they preferred to review material or explore additional branches on the interactive laserdisc. These findings suggest that the two-way working relationship of the cooperative setting hampers full utilization of the instructional benefits of interactive laserdisc training (e.g. exploration of multiple paths, branching, reviews, ect.)." (Lookatch, 1990b, p. 9).

Though Lookatch's conclusion appears discouraging as to the effectiveness of cooperative techniques with interactive video, the reader should interpret the results with caution. One point to keep in mind is that the cooperative incentives used were not explained and the reader is only informed that the researcher's definition of cooperative learning is two students assigned to a work station. Past research has found that for cooperative groups to outperform other groups, positive interdependence must be fostered with the use of cooperative incentives (Slavin, 1989) It seems evident that since Lookatch did not provide cooperative incentive structures to create positive goal interdependence learners did not perceive that their achievement was linked. Lookatch's (1990a, 1990b) findings, therefore, that the cooperative group did not outperform the facilitated group are consistent with comparative research which investigated cooperative and individualistic incentives (Slavin, 1989).

It appears from these two studies that further research is needed into how grouping in an interactive video environment effects performance and attitude. Without further investigation it is unclear what type of group structure is best to use, which incentive structure can safely be utilized with interactive video, and what guidelines to follow when creating an effective and efficient interactive video environment.

Audience-Response Research

Although much of this document has discussed group structure, group incentives, and group dynamics as they apply to environments with and without CAI and interactive video, it is important to look at how groups and individuals approach material they are attempting to master. Formative research has looked at the particular formal characteristics of mediated materials (mode of presentation, camera techniques, pace, structure, editing etc.) and their affect on the educational value of the presented material (Murray, 1980; Baggaley, 1982). This focus gained strength, however, only after the era of media comparison studies had run their course.

The focus of educational research in the 1960s was media-comparison; "Could this medium communicate an instructional message?", "Does it teach better than ... ?". This research was based on the naive assumption that the medium, rather than some specific attribute or quality of it, effected learning and failed to tell us what precise qualities accounted for differences (Salomon & Gardner, 1986). This type of research often tried to create the same situation on and off the medium and not surprisingly, significant differences were seldom found as effects canceled each other out as they were averaged across individuals. Once the media-comparison research had exhausted its course of "no significant difference", evaluation research returned as a means of product improvement. It then focused on specific, relatively unique features of the medium and developed more refined questions to determine which and how salient attributes and qualities of the medium influenced the viewer (Salomon & Gardner, 1986).

According to Krull (cited in Hannafin, 1985) attention is co-moderated by both the cognitive activities of the learner and the formal features of the instruction. The attention of the learner, therefore, "can be affected by both the expectancies and experiences of the learner *and* by the capability of the instruction to direct and maintain attention for effective comprehension" (Hannafin, 1985, p. 240). Comprehension may not be effective if learners

cannot or do not attend to the salient instructional features designed to direct and to maintain the learners' attention (Hannafin, 1985).

Coldevin (1981) did a thorough review of the formal feature literature and found, as did Baggaley (1976;1980), that changes in production and performer variables can influence a viewer's perception of mediated material. The investigation of formal features such as visual-audio visual reinforcement, still versus motion pictures, screen composition, special effects, attention-directing and controlling-cues by a viewer, can help the researcher to design instruction utilizing these factors most effectively (Coldevin, 1981). Baggaley (1976) found that in specific situations the credibility of persons or material seen on television and the views or information conveyed by them are affected by unconscious biasing factors that, once identified, may be controlled. Researchers should separate and study the threads of the complex phenomenon by studying how viewers respond to specific formal features in mediated materials.

The audience-response research and formal features research is not limited to past technologies and can be used to improve and develop new media Although new technologies possess characteristics which are unique, the findings of the effectiveness of their components need to be reviewed so mistakes of the past are not repeated. Research techniques used to investigate audience-response and the formal features of video-based instruction can contribute to our understanding of interactive video.

The following section presents an overview and a history of devices that have been used to track learners' progress through material in an attempt to improve the final product and add to our knowledge of the learning situation

A technique which has been used in the past to help determine the effectiveness and efficiency of mediated instruction is the use of audience-response tools (Cambre, 1981; Baggaley, 1989; Nickerson 1982) . These tools have been used to track viewers' minute-by-minute or second-by-second responses to television and video productions in an attempt to improve the final product. Both television and video present information in

a linear fashion, but a similar audience-response technique can be incorporated into a non-linear medium such as interactive video with a little ingenuity.

The audience-response tool for interactive video would have to take into account many more factors than an audience response tool for television or video instruction, since the options the viewer is able to choose from are simply greater with interactive video instruction. An audience-response tool for interactive video would have to track, not only if a viewer liked or disliked a particular segment of instruction, but also how long the viewer spent on that particular segment, whether they returned to it, received feedback or guidance related to it, in what format, and so on. This study utilized an audience-response tool in the form of online tracking created specifically for this study. This tool was used to track the non-linear pathways of students progressing through the interactive video program.

The online tracking program used in the study recorded the student's sequence through the software in terms of their frequency and time spent on all program events in terms of *still*, *video*, *step*, *freeze*, *menu*, *execute*, or *call*. These numerous events were condensed to 52 specific events classified as either a *video*, *step*, or *call (decision)*. The operational definition of these events are presented below.

- *Video* refers to full motion, audio-visual, segments.
- *Step* refers to a series of stills (montage) which presented information in a step-like fashion.
- *Call* refers to any decisions or choices the learner was presented with.

These events take into consideration four ways in which information can be presented in interactive video instruction.

As *video* was the main variable investigated in past audience-response research, this study was designed to provide information on the added variables that learners have access to as they progress through interactive video instruction. It was hoped that by tracking these additional variables it would be possible to assess the learner's use of time

as they progressed through the individual events that made up the interactive video instruction.

From the tracking data collected it is possible to create a map of each learner's pathways. Further analysis of these pathways can provide software designers with information as to how to optimally create effective software for learners of varying abilities. This type of tool offers great potential to researchers and software designers. The strengths and potentials of the online tracking program used in this study, as well as future online tracking programs, are illustrated in this study.

The next section demonstrates how past research of audience response tools with television and film can be used to help understand the dynamics within an interactive video environment.

History of audience-response tools Evaluation has been used extensively in film, television, video, and computer research to determine which audio-visual or visual segments, in terms of formal or presentational characteristics, should be included, excluded, or modified in order to create an effective and comprehensive product. Viewer response profiles, sets of sentences, or word items that are rated on scales such as agree/disagree, are often used. These measures, such as the Well's Reaction Profile, Leavitt's Multidimensional Profile, and the Schlinger's Viewer Response profile, provide researchers with viewers' responses to mediated materials (Zinkhan & Burton, 1989). These profiles are able to gauge a viewer's immediate reaction to material after it has been viewed in its entirety. Although these profiles may help to evaluate the effectiveness of a completed product (summative evaluation), they could also be used to evaluate a viewers reaction to material while it is in pre-production format (Young & Robinson, 1987) These scales, however, are not able to determine a viewers moment-by-moment reaction to material. The development of electronic and micro-computing facilities has added a new dimension to this formative research and media producers no longer have to rely

exclusively on this type of pen and pencil category-scaling measurement in determining a production's impact (Baggaley, 1989; Nickerson 1982).

The Program Analyzer developed by Lazarsfeld and Stanton in the 1940s was the first major mechanical device used to evaluate audience response to mediated materials, in this case radio (Cambre, 1981). Audience members simply pushed buttons to register their response to a program. Ratings were based on statements of like/dislike/indifference, learning/not learning and other variations of the same. The device mechanically recorded on a second-by-second basis the audience's reaction to the program. Results were illustrated in a rating profile; a graphical representation of the continuous reactions of the audience to the program as it proceeded (Cambre, 1981). The Program Analyzer gave way to subsequent models which allowed continuous tallying of nonverbal responses to test questions and presentations (Cambre, 1981) such as the Hopkins Televote Machine and the TELEVAV in late 40's and 50's (Millard, 1992).

In the early sixties specially equipped theaters (ASI), two-way cable TV systems (QUBE), and dedicated telephone lines (VOXBOX) were used to collect viewer-response information (Nickerson 1981). These systems, however, were criticized for having non-representative sampling, logistical inflexibility, limited analysis capability, and lastly high cost (Nickerson 1982). Five microcomputer-based audience response systems were developed in the 1970s and 1980s to overcome some of these research constraints. These were the PROMPT, the Program Evaluation Analysis Computer (PEAC), the Quick Tally, Speedback, and the Ballot Box systems.

The PROMPT system is an interactive system which, on the basis of a viewer response to an on-screen questionnaire, selectively presents individual viewers with appropriate video material or branches to further questioning (Nickerson, 1982). PROMPT presents two television channels, and allows the viewer to switch between channels using a numeric key pad depending on interest in the content. The computer

tracks the channel switching between the two stations and analyzes the data to determine the viewer's attention and interest to the material.

The PEAC system was developed by Nickerson and Mielke primarily to test young children's reactions to educational television (Baggaley, 1987). It allows a moment-by-moment record of viewers reactions (i.e., appeal, comprehension, persuasiveness) to mediated material as the respondents view the material. Using a portable, wireless, hand-held, remote control-like unit the researcher can replace written evaluation reports with data that easily converts to graphic outputs. The various buttons can be given any value relevant to the objectives of the research and appropriate to the respondents. By labeling keys with a scale ranging from A ⇒ E, representing "very good" to "very poor", the researcher can gather valuable minute-by-minute data that can be used to improve the production. With young children or people who cannot read "smile" and "frown" buttons can be used to measure viewers' emotional responses. When the continuous record of audience-responses is synchronized (literally superimposed) with the production itself, the producer can inspect data for momentary fluctuations in viewers' responses to create a more effective production (Baggaley, 1987).

The Quick Tally system was developed in Oregon with a focus on electoral polling and is very similar to the PEAC system. No systematic research has yet been published on this system as it is being used for advertising and persuasive purposes. The Speedback system, developed by Hughes, has been used to measure audiences continuous responses using a keypad and dial to events such as TV advertising and political speeches (Hughes, 1992). The Ballot Box, which uses a keypad similar to a touch tone phone, developed by The Wirthlin Group, was relied upon by the Reagan White House to measure audiences responses to the President's speeches (Millard, 1992). As political candidates and advertisers keep this information confidential, it is not clear how, or how widely, these systems, or similar systems, are being used today

The second-by-second precision of tools such as the Program Analyzer, PEAC system, the Quick Tally System, Speedback, and the Ballot Box allow the researcher to identify effects due to particular variations in production techniques. However, the speed with which information can be collected and analyzed can influence the researcher's objectivity. Caution must be taken not to over or under-estimate the findings from continual response research (Baggaley, 1987). Researchers should also use a large representative sample and be cautious of the novelty effect that could result from these audience-response tools.

It is hoped that with these tools producers or researchers will be able to observe, through monitoring, where levels of enjoyment are high. We have, therefore, progressed from evaluating whether or not a medium can teach to evaluating at which point a program loses its enjoyment for particular groups. These electronic evaluation systems have been found to be effective tools in evaluating emotional reactions, and but it is unclear if these tools can be used to effectively evaluate cognitive objectives (Schmid & Daningburg, 1988).

It is partly this potential to access the emotional reactions of viewers to material that has caused the PEAC and other similar systems to move away from the educational realm to the more profitable world of advertising and politics to evaluate image-making, phrase testing, and agenda setting. Instead of improving visual materials for the classroom, or exploring cognitive theories and basic issues, researchers in this area are more concerned about predicting the potential commercial success of particular productions.

In an attempt to make the analysis of television's impact a more precise science research has also attempted to investigate not only how viewers react to TV material, but also "*who*" is watching. By having members of the audience, often a family in their own home, push individually assigned buttons on a small data-entry terminal about the size of a TV converter, information on viewing status can be gathered (Lu & Kiewit, 1987). This

technique requires active cooperation on an on-going basis from people in the metered homes as they punch in when they begin to watch and again when they leave the room.

Audience-response research with CAL and ITS. Audience-response tools have also been used in computer-assisted-learning (CAL) and by intelligent tutoring systems (ITS) to help create computerized learning systems that are adaptive to students' needs (Becker, 1988; Holt & Wood, 1990). These tools are concerned with isolating students' misconceptions and do not require active participation from the learner. CAL uses "dribble files" which are files which track how students respond to the presented material ITS's tracking of students' progress is more complicated and attempts to model the student; the model being a representation of the errors or misconceptions that occur when the learner is exposed to the content. Learner models are compared to expert models (which contains correct answers), and if comparisons reveal differences, misconceptions can be isolated. A comprehensive student model in ITS would contain not only the students pathway or progress through the program, but also the students prior learning, learning style, and other types of related information (Holt & Wood, 1990). CAL and ITS attempt to behave as if they "understand" the student's competencies and thus apply the correct teaching methods to the learner (Holt & Wood, 1990).

Though ITS offer much potential to track students second-by-second progress through the material, and then directly apply this information, they are very expensive and have only been used successfully on procedurally defined tasks (Holt & Wood, 1990). Though CAL is less expensive and more widely used, research on the use of dribble files to determine where misconceptions lie, currently is too technical for the general audience in the educational field (Holt & Wood, 1990).

Audience-response research and interactive video Audience-response research in the area of film, television, CAL and ITS is available as was illustrated in the preceding

literature reviews. Audience-response research in the area of interactive video, however, is woefully lacking. Studies which investigated how learners respond to interactive video material on a second-by-second bases is almost nonexistent. A thorough review of the literature revealed only one study which attempted to track students' pathways through interactive video instruction (Hoelscher, 1990).

Hoelscher (1990) investigated students' pathways with an online computer program which simulated the experience of a junior partner in a law firm. The tracking device recorded each user's pathway (i.e., the series of steps and time elapsed between those steps) used to investigate a case. The usefulness of this study's tracking, however, is very limited as only nine steps were investigated and the available sequences through these steps was very linear. Tracking learner's pathways was not the main focus of the study and was not treated as such as the analysis described the process of moving through the software in a very static fashion.

Interactive video is not a static medium and because of its storage capacity, can keep an accurate record of every move the learner makes as they progress through the program. It can provide the researcher with data regarding how viewers divide their viewing into individual segments and which segments of instruction do and do not receive attention (Hansen, 1989). By providing the researcher with tracking information which reveals where students spend the most or least amount of time as well as the types of branching utilized by learners, the researcher can speculate as to why learners excelled or failed with the interactive video instruction.

Interactive video is a dynamic medium and needs dynamic models of representation to analyze the viewing process. What is lacking is a clear understanding of how learners progress through an interactive video program and what formal features are either utilized, avoided, helpful, or confusing to learners using this powerful learning tool.

Operational Definitions of Terms

Ability - In this study ability refers to the score, converted into a *z* score, achieved on the Comprehensive Ability Battery (CAB) achievement test on the verbal ability, numerical ability, spatial ability, inductive reasoning, and associative memory scales. A *z* score up to and including -.5 constitutes a low ability subject, -.49 through .49 a medium ability subject, and .5 or above a high ability subject.

Attitude - Attitude refers to the student's response on a 5 point Likert scale to questions regarding the level of enjoyment or usefulness of the program and the usefulness of pairing (dyad or individual).

Control group - The control group refers to a group of subjects who did not work with a partner and therefore did not have incentive structures or ability grouping. Subjects in this group worked individually and independently.

Cooperative group - The cooperative group refers to the presence of an incentive structure which fostered positive interdependence. Learners in this group were informed that the score on the post-test for one group member would be combined with the score of the other group member to obtain an average score which both group members would receive as their final score.

Heterogeneous Ability group - The term heterogeneous ability group refers to a group composed of different ability peers as measured on the CAB ability test. There are three possible heterogeneous ability groups: a high-ability subject with a low-ability peer, a high-ability subject with a medium-ability peer, and a medium-ability subject with a low-ability peer.

Homogeneous Ability group - The term homogeneous-ability group refers to a group composed of same ability peers as measured on the CAB ability test. High-ability subjects were grouped with another high-ability peer. A medium-ability subject was grouped with a medium-ability peer, and a low-ability subject was grouped with a low-ability peer.

Individualistic group - The individualistic group refers to the use of an incentive structure, not meant to foster positive interdependence, in which learners were informed that their score on the post-test would be unrelated to the score obtained by their partner. Each learner, therefore, was informed that they would receive their individual score as a final score.

Learning achievement - Learning achievement was measured by a case study post-test and a multiple-choice post-test.

Matched subjects - Subjects were matched, grouped closely on ability level, to create homogeneous-ability groups. Subjects were matched with subjects of different ability levels to create heterogeneous-ability groups.

Online Tracking or Sequence - Online tracking refers to the sequence subjects followed through the software in terms of frequency and time spent on 52 selected events. Events are classified as: *video*, *step*, or *call* (*decisions*).

Simulation - A simulation is a working representation of reality; it may be abstracted, simplified, or an accelerated model of the process. In this study the simulation used was a program called "The Business Disc: How to Start and Run a Small Business".

Time-on-Task - Time-on-task is the amount of time taken to complete the simulation as measured by an adjunct program to the Business Disc interactive video program.

Research Questions

The present research investigated the relationship between group incentive structures, ability grouping, and ability level on achievement, attitude, time-on-task, and student's sequence on a guided discovery, interactive video simulation. The following questions and hypotheses were investigated.

Q1. Will a cooperative incentive group's achievement be superior to that of a individualistic incentive group, or individuals working independently?

Q2. Will homogeneous (similar ability) or heterogeneous (dissimilar ability) group's achievement be superior?

Q3. Will there be an interaction between group incentives structure (cooperative or individualistic) and group composition (homogeneous, heterogeneous, or individuals working independently)?

Q4. Will learners with varying abilities perform differently in different treatments?

Q5. Will the time needed to complete a task be influenced by group incentive structure (cooperative or individualistic) or group composition (homogeneous or heterogeneous in terms of ability, or individuals working independently)?

Q6. Will attitude regarding a task be influenced by group incentive structure (cooperative or individualistic) or group composition (homogeneous or heterogeneous in terms of ability, or individuals working independently)?

Q7. Will student's sequence through the software, frequency, and time spent on events classified as *video*, *step*, or *call* (*decision)* be influenced by group incentive structure (cooperative or individualistic), group composition (homogeneous or heterogeneous in terms of ability, or individuals working independently), or ability?

Hypotheses

The hypotheses for this study are as follows:

H1. There will be a main effect for the cooperative incentive group when compared to the individualistic incentive and control group, in terms of superior achievement.

H2. There will be a main effect for the individualistic incentive group when compared to the control group in terms of superior achievement.

H3. There will be an interaction between group composition and ability as follows:

- High-ability subjects will perform better in heterogeneous-ability groups than in homogeneous ability groups or when working individually.
- Medium-ability subjects will perform better when working in groups than when working individually.
- Low-ability students will perform better in heterogeneous-ability groups than in homogeneous-ability groups or when working individually.

Hypothesis one and two are based on past research which assigned problem solving tasks and found that subjects working in small groups outperformed subjects working individually (Johnson & Johnson, 1986; Trowbridge & Durnin, 1984; Webb, 1984; Mevarech et al., 1987; Cox & Berger, 1985). It was hypothesized, therefore, that the cooperative and individualistic incentive groups would outperform subjects working individually in the control group. It was further hypothesized that the cooperative incentive group would outperform the individualistic incentive group and the control group based on the positive interdependence which was developed through the use of the cooperative incentives (Johnson & Johnson, 1986; Slavin, 1989).

Hypothesis three, an interaction between a subject's ability level and their performance on the assigned tasks, was also based on past research. Since past research demonstrated that subjects of different ability levels performed differently when grouped

with same or different ability peers, it was anticipated that a similar trend would be evident in this research (Hooper & Hannafin, 1988; Johnson & Johnson, 1990; Slavin, 1989; Swing & Peterson, 1982; Webb, 1980;1985).

It was hypothesized that high-ability subjects working in dyads would benefit from giving explanations to their lower-ability peers which would lead to a deeper understanding of the learning task for the high-ability subjects in the heterogeneous ability groups (Hooper & Hannafin, 1988; Bargh & Schul, 1980; Swing & Peterson, 1982, Peterson, Janicki & Swing, 1981; Webb, 1980). It was further hypothesized that low-ability subjects working in dyads with a medium or high-ability peer would benefit from being the target of explanations from their higher-ability partner, thus leading to increased learning for the low-ability students in heterogeneous ability groups (Hooper & Hannafin, 1988; Peterson, Janicki & Swing, 1981; Swing & Peterson, 1982; Webb, 1980).

Past literature on the performance of medium-ability subjects working in dyads offers conflicting guidance therefore the performance of medium-ability subjects working in homogeneous and heterogeneous groups was not hypothesized (Peterson, Janicki & Swing, 1981; Webb, 1980). It was hypothesized however, that all learners working in dyads, regardless of ability (high, medium, and low), would outperform learners working individually in the control group (see justification for hypotheses 1 & 2).

Chapter Three

Method

Subjects

The subjects for this study were 111 undergraduate students enrolled in management courses; "Managing a Small Business" (MANA 451); and "Entrepreneurship" (MANA 452) in the Faculty of Commerce and Administration at Concordia University. The simulation was integrated into the curriculum to become part of the students' required course work and counted for 10% of the students' final grade.

