ISSUES IN ACCOUNTING EDUCATION
Vol. 25, No. 1
2010
pp. 35–58

American Accounting Association
DOI: 10.2308/iace.2010.25.1.35

The Effects of a Hypertext Learning Aid and Cognitive Style on Performance in Advanced Financial Accounting

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ABSTRACT: This study extends previous work by combining the effect of cognitive style and the use or non-use of two versions of a hypertext learning aid and their interaction on student performance in advanced financial accounting. One-third of the students did not use a learning aid at all, one-third used a basic version of the learning aid (where only the solution was provided), and one-third used an extended version of the learning aid (where both the solution and derivation of the solution is provided). An additional extension of the prior literature is that these effects were investigated on two different kinds of examination questions. The results demonstrate that for a familiar exam question, only the learning aid was significant, and for an unfamiliar exam question, the learning aid, cognitive style, and the interaction between learning aid and cognitive style were significant. For both types of questions, performance differed based upon cognitive style. These results suggest that educators should be careful when designing and using learning aids.

INTRODUCTION

A concern of the Accounting Education Change Commission (AECC 1996) is that special emphasis should be given to instructing students to "learn how to learn." Specifically, the AECC is critical of accounting educators for failing to develop in students their "ability to identify and solve unstructured problems in unfamiliar settings" (AECC 1990, 311). At the same time, experimental research indicates that students' cognitive styles and abilities differentially affect their task performance. In studies by Jones and Davidson (1995), Amernic and Beechy (1984), and Shute (1979), the consistent finding was that students demonstrating higher levels of cognitive ability or abstract thought performed significantly better on unstructured, less-directed questions. However, when faced with structured, directed questions, this ability conferred no benefit compared to students who had lower cognitive ability or more concrete thought patterns.

Knowledge of students' cognitive style is, therefore, important in developing an understanding of the learning process. Such an understanding would help educators address some of the AECC's development goals in its "Objectives of Education for Accountants." These are:

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The authors are grateful for the helpful comments of Philip Beaulieu, Ronald A. Davidson, and Gisela Engels, as well as two anonymous reviewers.

Published Online: February 2010

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1. Capabilities for inquiry, abstract logical thinking, inductive and deductive reasoning, and critical analysis;
2. Ability to identify and solve unstructured problems in unfamiliar settings and to apply problem-solving skills in a consultative process; and
3. Ability to understand the determining forces in a given situation and to predict their effects. (AECC 1990, 311)

Another factor that affects the learning process is the type of instructional material. The personal computer can lead to significant changes in the way we teach accounting. However, users could treat the computer just as a simple electronic spreadsheet, and if so, it could be argued that this type of learning aid would do little to develop the skills that the AECC has identified. Two decades ago, Jensen (1990, 172) claimed that accounting education suffered from a "lack of effective, well-developed instructional materials." The creation of a hypertext computerized learning aid for accounting would potentially meet Jensen's challenge and would have more promise than simple electronic spreadsheets.

This study examines the separate and combined effects of a hypertext computerized learning aid and cognitive style on the performance of undergraduate students in an advanced financial accounting course. It extends the previous research by employing (1) two versions of the learning aid together with a control group that did not use any aid and (2) two different types of examination questions. The objective of this study is to examine whether cognitive style, either alone or in conjunction with the fully interactive learning aid, affects student performance on one question placed in a familiar setting and on a second question placed in an unfamiliar setting. If the interaction between cognitive style and the learning aid is significant, then properly designed instructional aids would be valuable tools, as they can be structured to allow for students' cognitive styles (Ghinea and Chen 2003).

The next section discusses the relevant literature and develops the hypotheses. The third section provides the research design and the following section presents the results. In the fifth section, we offer conclusions and discussion and suggest some limitations of the study.

LITERATURE REVIEW AND HYPOTHESES

Hypertext Learning Aids

Educators seek to improve student performance through a variety of techniques, including the use of Supplemental Instruction and hypertext learning aids (Jones and Fields 2001; Etter et al. 2000). Watson et al. (2007) advocate that accounting-based research addresses the effectiveness of technology on student performance; accounting education researchers have exploited the computer's ability to supplement conventional learning techniques through its hypertext and hypermedia capabilities. Kachelmeier et al. (1992) used a comprehensive spreadsheet template (albeit without a hypertext component) for illustrating SFAS No. 87, and found that significantly higher examination scores were achieved by the students who used the software compared to those who did not. Crandall and Phillips (2002) report that students provided with hypertext-enriched instructional material were better able to apply concepts to new accounting cases than those who learned from conventional instructional material. According to Unz and Hesse (1999, 279), hypertext involves "computer-based systems that consist of nodes and links…people can move non-linearly by following the links." These types of programs enable the learner to exert control by making decisions about the number and kinds of events that occur during instruction. Both learner control and adaptive control (the program controls the number and type of events) are ideal concepts for investigation using the computer. Unz and Hesse (1999, 280) raise the point that "because of its

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structure, hypertext facilitates active, exploratory learning … the system encourages inquiry and discovery and so enhances learning," although there is still insufficient theoretical and empirical understanding of learning using hypertext systems.

The most attractive feature of these programs is their interactivity. Lucas (1992) argues that we may conceptualize interactivity in terms of three levels. The most developed form, proactive interactivity, allows students to act as decision makers, where they construct and deduce principles from their actions and experiences. In the context of advanced financial accounting, a proactively interactive program could, for example, allow students to (1) create their own consolidation accounting problems, (2) produce solutions for them in the form of consolidated financial statements, and (3) change their initial parameters and observe the results of the change.

In this study, we use two forms of a computer program for learning consolidation accounting (described in more detail below) to test the effect of proactive interactivity within a hypertext learning aid on student performance. One form of the software incorporates (1) through (3) above and so provides complete proactive interactivity. The second or extended version of the program adds an additional feature to the learning aid such that students can see *why* the solution to a particular problem is the correct one. This provides a different level of proactive interactivity in that it allows students to see *where and why* a change in their chosen initial parameters impacts (or does not impact) the various components of the consolidated financial statements that they have prepared.

We argue that there will be a difference in performance due to the use of the software, but it is not clear in which direction it will affect performance. The basic version of the program may be no better, and no worse, than not using any program at all, since it only provides the correct answer and not how to arrive at that answer. Thus, it might be expected that for these two treatments (basic program and no program), there will be no difference. On the other hand, there may well be a difference simply because the basic program does at least provide the answer, and students may learn better (or worse than) when they have no software and must do everything themselves. One could argue that the extended version of the program (which not only prepares a set of consolidated financial statements from individual company statements but also provides a detailed analysis of every line of the consolidation), is a tremendous learning tool: students not only see the consolidated result, but also how it is obtained and why. On the other hand, it is entirely possible that students will use the extended version of the program as a crutch, and as a result, never learn how to "walk unaided." The basic and extended programs may function as nothing more than the electronic equivalent of placing a solution manual in the library and asking students to do problems out of the textbook. Faced with such a task, students may well read the problem and then proceed directly to reading the solution rather than trying to work it out first.