Materials

Ability test. The ability test selected for this study was the 'Comprehensive Ability Battery' (CAB). The overall guiding principle in the development of this test was to provide a broad battery of short subtests that could be used to economically measure 20 important ability constructs (Hakstian & Cattell, 1975). Each of the 20 subtests was designed to measure a single ability factor and could be used on its own or in combination with others since each subtest has it own reliability and validity measure. The subtests selected for the present study were the. (a) Verbal Ability (V), (b) Numerical Ability (N), (c) Spatial Ability (S), (d) Inductive Reasoning (I), and (e) Associative Memory (Ma). These subtests were chosen because the questions in each required finite answers and tested skills applicable to students in small business educational programs.

Other reasons for choosing these subtests were that four of the six subtests (V,N,S,I) were said to account for almost all the prediction when correlated with the Wechsler Adult Intelligence Scale (Hakstian & Cattel, 1975). Further it took only 30 minutes to complete the five subtests which was crucial since valuable class time was being used The subtests utilized in this study are discussed below.

1. The **Verbal Ability** factor determines a person's ability to understand written language which can figure prominently in academic success as well as occupations involving much reading and writing of reports. (Concept Validity = 0.79 Reliability = 0.77-0.80)
2. The **Numerical Ability** factor refers to the basic trait of facility in fundamental number operations. (Concept Validity = 0.91, Reliability = 0.74 - 0.81)
3. The **Spatial Ability** factor is concerned with perceiving spatial patterns accurately. (Concept Validity = 0.96, Reliability = 0.80 - 0.94)
4. The **Inductive Reasoning** factor refers to the ability to apply the process of induction and reasoning and since it places little or no reliance on learned material, words, or numbers, the scores would be a good indicator of non-verbal, non-culturally-biased intelligence. (Concept Validity = 0.80, Reliability = 0 59 - 0.77)
5. The **Associative Memory** factor involves the ability to recall material learned in a rote or nonmeaningful manner and is said to test long-term memory. (Concept Validity = 0.91, Reliability = 0.75 - 0.77)

Videodisc simulation. The interactive videodisc simulation selected for this study was "The Business Disc· How to Start and Run a Small Business" which is a business simulation developed by Maryland Interactive Technologies (MITEC). The simulation allows the learner to test ideas, react to consequences of decisions, and think through a business plan with the use of full motion video, slides, animation, illustrations, graphs, and an online glossary of the business terms used in the program. This problem-oriented simulation adds practical experience to the learner's knowledge base that would not usually be acquired by students until they are exposed to the actual business world.

The program is divided into two sections "The Planning Phase" and "The First Year of Business". In Part I "The Planning Phase", experts help the user determine the kind of business, type of ownership, location, income and insurance requirements, advertising needs, and start up capital requirements. Users also deal with personnel matters, cash flow statements, productivity expectations, and expense estimates. Learning opportunities continue in Part II; a simulated First Year of Business. Decisions must be made on such matters as employee issues, repairs, late deliveries, and a variety of emergencies. Many events are based on decisions made in the planning stage, providing insight into strong and weak points of the business plan, and allowing revisions and alternate action The simulation has won four awards including the "Nebby" Award for Best Educational Achievement and the Award of Excellence in Education Communications.

This simulation was selected because of its unique capability to allow users to make decisions which will later influence the success or failure of their business. In this manner the simulation is 'guided discovery' (Gagne, 1970) in that learners are not told what the consequences of their actions are. Instead, they discover the outcome as they are shown how their decisions effect future events and are guided in the right direction by the simulation. Therefore, the learner works from examples to higher order rules which has been shown to aid in long-term recall and/or transfer of information to other similar

learning tasks (Romiszowski, 1987) Discovery learning has also been shown to be particularity applicable to cooperative learning situations where students share ideas and explore pathways to a decision (Litchfield, 1990).

Dependent Measures

Achievement. *Achievement* was evaluated by paper and pencil, case study and multiple-choice post-tests (Appendix A & C). The post-tests used in this study were created with the help of three subject matter experts who helped to clarify the questions, answers, and idea units.

Case study post-test. The first post-test was a case study style post-test which consisted of four cases each with two to three questions The cases in this test were modified from *Entrepreneurship and Venture Management: Text and Cases* (Olm & Eddy, 1985). The questions were created to be specific to the program and were clarified with the help of subject matter experts. The cases were evaluated with idea units (see Appendix B). A total score of 28 recalled idea units was possible.

Multiple choice post-test. The second post-test was a multiple-choice test The questions were based on the concepts taught directly and indirectly by the program. The multiple-choice test evaluated concepts that would be seen by all subjects no matter how complex their sequence was through the program. The total possible score was 21.

The premise for using the two test styles, multiple-choice and case study, was to determine the effect of the experience on both recognition and the problem-solving in learners. While the multiple-choice test evaluated the student's grasp of basic principles and of pertinent facts, the case study test determined a subjects' problem-solving ability in dealing with the information presented. The case study test, therefore, evaluated

something more complex than the multiple-choice measure, by going beyond the straightforward application of a set of basic principles in an attempt to solve a well-defined problem It was felt that these two measures would provide insight into how grouping (whether it be by incentive structure, ability, or both) influenced thinking strategies to previously encountered and unencountered situations.

The grading of the post-tests was done by a panel and inter-rater reliability for a sample of the post-tests was determined. The panel consisted of three small business owners who helped to compose the questions and ideas units. They helped the researcher grade a sample of the post-tests on order to make sure the idea units were being interpreted as intended. The inter-rater reliability for the sample of the case study with the use of the idea units was 98%, while the inter-rater reliability for the multiple-choice measure was 99% as calculated by percentage agreement (# of agreements / (# of agreements + # of disagreements) × 100.

Attitude questionnaire. An attitude survey was used in the study which was composed of eight questions which subjects responded to with a 5-point Likert attitude scale (see Appendix D) which focused on the subjects' reactions to the treatment in terms level of enjoyment and usefulness of the program and the usefulness of pairing (dyad or individual)

Time-on-task. *Time-on-Task* was the total time (Part I and Part II of the Business Disc) taken to complete the videodisc program as measured by the online tracking program. Time is presented in minutes.

Online tracking. *Students' sequence* through the software was recorded in terms of frequency and time spent on specific events (see Appendix E). These events were classified as either a *video*, *step*, or *call* (*decisions*), and were recorded by an online

tracking device which was created specifically for this study by one of the computer programmers of the Business Disc. A total of 52 events were examined in detail.

This tracking device was created to help answer such questions as; (a) Do all types of learners (i.e. high, medium and low achievers) progress through material in the same fashion ? (b) Which mode of information gathering is most prevalent ? (c) How do the interactive video's formal features affect sequence ? and (d) How do learners divide their viewing into individual segments ?

The tracking device used in the present study, unlike audience-response tools of the past which required a separate and distinct unit for viewers to record their responses, had the ability to keep track of a viewer's progress through the material without any cooperation or knowledge by the user.

The data gathering technique used by the tracking device was very simple to implement and basically the information was collected on its own. A data file was created on the hard disk which collected the date the users signed onto the system, a brief description of each of the segments viewed by the user, the amount of time spent on each segment, and whether the users returned to any particular segment. The segments were classified according to formal features but since there were so many points in an interactive video program that could be classified as "formal features" it was necessary to limit the number that were investigated. This present study limited these features to 'video', 'step' (montage of choices), and 'call' (decisions). A flow chart of how the tracker program worked is illustrated below.

Flow Chart of Data Collection and Organization by Tracker Program

Standard Program	⇒	**With the use of the Tracker Program**
⇓		⇓
Saves some key information to student's file either on floppy or hard disc. (i.e.,: Student's name, type of business, previous and last task completed)		The Business Disc Executive File creates a file called Log2.dat (A condensed form of all collected data). (see Appendix F.1.)
		⇓
		A program (Master.scp) is then run to filter the Log2.dat information with cryptic, but, detailed information on each event. (see Appendix F.2.)
		⇓
		A second filter program (Montreal.exe) creates a detailed report of sequence/time for each student that is condensed and interpreted by the researcher. (see Appendix F.3.)

The information provided by the tracker program can then be used to provide information on students' pathways in terms of frequency of viewing and time spent on specified events.

Design and Data Analysis

The design used for the present study was a 2 x 2 x 3 factorial design with a control group. The independent variables were two levels of group incentive structure (cooperative and individualistic reward structures), with two levels of group composition (homogeneous and heterogeneous for ability), with subjects of three ability levels (high, medium, and low ability as measured by the Comprehensive Ability Battery [CAB] pretest). A control group was also used which consisted of individuals who completed the same task as the manipulated groups but on their own. The treatment groups are illustrated in Figure 1.

Figure1. 2 x 2 x 3 factorial. Ability grouping x incentive structure x ability level

INCENTIVE STRUCTURE	ABILITY GROUPING: Homogeneous	ABILITY GROUPING: Heterogeneous
Cooperative	n = 18 ABILITY High Ability Medium Ability Low Ability	n = 16 ABILITY High Ability Medium Ability Low Ability
Individualistic	n = 18 ABILITY High Ability Medium Ability Low Ability	n = 20 ABILITY High Ability Medium Ability Low Ability

Individuals	n =39* ABILITY High Ability Medium Ability Low Ability

* The control group has double the amount of subjects that are in each of the four treatment groups. This is because planned comparisons used to compare the control group with the different treatments requires equal cell sizes when one collapses the incentive structures or ability groupings.

The dependent variables used in this study were a multiple-choice post-test, a case study post-test, time-on-task, an attitude questionnaire, and online tracking of students pathways. Data were analyzed using multivariate (MANOVA'S) and univariate tests (ANOVA's) for all the dependent variables except the online tracking. The tracking data were analyzed qualitatively.

Procedure.

Before the start of the fall and winter semesters the teachers for MANA 451 and MANA 452 were contacted and asked to allot 10% of the total class grade towards the Business Disc project. All 6 teachers from 8 classes agreed, and 45 minutes of class time was allotted to pretesting. Students who did not wish to participate in the study were permitted to complete an alternate project which was assigned by their teacher and was worth 10% of their final grade. Participating students were informed what was expected of them, given a sheet of instructions (see Appendix G) and then asked to complete the timed 30 minute (CAB) pretest. After completion of the pretest students were provided with a sheet of instructions and told they could begin work on the project as soon as their partners were known, in about a week's time. This procedure was repeated until all classes in the fall semester had been pretested. Pretesting was carried out over the first two weeks of the semester. Any students who missed the pretesting in the classroom were pretested in the computer lab in the exact same fashion as the classes were.

When all pretests had been graded, the marks were converted into *z* scores and students were trichotomized into high (H = >.5), medium (M = .49 ⇒ -.49), and low (L = < -.5) thirds. *Z* scores, the number of standard deviations a score is from the mean, were used as a way of expressing location in terms that are comparable for all normal curves where the mean equals 0 and the standard deviation equals 1. High, medium, and low groups were defined, therefore, in relation to each other, not in relation to some absolute

standard and therefore the designation of "low" may still reflect considerable ability relative to the general population (Laughlin, 1978).

Subjects were then systematically assigned to one of three groups: (a) cooperative, (b) individualistic, or (c) individuals. The number of possible subjects in each of the groups as well as their ability level (high, medium or low) was controlled by the researcher so that all groups had roughly the same number of subjects and the roughly the same overall ability level. Subjects in treatments that required partners (a & b) were then systematically assigned a partner of either the same or different ability. This assignment to ability groups was done in the following way. The names of all students who were to have a partner in the cooperative treatment condition were written on small pieces of paper and placed in piles according to the ability level (i e high, medium and low). Slips of paper were then selected from the different piles to create homogeneous and heterogeneous groups. The number of homogeneous and heterogeneous groups created were controlled by the researcher so that roughly the same number of homogeneous and heterogeneous groups were created . The entire procedure was then repeated for the individualistic treatment condition. A list was created that contained the names of students with their partners if applicable. This list of subjects was then presented to each of the professors of MANA 451 and 452 who relayed this information to the students.

Students' names, and partners' name if applicable, were then placed on file folders which were organized alphabetically and placed in the learning lab in Concordia's Hall Building where the interactive video system was set up. The folders consisted of a users diskette (simply a formatted 5 1/4 diskette), a complete set of instructions on the software (see Appendix H), and instructions on the way students were to work through the program with their partner if they had one.

Students simply had to arrive at a predetermined time, sign an attendance sheet (have their partner do the same if applicable), give in their Concordia ID card, and they

would be given their folder and the laser disc. Students could sign up for a session (maximum of 2 1/2 hours at one time) and could return for as many sessions as were required to complete the program. The average number of sessions students needed to complete the package were three, one hour sessions. When students had completed the entire software program they were required to place a tick on the attendance sheet beside their name in a column entitled 'completed'. This list was checked every Tuesday and Thursday and students who had finished the program were phoned and scheduled for a post-test within a week of having completed the program. Scheduled students arrived at the learning lab at a predetermined time, were asked to spread themselves out around the available tables, and were asked to complete a series of Likert scale questions, four case studies, and a multiple-choice test. Students were given the tests as one package, but were asked not to refer back to any test. All tests were in paper and pencil format and took most students 1 1/2 to 2 hours to complete. After students had completed the post tests they were thanked and told they would be given 10% towards their final grade.

It should be clarified that subjects were initially informed that they could receive up to 10% towards their final grade when in reality all subjects who completed the project received the entire 10%. This was done so that students in the cooperative treatment could perceive that their success or failure affected the success or failure of their partner (the focus of the cooperative treatment) as they were informed at the start of their sessions. Students were also given the entire 10% to ensure that no students were penalized in the form of low marks for being placed in any one treatment condition. Test confidentiality for all subjects was maintained by assigning each student an identification number which was referred to instead of their name throughout the data analysis procedure.

Any student who was assigned to a dyad but whose partner dropped out, was permitted to complete the program and was given the 10% towards their final grade but was not included in the data analysis. The entire procedure was then repeated for the

winter semester. A total of 8 classes participated in the study; 4 from the fall semester and 4 from the winter semester.

The difference between the treatment groups and the control group are discussed below:

1. Subjects in **cooperative incentive groups** were instructed to work together, cooperate with their partner, achieve a group solution for each problem, make sure both understood the solution before the group moved on, make sure both partners participated and no one dominated, and listen carefully to the other, and when possible build on their ideas (see Appendix I). The subjects were informed that their achievement would be determined by the success of their business as determined by the software program and that their grade would be determined by combining their individual scores of a post-test to be taken after the completion of the software sessions. The perceived success or failure of one group member, therefore, was affected by the success or failure of the other (positive interdependence).

2. Subjects in **individualistic incentive groups** were not instructed how to work together and were informed that their grade would be determined by their separate scores on a post-test to be taken after the completion of the software sessions (see Appendix J). The perceived success or failure of one group member, therefore, did not affect the success or failure of the other (no positive interdependence).

3. Subjects in the **control group** were not grouped according to incentive structure or ability. Therefore the control group had the absence of grouping by incentive structure or ability, and the subjects worked individually and independently.

Chapter Four

Results

A one-way Analysis of Variance (ANOVA) on ability by the five cells was conducted and revealed that all groups were comparable in terms of ability, $p > .05$. Mean ability scores and standard deviations for each of the cells are shown below in Table 1.

Table 1.
Means and Standard Deviations for Pretest Expressed in *Z* Score

	Cooperative Homogeneous	Cooperative Heterogeneous	Individualistic Homogeneous	Individualistic Heterogeneous	Individual
M	-.10*	-.13	-.13	-.12	-.13
SD	.81	1.09	1.09	.99	.92
n	18	18	16	20	39

* (a *z* score ranging from -.49 to .49 denotes a subject of medium ability)

Multiple Analyses of Variance (MANOVA) on the multiple-choice and case study post-tests, by incentive structure (cooperative, individualistic), ability grouping (homogeneous, heterogeneous), and ability level (high, medium, low) were then carried out. No main effects or interactions were evident, $p > .05$. The means and standard deviations are illustrated in Tables 2 and 3, and the MANOVA is presented in Table 4.

Table 2.
Means and Standard Deviations for Case Study Post-Test by Incentive Structure, Ability Grouping and Ability Level

Code	Mean	Std. Dev	N
Low Ability			
Homogeneous			
Cooperative	14.50	3.62	6
Individualistic	18.00	2.83	6
Heterogeneous			
Cooperative	17.86	2.55	7
Individualistic	17.14	3.29	7
Medium Ability			
Homogeneous			
Cooperative	18.56	3.13	9
Individualistic	18.50	3.11	4
Heterogeneous			
Cooperative	15.67	3.62	6
Individualistic	17.33	3.39	6
High Ability			
Homogeneous			
Cooperative	17.67	2.08	3
Individualistic	18.00	2.90	6
Heterogeneous			
Cooperative	19.80	2.17	5
Individualistic	19.86	4.81	7
	17.75	3.36	72

Maximum Score Possible on Case-Study Post-Test = 28 Recalled Idea Units.

Table 3.
Means and Standard Deviations for Multiple-Choice Post-Test by Incentive Structure, Ability Grouping and Ability Level

Code	Mean	Std. Dev	N
Low Ability			
Homogeneous			
Cooperative	11.83	3.37	6
Individualistic	15.00	2.35	6
Heterogeneous			
Cooperative	13.00	2.38	7
Individualistic	12.71	2.49	7
Medium Ability			
Homogeneous			
Cooperative	14.33	2.60	9
Individualistic	15.25	.96	4
Heterogeneous			
Cooperative	12.83	1.72	6
Individualistic	13.83	1.72	6
High Ability			
Homogeneous			
Cooperative	14.33	1.16	3
Individualistic	15.33	1.03	6
Heterogeneous			
Cooperative	14.40	1.14	5
Individualistic	13.57	3.69	7
	13.83	2.44	72

Maximum Score Possible on Multiple-Choice Post-Test = 21.

Table 4.
MANOVA of Case Study and Multiple-Choice Post-Tests by Incentive Structure, Ability Grouping and Ability Level

Effect .. Ability by Incentive Structure by Ability Grouping

Test Name	Value	Approx.F.	Hypoth DF	Error DF	Sig. of F.	p
Pillais	.071	1.10	4.00	120.00	.359	>.05
Hotellings	.076	1.11	4.00	116.00	.358	>.05
Wilks	.929	1.10	4.00	118.00	.358	>.05
Roys	.070					

MANOVA's were then carried out on all of the possible combinations of the variables: incentive structure (cooperative, individualistic), ability grouping (homogeneous, heterogeneous), and ability level (high, medium, low) with the post-test. No main effects or interactions were evident, $p > .05$.

Three-way ANOVA's on the case study and multiple-choice post-tests by incentive structure, ability grouping, and ability level were then carried out. No significant differences were found as illustrated in Table 5 (case study), and Table 6 (multiple-choice).

Table 5.
ANOVA of Case Study by Incentive Structure, Ability Grouping and Ability Level

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	59.04	4	14.76	1.37	.256
ABILITY GROUP. (AG)	1.34	1	1.35	.13	.725
GROUP INCENTIVE (GI)	5.94	1	5.94	.55	.461
ABILITY (A)	46.32	2	23.16	2.15	.126
2-Way Interactions	67.09	5	13.42	1.24	.300
AG X GI	5.11	1	5.12	.47	.494
AG X A	61.54	2	30.77	2.85	.066
GI X A	2.80	2	1.40	.13	.878
3-Way Interactions					
AG X GI X A	27.94	2	13.97	1.30	.282
Explained	154.07	11	14.01	1.30	.248
Residual	647.43	60	10.79		
Total	801.50	71	11.29		

Table 6.
ANOVA of Multiple-Choice by Incentive Structure, Ability Grouping and Ability Level

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects		4			
ABILITY GROUP. (AG)	18.00	1	18.00	3.20	078
GROUP INCENTIVE (GI)	13.87	1	13.87	2.47	.121
ABILITY (A)	15.92	2	7.96	1.42	.250
2-Way Interactions		5			
AG X GI	15.05	1	15.05	2.68	.107
AG X A	7.06	2	3.53	0.63	.537
GI X A	1.53	2	0.76	0.14	.873
3-Way Interactions					
AG X GI X A	12.44	2	6.22	1 11	.337
Explained		11			
Residual	337.09	60	5.62		
Total		71			

A MANOVA of the case study and multiple-choice measures by incentive structure, ability grouping, and ability level which included the control group was carried out, but still no significant differences were evident, $p > .05$. The Means and standard deviations are illustrated in Table 7 and the MANOVA is in Table 8.