Cognitive Style

Phillips (1998) notes that in accounting education research, cognitive style and ability have received the greatest attention when assessing performance. A review of accounting education literature by Watson et al. (2007) includes a discussion of learning styles and technology. Cognitive style has been defined as "an individual preferred and habitual approach to organizing and representing information," (Chen and Macredie 2002, 3). One example of cognitive style is field-dependence, which a number of accounting researchers have used (see, for example, Hicks et al. 2007; Bernardi 2003; Awasthi and Pratt 1990; Gul 1990; Gul 1984). Individuals that are field-dependent will have their perceptions and information processing affected by the contextual field in which they are operating. It is "the extent to which the organization of the prevailing field dominates perception of any of its parts" (Witkin et al. 1971, quoted in Chen 2002, 450). Field-dependents rely on external frames of reference while field-independents rely on internal frames of

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reference. Goodenough (1976) suggests that an explanation might be that field-dependents focus on the most salient features presented to them. However, an alternative explanation is that there are differences in information processing: Davis and Cochran (1989) suggest that there is little performance difference when the amount of information to be processed is small, "however, when larger amounts of information must be analyzed or integrated, then the performance of field-independent individuals is more accurate and efficient" (Davis and Cochran (1989), 37).

Nevertheless, evidence suggests that there is more to the performance difference than simply the quantity of information being processed. Davis and Frank have shown that, in experiments dealing with free recall, field-independent learners are able to recall word lists better than field-dependent learners when the lists are constructed with more *difficult* patterns of organization (Davis and Frank 1979, as reported in Davis and Cochran 1989, 37; emphasis added). Moreover, "field-independent students were better at learning and remembering textual information which was high in structural importance" (Annis 1979, as cited in Davis and Cochran 1989, 37).

Leader and Klein (1996) suggest that field-dependence involves both perceptual and problem-solving abilities. The Group Embedded Figures Test (*GEFT*), which we have adopted in this research, is the test for field-dependence developed by Witkin et al. (1971). It consists of locating a simple figure within a larger more complex figure that is designed so as to insert or hide the simpler figure. The ability to find the simple figure within the complex figure also reflects "an ability to solve a cognitive problem by isolating a critical element and using it in a different context" (Leader and Klein 1996, 6). Individuals who are able to ignore the complex surroundings and thus "see" the simple figure inside are classed as field-independent, whereas those who have difficulty in locating the simple figure are classed as field-dependent.

Some researchers have criticized field-dependence, particularly as measured by the embedded figures test, as merely assessing cognitive or spatial ability rather than a cognitive style: abilities are competencies whereas styles are modes of processing (Johnson et al. 2000). We agree with Davis (1991) who argues that field-dependence is both ability and style as "field dependence sometimes acts as an ability and sometimes as a style, which is one of its intriguing features" (Davis 1991, 165). In support of an ability perspective, Davis argues that field-dependence tests are tests of ability (e.g., Witkin et al. 1977; Witkin and Goodenough 1981), and are also correlated with other ability tests (e.g., Cooperman 1980; Guilford 1980). Supporting a style perspective, Davis suggests: "[E]vidence regarding stylistic characteristics comes from studies that identify an individual's preference for methods of approaching different tasks and situations" (Davis 1991, 164).[1]

The *GEFT* instrument is considered to be one of the more well-established and widely researched models (O'Brien and Wilkinson 1992) and has continued to be used in accounting (see, for example, Hicks et al. 2007; Bernardi 2003) and other fields (see, for example, Sisco and Leventhal 2007; Chapman and Calhoun 2006; Liu 2006; Guillot and Collet 2004; Cakan 2003; Chao and Huang 2003; McMorris et al. 2002; O'Brien et al. 2001; Salbod 2001; Huang and Chao 2000). Field-independent individuals exhibit greater analytical skills than field-dependent individuals (Bernardi 1993), and disciplines such as accounting, engineering, and science tend to attract more field-independent individuals, while the opposite is found for disciplines such as nursing and the arts (Hicks et al. 2007).

Davis and Cochran (1989) indicate that research generally shows that "field-independent students reflect higher levels of achievement than field-dependent students do" (Davis and Co-

[1] It should be pointed out, however, that any distinction between style and ability is not critical for this study because we are concerned with the fact that field-independent students would seem to be better able to handle unstructured tasks.

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chran 1989, 41). In general, as the extant literature suggests that field-independent students perform better than field-dependent students, it is argued that field-independent students will perform better in advanced financial accounting than field-dependent students.

Interaction between Cognitive Style and Hypertext Learning Aids

Proponents have heralded hypertext and hypermedia-based instruction as ideal mechanisms to accommodate learners' individual differences. They claim that hypermedia, in particular, allows individuals to learn in accordance with their own unique needs, desires, and preferences (Daniels and Moore 2000; Weller et al. 1994; Park 1991). However, it is possible that it may not suit all types of learners equally, as very little research has been carried out on the interaction of learner traits with a hypermedia environment (Daniels and Moore 2000; Weller et al. 1994).

Chen (2002) argues that while hypermedia provides freedom, it also places a burden of independent work on the student. She argues that this is a:

> congruent and congenial approach for Field Independent students, because they tend to take an active approach and are able to extract the relevant cues that are necessary for completion of a task (Goodenough 1976). Conversely, Field Dependent students tend to take a passive approach and attend to the most salient cues regardless of their relevance (Davis and Cochran 1989). That is probably the reason why they appeared to experience more disorientation problems. (Chen 2002, 455)

In studies involving a hypermedia environment, Liu and Reed (1994) report a high correlation between field-dependence and the type of media selected for vocabulary instruction. They found that field-dependent students chose more video information, while field-independent students opted for text-based presentations, such as the one used in the current study. Weller et al. (1995) found that field-independent students learned computer ethics with hypermedia-based instruction more effectively than did field-dependent students. Leader and Klein (1996) established that field-independent students are more effective using an index/find search tool because it involves "disembedding words and concepts from their context at a screen and transferring those to other contexts at other screens" (Leader and Klein 1996, 7). They also found a main effect of cognitive style with field-independent learners performing significantly better than field-dependent learners.

We must also consider the possible interaction effects between use of the interactive computer program and the cognitive style variable. We are interested in the general question whether cognitive style changes the degree to which the use of the interactive program aids or hinders an individual's ability to solve problems. Given the results of Liu and Reed (1994), it is likely that field-dependent students will be less receptive toward text-based instructional media than their field-independent counterparts and consequently benefit less (or be disadvantaged more) from using such an interactive learning aid program.

Type of Question

The marks on two of the questions (*Q1* and *Q2*) on the final examination dealing with consolidation accounting were used to measure performance. *Q1* was marked out of 50 points and *Q2* was marked out of 24 points. *Q1*, although complicated, was familiar in the sense that it followed the usual pattern: there was a parent with two subsidiaries and numerous intercompany transactions and it required the preparation of consolidated financial statements. *Q2* was an unfamiliar question, thus meeting the AECC's requirements that students be capable of functioning in unfamiliar settings and required a fundamentally different approach for its solution. Only the beginning balance of consolidated retained earnings plus a few of the reconciling items were provided, and students were required to produce the missing items and provide the correct ending balance of consolidated retained earnings. Not only was *Q2* a type of question that was not

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otherwise used in the course, in the classroom, homework, or in materials at the textbook publisher's website, it was also a type that prevented students from being able to "begin at the beginning" and work forward in a logical, sequential manner as they could for *Q1*. Instead, students had to work in different directions rather than just forward, and had to "park" intermediate calculations and return to them later on. *Q2* is an "incomplete consolidation" rather than a so-called "reverse consolidation" and its style should therefore be unfamiliar to the students.

A number of researchers have found that field-independent subjects perform better than field-dependent subjects when faced with unfamiliar situations. For example, Neimark argues that field-dependent individuals lack skills for dealing with unstructured tasks and ambiguous instructions (Neimark 1981). According to theory, "actual learning outcomes should not differ as a function of cognitive style when task demands are clear, when the material to be learned is familiar, when task-relevant information is readily available and distractions are minimal" (Rollock 1992, 807–808).

As further evidence that field-dependence is likely to affect the approach that individuals take to solving different types of problem, Chen and Macredie (2002, 4) suggest that:

> Field-Independent individuals tend to adopt an analytical approach to problem solving, sample more cues inherent in the field, and are able to extract the relevant cues necessary for the completion of a task. Conversely, Field-Dependent individuals take a passive approach, are less discriminating, and attend to the most salient cues regardless of their relevance.

Studies have indicated that individuals exhibiting high field-independence perform significantly better in solving problems of the type where the solution depends on using a critical element in a different context from the one in which it has been presented (Karp 1963; Fenchel 1958; as referenced in Witkin et al. 1971). In addition, field-independent learners, when faced with a limited amount of unambiguous task-relevant information (suggesting the presence of more ambiguity), will frequently outperform their field-dependent learner peers (Rollock 1992). Weller et al. (1995, 452) argue that "field-dependent learners are less likely to impose a meaningful organization on a field that lacks structure and are less able to learn conceptual material when cues are not available."

Given the above, the effect of the independent variables (learning aid, cognitive style, and their interaction) are likely to be different for the familiar question than for the unfamiliar question; particularly so for cognitive style and the interaction between treatment and cognitive style. Consequently, it is necessary to investigate separately the effects for *Q1* and for *Q2*. It should be noted that we are examining the effects on performance on *Q1* and the effects on performance on *Q2*; we are not testing for differences in performance *between Q1* and *Q2*.

This leads to the following hypotheses stated in the alternative form:

For *Q1* (familiar question):

H1a: There will be a difference in examination performance on *Q1* between students in any of the three learning-aid treatment groups.

H1b: Field-independent students will perform better on *Q1* than will field-dependent students.

H1c: There will be a difference on *Q1* based on the interaction between field-dependence and any of the three learning-aid treatment groups.

For *Q2* (unfamiliar question):

H2a: There will be a difference in examination performance on *Q2* between students in any of the three learning-aid treatment groups.

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H2b: Field-independent students will perform better on *Q2* than will field-dependent students.

H2c: There will be a difference on *Q2* based on the interaction between field-dependence and any of the three learning-aid treatment groups.

GPA

Accounting education researchers usually control for *GPA* as they generally consider it to be a measure of performance ability. For example, Shute (1979) found in his study of accounting students and abstract reasoning that the relationship between cognitive level (*CL*) and *GPA* was significant. Similarly, Amernic and Beechy (1984) used the *GPA* of each student as a control variable in their study on accounting students' performance and cognitive complexity but found it significant at only the 10 percent level. Jones and Davidson (1995) compared performance by high and low reasoning level students and *GPA* was a significant variable in predicting the performance on concrete-operational questions, but was not significant for the formal-operational ones.[2] Rollock (1992) controlled for grade-point average in his study of field-dependence, and Bonham et al. (2003) found that grade-point average was a significant predictor of student performance using typical end-of-textbook problems in a physics class. In the current study, grade-point average is assumed to be a factor in student performance and is included as a control variable.

RESEARCH DESIGN

Fourth-year accounting students in the advanced financial accounting class of an AACSB-accredited management school of a large Canadian university were chosen for this experiment. This course is only offered once per semester; consequently, the study was conducted over three consecutive semesters covering an 18-month period, thus producing a nonrandom design. The total sample size consisted of 107 students. The course content, including delivery and final exam, was identical for the three semesters, and the same instructor, who is one of the authors of the study, taught all three sections.[3] The instructor conducted all classes at the same time of day and used the same textbook throughout. There were also no statistically significant gender differences in any of the three semesters. The important difference among the three semesters was whether and how the hypertext consolidation program was employed. In one semester, no program (*NP*) was available to be used, in a second semester students were required to use the basic version of the consolidation program (*BP*), and finally in a third semester students were required to use the extended hypertext consolidation program (*EP*). Hence students were in one of three treatment conditions (*TREATMENT*) in a non-randomized design.

To capture the effect of cognitive style, we used part of a tutorial session toward the end of each semester so that students could complete the *GEFT*. In this time-limited test there are a number of complex figures within which are hidden (embedded) simpler figures, and students must identify the simpler figure by tracing its outline. Field-independent students are able to

2 The terms concrete-operational and formal-operational originate in the work of Inhelder and Piaget (1958). Shute (1979) defines concrete-operational as including the ability to think about the observable world, while formal-operational adds the further ability to reason abstractly about the unobservable world.

3 It was possible for the final exam to remain the same for each section of the course because the final exams were not returned to the students. Although there remains the possibility that students in one section may have "accurately" told students in another section what was on the exam in a previous semester, it is not likely that the students would remember the details of an exam that was not returned to them. A greater risk would have occurred if all the classes were held in one term because the students using the programs would likely have aided the students not using the program and, therefore, contaminated the results.

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identify more figures than are field-dependent students. In addition, we collected data from university records on the students' cumulative grade-point average immediately prior to the semester in which they took the advanced financial accounting course.

Two questions on the final examination dealing with consolidation were used in the study, and they were marked by the same marker (who is a professional accountant familiar with consolidations) in each of the three semesters from an answer key provided by the instructor. The instructor then re-marked the questions and any differences were reviewed and reconciled. Any observed differences were minor. The first question was the familiar question and the second question was the unfamiliar question.