Table 7.
Means and Standard Deviations for Control Group for Multiple-Choice Post-Test and Case Study Post-Test

Code	Mean	Std. Dev	N
Case Study			
Low Ability	12.92	2.57	13
Medium Ability	18.86	4.59	14
High Ability	17.92	2.54	12
Multiple Choice			
Low Ability	13.08	2.53	13
Medium Ability	13.93	2.20	14
High	13.92	2.43	12

Table 8.
MANOVA of Case Study and Multiple-Choice Post-Tests by Incentive Structure, Ability Grouping and Ability Level and Control Group

Effect .. Ability by Incentive Structure by Ability Grouping by Control

Test Name	Value	Approx.F.	Hypoth DF	Error DF	Sig. of F.	p
Pillais	.201	1.34	16.00	192.00	.174	>.05
Hotellings	.239	1.40	16.00	188.00	.144	>.05
Wilks	.803	1.37	16.00	190.00	.158	>.05
Roys	.070					

Two-way ANOVA's on the case study post-test, multiple-choice post-tests, and time-on-task by "treatment" and ability were then conducted. The term "treatment" refers to five groups; cooperative homogeneous, cooperative heterogeneous, individualistic homogeneous, individualistic heterogeneous, and the control group. It was necessary to analyze the influence of the control group on learners' achievement and task efficiency in this fashion as it not part of the 2 x 2 x 3 factorial. The two-way ANOVA between the means of the case study dependent measure, the five treatment groups, and ability revealed a significant 2-way interaction between treatment group and ability F (8,96) = 2.39, p <.05. Table 9 shows the results of the two-way ANOVA on this measure.

Due to the small and uneven cell sizes in the representation of the data in Table 2, this interaction was further analyzed by looking at the manipulated variables separately (illustrated in Tables 10, 11, 12 & 13) with the individual treatment groups using a minimum range. This was felt to be the best approach as an ANOVA on reward structure x group structure (which excludes the individual treatment group) revealed no main effects, F (1, 68) = .158, p > .05.

Simple planned comparisons (Scheffe tests) of the case study measure revealed that the low-ability subjects working in cooperative and individualistic groups performed better than low-ability subjects working alone in the control group, $p < .05$ Simple comparisons further revealed that, overall, the low-ability subjects were outperformed by both the medium and high ability subjects, (low = 15 59, medium = 18 03, high = 18 61). Simple planned comparisons of the case study measure also revealed that the subjects working in the homogeneous and heterogeneous groups outperformed low-ability subjects working individually in the control group, $p <$ 05. Both of these simple comparisons illustrate the same interactions that superior achievement was evident for low-ability subjects who worked with a partner rather than those who worked alone No other significant differences were found between treatment means on the case study measure

Table 9.
ANOVA of Case Study by Treatment Group and Ability

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	242.78	6	40.46	3.63	<.05
TREAT	52.08	4	13.02	1.167	>.05
ABILITY	194.47	2	97.23	8.72	<.05
2-Way Interactions					
TREAT ABILITY	213.23	8	26.65	2.39	<.05
Explained	456.01	14	32.57	2.92	<.05
Residual	1070.98	96	11.16		
Total	1526.99	110	13.88		

Table 10 illustrates the means and standard deviations for the case study post-test by the reward structure and ability. Table 11 illustrates that no significant main effects were evident for reward structure, therefore, the results of study did not support its first two hypotheses. Table 12 illustrates the means and standard deviations for the case study post-test by group composition and ability and Table 13 illustrates an ANOVA for this dependent measure. Tables 12 and 13 illustrate that no main effects were evident for group composition.

Instead, hypothesis three (H3), an interaction between group composition and ability, was supported, as an interaction was evident as illustrated in both Tables 11 and 12 and Figures 2 and 3. It is important to keep in mind that Figures 2 and 3 illustrate the same interaction. The interaction between group composition and ability was not specifically as predicted. High and medium-ability students did not perform differently in any of the treatment groups, but low-ability students were found to perform better in groups versus working individually.

Table 10.
Means and Standard Deviations for Case Study by Incentive Structure and Ability

	Low Ability	Medium Ability	High Ability
Cooperative Incentive Structure			
M	16.31	17.40	19.00
SD	3.43	3.52	2.27
n	13	15	8
Individualistic Incentive Structure			
M	17.54	17.80	19.00
SD	2.99	3.16	4.00
n	13	10	13
Individuals			
M	12.92	18.86	17.92
SD	2.56	4.59	2.54
n	13	14	12

Table 11.
ANOVA of Case Study by Incentive Structure by Ability

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	238.36	4	59 59	5.23	<.05
REWARD	47.66	2	23.83	2.09	>.05
ABILITY	193.41	2	96.71	8.48	<.05
2-Way Interactions					
REWARD ABILITY	125.88	4	31.47	2 76	<.05
Explained	364.24	8	45.53	3 99	<.05
Residual	1162.75	102	11.40		
Total	1526.99	110	13.88		

Table 12.
Means and Standard Deviations for Case Study by Ability Grouping and Ability Level

	Low Ability	Medium Ability	High Ability
Homogeneous Grouping			
M	16.25	18.54	17.89
SD	3.60	2.99	2.52
n	12	13	9
Heterogeneous Grouping			
M	17.50	16.50	19.83
SD	2.85	3.45	3.79
n	14	12	12
Individuals			
M	12.92	18.86	17.92
SD	2.56	4.59	2.54
n	13	14	12

Table 13.
ANOVA of Case Study by Ability Grouping by Ability

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	231.93	4	57.98	5.29	<.05
ABILITY GROUP.	41.23	2	20.61	1.88	>.05
ABILITY	195.52	2	97.76	8.92	<.05
2-Way Interactions					
ABILITY GROUP. BY ABILITY	176.97	4	44.24	4.04	<.05
Explained	408.90	8	51.11	4.66	<.05
Residual	1118.09	102	10.96		
Total	1526.99	110	13.88		

Figure 2. **Means of case study measure for ability groups, by low, medium, and high-ability.**

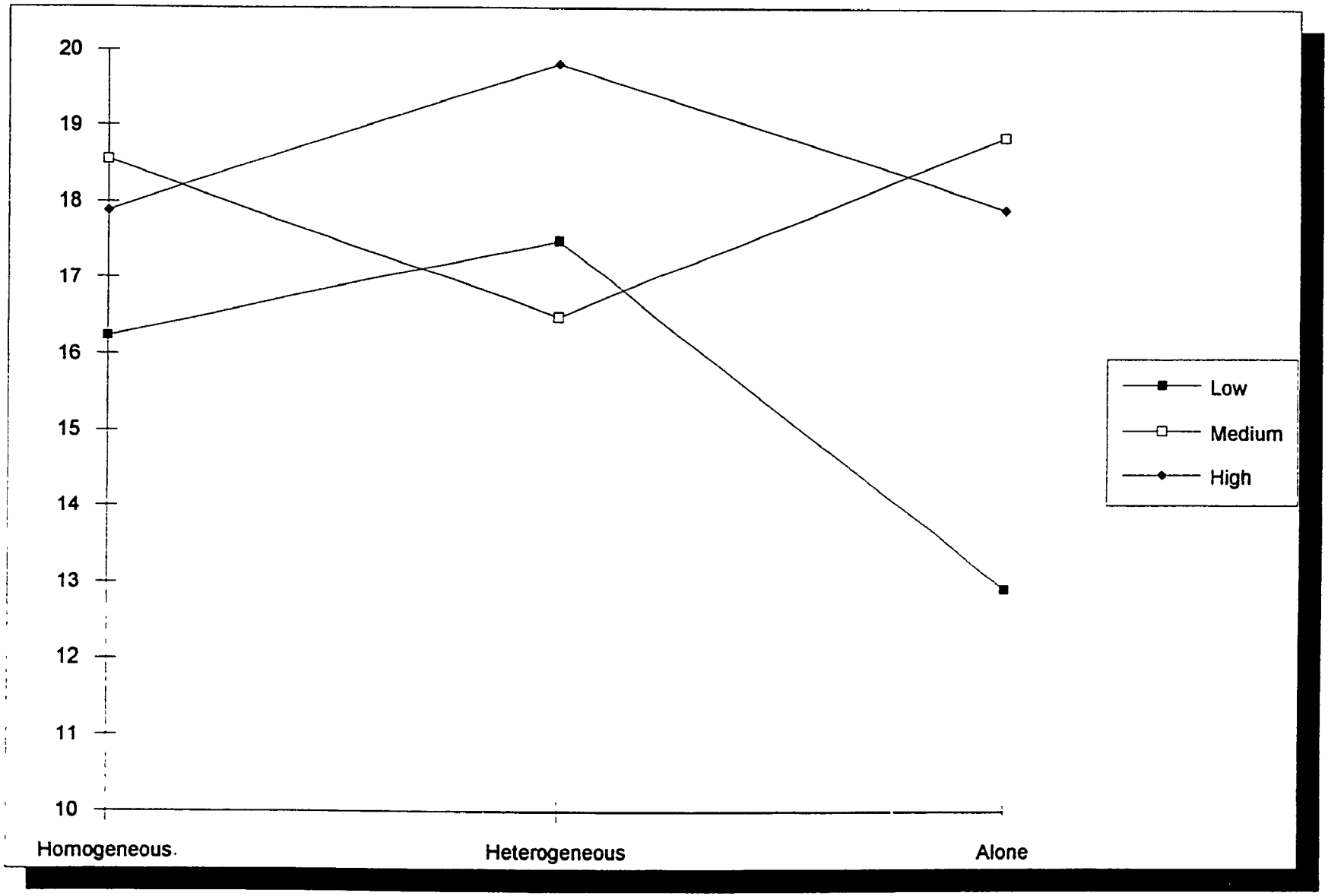
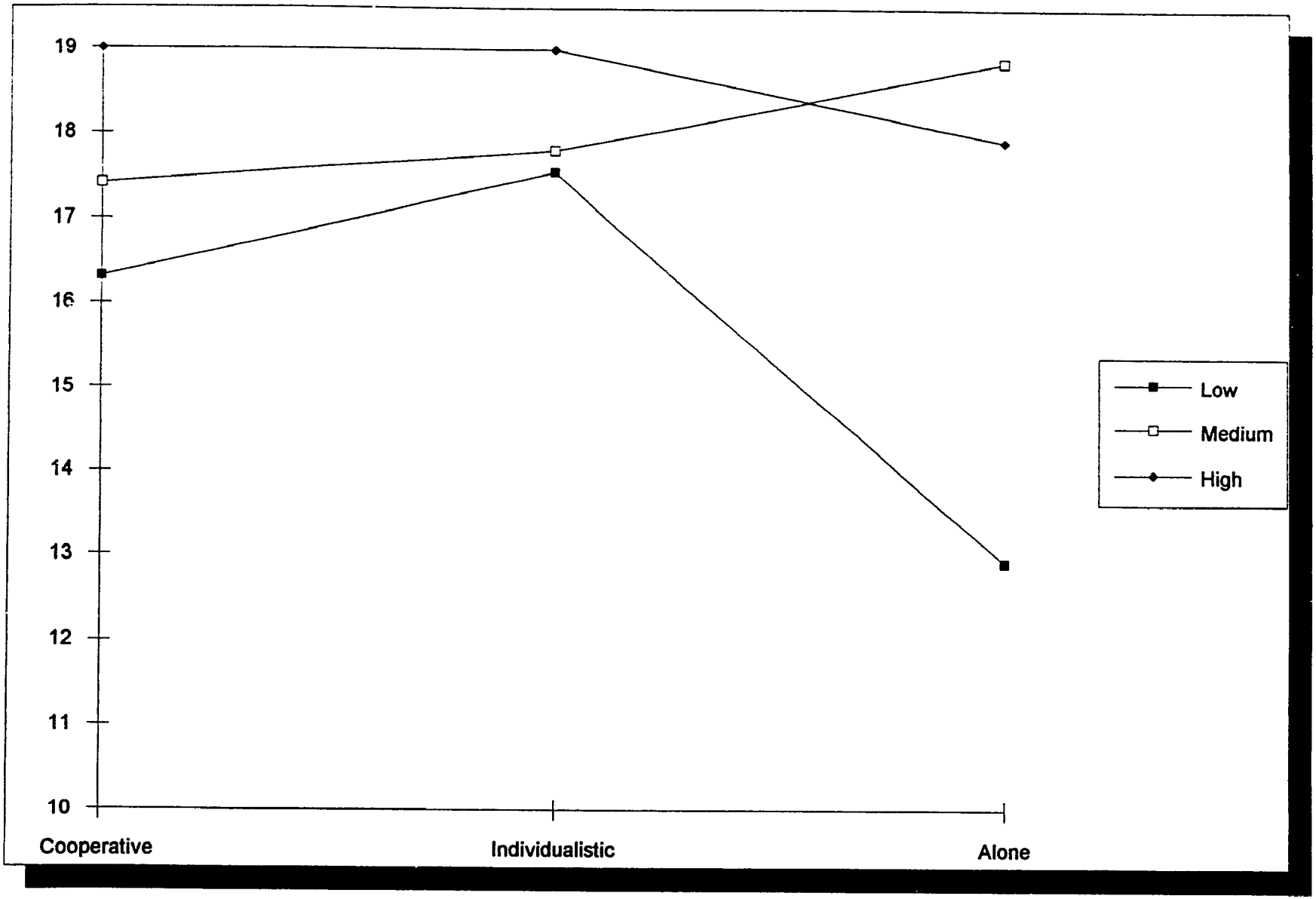


Figure 3. Means of case study measure for incentive structure by low, medium, and high- ability.



A two-way ANOVA between the means of the multiple-choice dependent measure, the five treatment groups, and ability revealed no significant main effects or interactions, $p > .05$, and is illustrated in Table 14.

Table 14.
ANOVA of Multiple-Choice Test by Treatment Group and Ability

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	71.92	6	11.99	2.12	>.05
TREAT	50.25	4	12.56	2.23	>.05
ABILITY	21.79	2	10.89	1.93	>.05
2-Way Interactions					
TREAT ABILITY	22.13	8	2.77	.49	>.05
Explained	94.05	14	6.72	1.19	>.05
Residual	541.86	96	5.64		
Total	635.91	110	5.78		

A three-way ANOVA between the means of time-on-task, the five treatment groups, and ability revealed a significant main effect for ability $F(2,53) = 3.38$, $p < .05$. Tukey's multiple comparison tests were carried out to determine where the interaction lay for time-on-task. Table 15 shows the means and standard deviations for time-on-task across low, medium, and high-ability subjects. The results of the three-way ANOVA on the dependent measure of time-on-task are illustrated in Table 16.

Table 15.
Means and Standard Deviations for Time-on-Task in Minutes

Low Ability	
M	245.21
SD	61.02
n	34
Medium Ability	
M	212.32
SD	62.68
n	34
High Ability	
M	205.59
SD	55.67
n	32

Table 16.
ANOVA of Time-on-Task in Minutes by Ability Grouping, Incentive Structure and Ability

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	23818.69	4	5954.67	2.36	.065
ABILITY GROUP. (AG)	9467.33	1	9467.33	3.75	.058
GROUP INCENTIVE (GI)	3270.63	1	3270.63	1.29	.260
ABILITY (A)	11311.31	2	5655.66	2.24	.117
2-Way Interactions	22824.96	5	4564.99	1.81	.128
AG X GI	2786.01	1	2786.01	1.10	.299
AG X A	17982.791	2	8541.40	3.38	.042
GI X A	1909.72	2	954.86	.378	.687
3-Way Interactions					
AG X GI X A	5529.11	2	2764.55	1.09	.342
Explained	52172.76	11	4742.98	1.876	.064
Residual	133966.381	53	2527.69		
Total	186139.14	64	2908.42		

Tukey multiple comparison tests of time-on-task revealed that the low-ability group took more time to complete the program than the medium and high-ability groups, $p < .05$. No significant difference was found between the medium and high groups in terms of time.

Two one-way ANOVA's between the means on the attitude questionnaire (Q1-Q10) and ability level and treatment group revealed no significant main effects for any of the attitude questions. Table 17 shows the means and standard deviations for Q1- Q10. Pearson correlation revealed that there was a strong positive correlation between questions Q1-Q4 and Q9-Q10. A strong positive correlation was also evident between Q7 and Q10, and negative correlations were evident between Q6 and Q8, and Q5 and Q7.

Table 17.
Means and Standard Deviations for the Attitude Questionnaire

Questionnaire Item		M	SD	n
Q01.	I enjoyed using the Business Disc Program. (1 very little .... 5 very much)	3.72	.95	107
Q02.	I found the Business Disc Program straightforward and easy to use.	4.13	.90	107
Q03.	I found the Business Disc Program helped me to develop my Business Plan.	3.38	1.00	107
Q04.	I found the Business Disc program general enough to allow me to develop my business as I chose to do.	3.28	1.02	107
Q05.	I enjoyed working with a partner.	3.70	.94	66
Q06.	I enjoyed working alone.	4.17	.97	41
Q07.	I feel I would have done better in the Business Disc program without a partner.	2.44	1.19	66
Q08.	I feel I would have done better in the Business Disc with a partner.	2.07	1.13	41
Q09.	I feel other Management students in Concordia small business courses should have a chance to use the Business Disc Program.	4.06	.95	107
Q10.	I would like to use the Business Disc Program again when I start a small business and have more information about my actual financial situation.	3.87	1.31	107

Analysis of the online data was more difficult and complex than the audience-response tools discussed earlier in the literature review due to the combination of both the video and computer components. It was not possible, for example, to superimpose a graph directly onto video material as was done with the PEAC system to examine the reaction of viewers. Instead, the computer tracked and organized the user's sequence based on a specific set of formal features and these data were saved and later printed, providing a record of the students' pathways. This record allowed the researcher to

investigate issues such as frequency of use and amount of time spent on certain formal features, and when data were combined it was possible to determine what was the most or least common sequence through the software for the different treatment groups and abilities.

The detailed moment-by-moment pattern as represented in the line graphs (Figures 4 - 7) show the cumulative scores, the final average of all the responses (mean responses) in terms of frequency, and duration of choices (time). This information was analyzed qualitatively as illustrated below.

The following steps were used to analyze the online tracking data First, the data were condensed by deleting information that was "required", all students had to see this information and all redundant material. The data were then organized into a manageable matrix which represented 52 events (see Appendix E) that students chose to view or not to view, or loops students repeated as they progressed through the interactive video program. The frequency and time spent on each of these events were averaged for each of the low, medium and high ability unpaired subjects, as well as pairs that contained one low-ability partner. Pairs that did not contain one low-ability member were not used in this analysis as the only significant differences that were evident were how the low achievers performed on their own as opposed to working with a peer.

The averaged data were then graphed using Microsoft Excel to compare the pathways of low, medium and high individuals, as well as low ability subjects grouped with a medium, high or another low-ability partner. The graphs illustrate the pathways learners took through the 52 events in terms of frequency of viewing (see Figures 4 & 5) and time* spent on each of the events (see Figures 6 & 7).

The data were examined to determine which events were viewed more by low-ability students who worked on their own, and which events low-ability students spent

* It should be kept in mind that since the data were condensed "time" should be used as a representation of the amount of time and not the actual time taken to complete the event.

more time on. The data were further examined to determine how low-ability students pathways changed when they were grouped with a peer These findings were then analyzed qualitatively to determine if any trends existed. The tracking data were graphed and are presented in Figures 4 - 7. The tracking data revealed that the pathways of low-ability students working individually differed from that of medium and high-ability students working individually and from dyads, in some areas.

The graphed data on frequency (see Figures 4 & 5) revealed that low ability subjects who worked on their own repeated event # 34, revising of their business plan, more than medium or high ability subjects working individually or paired low-ability subjects. In this event subjects were required to complete a business plan which presented charts such as the business profile, personal income statement, job descriptions, work hours, cash flow statement, and monthly sales projection in an effort to get a bank loan. If learners had miscalculated some portion of their business plan they would receive a report on why the loan was turned down and have the opportunity to make appropriate revisions and resubmit the plan.

Low-ability students who worked on their own did make revisions to their business plan but is it evident from the frequency data (see Figures 4 & 5) that they had more unsuccessful attempts to obtain a bank loan than the medium or high-ability subjects working individually, or the paired low-ability subjects. From the time data, it is evident that these unsuccessful tries took more time and after the excessive time spent modifying their business plan, it appears that low-ability students after performing repetitive activities without sufficient feedback or guidance followed a different path following this event than other paired and unpaired subjects. Low-ability students working on their own may not have received needed feedback to focus attention correctly and to detect and clarify misconceptions to help them modify their business plan sufficiently to obtain a bank loan, while paired low-ability students may have received this feedback and guidance from their partners. It appears, therefore, that the poor performance of low-ability students working

individually on the Business Disc may have been caused by the effect of the excessive time they spent trying to obtain a bank loan and the influence this had on their progress through the rest of the program.

Since low-ability students working individually apparently did not get the feedback or guidance they required it may have caused them to avoid looking at certain events after this event, perhaps in an attempt to make up time. From Figures 4 and 5, it is evident that low-ability students who worked on their own avoided viewing events # 37, 38, 40, 42, and 46 (see Appendix E), more often than other subjects as demonstrated by their lower frequencies. These events, which could be classified as 'guidance' or 'feedback' events, informed the students how their business was functioning and made recommendations for revising advertising, cash flow, productivity, and so on. From the Figures 5 and 6 it appears that low ability subjects decided to begin to request these 'monthly' guidance and feedback options consistently only after three-quarters of the simulated year had passed as is evident by the increase in the frequency of event # 47, 48, 49, and 50. In other words, low-ability students working on their own did not chose to view feedback or guidance consistently for the simulated months of January through August even though this option was provided monthly. Medium and high-ability students who worked on their own or with a partner, as well as low achievers working with a partner did not follow the same path.