Throughout the semester, the instructor presented typical consolidation problems during classroom time and required the students to solve them. In the no-program group, he did this "the old-fashioned way" using overheads and chalkboard. The instructor's teaching approach was to ask students at random how to solve each part of the consolidation problem, so students learned early on that they had to come to class having already prepared a solution. For the other treatment groups (basic program and extended program), the instructor, using the same problems, demonstrated how the learning aid functioned, but only for the first few weeks of class. The students learned during this time how to input data using the programs, and how to display the results. In the case of the extended-program group, students also learned why the answers displayed were the correct ones. For both program groups, the instructor made the learning aid available in the computer laboratory for the duration of the course. As with the no-program group, students knew they would be asked to provide solutions to the problems in front of the rest of the class.

In addition to the quizzes, mid-term, and final exams, all three groups had to complete two projects as part of the overall course requirements; this component was worth 25 percent of the total course grade. There were two parts to this project; the first being an unstructured group project involving the creation of a comprehensive consolidation problem together with its solution and full explanatory details of how the solution was derived. Students were told that the marks awarded on this project would depend on the complexity and comprehensiveness of the problem they designed. The second project was an individual case that the instructor had created. This was a comprehensive consolidation problem requiring preparation of consolidated statements and answering directed questions about fundamental consolidation concepts.

Requiring both a group and an individual project reduces the "free-rider" effect that sometimes occurs when some group members do not work as hard as others. This was a particularly important concern for the two software program groups, since it was necessary for this study that all students used the learning aid. Additionally, making these two projects worth a significant component of the overall grade ensured that students took the projects seriously.[4] The only difference for the three semesters was that the basic-program and extended-program group students had to use the learning aid for both projects, and the no-program group students had to complete the assignments manually. The group projects took approximately 15 hours per group member to complete and the individual assignments had to be completed one week after they had been handed out. The completed group project was typically 40 pages long: it included the problem that the members had created, the solution to it, and the detailed analyses for all the accounts that were significant. The procedures for the individual project were the same as for the group project, and the project typically took an average of 10 hours for its completion, requiring at least eight pages for the analysis. In this regard, it should be realized that for both the individual and group projects, the no-program treatment group would have spent the longest time preparing their submission, as it was done manually.

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4 A test for correlations between project scores and performance on *Q1* and *Q2* respectively yielded no significant results.

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Hypertext Consolidation Software

The software was designed several years ago by one of the researchers to improve students' understanding of the syntactical side to consolidations. It was felt that having the program available to students in the laboratory would allow the instructor to dwell more on the semantic side to consolidations in the classroom. Over time, the module became used more and more in the classroom and students were encouraged to "play" with it on their own. Eventually, a research question began to form, which was whether students who used the program actually performed better or worse than those who did not, and the way to test this would be to compare examination results of those who did and did not use the program.[5] Eventually the research question was refined and became embodied in the hypotheses developed in the "Literature Review and Hypothesis" section. In the study, we employed two versions of the consolidation software. In both versions, students enter pertinent data about the parent and subsidiary company on the DATA page, which also includes hypertext–type links to other pages that explain some of the terms involved. The second page is where the student enters the financial statements of the parent and subsidiary for the consolidation year. By clicking on the consolidation sheet, the resulting consolidated financial statements are displayed.

In the extended version of the software every line of the output—the elements of the consolidated financial statements—is "live." When the student clicks on any output cell in the consolidated statements, a page displays that derives the number shown in the statement. In the basic version of the software this feature is unavailable. Students can see the line items of the output but cannot access any help in how the items were derived. Members of this treatment group would need to figure out for themselves how to derive the numbers. Although the basic version deliberately restricts the functionality of the program, it is still a proactively interactive learning aid as described in the second section. Students assigned to either version of the program are able to deduce the principles and concepts that underlie consolidation accounting based on their actions.

RESULTS

As discussed in the experimental design section, the membership in the three treatment groups was not random, and accordingly we compared the *GPA* and *GEFT* scores of the three groups. These findings are provided in Table 1. The three groups were the same with the exception that the students in the basic-program treatment had a statistically higher *GPA* than the students in the extended-program treatment ($p = 0.008$). We also assessed the number of courses and the number of accounting courses taken concurrently with advanced financial accounting to determine if the student course loads were comparable. There was no difference in the number of accounting courses taken concurrently but there was a difference in the total number of courses taken concurrently. The no-program group took an average of 4.00 courses, the basic-program group took an average of 4.58 courses, and the extended-program group took an average of 4.11 courses. The difference between the no-program group and the basic-program group was significant ($p = 0.013$) as was the difference between the basic-program group and the extended-program group ($p = 0.032$). However, although the students in the basic-program group had the highest average *GPA* they also had the highest average total course load. Since one factor could confer an advantage and one factor could confer a disadvantage, this should result in the basic-program treatment group having no net advantage over either of the other treatment groups. In any event, the analysis included *GPA* as a control variable.

In order to test the hypotheses, we coded the variable *GEFT* 0 for low *GEFT* (Field-

[5] Note that the software was never specifically designed to help a student having a particular cognitive style.

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TABLE 1
Descriptive Statistics

	No-Program	Basic-Program	Extended-Program
Sample	n = 33	n = 36	n = 38
GPA[a]	3.24	3.36	3.10
GEFT	12.48	13.58	14.29
No. of Courses[b]	4.00	4.58	4.11
No. of Accounting Courses	2.18	2.00	1.95
% Male	48	42	47
Q1	36.39	40.61	32.63
Q2	22.21	21.06	18.29

a *GPA* was significantly different (0.008) between students in the basic-program treatment and in the extended-program treatment.

b No. of courses was significantly different (0.013) between students in the no-program treatment and in the basic-program treatment and significantly different (0.032) between students in the basic-program treatment and in the extended-program treatment.

Variable Definitions:

GPA = the cumulative grade point average in the semester prior to the advanced financial accounting course;
GEFT = the score out of 18 on the Group Embedded Figures Test;
No. of Courses = the total number of courses taken concurrently with the advanced financial accounting course;
No. of Accounting Courses = the total number of accounting courses taken concurrently with the advanced financial accounting course;
% Male = the percentage of male students in the treatment group;
Q1 = the mark received (mean score) on *Q1* (familiar question) in the final exam in the advanced financial accounting course; and
Q2 = the mark received (mean score) on *Q2* (unfamiliar question) in the final exam in the advanced financial accounting course.

Dependent) and 1 for high *GEFT* (Field-Independent)[6] based on the median score of 14 for the sample.[7] This is consistent with Daniels and Moore (2000) and Gul (1984). Similarly, we coded the control variable *GPA* 0 for low *GPA* and 1 for high *GPA* based on the median score for the sample.

Table 2 provides the Pearson and Spearman correlations for the dependent variables (*Q1* and *Q2*) and the independent variables (*TREATMENT*, *GEFT*, and *GPA*). There is no significant multicollinearity present; specifically, the highest correlation reported among the independent variables is 0.327, which is between *GEFT* and *GPA*.[8]

The hypotheses were tested using a full factorial analysis of variance (ANOVA) rather than an analysis of covariance (ANCOVA) due to violations of statistical assumptions that are necessary to use ANCOVA appropriately. ANCOVA is considered to be a superior statistical technique because of its:

[6] In this paper, we use the abbreviations *FD* and *FI* when referring to the field-dependent and field-independent student subjects respectively in our study, and for the concept itself, we spell out the words field-dependent and field-independent.

[7] We conducted a sensitivity analysis by using cut-off scores for field independence of 13, 14, 15, and 16. The results were still significant for cut-offs of 14 and 15 but not for 13 and 16.

[8] According to Hinkle et al. (2003, 109), a correlation between 0.00 and 0.30 is "little, if any correlation" and a correlation between 0.30 and 0.50 is "low positive (negative) correlation."

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TABLE 2
Correlation Matrix

	Q1	*Q2*	*TREATMENT*	*GEFT*	*GPA*
Q1	1.00	0.442 *	0.349 **	0.129 **	0.289**
		(.000)	(.000)	(.187)	(.003)
Q2		1.00	0.366 **	0.116 **	0.310**
			(.000)	(.235)	(.001)
TREATMENT			1.00	−.136 **	.113**
				(.163)	(.246)
GEFT				1.00	0.327**
					(.001)
GPA					1.00

*, ** Two-tailed significance of the Pearson and Spearman correlations, respectively, is shown in parentheses.

Variable Definitions:

Q1 = the mark received on *Q1* (familiar question) in the final exam in the advanced financial accounting course;

Q2 = the mark received on *Q2* (unfamiliar question) in the final exam in the advanced financial accounting course;

TREATMENT = coded as 1 if the student is in the no-program treatment group, coded as 2 if the student is in the basic-program treatment group, and coded as 3 if the student is in the extended-program treatment group;

GEFT = coded as 0 if the score out of 18 on the Group Embedded Figures Test is less than or equal to the median of 14, and coded as 1 if the score out of 18 on the Group Embedded Figures Test is greater than the median of 14; and

GPA = coded as 0 if the cumulative grade point average in the semester prior to the advanced financial accounting course is less than or equal to the median of 3.24, and coded as 1 if the cumulative grade point average in the semester prior to the advanced financial accounting course is greater than the median of 3.24.

> ability to reduce the error variance in the outcome measure and the ability to measure group differences after allowing for other differences between subjects. In ANCOVA, the variation from this variable is measured and extracted from the within (or error) variation. The effect is the reduction of error variance and therefore an increase in the power of the analysis. Power is the likelihood of correctly rejecting the null hypothesis. (Munro 2005, 199)

The statistical requirements for ANCOVA are stricter than for ANOVA. In addition to the requirements of ANOVA, ANCOVA requires that the relationship between the dependent variable and the covariate be linear (assumption of linearity) and requires the regression lines for the individual groups to be parallel (assumption of equality of slopes). In the current study, *GPA* violates the linearity assumption, and transformations of the *GPA* variable did not resolve the issue. Consequently, ANOVA was used despite its limitations compared to ANCOVA.

Results for the Familiar Question

The first set of hypotheses relates to the familiar question (*Q1*). These are analyzed with a full factorial analysis of variance; the results are presented in Table 3. For *Q1*, only *TREATMENT* (p = 0.001) is significant; neither *GEFT*, the interaction between *TREATMENT* and *GEFT*, nor *GPA* are significant. Therefore, we reject a null hypothesis of no effect for *TREATMENT* (H1a) but we cannot reject the null for *GEFT* (H1b), nor for the interaction between *TREATMENT* and *GEFT* (H1c).

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TABLE 3
Analysis of Variation of *Q1*

Panel A: ANOVA Analysis ($R^2 = 0.953$; Adjusted $R^2 = 0.947$)

	Sum of Squares	DF	Mean Square	F	Sig.
Model	144,826.796	12	12,068.900	161.663	0.000*
TREATMENT	1,087.179	2	543.590	7.281	0.001*
GEFT	186.194	1	186.194	2.494	0.118
GPA	169.716	1	169.716	2.273	0.135
TREATMENT × *GEFT*	349.664	2	174.832	2.342	0.102
TREATMENT × *GPA*	55.748	2	27.892	0.374	0.689
GEFT × *GPA*	309.563	1	309.563	4.147	0.045*
TREATMENT × *GEFT* × *GPA*	49.426	2	24.713	0.331	0.719
Error	7,092.204	95	74.655		
Total	151,919.000	107			

Panel B: Summary of Marginal Means (Dependent Variable: *Q1*)

TREATMENT	*GEFT*	*GPA*	Mean	*TREATMENT*	*GEFT*	*GPA*	Mean
NP	0	0	33.8182	BP	0	0	40.0833
		1	34.2500			1	42.1250
		Total	34.0000			Total	40.9000
	1	0	35.0000		1	0	34.8000
		1	40.9091			1	42.7273
		Total	39.6429			Total	40.2500
	Total	0	34.0714		Total	0	38.5294
		1	38.1053			1	42.4737
		Total	36.3939			Total	40.6111
EP	0	0	29.6154	Total	0	0	34.3889
		1	24.0000			1	36.6111
		Total	28.8667			Total	35.1296

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Panel B: Summary of Marginal Means (Dependent Variable: *Q1*)

TREATMENT	***GEFT***	***GPA***	**Mean**	***TREATMENT***	***GEFT***	***GPA***	**Mean**
	1	0	31.0000		1	0	32.7222
		1	38.2308			1	40.4857
		Total	35.0870			Total	37.8491
	Total	0	30.2174		Total	0	33.8333
		1	36.3333			1	39.1698
		Total	32.6316			Total	36.4766

* Significant at 0.05.

Dependent Variable:
Q1 = the mark received on *Q1* (familiar question) in the final exam in the advanced financial accounting course.

Independent Variables:
TREATMENT = coded as 1 if the student is in the no-program treatment group (*NP*), coded as 2 if the student is in the basic-program treatment group (*BP*), and coded as 3 if the student is in the extended-program treatment group (*EP*); and
GEFT = coded as 0 if the score out of 18 on the Group Embedded Figures Test is less than or equal to the median of 14, and coded as 1 if the score out of 18 on the Group Embedded Figures Test is greater than the median of 14.