The tracking data also revealed that low-ability students working individually spent less time gathering information about real estate options (event # 16) and more time completing the depreciation table information (event # 28).

Figure 4. Students' sequence through the program in terms of 52 events; frequency of viewing for low, medium, and high-ability.

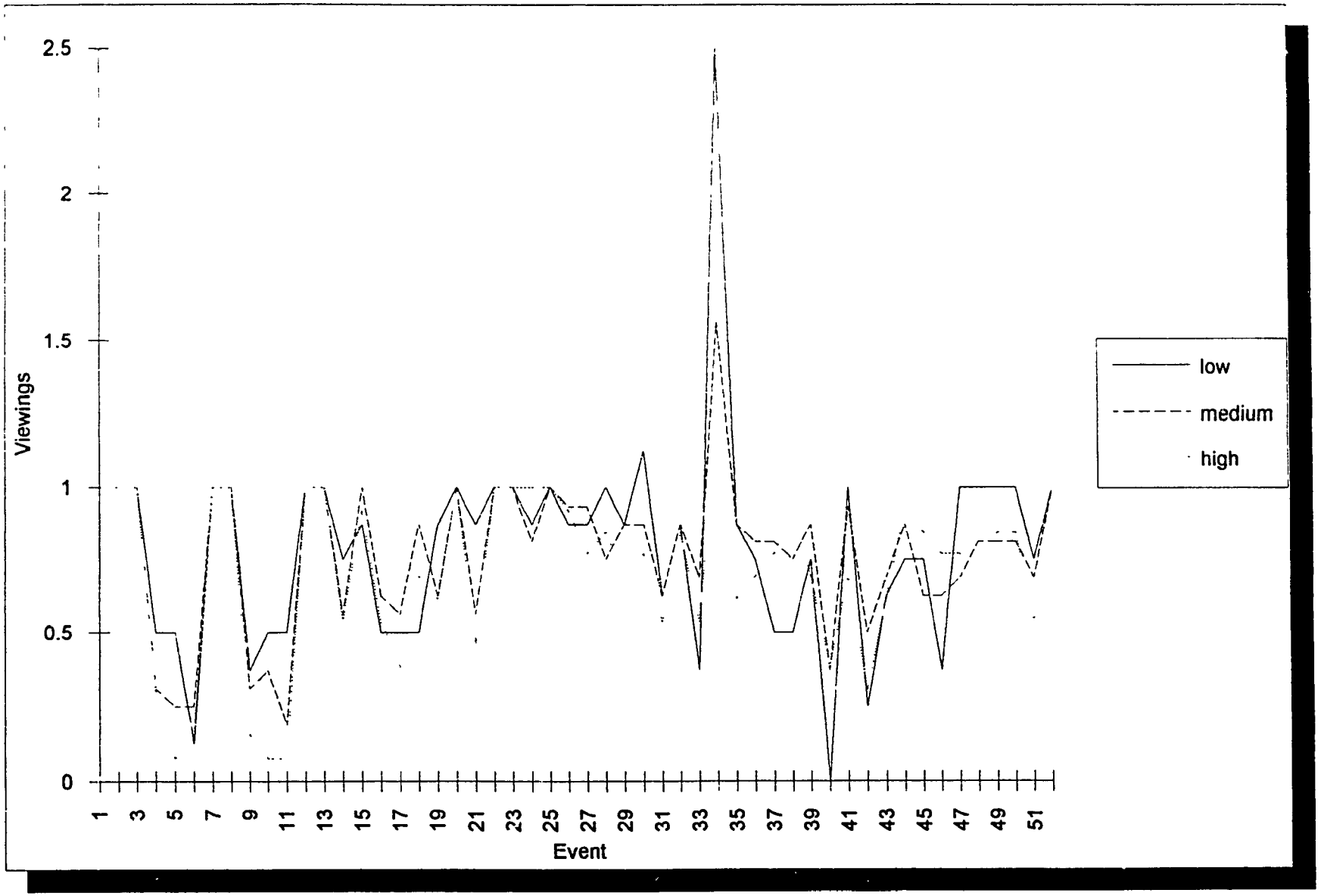
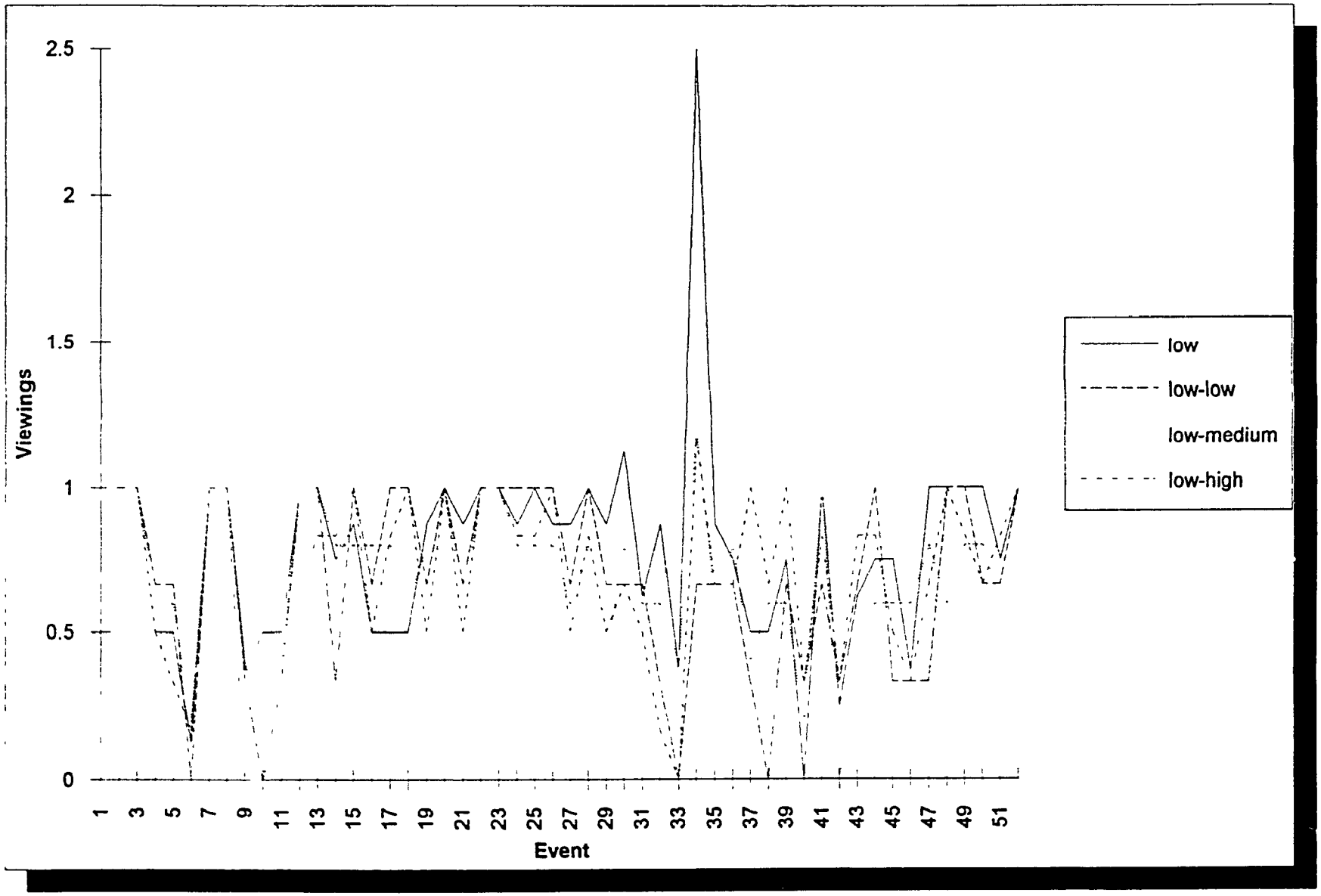


Figure 5. Students' sequence through the program in terms of 52 events; frequency of viewing for low-ability individuals and low-ability pairs.



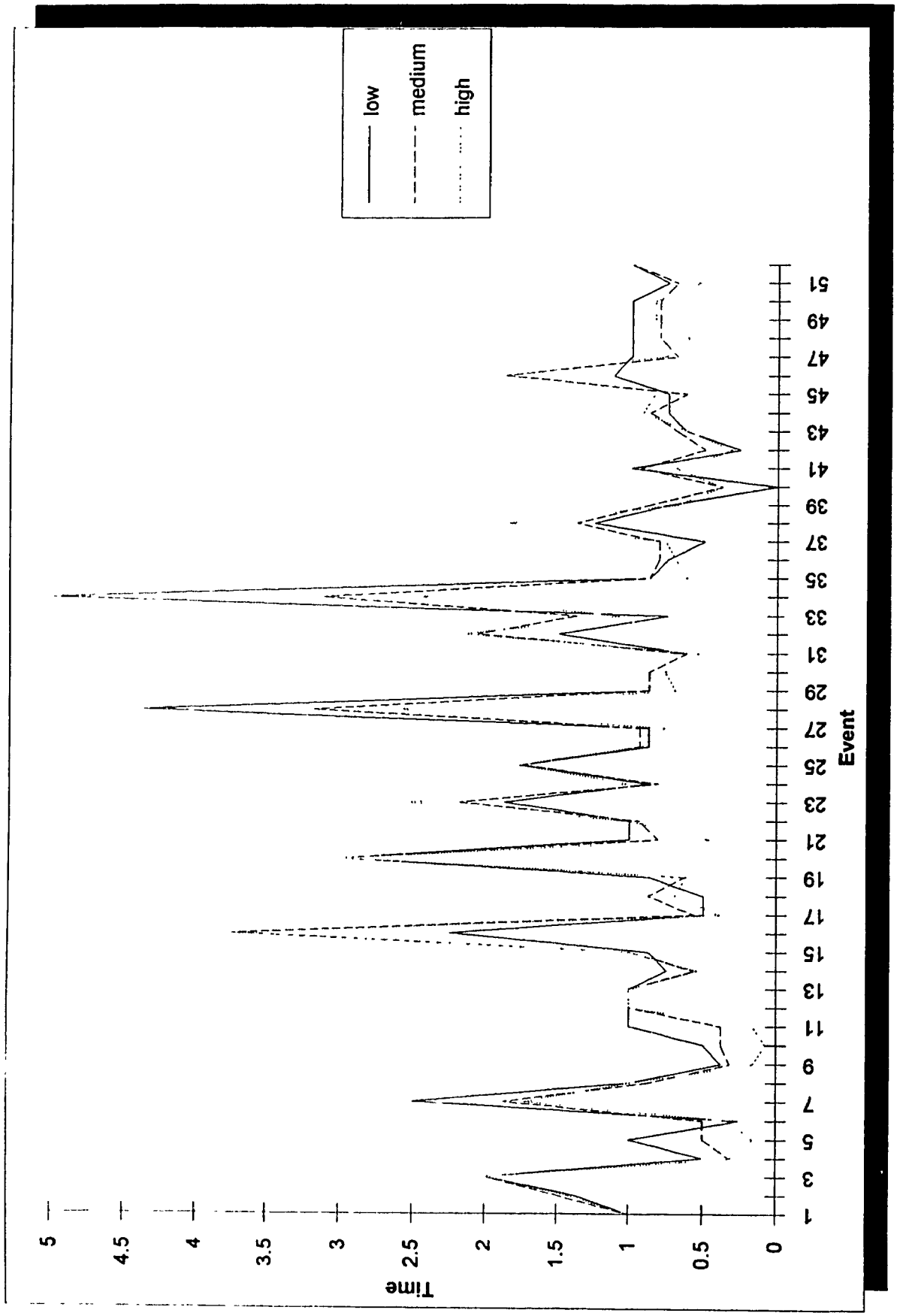
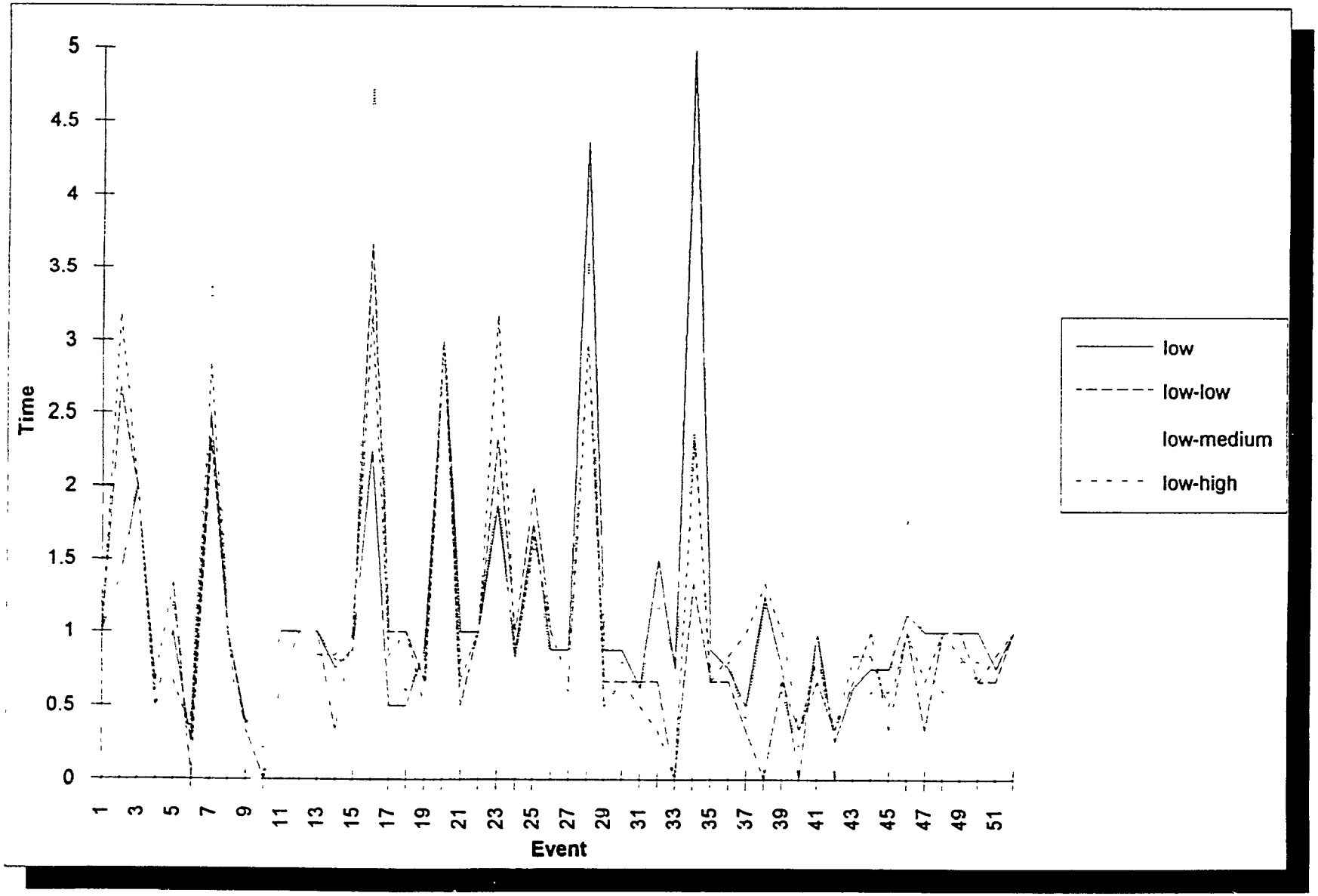


Figure 6. Students' sequence through the program in terms of 52 events; time of viewing for low, medium, and high-ability.

Figure 7. Students' sequence through the program in terms of 52 events; time of viewing for low-ability individuals and low-ability pairs.



The tracking data were further analyzed to determine if the average amount of time that low, medium, and high-ability students spent on events (classified as call, step, and video) were influenced by having them work alone (the control group), or with a partner provided with different incentive structures in various ability-group compositions (graph's scale = relative average time in minutes) (see Figures 8-14).

The graphed data revealed that.

- low-ability subjects working individually spent more time, on average, on call, step, and video events than did medium and high-ability subjects working individually (see Figure 8).

The amount of time low, medium and high-ability subjects spent on call, step, and video events were also combined across all treatment conditions, and revealed that:

- overall low-ability subjects spent more time on the step and video events than medium and high-ability subjects (see Figure 9).

The data presented in Figures 8 and 9, therefore, support earlier reported findings that low-ability students took more time to complete the program than medium and high-ability students.

The graphed data for the amount of time spent on call, step, and video for homogeneous and heterogeneous ability-pairs versus low, medium, and high-ability students working individually revealed that on average:

- low-ability subjects working individually spent more time on call events than low, medium, and high-ability homogeneous and heterogeneous pairs (see Figures 10-12).
- any ability-group that contained a high-ability student spent more time on the step events than any other homogeneous or heterogeneous ability group except for the combination of low-ability students working with medium-ability peers (see Figures 10-12)
- any homogenous or heterogeneous dyad that contained a low-ability student spent more time on the video events than any other pair (see Figures 10-12).

The graphed data for incentive structure, group composition, and the control group revealed that on average:

- students in the control group spent more time on call events and less time on step events than students who worked with a partner (see Figures 13 and 14).
- students with cooperative incentives spent more time on call and step events than students with individualistic incentives (see Figure 13).
- no substantial differences existed between incentive structure, group composition and the control group for the amount of time spent on video events (see Figures 13 and 14).

Figure 8. Average time spent on call, step, and video events for low, medium, and high-ability students working individually.

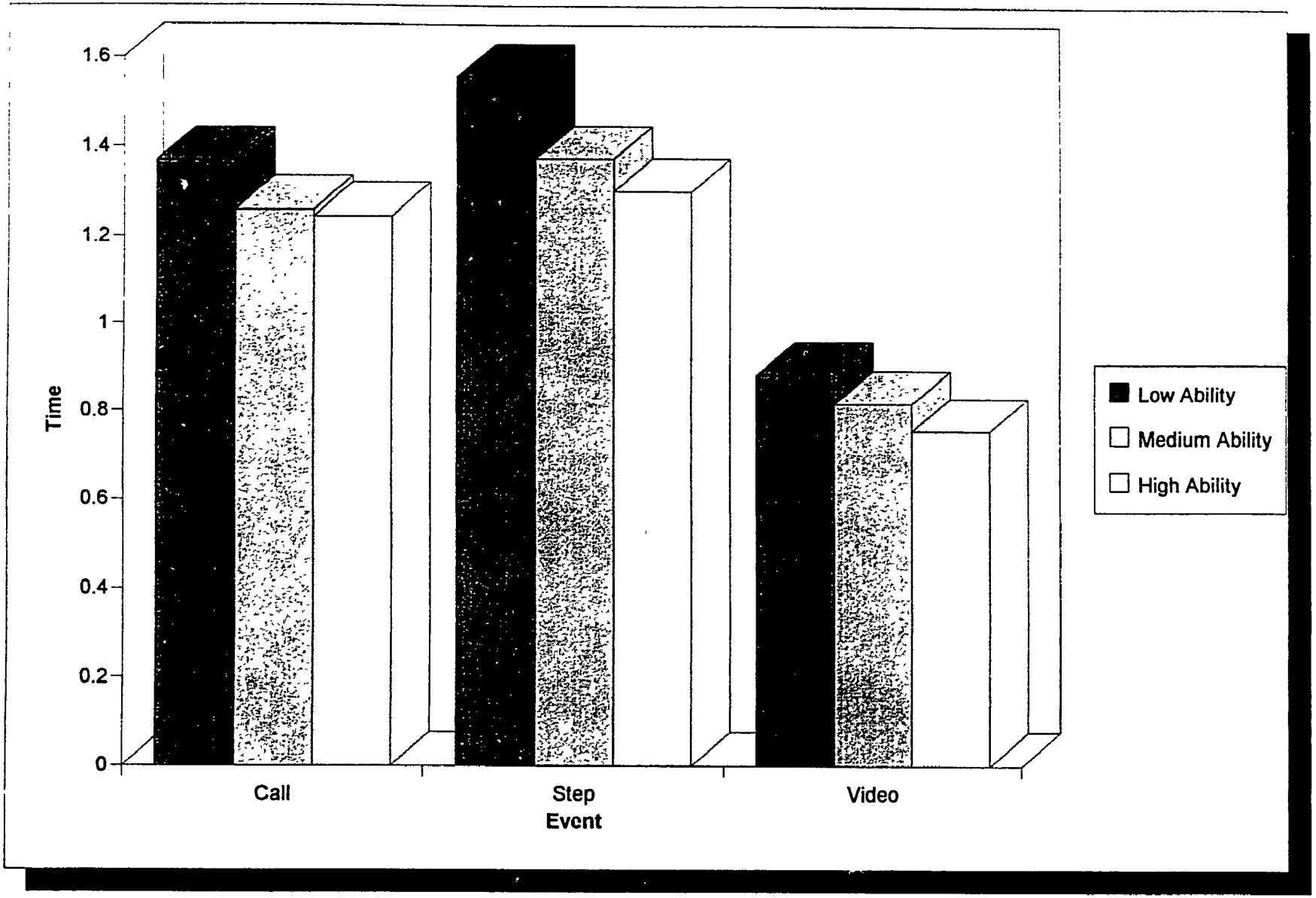


Figure 9. Average time spent on call, step, and video events for low, medium, and high-ability students.