Control Variable:
GPA = coded as 0 if the cumulative grade point average in the semester prior to the advanced financial accounting course is less than or equal to the median of 3.24, and coded as 1 if the cumulative grade point average in the semester prior to the advanced financial accounting course is greater than the median of 3.24.

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To identify which *TREATMENT* groups are significantly different from one another, we ran a *post hoc* Scheffé Linear Contrast. This analysis shows that the only significant difference was between basic-program and extended-program users ($p = 0.001$); there being no significant difference between basic-program users and no-program users (mean 40.61 and 36.39 respectively) or between extended-program (mean 32.63) and no-program users.

Although the hypothesized interaction effect between *TREATMENT* and *GEFT* is not significant, the ANOVA analysis did reveal a significant ($p = 0.046$) interaction between *GEFT* and *GPA*, which was not hypothesized. Nevertheless, to analyze this significant interaction effect, we conducted a simple effects *post hoc* contrast analysis. Results show that the interaction is driven by (1) the difference between low and high *GPA* within the *FI* students ($p = 0.002$; mean 32.72 and 40.49 respectively), and (2) between *FD* and *FI* students within high *GPA* ($p = 0.041$; mean 36.61 and 40.49 respectively). Therefore among *FI* students, high *GPA* students performed at a significantly higher level than low *GPA* students and among high *GPA* students, *FI* students performed at a significantly higher level than *FD* students. The overall highest performers were thus *FI* students with high *GPA*.

Results for the Unfamiliar Question

The second set of hypotheses relates to the unfamiliar question (*Q2*). The hypotheses are analyzed with a full factorial analysis of variance with the results presented in Table 4. For *Q2*, *TREATMENT* ($p = 0.000$), *GEFT* ($p = 0.014$) and the interaction between *TREATMENT* and *GEFT* ($p = 0.047$) is significant. Therefore, we can reject the null of no effect for *TREATMENT* (H2a), for *GEFT* (H2b), and the interaction between *TREATMENT* and *GEFT* (H2c).

To identify which components of *TREATMENT* are significantly different from one another, we ran a *post hoc* Scheffé Linear Contrast. This analysis shows that the extended-program group achieved the lowest level of performance (mean 18.29) and that this difference was significantly different ($p = 0.003$) from the basic-program group (mean 22.21), which had the highest performance. The no-program group (mean 21.06) was significantly better than the extended-program group ($p = 0.000$) but not different than the basic-program group. This is consistent with the result for *Q1*.

Since there are only two components to *GEFT* (i.e., *FD* and *FI*), it is necessary only to compare the means of the two to determine the direction of the significant *GEFT* finding from the ANOVA analysis. *FI* students (mean 21.23) performed better than *FD* students (mean 19.65). A univariate t-test also confirms that this difference is significant ($p = 0.040$). The interaction between *TREATMENT* and *GEFT* for the unfamiliar question (*Q2*) is portrayed graphically in Figure 1, which shows that for both *FD* and *FI* students, extended-program users achieved lower grades than did either no-program or basic-program users. However, Figure 1 clearly demonstrates that this difference is asymmetric: *FD* students have lower scores than *FI* students for all three groups. We investigated this interaction further using a simple effects *post hoc* contrast analysis as shown in Panels A and B of Table 5.

Panel A examines *GEFT* within each *TREATMENT* group. The only significant difference *between FI* and *FD* students is for those who were in the extended-program group ($p = 0.019$). The *FI* students in the extended-program group performed at a significantly higher level than did the *FD* students in the extended-program group (means 35.09 and 28.87 respectively). Panel B examines *TREATMENT* within each *GEFT* level. *TREATMENT* within *FD* is significant ($p = 0.000$) while *TREATMENT* within *FI* is not significant. As there are three *TREATMENT* groups, we used a *post hoc* Tukey test to investigate which *TREATMENT* groups *among* the *FD* students are significantly different from one another and we present the results in Table 6. The no-program and basic-program groups perform statistically better than the extended-program group ($p = 0.000$

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TABLE 4

Analysis of Variation of *Q2*

Panel A: ANOVA Analysis ($R^2 = 0.977$; Adjusted $R^2 = 0.974$)

	Sum of Squares	DF	Mean Square	F	Sig.
Model	45,299.945	12	3,774.995	340.233	0.000*
TREATMENT	267.831	2	133.916	12.070	0.000*
GEFT	69.155	1	69.155	6.233	0.014*
GPA	24.249	1	24.249	2.186	0.143
TREATMENT × *GEFT*	69.907	2	34.954	3.150	0.047*
TREATMENT × *GPA*	59.270	2	29.635	2.671	0.074
GEFT × *GPA*	15.225	1	15.225	1.372	0.244
TREATMENT × *GEFT* × *GPA*	40.301	2	20.150	1.816	0.168
Error	1,054.055	95	11.095		
Total	46,354.000	107			

Panel B: Summary of Marginal Means (Dependent Variable: *Q2*)

TREATMENT	*GEFT*	*GPA*	Mean	TREATMENT	*GEFT*	*GPA*	Mean
NP	0	0	22.64	BP	0	0	18.58
		1	20.88			1	23.13
		Total	21.89			Total	20.40
	1	0	21.33		1	0	20.20
		1	23.00			1	22.64
		Total	22.64			Total	21.87
	Total	0	22.36		Total	0	19.06
		1	22.11			1	22.84
		Total	22.21			Total	21.06
EP	0	0	16.08	Total	0	0	18.92
		1	14.00			1	21.11
		Total	15.80			Total	19.65
	1	0	18.80		1	0	19.61

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Panel B: Summary of Marginal Means (Dependent Variable: *Q2*)

TREATMENT	***GEFT***	***GPA***	**Mean**	**TREATMENT**	***GEFT***	***GPA***	**Mean**
		1	20.77			1	22.06
		Total	19.91			Total	21.23
	Total	0	17.26		Total	0	19.15
		1	19.87			1	21.74
		Total	18.29			Total	20.43

* Significant at 0.05.

Dependent variable:
Q2 = the mark received on *Q2* (unfamiliar question) in the final exam in the advanced financial accounting course.

Independent variables:
TREATMENT = coded as 1 if the student is in the no-program treatment group (*NP*), coded as 2 if the student is in the basic-program treatment group (*BP*), and coded as 3 if the student is in the extended-program treatment group (*EP*); and
GEFT = coded as 0 if the score out of 18 on the Group Embedded Figures Test is less than or equal to the median of 14, and coded as 1 if the score out of 18 on the Group Embedded Figures Test is greater than the median of 14.

Control variable:
GPA = coded as 0 if the cumulative grade point average in the semester prior to the advanced financial accounting course is less than or equal to the median of 3.24, and coded as 1 if the cumulative grade point average in the semester prior to the advanced financial accounting course is greater than the median of 3.24.

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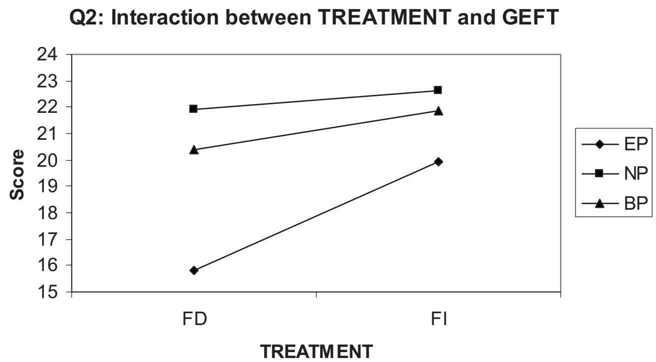
FIGURE 1
Interaction Effects



Variable Definitions:
NP = no-program treatment group
BP = basic-program group
EP = extended-program group
FD = field-dependent
FI = field-independent

and 0.001 respectively), while there is no significant difference between no-program and basic-program users (p = 0.408). This is in sharp contrast to the *FI* students who did not perform significantly differently in any of the treatment groups.[9]

DISCUSSION AND CONCLUSION

The current study makes an important contribution to the literature through its research design. Previous research has examined the effect on student performance of using hypertext-based instructional aids in comparison with not using hypertext-based instructional aids (e.g., Crandall and Phillips 2002) or have examined the interaction effect between cognitive style and the required use of one of several forms of hypertext based instructional aids (e.g., Weller et al. 1995). The current study uniquely combines both of these approaches by examining the effect on examination performance of cognitive style *in combination with* the use of either no hypertext instructional aid or one of two hypertext instructional aids (which vary on the level of interactivity), and it adds a further distinct contribution to the literature because it examines these effects by testing performance on two kinds of examination questions—one couched in a familiar setting and the other in an unfamiliar setting.

The study's hypotheses investigated the effects of *TREATMENT* (use of the learning aid), *GEFT* (the measure of cognitive style), and the interaction between *TREATMENT* and *GEFT* on examination performance as measured by the familiar question (*Q1*) and the unfamiliar question (*Q2*). The results indicate that *TREATMENT* was significant for both *Q1* and *Q2*; *GEFT* was significant for *Q2*, as was the *TREATMENT*—*GEFT* interaction for *Q2*; but the control variable

[9] We also conducted a repeated-measures design using *Q1* and *Q2* as the repeated measures of performance. The results were consistent with the ANOVA results for *Q2*: *TREATMENT* was significant (0.000); *GEFT* was significant (0.034); and the interaction between *TREATMENT* and *GEFT* was significant (0.048).

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TABLE 5

Supplementary Analysis of *Q2*
Simple Effects *Post Hoc* Contrast Analysis of *TREATMENT-GEFT* Interaction
(Dependent Variable: *Q2*)

Panel A: *GEFT* within *TREATMENT* ($R^2 = 0.061$; Adjusted $R^2 = 0.034$)

	Sum of Squares	DF	Mean Square	F	Sig.
Model	103.90	3	34.63	2.24	0.088
GEFT within *TREATMENT* (*NP*)	0.22	1	0.22	0.01	0.905
GEFT within *TREATMENT* (*BP*)	15.11	1	15.11	0.98	0.325
GEFT within *TREATMENT* (*EP*)	87.88	1	87.88	5.69	0.019*
Within + Residual	1,590.33	103	15.44		
Total	1,694.22	106	15.98		

Panel B: *TREATMENT* within *GEFT* ($R^2 = 0.209$; Adjusted $R^2 = 0.178$)

	Sum of Squares	DF	Mean Square	F	Sig.
Model	354.65	4	88.66	6.75	0.000*
TREATMENT within *GEFT* (*FD*)	301.01	2	150.51	11.46	0.000*
TREATMENT within *GEFT* (*FI*)	50.66	2	25.33	1.93	0.151
Within + Residual	1,339.58	102	13.13		
Total	1,694.22	106	15.98		

*Significant at 0.05.

Variable Definitions:
NP = no-program treatment group;
BP = basic-program treatment group; and
EP = extended-program treatment group
FD = field-dependent
FI = field-independent

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TABLE 6
Tukey Analysis for *TREATMENT* within *FD*
(Dependent variable: *Q2*)

TREATMENT	TREATMENT	Mean Difference	Std. Error	Sig.
NP	*BP*	1.490	1.1608	0.408
	EP	6.090*	1.2516	0.000*
BP	*NP*	−1.490	1.1608	0.408
	EP	4.600*	1.2377	0.001*
EP	*NP*	−6.090*	1.2516	0.000*
	BP	−4.600*	1.2377	0.001*

* Significant at 0.05.

Variable Definitions:
NP = no-program treatment group;
BP = basic-program group; and
EP = extended-program group.

GPA was not significant for either question. The results for *TREATMENT* were contradictory to those found by Crandall and Phillips (2002) who found that hypertext instructional material improved performance. Closer examination of the *TREATMENT* results suggests that use of the extended version of the program results in the lowest performance. The basic-program group attained the highest performance for the familiar question but the no-program group attained the highest performance for the unfamiliar question; however, for both questions there was no statistical difference between the no-program group and the basic-program group.

The finding that the extended-program group achieved the lowest marks may be due to the manner in which the extra layer (the key feature) of the extended program is used as compared to the basic program. When learners are provided all the details of why it is correct, they may merely read it rather than work through it on their own. For learners who perceived time to be a scarce commodity, the opportunity this presents would be tempting. The extended program may have been too helpful, lulling students into a false sense of security, with the result that they achieved an insufficient grasp of the fundamental concepts. With the basic program, the learners would have to work through each line on their own if they wanted to understand why a particular number was correct and may have learned more as a result.

Arnold and Sutton (1998) in their theory of "Technology Dominance" suggest that repeated use of a decision aid can lead to the "de-skilling" of the user. The authors provide an example of student use of calculators and illustrate two aspects of de-skilling. One is that students become dependent on the calculator for the simplest of arithmetic calculations and the second is that students lose the ability to discern whether a calculated answer appears reasonable (Arnold and Sutton 1998, 187–188). It is possible that if the learning aid does all the work for the students, students will become dependent upon the learning aid and be unable to solve consolidation problems for themselves.

The second independent variable, *GEFT*, was significantly associated with performance on the unfamiliar question (*Q2*) but was not significantly associated with the familiar question (*Q1*). Students with a low level of field-independence appear to perform worse than students with a high level of field-independence when confronted with questions that are not structured in a similar fashion to previous questions. This result is consistent with Leader and Klein (1996) and Davis

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and Cochran (1989). Prior research examined such concepts as the effect of ambiguity or structure on performance by field-independent and field-dependent individuals (i.e., Weller et al. 1995; Rollock 1992); however, the current study adds to the literature by examining the effect of field dependency in a familiar setting and an unfamiliar setting.