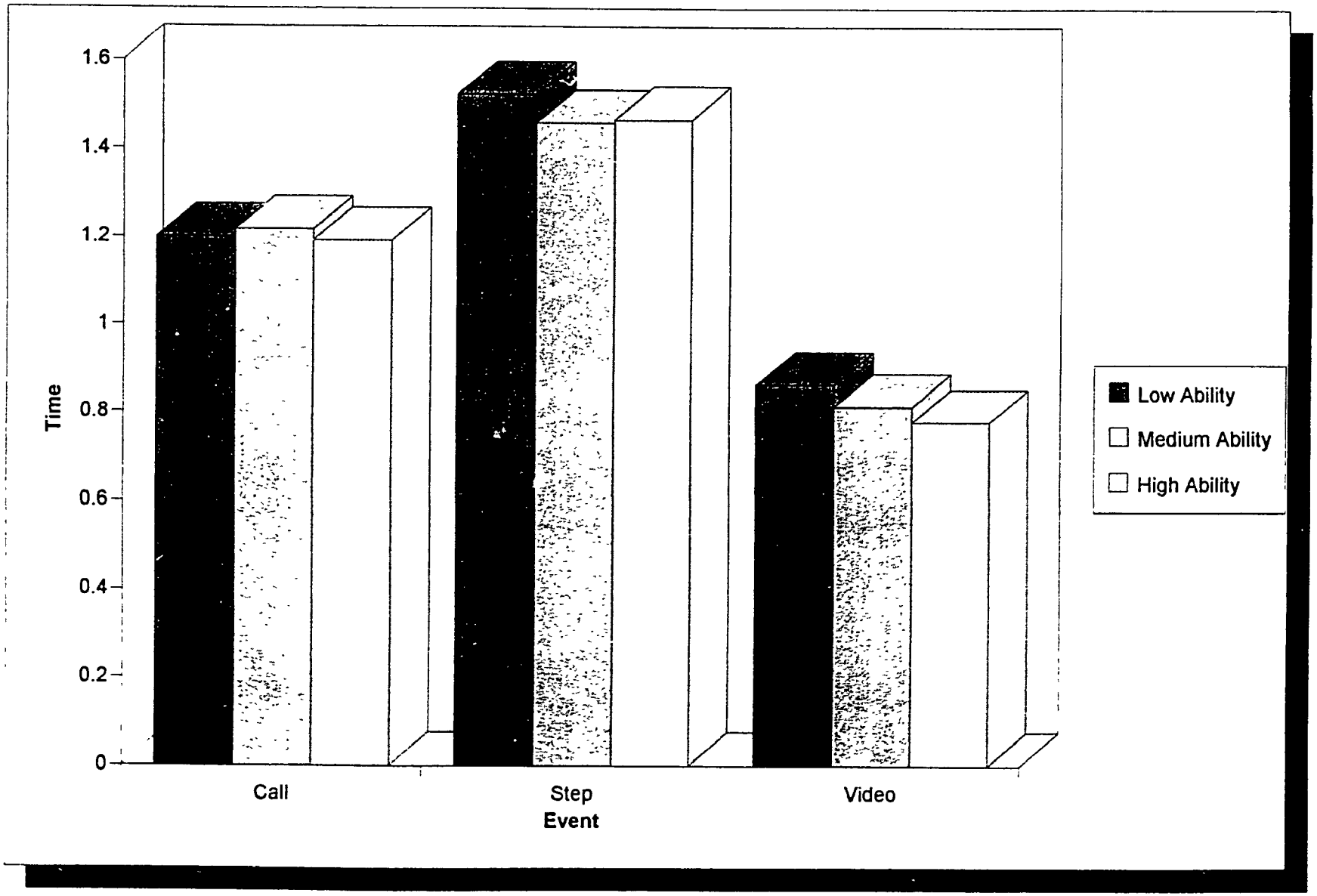


Figure 10. Average time spent on call, step, and video events for low-ability pairs and low-ability individuals.

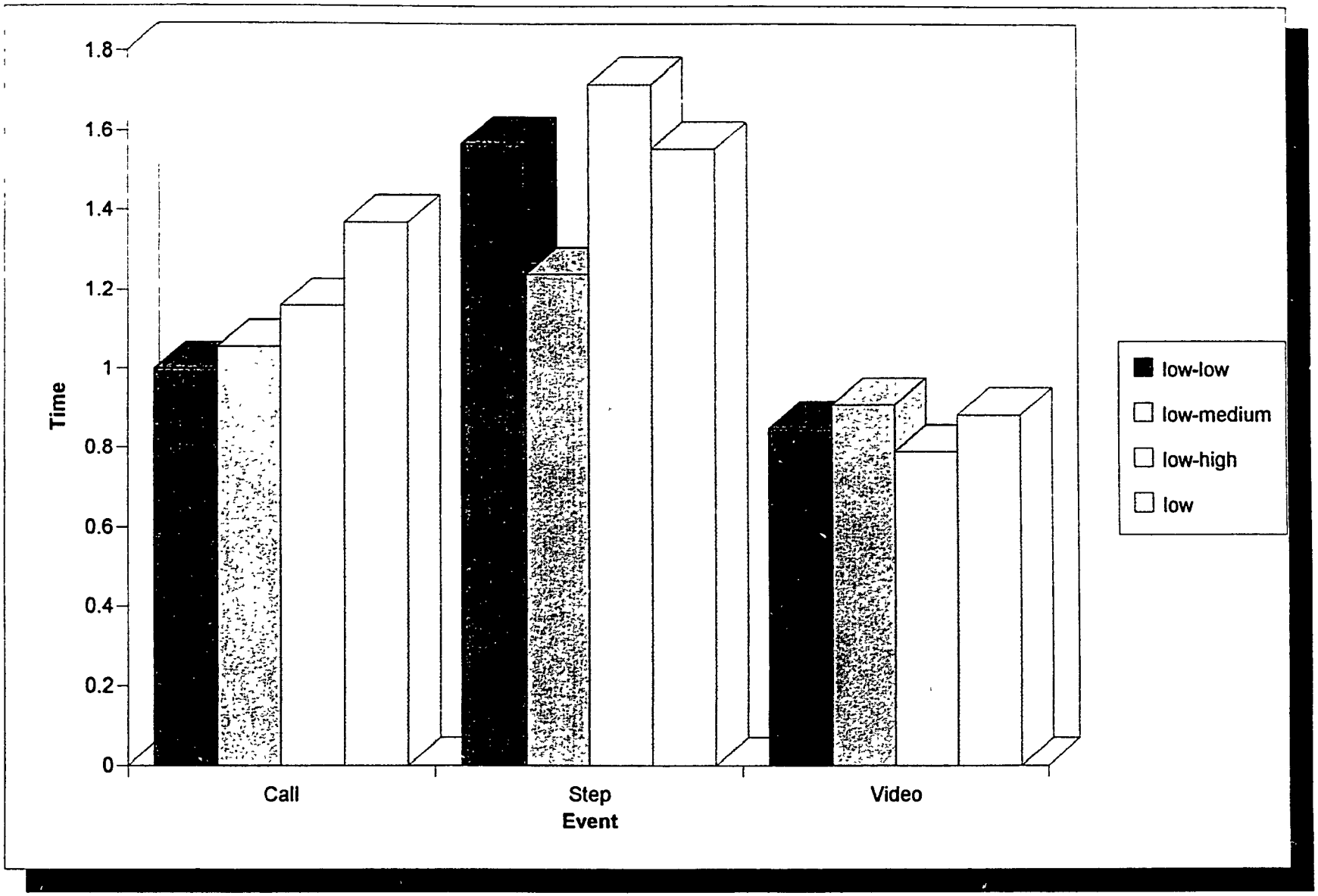


Figure 11. Average time spent on call, step, and video events for medium-ability pairs and medium-ability individuals.

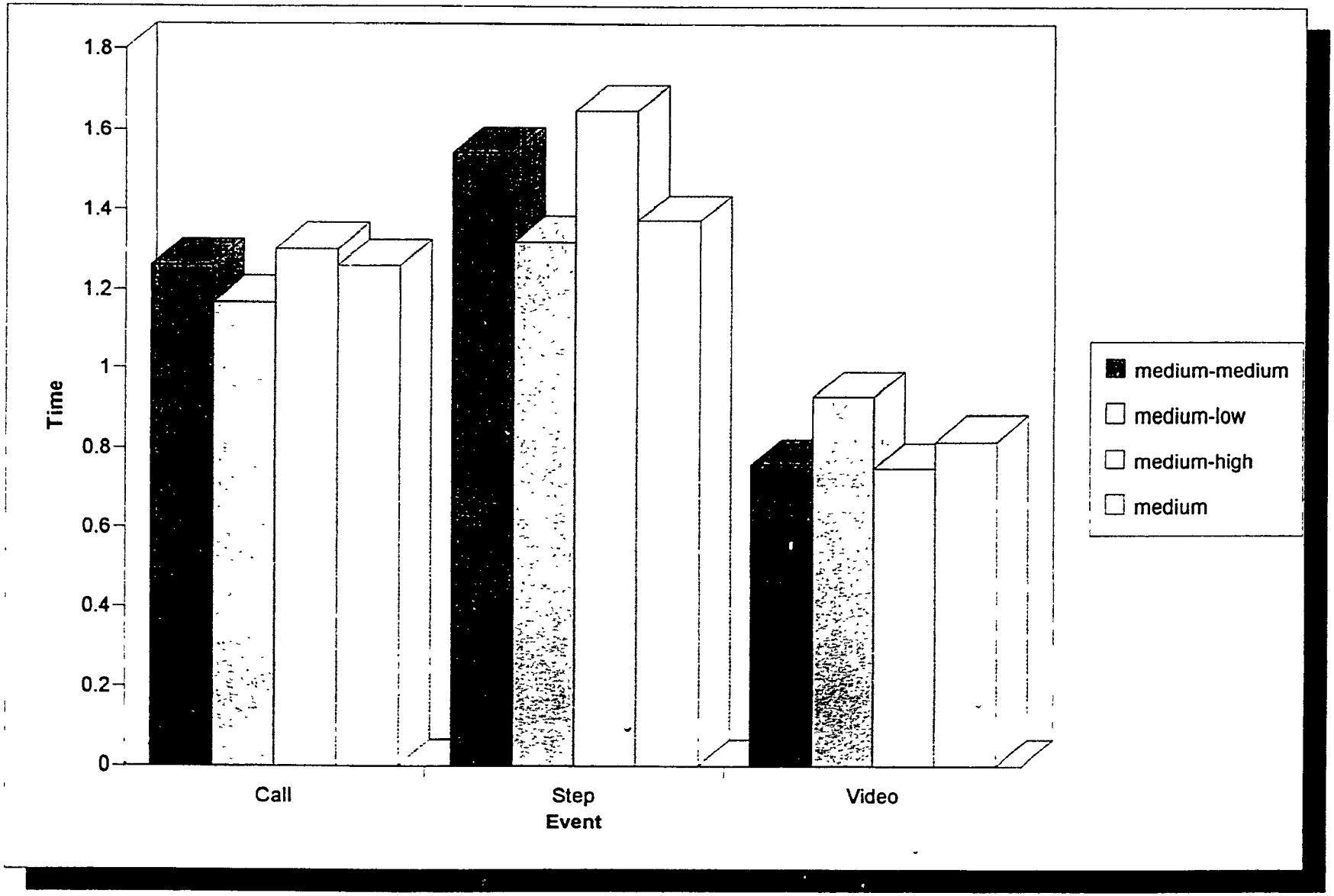


Figure 12. Average time spent on call, step, and video events for high-ability pairs and high-ability individuals.

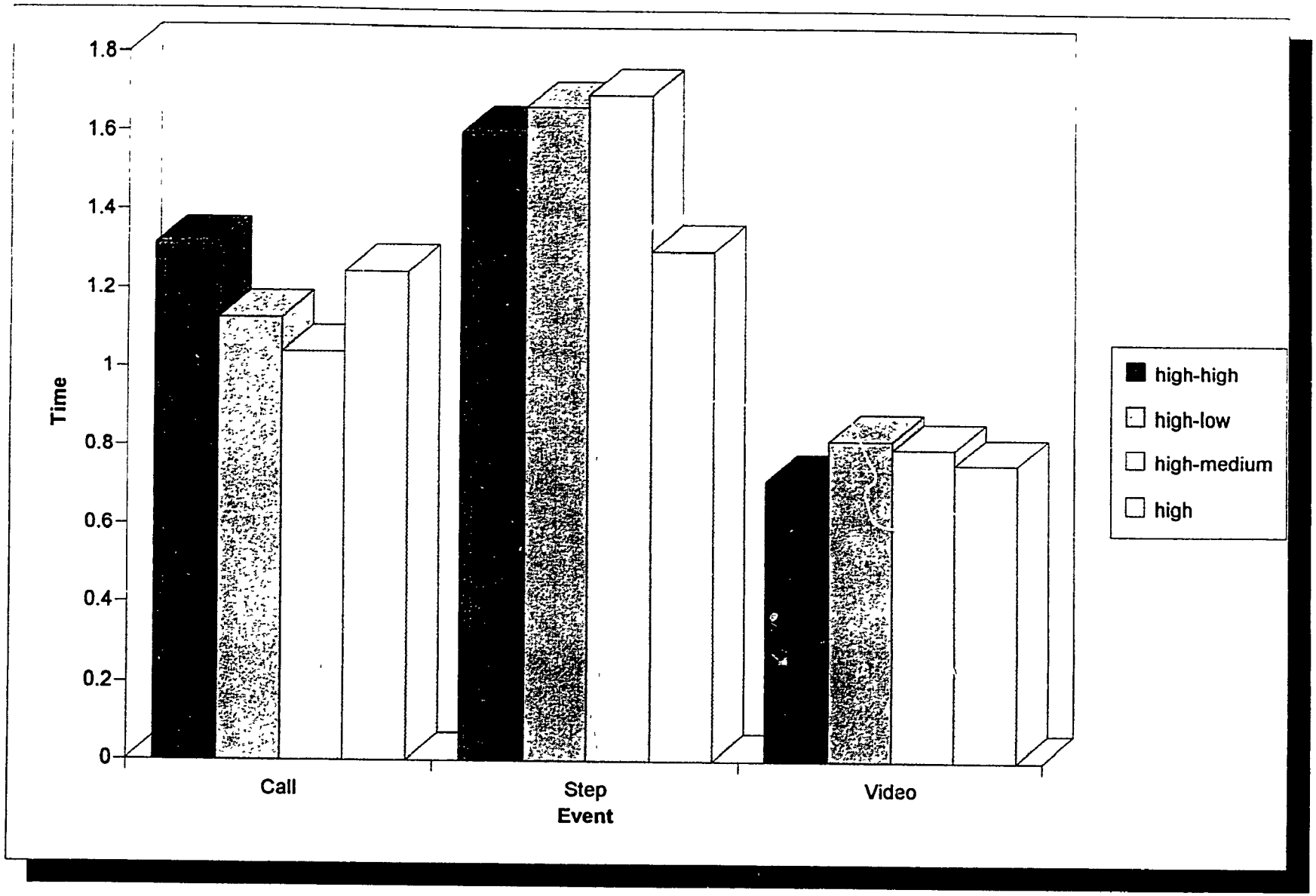


Figure 13. Average time spent on call, step, and video events for cooperative, individualistic groups, and students working alone.

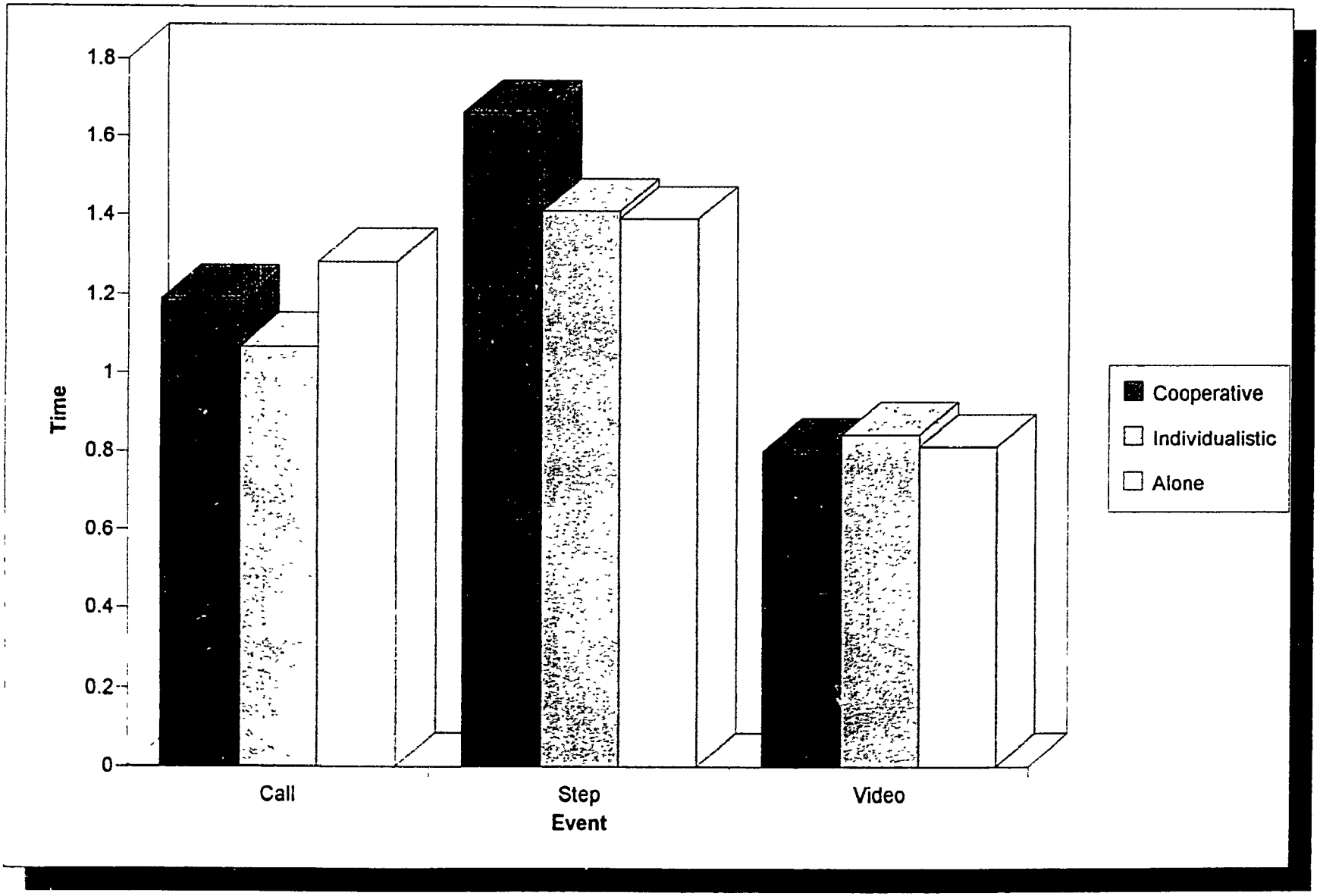
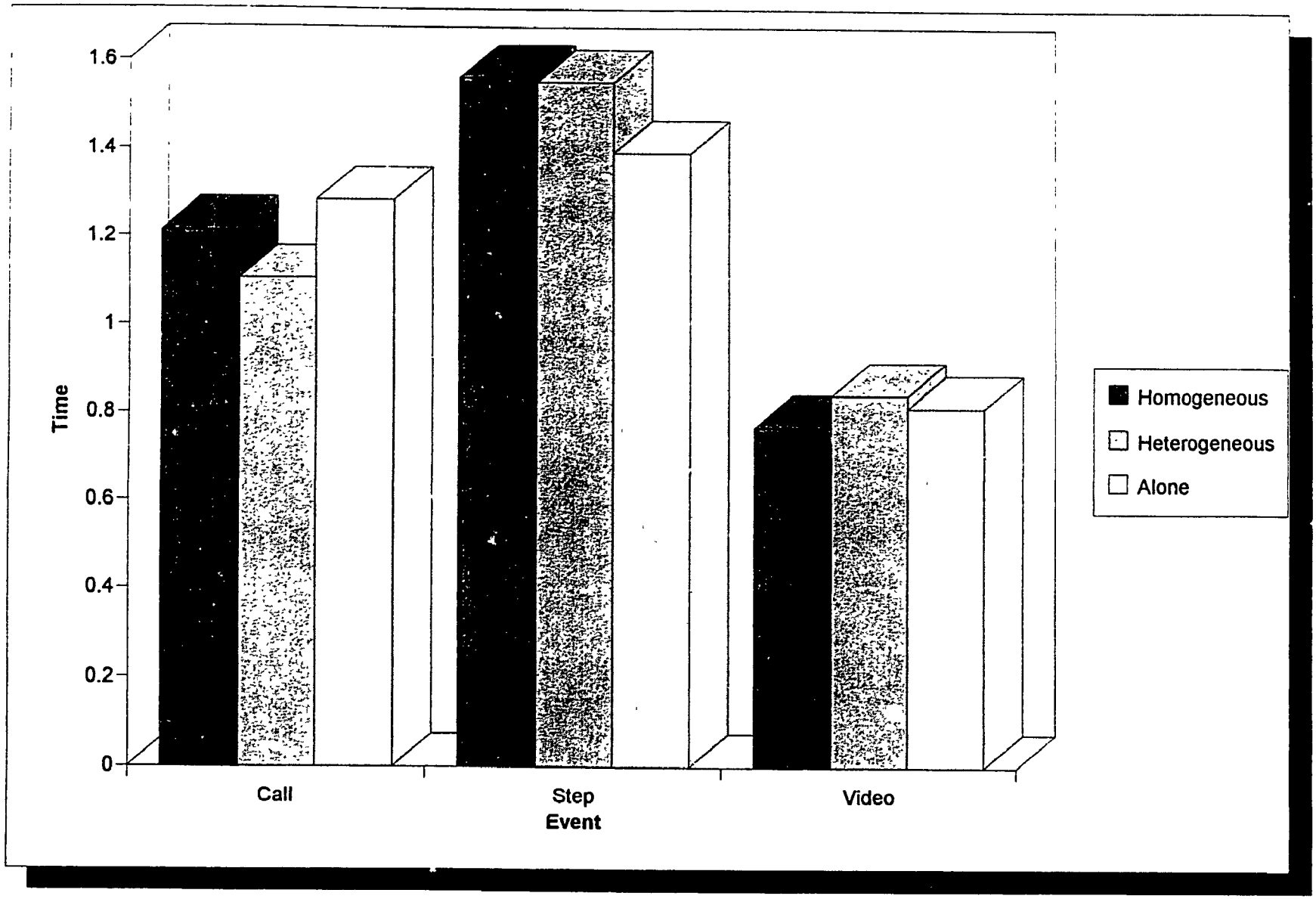


Figure 14. Average time spent on call, step, and video events for homo and heterogeneous groups, and students working alone.