The third hypothesis in the study was the interaction between *TREATMENT* and *GEFT*. This was significant for the unfamiliar question but not for the familiar question. For *Q2* it was apparent that the subgroup that was most different from the others was the *FD* students within the extended-program treatment group. It is clear that students in the extended-program group performed significantly worse than those in either the basic or no-program groups; and this was true regardless of cognitive style. When cognitive style is factored in, the *FD*s trail (significantly) the *FI*s in the extended-program group. Additionally, extended-program group *FD*s perform significantly worse than basic and no-program group *FD*s. While *FI* students in the extended program treatment group performed statistically better than *FD* students in the extended-program treatment group, there was no difference statistically between treatment groups among *FI* students; their *GEFT* level appears unable to compensate for the treatment group to which they belong. These findings can be compared to Weller et al. (1995) who also found an interaction effect with field dependency (field-independent students learned more effectively than field-dependent students) and hypermedia-based instruction.

An important implication of the results for accounting educators is that they must be cautious in designing and/or using computer-based instructional aids. Accounting educators should not simply assume that any teaching materials they develop or use (including packages developed by publishers and other third parties) will actually improve learning and performance on exams, even if students provide high praise for the materials. In fact, instructional aids may not even be benign and may actually reduce student learning and performance. With computer-based instructional aids in particular, a nonlinear learning environment often causes disorientation (Gay et al. 1991), either through information overload or poor design of the database (Jonassen 1991; Marchionini 1988). Indeed, it has been suggested that it may not be possible, or even necessary, to make hypermedia-assisted instruction useful or available to all types of learners (Heller 1990). A more recent study supports the premise that many students need experience with hypermedia before nonlinear information structures (such as the ones found in both versions of the program) can be fully utilized (Ayersman and Michael 1998).

An important implication for future accounting research is the significance of cognitive style for positive outcomes on particular types of tasks and for positive outcomes in using computerized learning aids. While all users in the study were adversely affected, the field-dependent users were more disadvantaged than field-independent users. This result is consistent with findings in the cognitive style literature that field-dependent individuals perform at a lower level than their field-independent colleagues on analytical tasks. Where tasks are straightforward, such as in *Q1*, and require essentially only an algorithmic approach to problem solving, the cognitive style of the student does not make a significant difference to the result. Similar findings have been reported by other researchers. For example, Neimark (1981) argues that field-dependent subjects do not have the same skills for handling unstructured tasks as do field-independent subjects, and Leader and Klein (1966) argue that field-independent subjects have a greater ability to solve cognitive problems—by being able to isolate a critical element and using it in a different context. However, when faced with out-of-context situations, such as in *Q2*—situations that the AECC recognize as being important for accounting professionals to handle—cognitive style becomes significant with field-independent students being better able than field-dependent students to tolerate the uncertainty associated with this type of situation. Moreover, the effect of the interactive computer program does not appear to be helpful and can affect the learning process adversely.

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That field-dependent and field-independent individuals are served differently by hypermedia-based instruction has been noted by Weller et al. (1994) and Repman et al. (1991). Chen (2002) suggests that field-dependent students feel disoriented or lost in hypermedia-based instruction settings. According to Daniels and Moore (2000), field-dependent individuals may benefit if there is an option for them to choose a single-channel message when they experience cognitive overload. Therefore, future accounting researchers should incorporate cognitive style such as field dependency in their study designs.

Another important implication for accounting educators is that it may be possible to encourage field-dependent individuals to develop a higher facility for abstract thinking so that they may function more like field-independent individuals when faced with less-directed questions and unfamiliar situations. Hadfield and Maddux (1988) report that individuals can be taught to move from a global (field-dependent) approach in thinking to a more articulated (field-independent) approach. In any event, it would be inappropriate to imply that field-dependent students are somehow less desirable than field-independent ones. Both types "bring something to the table." Field-dependents, for example, tend to exhibit higher interpersonal skills than field-independents (Witkin et al. 1977), a skill set recognized by the AECC as necessary for accountants: "To become successful professionals, accounting graduates must possess communication skills, intellectual skills, and interpersonal skills" (AECC 1990, 307).

Accounting educators could initially give field-dependent students access to directed questions in familiar settings, who would then be gradually weaned by exposing them to more and more unfamiliar and abstract situations. Alternatively, since applying differential pedagogical approaches is resource intensive and could well create ethical difficulties in assessing student learning styles, a more practicable solution for accounting educators may be to apply the directed-question approach to all students initially. Gradually, as students master the more directed questions in familiar settings at their own pace, they can be introduced to the less directed and unfamiliar-setting questions. Such a course of action, however, would probably be best begun in the introductory financial accounting class rather than in an advanced one. Whether computerized interactive learning aids should be employed by accounting educators in such an endeavor is difficult to say: the results of the present study suggest that using one such instrument without having regard to the cognitive style of the student will produce at best no significant improvement in learning over the "old-fashioned" way, and at worst, it will produce a negative learning outcome. That hypermedia-learning programs may not be suitable for all learners has been reported by Chen (2002), who cautions that field-dependent learners may need greater support and guidance from their instructors than field-independent learners. It is, therefore, very important for accounting educators to be cautious about the implementation of computerized learning aids, particularly given the time and resources necessary to create and use them effectively.

We note some limitations of this study. We did not set out to create software to test our hypotheses. Rather, we decided to use software that had been designed initially to allow students to learn the mechanics of consolidations, thereby freeing up classroom time for the instructor to devote to conceptual issues. As a result, the software has not been rigorously tested for its suitability for a particular cognitive style in the research. Another limitation is that the design did not involve a random assignment of students to the three treatment groups. It is possible that the students' course selection process, by which they decide when to take the advanced financial accounting course, is correlated with an important factor affecting examination performance. Related to this is the possibility of "missing variables" that were not included in the design but which affect performance. A third limitation is that although we classified the questions as "familiar" and "unfamiliar," we did not actually ascertain whether the students were unfamiliar with the "unfamiliar" question. An additional limitation is that the three treatments were not run in the same semester but over three consecutive semesters covering one and a half years, which might

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have led to "maturation" of the study design.[10] A further limitation is that the results of using this software and this set of questions may not be generalizable to other types of software or other sets of questions. Finally, the results may not be generalizable to students at other universities.

This study has investigated the interaction of one student attribute on the learning process: cognitive style as measured by field-dependence. Future research might include psychometric instruments that examine other attributes, such as tolerance for ambiguity, and those that measure students' ability to handle abstract reasoning tasks. One could also extend the current study to students in different courses; in particular the introductory class where students are first exposed to the discipline of accounting.

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[10] By this we mean students in the first or second semester accurately remember the questions from the final exam (although final exams were not returned to students) and disclose them to students in a later semester.

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