Chapter Five

Discussion

The results of the present study suggest that low ability-subjects working with a partner outperform low-ability subjects working individually on a problem-solving case study measure. No significant differences were evident between paired and unpaired low ability-subjects on the multiple-choice test which measured students' recall Medium and high-ability subjects were seen to perform equally well, whether they worked individually or with a partner, on both the case study and multiple choice measures.

The present research partially supports past research which found superior achievement for subjects working in groups compared to those working individually on problem-solving tasks (Cox and Berger, 1985; Johnson & Johnson, 1986, Mevarech et al , 1987; Trowbridge & Durnin, 1984, Webb, 1984) Past research attributed the success of group work to the fact that individuals working alone at the computer have exclusive access to the program but normally do not articulate their ideas verbally, while students working as a member of a group may have less access to the keyboard but do have opportunities for social and verbal interaction (Trowbridge & Durnin, 1984). Therefore, success of learners working with a partner could be caused by the feedback, guidance, reinforcement, motivation, and/or insights provided from interacting and verbalizing with peers which results in a more thorough understanding of the material

The present study, however, found that grouping benefited only low-ability subjects. These low-ability learners may have experienced difficulty mastering the material on their own and needed greater guidance and feedback provided by their peers than medium or high achievers Tobias (1981) and Bovy (1981) support this speculation, and stated that it is logical to expect an inverse relationship between prior achievement and the amount of instructional support the learner needs.

In an attempt to understand how intragroup feedback and guidance function, past research has investigated the verbalization process that occurs between peers when working in groups (Carrier & Sales, 1987, Dalton, 1990; Guntermann & Tovar, 1987; Hooper & Hannafin, 1991; King, 1989, Webb, 1982, 1984). The findings of these studies suggests that 'giving' and 'receiving' elaborated help is encouraged when students work together and that it is this helping behavior which may increase performance. It is not possible in the present study to delve deeper into the verbal interactions which took place in each of the groups as their interactions were not observed. Future research which records intragroup verbal interactions of university learners may help us determine if, and how, giving and receiving clear explanations helps low-ability students master the material. Future research needs to determine which components of pair work account for its success with low ability university students and whether the quality of the interactions of learners working together is an important determinant in the power of the partnership in CAI.

Future research should also investigate the dynamics of two low ability partners working together on problem-solving tasks. One would not expect this group to function significantly better than low-ability subjects working individually solely on the basis of giving and receiving elaborated help, as low-ability subjects likely do not have as much information to provide to their partners as medium and high-ability subjects do It may be that the effectiveness of this group was caused more by its ability to increase motivation or on-task behavior and not solely on the basis of giving and receiving elaborated help

The current study failed to support past research findings on the influence of incentive structure on performance. Earlier research, which encouraged students to work together and help one another do well on the task, found performance was increased by encouraging this type of helping behavior (Johnson et al., 1981, Slavin 1983; 1989) No significant differences were found in the present study between the cooperative group,

which attempted to foster peer help and positive interdependence, and the individualistic groups which was not provided any incentive for aiding their partner.

Possible explanations for these differences between the findings of the past and present research could lie in the fact that the majority of past research investigated the issue of cooperative learning with younger learners, while this study investigated this issue with older, university level, students. It is possible that the cooperative incentive structure which is successful with younger learners has no effect or functions quite differently with older students who tend to be more self-motivated and independent.

It is also possible that both groups, cooperative and individualistic, functioned cooperatively with students helping and encouraging each other to succeed even though they were not instructed to do so It is more likely, however, that since university students have many years of individually, competitively graded material, the task may have been completed competitively or individualistically instead of cooperatively as was encouraged, thereby causing no significant differences between groups. Perhaps training the groups to work cooperatively would have given them the skills and motivation to help their peers.

This training could begin by teaching learners interpersonal and social skills to try and undo years of individual work which stressed that learners do not share materials and are the only ones responsible for their grades. Learners could be trained in the dynamics of group work and taught to become more accustomed to suggesting, challenging, defending ideas, managing confrontation, and taking the perspective of other students (Simpson, 1986) According to Johnson, Johnson and Holubec (1988) there are numerous interpersonal skills that affect the success of collaborative efforts, and the cooperative skills teachers emphasize in their classes should depend on what skills their students have and have not mastered. For guidance in teaching cooperative skills there are numerous activities provided in the book titled *Cooperation in the Classroom by* Johnson et al , (1988). Future research should investigate if cooperative training is required and/or beneficial in increasing the performance of university learners.

The present research also does not support the majority of previous findings on the influence of group composition on performance as no significant differences were found between homogeneous and heterogeneous groups Precautions were taken in the current study (i.e., randomization using *z* scores) to create representative dyads which were homogeneous or heterogeneous for ability. Past research in ability grouping has found some inconsistencies which have been blamed on the composition of the ability groups studied in the research (Webb, 1982). It is possible, in the present study, that the distinction between the groups was blurred and that groups were not purely homogeneous or heterogeneous for ability since this study randomly assigned all low, medium, and high-ability subjects in the sample. The performance of subjects, therefore, could depend on "the mean level of group ability as well as the range of ability in the group" (Webb, 1982, p. 432) and the influence these factors have on the quality of group interactions.

Another possibility as to why ability grouping had no effect on achievement may have been because group composition has no effect on university level learners. This notion is supported by Hooper, Ward, Hannafin, & Clark (1989) who found that group composition had little influence on achievement for college learners. They proposed that college students may be unaware of the learning potentials and limitations of their partners, assuming other group members comprehend the lesson, consequently not providing high-level elaboration. It is not known whether adult learners provide less high-level elaboration than younger learners as Hooper et al , (1989) suggest and future research with university level learners is needed to determine if Hooper's findings are replicated

An area of concern in ability grouping research is matching subjects overly strictly for ability, for example the lowest ability low with the highest ability high, or throwing out all medium subjects to make sure groups are truly homogeneous or heterogeneous for ability. This technique may provide the researcher with significant differences due to grouping but the usefulness and generalizability of these results may be questionable. The

results of such studies tell us very little about how average ability students perform in different groups and such studies are not helpful for educators who have students from a large variety of ability levels Future research should continue to investigate ability grouping in a manner which is representative, and useful, to the educator and whose results can be easily generalized from samples to populations.

Another finding of the present study was that no significant differences existed between the time taken to complete the program by dyads versus individuals, thus pairing subjects did not significantly increase the amount of time required to complete the program For educators who work within the constraints of class time and semesters this should be encouraging, as pairs take no more class time to complete the material than individuals According to ability, however, the time required to complete the program varied, as low achievers took significantly more time than medium or high-ability subjects to finish the program Low-ability student's slow progress, however, did not appear to have discouraged these learners as they reported that they enjoyed the program and that it helped them to develop their business plan.

This finding of the slow progress of low achievers in learner controlled interactive video instruction is supported by past research which found that low-ability subjects performed more efficiently in 'linear controlled' instruction over more 'learner controlled' instruction (Goetzfried & Hannafin 1985) The low achievers own pace, therefore, may not be the best pace and the feedback and guidance that could have been provided by a partner may have helped improve learning efficiency. This is explained in more detail further in this document with the help of the online tracking data.

Attitude towards the videodisc program and grouping did not differ significantly between treatment groups No significant differences were evident in terms of enjoyment or perceived usefulness of the program or pairing (dyad versus individual). Past research has found that grouping fosters feelings of greater peer support and more positive attitudes towards the learning environment and each other (Slavin, 1983; Johnson et al.

1981; Sharan, 1980, Slavin, 1983), but these findings were not supported in this study. The average level of enjoyment, however, was quite high and was 3.72/5.00 where 5 is equal to 'very much' The enjoyment of working with a partner or alone were rated as 3.70/5.00 and 4.17/5.00 respectively. Since pairing subjects did not seem to negatively influence the level of enjoyment of learners, future research should investigate whether increasing group size to three or four members would have an effect on attitude as the potential cost savings for schools could be great.

In order to further understand how learners of different abilities functioned working individually or within groups, the pathways of learners were 'tracked' with the use of an online tracking program. The usage patterns of unpaired, low, medium and high ability subjects, as well as paired low-ability subjects were investigated The amount of time that low, medium, and high-ability students spent on events (classified as call, step, and video) were also investigated. These data were collected to help the researcher understand how groups and individuals of varying abilities progressed through the videodisc program and how these pathways may have affected their achievement, attitude, and time-on-task.

The tracking data indicated that low-ability subjects progressed through the interactive video program in a sequence that was different from low and medium ability-subjects working on their own and low-ability subjects grouped with different ability peers. The difference was that low-ability students who worked on their own made more unsuccessful attempts to gain a bank loan and when the loan was finally received, failed to look consistently at 'monthly' assistance events that followed. These 'assistance' events were available to learners to help them determine how their simulated business was performing and what changes, if any, should be made

It is the researcher's opinion that avoiding these events would leave the learner without a clear understanding as to why his simulated business was performing effectively or ineffectively and what, if any, modifications were needed to strengthen the business. It

is believed that avoiding these events would deny the learner the opportunity to obtain a deep understanding of the functioning of a small business and thus effect his performance on the post-test and time-on-task

It seems that since low-ability students who worked individually tried unsuccessfully over and over to get a bank loan, sufficient feedback was not provided to these low-ability students when needed These low-ability students then followed a path which did not spend time consistently looking at 'guidance' or 'feedback' that was offered until, perhaps, it was too late. Though it is evident from the time data that viewing these 'feedback' events for the early simulated months took little time in comparison to revising the business plan, low-ability students who worked alone did not seem to know when they needed the feedback and may not have requested to view it in a successful fashion. This inability of low-ability students to request feedback when needed is supported by past research which found that low-ability learners often lack the ability to determine when remedial help is needed (Judd, Daubek, & O'Neil, 1975).

The tracking data also revealed two events that low-ability students working individually spent different amounts of time on than did medium and high-ability subjects working individually, or paired low-ability subjects. Low-ability learners working individually spent less time gathering information about real estate options (event # 16) and more time completing the depreciation table information (event # 28). Though the pathway of low achievers did not differ from other paired low's or individuals after these events, they could also have contributed to the poor performance of low ability individuals.

The information provided in event #16 on real estate was quiet detailed and provided information which was used throughout the program. The amount of time spent viewing this information could, therefore, have effected achievement. The completion of the depreciation table (event #28) required subjects to decide what property would be purchased by the company, its cost, useful life, and depreciation. The depreciation table

provided the user with little guidance or feedback and learners were expected to apply their own judgment This information had to be completed realistically before a bank loan could be approved. It is speculated that low-ability students would have spent less time on this event had more guidance been provided by a higher-ability partner, and perhaps more time on effectively creating and revising the rest of their business plan It is further speculated that low-ability subjects working with a similar-ability peer would also have spent less time on this event had the motivation to stay on task been provided by a similar-ability peer These speculations are supported by the online tracking data which found that low-ability subjects working with a partner, regardless of the ability of the partner, spent less time trying to obtain a bank loan than low-ability subjects working individually in the control group.

The tracking data also revealed that low, medium and high-ability subjects spent varying amounts of time on the program's formal features (classified as call, step, and video). A consistent difference was that low-ability subjects working individually spent more time on call events than medium and high-ability subjects working alone, and more time than all homogeneous and heterogeneous ability-pairs. A call event refers to any decision or choice a learner was required to make as they progressed through the Business Disc program. It is possible that low-ability subjects working individually were unsure of their decisions, spent perhaps too much time making up their minds as best illustrated by their unsuccessful attempts to obtain a bank loan, and thus performed poorly on the case-study post test. These data reinforce the speculation that feedback and guidance are needed for low-ability students who are working on their own to help optimize their use of time.

The tracking data also illustrate that low-ability subjects spent more time on video than all other subjects working with a partner or individually. Courseware designers may be able to apply this information to improve the achievement of low-ability learners by

ensuring that there is redundancy of information presented, and prompting to access both feedback and guidance, in video segments.

The tracking data also revealed that any ability-group that contained a high-ability student spent more time on the step events than any other homogeneous or heterogeneous ability group except for the combination of low-ability students working with medium-ability peers. As no significant differences in achievement were evident for high-ability homogenous and heterogeneous groups, or low-ability students working with medium-ability peers, it is unclear how the time spent on step events affected their performance. Perhaps future research will help explain these results.

The tracking data further illustrated some differences in the time students spent on call and step events in terms of incentive structure, group composition, and the control group. The individualistic group spent more time on call events than subjects working cooperatively or alone, and that the cooperative group spent more time on step events than students working individualistically or alone. Students working alone regardless of ability level spent more time on step events than students working with a partner. Although it is not possible to speculate how the time spent on these events affected achievement, the results do suggest that differences existed between the progress of cooperative and individualistic groups, and between students who worked alone and those who worked with a partner. These results are interesting and future research on cooperative incentives and group work should utilize such tracking programs to help further explain the impact of incentive structures and group work on students' use of time.

The use of the tracking data, therefore, provided the researcher with a unique "inside look" into the strategies employed by learners of different abilities working either individually or in groups with different incentive structures and group-ability compositions. It was used in the present study to help determine which factors contributed to the poor achievement of unpaired low-ability students on the post test. The tracking graphs suggested that spending a lot of time repeating an event without sufficient

'guidance' and 'feedback' provided by peers caused low achievers to avoid 'guidance' and 'feedback' options that were provided and, perhaps, needed The graphs also illustrate that spending excessive time making choices and decisions (call events) may have negatively affected low-ability subjects' achievement on the post test

If providing low-ability students with a partner assisted them in mastering the material, then it should be used as an instructional strategy to improve low-ability students achievement when working in computer simulation environments This tracking of online pathways offers much potential to examine specific interactive video packages but it also offers the opportunity to future researchers who are utilizing other forms of multimedia to understand how material is being mastered.

The online tracking program in this study was used to judge how pathways effect achievement, time-on-task, and attitudes towards a task without any knowledge or any more active participation required by the user. If a future task does not lend itself to grouping, the use of a pathway tracking device could still be helpful to researchers in analyzing if, and how, learners working individually would benefit from teaching strategies such as the introduction of advance organizers (Ausubel, 1968), or the added opportunity to rehearse or practice the material (Schwier & Misanchuk, 1988)

Researchers need to determine how learners are spending their time in an interactive video program, whether it is being used effectively, and what type of guidance and feedback are needed by the learner to effectively progress through the software

In summary, tracking students' sequence helped to explore how interactive video conveys its message by keeping the user firmly in focus This study did not look solely at the phenomenon of interactive video, but rather investigated the forces behind this powerful teaching tool. Although this research examined an interactive video production in its completion (summative), interactive video is not a fixed entity and, therefore, the collected data has the potential to guide the producer of *this* software as well as other similar packages in creating a more effective product

In conclusion, the present study contributed to our knowledge of group work by finding that working on a problem-solving, interactive video simulation with a partner can increase the performance of low-ability subjects over working individually. The present study also illustrated that medium and high-ability subjects learned equally well on the case study measure whether they worked individually or with a partner. The multiple-choice measure did not find any significant differences between group work versus working individually. These findings are partially supported by past research which found that when subjects' achievement was evaluated with problem-solving type questions, subjects in groups had superior performance to those working individually (Johnson & Johnson, 1986, Trowbridge & Durnin, 1984; Webb, 1984; Webb et al. 1986; Cox and Berger, 1985). Also in support with past research, this study did not find any significant difference in terms of achievement for subjects whose performance was evaluated with more recognition type questions (Cartwright, 1972; Carrier & Sales 1987; Okey & Majer, 1976).

The findings of the present study should be encouraging to educators who want to promote the maximum amount of learning but are forced to place more than one student at a microcomputer work station due to budget or time constraints Placing a student with a partner was found to be not only nondetrimental to performance or time-on-task but it also did not negatively affect subjects' attitudes. The benefit of group work, found by this study, was that low-ability students were aided by the assistance provided by a partner in terms of achievement. Since pairing students at the microcomputer workstation requires no added precourse preparation or expenses and does not require the use of extra professors or teaching assistants, it may be a very practical and economical way to increase the achievement of low-ability students.

It is hoped that this study will encourage future research into what is the optimum group size and incentive structure in terms of attitude, performance, and time-on-task with university level learners working in an interactive video or multimedia environment. Future

research should also investigate peer interactions and which interactions within a group promote success for its members. It is also hoped that this study will encourage the use of tracking programs that can provide researchers with insight into which learning conditions are necessary and sufficient to optimize the learning process for learners of different abilities and characteristics.

References

Anderson, R E (1983, March). Innovative microcomputer games and simulations: An introduction Simulation and Games, 14(1), 3-9

Anderson, D R. & Lorch, E. P (1983) Looking at television: Action or reaction? In J. Bryant & D.R. Anderson. (Eds). 1983 Children's understanding of television: Research on attention and comprehension. New York: Academic Press.

Ausubel, D P (1968) Educational psychology A cognitive view, New York: Holt, Rinehart and Winston.

Baggaley, J (1976) Dynamics of television. Aldershot: Gower Publishing Company.

Baggaley, J (1980) Psychology of the TV image. Aldershot· Gower Publishing Company.

Baggaley, J. (1982, March) TV production research and media development. Media in Education and Development, 46-48.

Baggaley, J (1987, Summer). Continual response measurement: Design and validation. Canadian Journal of Educational Communication, 16(3), 217-238.

Baggaley, J. (1989). Continual response measurement: Design and validation. Canadian Journal of Educational Communication, 16(3), 217-238.

Bargh, J A. & Schul, Y (1980). On the cognitive benefits of teaching. Journal of Educational Psychology, 72, 593-604

Baron, L J. & Abrami, P. C. (1992). Microcomputer learning and tutorial program-manipulating group size and exposure time. Journal of Computing in Childhood Education, 3(3/4), 231-245.

Becker, L A. (1988, February). Computer-aided misconception-based intelligent tutoring and exercise generation. Programmed-Learning-and-Educational-Technology, 25(1), 67-73.

Beaman, A. L , Diener, E. , Fraser, S. C & Endresen, K. L. (1977). Effects of voluntary and semi-voluntary peer-monitoring programs on academic performance. Journal of Educational Psychology, 69(2), 109-114

Birt, D (1976, July) History simulations alive and well and living in textbooks Programmed Learning and Educational Technology. 13(3), 19-24.

Bovy, R. C. (1981). Successful instructional methods: A cognitive information processing approach. Educational Communication and Technology Journal, 29(4), 203-217.

Braden, R A (1986, May) Visuals for interactive video: Images for a new technology (with some guidelines). Educational Technology, 18-22.

Cambre, M. A. (1981, Spring). Historical overview of formative evaluation of instructional media products. Educational Communication and Technology Journal, 3-25

Carlson, H. L , & Falk, D R (1989, Summer) Effective use of interactive videodisc instruction in understanding and implementing cooperative group learning with elementary pupils in social studies and social education Theory and Research in Social Education, 17(3), 241-258

Carrier, C., & Sales, G (1987, Winter). Pair versus individual work on the acquisition of concepts in a computer-based instructional lesson Journal of Computer-Based Instruction, 14 (1), 11-17

Cartwight, G. (1972). The use of groups in computer-assisted instruction, Paper presented at the Canadian Symposium on Instructional Technology, May 24-26. Department of Educational Psychology, Edmonton, 395-404

Choi, B & Gennaro, E. (1987) The effectiveness of using computer-simulated experiments on junior high students' understanding of the volume displacement concept Journal of Research in Science Teaching, 24(60), 539-552.

Cockayne, S. (1991, February) Effects of small group sizes on learning with interactive videodisc. Educational Technology, 43-45.

Coldevin, G. O. (1981, May) Experimental research in television message design: Implication for ETV. Programmed Learning and Educational Technology, 18(2), 86-99.

Cooper, J., Prescott, S , Mueck, R., Cook, L., Cusco, J., & Smith, L. (1990) Cooperative learning and college instruction; Effective use of student learning teams. The California State University Foundation

Cornford, F.M. (1941) (trans) The republic of Plato. Oxford, England: Claredon Press

Cox, D. A., & Berger, C. F (1985) The importance of group size in the use of problem-solving skills on the microcomputer. Journal of Educational Computing Research, 1(4), 459-468

Dalton, D. W (1990, Winter) The effects of cooperative learning strategies on achievement and attitudes during interactive video Journal of Computer-Based Instruction, 17(1), 8-16

Dalton, D. W., Hannafin, M. J , & Hooper, S. (1989). Effects of individual and cooperative computer-assisted instruction on student performance and attitudes Educational Technology Research and Development, 37(2), 15-24

Daningburg, S. & Schmid, R F. (1988). Educational television evaluation the impact of methodology on validity and learning Journal of Educational Television, 14(3), 177-191.

Dansereau, D. F. (1983). Cooperative learning: Impact on acquisitions of knowledge and skills. ERIC Document Reproduction Service No. ED 107 215.

Davidson, N (1985) Small-group learning and teaching in mathematics: A selective review of the research In Learning to cooperate, Cooperating to Learn Edited by R.E. Slavin, S. Sharan, S Kagan, R H. Larorowitz, C Webb, and R. Schmuck, New York: Plenum.

Dawson, M. M. (1987). Beyond ability grouping: A review of the effectiveness of ability grouping and its alternatives Psychology Review, 16, 348-369.

de-Moura-Guimaraes, A.& Dias, R.(1992, March). Some considerations for the design and implementation of an instructional hypercard-based simulation. Simulation-Games-for-Learning, 22(1), 16-31.

Dekkers, J & Donatti, S. (1981, July/August). The Integration of research studies on the use of simulation as an instructional strategy. Journal of Educational Research, 74(6), 424-427.

Esposito, R. W. (1973) Homogeneous and heterogeneous ability grouping: Principle findings and implications for evaluating and designing more effective educational environments. Review of Educational Research, 43(2), 163-179.

Evans, W. A & Sculli, D (1984, Spring). An evaluation of business games with respect to the development of managerial talent. Simulation/Games for Learning, 14(1), 3-13.

Foster, D. (1984, Fall). Computer simulations in tomorrow's schools. Computers in the Schools, 1(3), 81-89.

Fraser, S. C., Beaman, A. L. , Diener, E., & Kelem, R. T. (1977). Two, three, or four heads are better than one: Modification of college performance by peer monitoring. Journal of Educational Psychology, 69 (2), 101-108.

Gagne, R. M (1970). The conditions of learning. (2nd ed.). New York: Holt Rinehart and Winston.

Goetzfried, L., & Hannafin, M. J. (1985, Summer). The effect of the locus of CAI control strategies on the learning of mathematics rules. American Educational Research Journal, 22(2), 273-278.

Good, T. L., & Marshall, S. (1984). Do students learn more in heterogeneous or homogeneous groups? In P. Peterson, L. Cherry Wilkenson, & M. Hallinan (Eds.), Student diversity and the organization, process, and use of instructional groups in the classroom. New York: Academic Press, 15-37.

Goodhardt, G J., Ehrenberg, A S. C. & Collins, M. A. (1975). The television audience: Patterns of viewing, England: Saxon House.

Guntermann, E . & Tovar, M. (1987). Collaborative problem-solving with LOGO: Effects of group size and group composition. Journal of Educational Computing Research, 3(3), 313-334.

Hakstian, A. R., & Cattell, R. B. (1975-1982). Comprehensive Ability Battery (CAB).

Hannafin, M. J. (1984). Guidelines for using locus of instructional control in the design of computer-assisted instruction. Journal of Instructional Development, 7, (3), 6-10.

Hannafin, M .J. (1985). Empirical issues in the study of computer-assisted interactive video. Education Communication and Technology Journal, 33(4), 235-247.

Hannafin, M. J. (1987). The effects of orienting activities, cueing, and practice on learning of computer-based instruction. Journal of Educational Research, 81(1), 48-53.

Hannafin, M. J., Phillips, L., Rieber, L. P., & Garhart, C. (1988) Effects of orienting activities and cognitive processing time on factual and inferential learning. Educational Communication and Technology Journal, 35(2), 75-84.

Hannafin, M. J , & Calamaio, M. E. (1987). The effect of variation in lesson control and practice on learning from interactive video. Educational Communication and Technology Journal, 35(4), 203-212.

Hannafin, M. J., & Hughes, C. W (1986) A framework for incorporating orienting activities in computer-based interactive video. Instructional Science, 15, 239-255.

Hannafin, M. J., & Phillips, T. L. (1987). Perspectives in the design of interactive video: Beyond tape versus disc. Journal of Research and Development in Education, 21(1), 44-60

Hansen, E. J. (1989, July). Interactive video for reelection Learning theory and a new use of the medium. Educational Technology, 7-15.

Harp, B. (1989). What do we put in the place of ability grouping ? Reading Teacher, 42(7), 534-535.

Hoelscher, K. J. (1990). Bridging the Classroom and the real world: A videodisc implementation study at Harvard Law School, (ERIC Document Reproduction Service No. ED 320 561).

Hooper, S. & Hannafin, M. J. (1988). Cooperative CBI: The effects of heterogeneous versus homogeneous grouping on learning on progressively complex concepts Journal of Educational Computing Research, 4(4), 413-424.

Hooper, S. & Hannafin, M. (1991). The effects of group composition on achievement, interaction, and learning efficiency during computer-based cooperative instruction Educational Technology Research and Development, 39(3), 27-40

Hooper, S , Ward, T. J., Hannafin, M. J , & Clark, H J (1989, Summer). The effects of aptitude composition on achievement during small group learning. Journal of Computer-Based Instruction, 16(3), 102-109.

Holt, P. & Wood, P. (1990, Summer). Intelligent tutoring systems. A review for beginners. Canadian Journal of Educational Communication, 19(2), 107-123.

Hughes, G. D. (1992, May/June) Realtime response measures redefine advertising wearout. Journal of Advertising Research, 61-77.

Hunter, R., & Clark, R. E. (1977). Simulation/gaming research. Educational Technology, 17(7), 44-46.

Johnson, D. W., & Johnson, R. T. (1982). Cooperation in learning: Ignored but powerful. Lyceum, 5, 1-13.

Johnson, D. W. & Johnson, R T (1985, October). Cooperative learning: One key to computer assisted learning. The Computing Teacher, 11-15.

Johnson, D. W., & Johnson, R. T. (1986, January). Computer-assisted cooperative learning Educational Technology, 12-18.

Johnson, D. W , & Johnson, R. T. (1990). Cooperative learning and achievement, In S. Sharan (Ed.), Cooperative Learning: Theory and Research, (pp 22-37), New York: Praeger.

Johnson, D. W., Johnson, R. T, & Holubec, E. J. (1988). Cooperation in the classroom, Minnesota: Interaction Book Company.

Johnson, D. W , & Johnson, R. T., & Stanne, M. (1985). Effects of cooperative, competitive and individualistic goal structures on computer-assisted instruction. Journal of Educational Psychology, 77 (6), 668-677.

Johnson, D. W., Maruyama, G., Johnson, R., Nelson, D., & Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. Psychological Bulletin, 89(1), 47-62.

Judd, W. A , Daubek, K. & O'Neil, H. F. Jr. (1975). Individual differences in learner controlled CAI, The University of Texas at Austin, (ERIC Document Reproduction Service No. ED 107 215).

Kagan, S. (1989, Ed). Cooperative learning - Resources for teachers, Printing and Reprographics, University of California.

Kearsley, G. P. & Hillelsohn, M. J. (1982). Human factors considerations for computer-based training. Journal of Computer-Based Instruction, 8(4), 74-84.

King, A. (1989). Verbal interaction and problem-solving within computer-assisted cooperative learning groups. Journal of Computing Research, 5(1), 1-15.

Kulik, J. A., & Kulik, C. L. C. (1979). College teaching. In P.L. Peterson & H.J. Walberg (Eds.), Research on teaching: Concepts, findings, and implications. Bereley, CA: McCutcheon.

Ladousse, G. P. (1982, Summer). Role play and simulation in language learning. Simulation/Games for Learning, 12(2), 51- 60.

Laughlin, P. R. (1978). Ability and group problem solving Journal of Research and Development in Education, 12 (1), 114-120.

Laughlin, P. R., & Branch, L. G., (1972) Individual versus triadic performance on a complementary task as a function of initial ability level Organizational Behavior and Human Performance, 8, 201-216.

Laughlin, P. R., Branch, L. G., & Johnson, H. H. (1969). Individual versus triadic performance on a unidimensional complementary task as a function of initial ability level. Journal of Personality and Social Psychology, 12, 144-150.

Laurillard, D. M. (1984, June). Interactive video and the control of learning. Educational Technology, 7-15.

Litchfield, C. (1990, July). Criteria for evaluating videodisc interactivity Performance and Instruction, 29(6), 23-26.

Lookatch, R. P. (1989, December). Options for interactive video. Training and Development Journal, 65-67.

Lookatch, R. P. (1990a, Winter) The development of critical thinking skills through the use of instructional technologies. Journal of Interactive Instruction Development, 26-30

Lookatch, R. P. (1990b, May). The efficacy of interactive laserdisc-based employment skills training for disadvantaged young adults Interactive Performance systems, Research Report: Interactive Performance Systems, 1-12.

Lorch, E. P., Anderson, D. R. & Levin, S. R. (1979). The relationship of visual attention to children's comprehension of television. Child Development, 50, 722-727.

Lu, D. & Kiewit, D. A. (1987, June/July). Passive people meters: A first step. Journal of Advertising Research, 9-14.

Maclean, R. (1976, July). Simulation and games, with particular reference to the teaching of economics. Programmed Learning and Educational Technology. 13(3), 11-18.

Manning, M. L., & Lucking, R. (1990, Summer). Ability grouping: Realties and alternatives. Childhood Education, 254-258.

McDonald, B. A., Larson, C. O., Dansereau, D. F., & Spurlin, J. E. (1985). Cooperative dyads: Impact on text learning and transfer Contemporary Educational Psychology, 10, 369-377.

McLuhan, M. (1964). Understanding media: The extensions of man, New York: McGraw-Hill.

McNeil, B. J , & Nelson, K. R. (1991). Meta-analysis of interactive video instruction: A 10 year review of achievement effects. Journal of Computer-Based Instruction, 18(1), 1-6.

Megarry, J. (1978). Retrospect and prospect In Perspectives on Academic Gaming and Simulation 3, 181-185, Kogan Page, London, England.

Mevarech, Z R., Stern, D & Levita, I. (1987, Jan/Feb). To cooperate or not to cooperate in CAI: That is the question. Journal of Educational Research, 80(31), 164-167.

Milheim, W D. & Evans, A D (1987, June) Using interactive video for group instruction. Educational Technology, 35-37

Millard, W. J. (1992). A history of handsets for direct measurement of audience response. International Journal of Public Opinion Research, 4(1), 1-17.

Mitchell, P. D (1982) Simulation and gaming in higher education. In C. Knapper (Ed.), New directions for teaching and learning: Expanding learning through new communications technologies, no. 9 , (pp. 57-67). San Fransisco: Jossey-Bass.

Morgan, M. (1989) Ability grouping in reading instruction: Research and alternatives. Focused Access to Selected topics (FAST), (ERIC Document Reproduction Service No. ED 007 570).

Murray, J. P. (1980). Television and youth: 25 years of research and controversy, Nebraska, USA.

Nickerson, R. B (1982). Second generation electronic testing technology applied to television evaluation. In J. Baggaley and P. Janega (Eds.), Processing of the forth international conference on experimental research in TV instruction, Volume 4,(pp. 109-114). Memorial University of Newfoundland, Newfoundland, Canada.

Nie, N H. (1975). Statistical package for the social sciences. New York: McGraw-Hill.

Noddings, N. (1989, May). Theoretical and practical concerns about small groups in mathematics The Elementary School Journal, 89(5), 607-623.

Norton, P. (1985, January). An agenda for technology and education: Eight imperatives. Educational Technology, 15-20.

Nugent, G. C. & Stone, C. G. (1980, May). Videodisc instructional design. Educational Technology, 29-32

Okey, J. R., & Majer, K. (1976, Spring). Individual and small group learning with computer-assisted instruction. AV Communication Review, 24(1), 79-86.

Olm, K. W. & Eddy, G. G. (1985). Entrepreneurship and venture management: Text and cases, U.S.A.: Charles E. Merrill Publishing Company, .

Peterson, P. L , Janicki, T. C., & Swing, S. R. (1981, Winter). Ability X treatment interaction effects on children's learning in large-group and small-group approaches. American Educational Research Journal, 18 (4), 453-473.

Raybould, B. (1990). Solving human performance problems with computers. A case study: building an electronic performance support system. Performance-and-Instruction, 29(10), 4-14.

Romiszowski, A. J. (1987). Designing instructional systems; Decision making in course planning and curriculum design, New York. Kogan Page Ltd

Rosenbaum, J. E. (1980). Social implications of educational grouping Review of Research in Education, 8, 361-401.

Ross, S. M. (1984, Spring). Matching the lesson to the student: Alternative adaptive designs for individualized learning systems, Journal of Computer-Based Instruction, 11(2), 42-48

Ross, S. M., & Rakow, E. A. (1983). Learner control versus program control as adaptive strategies for selection of instructional support on math rules Journal of Educational Psychology, 745-753.

Rysavy, S. D., & Sales, G. C. (1991). Cooperative learning in computer-based instruction. Educational Technology Research and Development, 39(2), 70-79.

Salomon, C. & Gardner, H. (1986, January). The computer as educator. Lessons from television research. Educational Researcher, 13-19.

Schwier, R. A. & Misanchuk, E. R. (1988, Fall). The effect of interaction and perceived need for training on learning and time spent learning from computer-based instruction. Canadian Journal of Educational Communication, 17(3), 147-158.

Sharan, S. (1980, Summer). Cooperative learning in small groups: Recent methods and effects on achievement, attitude, and ethnic relations. Review of Educational Research, 50,(2), 241-271

Sherman, L. W., & Thomas, M. (1986). Mathematics achievement in cooperative versus individualistic goal-structured high school classrooms. Journal of Educational Research, 79, 169-172.

Shirts, R. G. (1976, July). Simulation games· An analysis of the last decade. Programmed Learning and Educational Technology, 13(3), 37-41.

Simpson, J. (1986, October). Computers and collaborative work among students. Educational Technology, 37-44.

Slavin, R. E. (1983). When does cooperative learning increase student achievement? Psychological Bulletin, 94 (3), 429-445.

Slavin, R. E. (1987a, Fall). Ability grouping and student achievement in elementary schools: A best-evidence synthesis. Review of Educational Research, 57 (3), 293-336.

Slavin, R. E. (1987b). Grouping for instruction in the elementary school. Educational Psychologist, 22, 109-127.

Slavin, R.E. (1989). Research on cooperative learning· an international perspective. Scandinavian Journal of Educational Research, 33 (4), 231-243.

Slavin, R. E (1989/1990, December/January). Research on cooperative learning: Consensus and controversy Educational Leadership, 52-54.

Slavin, R. E (1990, Fall). Achievement effects of ability grouping in secondary schools: A best-evidence synthesis. Review of Educational Research, 60(3), 471-499.

Slavin, R. E., & Karweit, N. L. (1985). Effects of whole-class, ability grouped, and individualized instruction on mathematics achievement. American Educational Research Journal, 22, 351-367.

Smith, D G. (1977) College classroom interactions and critical thinking. Journal of Educational Psychology, 69, 180-190.

Spurlin, J. Dansereau, D., Larson, C., & Brooks, L. (1984). Cooperative learning strategies in processing descriptive text: Effects of role and activity level on the learner. Cognition and Instruction,1 (4), 451-463.

Steinberg, E. R. (1977). Review of student control in computer-assisted instruction. Journal of Computer-Based Instruction, 3, (3), 84-90.

Stopp, P. (1976, July). Understanding, and evaluating, the use of simulations and games in schools. Programmed Learning and Educational Technology. 13(3), 29-36.

Storad, C. J. (1985, October). The role of simulations in the mathematics classroom. Media and Methods, 17-19.

Swing & Peterson, (1982, Summer). The relationship of student ability and small-group interaction to student achievement. American Educational Research Journal. 19(2), 259-274.

Taylor, R. (1989). The potential of small-group mathematics instruction in grades four through six. The Elementary School Journal, 89(5), 633-642.

Tennyson, R. D. (1980). Instructional control strategies and content structure as design variables in concept acquisition using computer-based instruction, University of Minnesota, (ERIC Document Reproduction Service No. ED 189 134).

Tennyson, R D., Thurlow, R. & Breuer, K. (1987). Problem-oriented simulations to develop and improve higher-order thinking strategies. Computers in Human Behavior, 3, 151-165.

Tobias, S. (1981) Adapting instruction to individual difference among students. Educational Psychologist, 16, (2), 111-120.

Trowbridge, D., & Durnin, R. (1984). Results from an investigation of groups working at the computer California University, Irvine, Educational Technology Center. (ERIC Document Reproduction Service No. ED 238 724).

Vadas, J E (1986). Interactive videodisc for management training in a classroom environment. Proceedings of the Sixth Annual Conference on Interactive Videodisc in Education and Training, 64-70.

Walker, D. R. (1978). Computer-based games and simulations in geography: A Problem in innovation and diffusion. In Perspectives on Academic Gaming and Simulation, (pp. 187-207). London, England: Kogan Page.

Webb, N. M. (1982, Fall). Student interaction and learning in small groups Review of Educational Research, 52(3), 421-445.

Webb, N. M. (1984). Microcomputer learning in small groups: Cognitive requirements and group processes. Journal of Educational Psychology, 76(6), 1076-1088.

Webb, N. M. (1985). Student interaction and learning in small groups: A research summary. In R. Slavin, S. Sharan, S. Kagan, R.H. Lazarowitz, C. Webb, & R. Schmuck (Eds.), Learning to cooperate, Cooperating to learn, (pp. 147-172), New York: Plenum Press, .

Webb, N. M. (1989). Peer interaction and learning in small groups. International Journal of Educational Research, 13(1), 21-39.

Webb, N. M., Ender, P., & Lewis, S. (1986). Problem-solving strategies and group processes in small groups learning computer programming. American Educational Research Journal, 23(2), 243 -261.

Yueh, J., & Alessi, S. M. (1988, Winter). The effect of reward structure and group ability composition on cooperative computer-assisted instruction. Journal of Computer-Based Instruction, 15(1), 18-22.

Young, C. E. & Robinson, M. (1987, June/July). Guideline. tracking the commercial viewer's wandering attention. Journal of Advertising Research, 1(2), 15-22.

Zinkhan, G. M. & Burton, S. (1989). An examination of three multidimensional profiles for assessing consumer reactions to advertisement. Journal of Advertising, 18(4), 6-14.

Appendix A

Case Study Post Test

NAME: _____

DATE: _____

CLASS: _____

Please read the following four cases and answer the questions that follow each of the cases. If you require more space to write your answers please continue writing on the back of the test pages.

CASE 1

Donna Southwell and Peg Weber wanted to open a women's designer dress shop, 'Clothware', in Quebec City. The 'Clothware' concept was very simply to provide an alternative to mass-produced, overpriced, department store apparel for discriminating women. Peg and Donna decided to rent an attractive small shop called Liberty House. The two partners hired some help to assist them in designing, manufacturing, and retailing the finished product, as well as providing help with designing and sewing. After three and a half weeks of intensive labour, just before opening day, Peg received an early morning phone call from Donna.

"Peg! Peg! Oh my God, you'll never believe this! I'm stunned! I'm devastated. Oh Peg ... I" .. as her nearly incoherent words trailed off.

"What on earth are you talking about Donna? What's happened an accident ?"

"Accident ? My God, has there been an accident. Oh Peg our shop has burned down !"

Questions for CASE 1

Q1. What kind of insurance is available to protect a small business enterprise such as 'Clothware' against this type of risk?

Q2. What are some of the other insurable risks faced by a small business enterprise?

CASE modified from : Olm, K.W. & Eddy, G.G. (1985). Entrepreneurship and Venture Management: Text and Cases, Englewood Cliffs, N.J.: Charles E. Merrill Publishing Company.

CASE 2

When James R. Eure retired from 25 years in the Air Force he did not have anything specific in mind as to what to do with his time. He started to think about going into the restaurant business. He managed to scrape up enough money to open a small pizza parlour on the outer limits of town. In addition to pizza, the restaurant was to serve charburgers and submarine sandwiches. The business venture was to be called the 'Yucca Hut'. The business looked hopeful at first but it was not a success and had to close in less than a year. Many factors could have contributed to the failure of the pizza parlour, but Eure's justification for the location of the 'Yucca Hut' may have been a major contributing factor. Eure stated:

"I don't know why I picked the location except that the rent was cheap. It was a location which many of my subsequent locations have been - dismal failures - but these are the locations you can get on your own terms."

Questions for CASE 2

Q1. What aspects of locating a business did James Eure fail to take into account?

Q2. Discuss the particular concerns of locating a business in ***either*** a home business, urban residential, downtown, shopping center ***or*** highway location?

CASE modified from : Olm, K.W. & Eddy, G.G. (1985). Entrepreneurship and Venture Management: Text and Cases, Englewood Cliffs, N.J.: Charles E. Merrill Publishing Company.

CASE 3

Bill Wheeless is foreman in a large welding business, but he knows the problems faced by farmers. A close relation of his owns a large farm and Wheeless owns a small farm of his own. He proposes to start a business to repair agricultural equipment. Normally, repairs would consist of removing broken or damaged parts of machinery and replacing them. Great efforts will be undertaken to establish a reputation for high-quality design, repair, and fabrication, as well as courteous and energetic service at fair competitive prices.

Questions for CASE 3

Q1. What factors should Bill Wheeless be concerned with in setting prices?

Q2. If Wheeless calculated that his average costs of sales were $500.00 and the average monthly disbursements were $100.00, estimate a feasible number of sales he might expect, and decide on a competitive percentage of profit he should take, and then calculate the price Wheeless might charge his customers.

Q3. What can Bill do, in addition to his pricing policy, to expand the market for the goods he sells?

CASE modified from : Olm, K.W. & Eddy, G.G. (1985). Entrepreneurship and Venture Management: Text and Cases, Englewood Cliffs, N.J.: Charles E. Merrill Publishing Company.

CASE 4

Sam and Sue LeGrand of Otttawa decided to open an "energy-saving" store carrying such products as ceiling fans, storm doors and windows, water heater jackets, thermostat timers, and water saving devices. Sam was to be in charge of planning for the organization especially middle and long range planning. He was to do the sales forecasts and was to be the motivator for the organization. Sam, however, did not believe in spending time and money on "book" works. His motto was Make the sale and Collect the Money. The closest thing the LaGrands had to a financial statement was a monthly "income statement" from a computerized data service. The statement merely recapped the sales volume and listed expenses; it gave no valuable management information.

Questions for CASE 4

By answering the following three questions, evaluate Sam's apparent insensitivity to comprehensive and systematic record keeping.

Q1. Discuss WHY record keeping is important in the management of a small business enterprise such as the LeGrand's energy saving store ?

Q2. HOW should the LeGrand's record keeping be done on a day-to-day basis ?

Q3. WHAT are the basic accounting records that the LaGrand's should keep, and what purpose do they serve ? (continue on back if necessary)

CASE modified from : Olm, K.W. & Eddy, G.G. (1985). Entrepreneurship and Venture Management: Text and Cases, Englewood Cliffs, N.J.: Charles E. Merrill Publishing Company.

Appendix B

Idea Units for Case Post-Test

Case 1

Points	Description
Q1.	
1	-fire insurance
Q2	
1	-to cover disaster - theft, fire ect
1	-if someone or something injured on property OR liability
1	-product liability insurance OR damage or defect caused in product or servicing
4	

Case 2

Points	Description
1	-zoning
1	-financial situation
2	

home

Points	Description
1	-set own hours
1	-no car - transportation unnecessary
1	-low start up costs
1	-self discipline
4	

OR

urban residential

Points	Description
1	-built in customers
1	-feel a loyalty to the business
1	-walk by business
1	-urban convenience
4	

OR

downtown

Points	Description
1	-downtown convenience
1	-high visibility
1	-constantly being renovated or improved
1	-expensive rent wise
4	

OR

shopping center

Points	Description
1	-walk in trade
1	-customers attracted by department and food stores
1	-high visibility
1	-convenience
4	

OR

highway

Points	Description
1	-high visibility
1	-low rent compared to downtown
1	-drive by business
1	-highway convenience for delivery
4	

(NOTE: Students were asked to choose one of the five locations.)

Case 3

a)

Points	Description
1	-cover costs
1	-make a profit
1	-stay competitive
3	

b)

Points	Description
1	-cost to customer- correctly calculated
1	-competitive % of profit
1	-reasonable # of sales
3	

c)

Points	Description
2	-advertise
1	-flyers or brochures
3	

Case 4

a)

Points	Description
1	-helps to control business or give an idea how business is doing
1	-needed by banker for loan
1	-vital for income taxes
3	

b)

Points	Description
1	-list information (i.e., dollar amounts, due date, and date of actual payment)
1	-records kept 3 years
2	

c)

Points	Description
.5	-personal income statement
.5	-cash flow projection
.5	-letter of intent
5	-business profile

2

c)

Points	Description
.5	-list of earnings and personal expenses right now
.5	-chart of business income and expenses
.5	-statement of how much money you need to borrow and how you will spend it
.5	-description of your business

2

Appendix C

Multiple-Choice Post-Test

Name _____
Program _____
Year in program_____

A. In items 1 - 5 please **match** the following terms with their definitions by noting the correct letter in the space provided.

a) Business Profile
b) Personal Income Statement
c) Cash Flow Projection
d) Letter of Intent
e) none of the above

1. A statement of how much money you need to borrow and how you will spend it. ____

2. A list of your earnings and personal expenses right now. ____

3. A chart of your business's income and expenses. ____

4. A description of your business. ____

5. An item-by-item list of expenses ____

B. In items 6 - 12 please **match** the following terms with their purpose by noting the correct letter in the space provided.

a) Business Profile
b) Personal Income Statement
c) Cash Flow Projection
d) Letter of Intent
e) none of the above

6. Its purpose is to show whether you have the required portion of the start-up costs and first year's expenses. ____

7. Its purpose is to show the relationship between receipts and disbursements. ____

8. Its purpose is to show whether you have made adequate provisions for living expenses during the first year or two of business operation. ____

9. Its purpose is to request a bank loan for the business. ____

10. Its purpose, if provided monthly, is to provide immediate feedback on the health of your business. ____

11. Its purpose is to provide a statement of the who, what, when, where and how of your business. ____

C. In items 12 - 22 please choose the best answer by circling the corresponding letter.

12. Which of the following factors regarding employees is **not** determined by a small business owner?

a) job descriptions
b) work hours
c) withholdings
d) salary
e) all are determined by the small business owner

13. Insurance that should be purchased by a small business is/are:

a) business liability
b) property insurance
c) inventory insurance
d) product liability
e) all of the above

14. Which of the following services can be provided by a lawyer?

a) selecting proper organization structure of the business
b) providing advise on taxes and leases
c) handling any law suits that may arise
d) providing advise on contracts and licenses
e) all of the above

15. Which of the following statements concerning proper record keeping is correct?

a) records should be kept ,dating back up to two years
b) without records of inventory you will not know when to order supplies
c) important records should be kept in a locked drawer in your office
d) your checking account statement should be studied so that you can separate business expenses from personal expenses
e) all of the above

16. In a company that makes candy the volume of sales will likely be:

a) constant from month to month
b) fluctuate without apparent reason from month to month
c) fluctuate in a relatively predictable pattern month to month
d) completely unpredictable for the first few years of a new business
e) none of the above

17. How would the candy company calculate its average monthly expenses?

a) monthly cost of sales + monthly disbursements
b) annual costs of sales + annual disbursements divided by 12
c) items per month x cost of item
d) items per year x cost of item divided by 12
e) none of the above

18. The price of product should cover costs, make a profit, while also proving to be attractive to the customers. If, however, the price of your product is too high compared to the competition you should do the following to keep your company viable **except:**

a) increase your sales
b) make the price appear more appealing
c) increase your profit
d) decrease your expenses
e) all of the above can be used to keep your company viable

19. What portion of sales receipts should be spent on start up advertising?

a) 1% to 2%
b) 3% to 6%
c) 7% to 10 %
d) 11% to 14%
e) none of the above

20. Which aspect is the small business owners **unable** to modify monthly?

a) the number of employees
b) employee productivity
c) product pricing
d) advertising
e) all can be modified monthly

21. If the average cost of sales is $600, the average disbursements monthly is $400, the sales per month are 10, and the % of profit is 50% what is the cost of the item to the customer ?

a) $25.00
b) $50.00
c) $100.00
d) $150.00
e) $200.00

Answers to Multiple-Choice Test

1. d
2. b
3. c
4. a
5. e
6. b
7. c
8. b
9. d
10. c
11. a
12. c
13. e
14. e
15. b
16. c
17. b
18. c
19. c
20. e
21. d

Appendix D

Attitude Questionnaire

NAME _____

Please choose the answer that represents what you **feel** or comes closest to what you feel by circling the corresponding number.

1. I enjoyed using The Business Disc Program.

1	2	3	4	5
very little	somewhat	average	much	very much

2. I found the Business Disc program straightforward and easy to use.

1	2	3	4	5
very little	somewhat	average	much	very much

3. I found the Business Disc program helped me to develop my Business Plan.

1	2	3	4	5
very little	somewhat	average	much	very much

4. I found the Business Disc program general enough to allow me to develop my business as I chose to do.

1	2	3	4	5
very little	somewhat	average	much	very much

5. I enjoyed working with a partner. (leave blank if you worked alone)

1	2	3	4	5
very little	somewhat	average	much	very much

I enjoyed working alone. (leave blank if you worked with a partner)

1	2	3	4	5
very little	somewhat	average	much	very much

6. **I feel I would have done better in the Business Disc program without a partner. (leave blank if you worked alone)**

1	2	3	4	5
very little	somewhat	average	much	very much

I feel I would have done better in the Business Disc program with a partner. (leave blank if you worked with a partner)

1	2	3	4	5
very little	somewhat	average	much	very much

7. **I feel other Management students in Concordia small business courses should have a chance to use the Business Disc Program.**

1	2	3	4	5
very little	somewhat	average	much	very much

8. **I would like to use the Business Disc program again when I start a small business and have more information about my actual financial situation.**

1	2	3	4	5
very little	somewhat	average	much	very much

Additional Comments:

Appendix E

Tracking Events

1. Video - Introduction to Business Disc
2. Step - Slide show of Example Business
3. Call - Option to decide on business disc
4. Video - Information on service
5. Video - Information on retail
6. Video - Information on manufacturing
7. Call - Decide on business type
8. Video - Information on organizational structure
9. Call - Information on Sole Proprietorship
10. Video - Sole Proprietorship
11. Video - Information on Partnerships
12. Call - Information on structure of business
13. Call - See banker for loan (pre-mature)
14. Video - Advisement to return to bank when better prepared
15. Video - Information on various location options
16. Video - Information on real estate - home or rent
17. Video - Information regarding lease
18. Video - Information provided through "business book beat"
19. Video - Information on record keeping
20. Step - Step mode through records to keep
21. Step - Step - service records to keep
22 Video - Host offers opportunity to practice
23. Call - Practice record keeping
24. Video - Information on business profile
25. Call - Start up costs module
26. Call - Owners contribution to start up costs
27. Call - Letter of Intent
28. Call - Depreciation Form
29. Step - Decision due from bank
30. Video - User waiting for bank loan
31. Video - advertising budget
32. Call - Revise business plan based on capitalization
33. Call - Revise business plan based on owners salary
34. Call - Revise business plan based on advertising budget
35. Video - Bank approval of loan
36 Call - Small business Score Seminar report - January
37 Call - Small business Score Seminar report - February
38 Call - Small business Score Seminar report - March
39 Video - Advertising Seminar
40. Call - Small business Score Seminar report - April
41 Video - Brochure Offer
42. Call - Small business Score Seminar report - May
43 Call - Small business Score Seminar report - June
44. Call - Small business Score Seminar report - July
45 Video - Television news report
46 Call - Small business Score Seminar report - August
47. Call - Small business Score Seminar report - September
48 Call - Small business Score Seminar report - October

49. Call - Small business Score Seminar report - November
50. Call - Small business Score Seminar report - December
51. Video - Donation to community
52. End program

Appendix F (1, 2, 3)

Examples of Tracking Data

F.1.- Example of printout from **log2.dat**

```
start session          1991-10-2      16:32:23:84
1                      1991-10-2      16:33:10:75
1c                     1991-10-2      16:33:17:84
2                      1991-10-2      16:33:22:45
35                     1991-10-2      16:37:42:47
2a                     1991-10-2      16:38:55:96
Name : Penelope Nicholson
2b                     1991-10-2      16:39:21:72
```

F.2. Example of printout from **Master.scp.**

```
e1/t0/s29220/z29394/o1/n1c/c   Business Disc
e1c/t2/s29405/x400/o1/n2/c     Memo-see Harry, accountant, program host
e2/t0/s1/z7709/n35/o2/c        Welcome - Harry and Margaret
e35/t14/fFn 0/n35b/c           Special function keys tutorial
e35b/t0/s7710/z7835/o1/n2a/c   "Let me get some information"
e2a/t4/fBP 1/n2b/c             Get info (name, tax, sex)
e3/t11/s9697/z9698/n36/c       Slide show of example businesses
e36/to/s9700/z12725/n36b/c     Harry explains kinds of businesses
```

F.3. Example of printout from **Montreal.exe.**

```
start session      1991-10-2 Video    16:32:23:84 Business Disc
1                  1991-10-2 Still    16:33:10:75 Memo-see Harry,accountant, host
1c                 1991-10-2 Video    16:33:17:84 Welcome - Harry and Margaret
2                  1991-10-2 Step     16:33:22:45 Special function keys tutorial
35                 1991-10-2 Call     16:37:42:47 "Let me get some information"
Name:  Penelope Nicholson
2b                 1991-10-2 Video    16:39:21:72 Get info (name, tax, sex)
3                  1991-10-2 Step     16:40:22:08 Slide show of example businesses
```

Appendix G

Student Information Sheet

MANA 451/ 452: In order to operate the program and complete it to gain your 10% you must do the following:

1. Sign up for a time block (max 2 1/2 hours at one time) in advance in the Learning Lab H523-527 (525). Hours Monday - Friday 8:45am - 10:00pm and Saturday 10:00am - 2:00pm.

2. When you arrive at your appointed time, check the space beside your name on the attendance record that is kept at the information window for the session and hand over your Concordia ID card. If you are working with a partner make sure your partner also signs the attendance sheet and hands over their Concordia ID card.

3. When you have completed Step #2 you will be provided with a folder which will contain a computer diskette, a list of computer instructions, and the way you are to work through the program.

PLEASE do not discuss any of the information in your envelope, or the computer program with anyone apart from your partner if you are assigned a partner. It is very important that you read the information in the folder very carefully and follow the instructions accordingly for every session you work at the computer.

4. After you have received and read the information provided in your folder you will need to turn on the machines insert your data disk and the video disc in their respective slots. Please refer to the instructions "Operating the System" in order to do this properly.

DO NOT MOVE THE EQUIPMENT OR USE FORCE IN ANY WAY. IF YOU ARE UNSURE OF THE CORRECT PROCEDURE TO OPERATE THE EQUIPMENT ASK A LAB MONITOR.

5. You can progress through the program in any route you wish, you can choose to see additional information when it is offered, and can go back and forth between on-screen forms if you so choose. You can pause and take a break anytime by pressing the F2 key and then the "Y" key and return at a later time (remember to sign up before hand). You must, however, complete the whole program in order to gain the 10%.
There are two places, however, where you do not have the option of choice. These are listed below.

1. If you are turned down for a bank loan you must continue until your loan is approved. 2. When you are asked whether you wish to "continue the dream of owning a business" you must answer "Yes".
* Do not worry these choices are very obvious when presented.
6. When you are finished your session, return **all** materials to the folder and return the folder to the information window, and your ID card will be returned.

7. When you have completed the entire program request the attendance record and place a tick in the column that is labeled "completed". You will then be telephoned within the week about setting up an appropriate time for the post test completion, and after completion of the test you will be given up to 10% towards your final grade.

Appendix H

Instructions for the Business Disc

Introduction to the Business Disc

The Business Disc is an interactive videodisc program which uses the technologies of both video and computers to help you plan and manage a business. The program guides you step-by-step through the process of creating a business plan and then through a simulation of the first year of operating that business.

You will be asked to make a series of decisions at each stage of the process. The program saves that information on your provided Data Diskette, and the computer remembers all your decisions and uses them to demonstrate what might happen to the business as a result of those decisions.

For you as a business student, this is your chance to gain practical experience in a short period of time. You will provided the chance to try out ideas about your business such as product, location, advertising, employees, expenses and income, without risking any money.

Using the Program

In order to use the program you will have to use special function keys on your computer. Listed below are those function keys which are relevant to you. You can call up the list on the computer at any time by pressing the F10 key.

Note : Please do **not** use any function keys which refer to the printer as you do not have this option.

F1 to return to the beginning of a section

F2 to save work and turn the computer off

Caution - If the computer is turned off without pressing F2, you may lose some of your wok. F2 saves your responses and lets you resume work at the appropriate section later.

F4 To go the Glossary

F6 to go back to any table or form and change the data. A menu will be displayed, from which you may select the form you wish to edit.

F9 Some screens have information you can enter and change repeatedly. Once satisfied, you can use the F9 key. The F9 allows you to move on to the next section.

Alt/H When you see the words "type Alt/h for help" displayed on the screen (and only when these words are displayed) you may receive helpful information by simultaneously pressing the "Alt" and "h" keys.

When ever you want to enter information in the form of numbers or words use the following directions to enter responses.

Note that these directions will be explained fully at the beginning of the program. If you have ever used computers before you are likely already familiar with these functions.

Return or Enter Key	Use this key after you type in words or numbers to signal the computer you are ready to move on.
Escape Key	Some screens have information you can enter and change repeatedly. Pressing the ESC key will erase information from the block the cursor is in.
Right Arrow	A right arrow at the bottom of the screen means you can press this key to move forward to the next screen. If you are entering data into on-screen forms (also called spreadsheets), pressing this key will move you to the next box.
Left Arrow	A left arrow at the bottom of the screen means you can press this key to back up one picture at this time, or in the cases of on-screen forms (also called spreadsheets) move backward to prior boxes.
Up Arrow	The up arrow key moves the cursor to the line above your current entry.
Down Arrow	The down arrow key moves the cursor to the line below the one you are currently on. Use the up and down arrows, along with the left and right arrows, to move around your spreadsheets and tables.
Back Space	This key is used to back up and "erase" mistakes before you press return.
Delete Key	Use this key to delete (erase) letters or numbers. Place the cursor over the character you wish to remove. Press the Del key to erase that letter.

Operating the Program

Step 1 Locate the "POWER" button on the videodisc player (FIG 2). Press this button to turn the power on. Do not turn on any other equipment until requested to do so.

Step 2 Locate the "DISC SET" on the videodisc player. Press this button. The disc table or hood will open slightly. Gently open the disc table drawer or hood until it stops.

Step 3 Locate the videodisc marker "SIDE ONE" on the label and place it in the player with "SIDE ONE" up.

Step 4 Gently close the disc drawer or hood. DO NOT PRESS THE "PLAY" BUTTON NOR ANY OTHER BUTTONS ON THE VIDEODISC PLAYER. The computer will control the player.

Step 5 Open the door on the computer disk drive. Do this by turning the small lever up. Place the diskette from your folder in drive with the label facing up (FIG 3). If you have difficulty opening the drive door ask for help.

Step 6 Locate the power switch (the red switch in front of the monitor) on the monitor and turn on the power.

Step 7 Locate the power switch on the computer (the red switch on the right side of the computer) and turn the power on.

Step 8 Wait for program to load (approximately 30sec to a minute) and then follow the instructions as they appear on the screen.

Ending a Session

Step 1 Press the F2 key, then the "Y" key. Failure to do this may result in the loss of some of the data (responses) you entered.

Step 2 When the red light goes out on the floppy drive, remove the floppy diskette from the computer and return it to your folder.

Step 3 Turn off the Monitor and the computer.

Step 4 Press the "DISC SET" button on the videodisc player. When the table drawer or hood opens, carefully remove the videodisc and return it to its case. Gently close the table drawer or hood. Wait five seconds, then turn off the player by pressing the "POWER" button.

Step 5 Return all items (videodiscs and folder with all its materials) to the front window.

Step 6 If you have completed the entire program tick the completed column on the attendance sheets at the front window.

Appendix I

Cooperative Instructions

IMPORTANT

FOR EVERY SESSION

Welcome to the Business Disk Program. This program will guide you step-by-step through the process of creating a business plan, and then through the simulated first year of operating your business.

While working through the program;

a) work together,

b) cooperate with your partner,

c) achieve a group solution for each problem,

d) make sure you both understand the solution before your group moves on,

e) make sure both group members participate and that no one dominates, and

f) listen carefully to your partner, when possible build on their ideas.

Your score will be determined by combining yours and your partners scores of a post test to be taken after the completion of the software sessions. Your success or failure, therefore, depends on the success or failure of your partner.

Appendix J

Individualistic Instructions

IMPORTANT

FOR EVERY SESSION

Welcome to the Business Disk Program. This program will guide you step-by-step through the process of creating a business plan, and then through the simulated first year of operating your business.

Please note that your score will be determined by your separate scores on a post test to be taken after the completion of the software sessions. Your success or failure, therefore, does not affect the success or failure of your partner.