AN INVESTIGATION INTO THE FEASIBILITY OF USING AN INTERNET-BASED INTELLIGENT SYSTEM TO FACILITATE KNOWLEDGE TRANSFER

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ABSTRACT

The issue of how to increase the effectiveness of transferring knowledge to a novice is important. Capturing the main theme of a concept that requires a deep understanding is difficult for a novice. Subjects to whom the knowledge is transferred are usually overwhelmed with the amount of information to learn. The objective of this study is to investigate the feasibility of using an Internet-based intelligent system to facilitate the transfer of knowledge to subjects who are considered novices in the content of the knowledge transferred. Such a system might prove to be highly beneficial to both organizations and researchers.

Key words and phrases: Intelligent system, internal controls, knowledge transfer, learning theory

INTRODUCTION

Knowledge transfer has long been a significant concern of both organizations and researchers. Increasing the effectiveness and efficiency of such a transfer from one source to another is also an issue concerning most organizations. Transferring knowledge effectively and efficiently usually results in less cost and more benefits to the firm. In an effort to capture this knowledge transfer, many different techniques have been developed.

For many years both researchers and practitioners have tried to find an effective way to transfer knowledge from one source to another (2, 3, 9, 22). Besides looking at the results of the knowledge transfer, in order to increase the effectiveness of transferring knowledge, it is also crucial to understand how the subject is willing to learn and how he or she is able to improve his or her performances after such learning. Essentially, there are two major issues: (1) how to make subjects actually learn and (2) how to improve their attitude and confidence toward the learning process.

Understanding how to encourage a subject to learn the material instead of simply trying to memorize the contents is one of the greatest difficulties faced in the issue of knowledge transfer. Experience with problem-based learning indicates that people can significantly improve their problem solving skills if they practice often. However, the issue of how to make them practice with problems needs to be addressed. The learning environment needs to be open and flexible enough to motivate the subject to learn.

Along with advances in technology, an Internet-based intelligent system with its ease of use and continuous access may help improve the subject's attitude toward learning. Because of the Internet-based nature, users will be able to practice with the system until they feel comfortable with the knowledge being presented. This study investigates the feasibility of using an Internet-based intelligent system to facilitate the transfer of knowledge from one source to another.

BACKGROUND, THEORETICAL BASIS, AND HYPOTHESES

Information processing theory uses the computer as a model for human learning (17). Like the computer, the human mind takes in information, performs operations to change its form and content, stores and locates it, and generates responses to it. Thus, processing involves gathering and representing information (encoding), holding information (retention), and finding the information when needed (retrieval). Intelligent systems are designed to act like humans when solving problems and learning new information.

However, before investigating how an intelligent system can facilitate the learning process, it is important to examine the type of problems that are appropriate for this type of system. Typically, an intelligent system fits best with problems that are semi-structured (7, 16, 20). In this study, an internal control evaluation process is used as the prototyped knowledge.

Internal control is defined by the American Institute of Certified Public Accountants (AICPA) as a process – affected by an entity's board of directors, management, and other personnel – designed to provide reasonable assurance regarding the achievement of objectives in the following categories: reliability of financial reporting, effectiveness and efficiency of operations, and compliance with applicable laws and regulations (1). The internal control evaluation process is a complex decision process that requires numerous qualitative judgments (7, 15, 24). Due to the large number of potential internal control weaknesses, it is not trivial and cannot be solved with common sense. This mix of objective and subjective inputs, along with its use of heuristic rules for determining how well the client's controls support specific assertions for specific accounts, makes internal control evaluation a prime candidate for this research study (11, 20). It has objective inputs dealing with the specific control activities while its subjective nature arises from the perceived integrity of management.

Transferring an auditor's internal control evaluation knowledge is very challenging. For each accounting cycle, more than 100 weaknesses can occur in an organization. Subjects tend to be overwhelmed with these potential internal control weaknesses. Anyone who only attempts to memorize the different internal control weaknesses finds this topic very boring. The topic also requires a deep understanding, making it hard to capture the main concept. This is the essential issue concerning teaching internal control concepts.

Prior studies have also shown that an intelligent system could be used to transfer knowledge of internal control evaluation from expert to non-expert (4, 5, 12, 13, 14, 19, 23). The results report that subjects who practiced making decisions with the aid of the system were better and quicker at reaching decisions than subjects who practiced without the support of the system (8, 10, 18). However, the literature contains no example of a system developed to facilitate the learning of the internal control evaluation technique via an Internet-based technology. The primary purpose of this project is to offer a new technique, which will hopefully be able to facilitate the learning process in a much more interesting way.

Unlike previously developed systems, the system developed in this study provides a cutting-edge and interactive learning experience. It was developed as an Internet-based application that is appealing to subjects because of its ease of access and flexibility. The system also provides an open-enrollment atmosphere. The online feature allows subjects to learn at their own pace. They can practice with the system at their convenience—during the workday, at night, or on weekends. In order to study the value of the system in transferring an auditor's internal control evaluation knowledge to subjects, eight hypotheses were tested as presented in Table 1.

TABLE 1
Hypotheses

Ha	Descriptions
H1	There is no difference between participants in the Intelligent System (IS) Group and the Traditional Technique (TT) Group on the accuracy of detecting internal control weaknesses.
H2a	There is no difference between participants in the IS Group and the TT Group on their perceptions about the difficulty of the task (i.e., detecting internal control weaknesses).
H2b	There is no difference between participants in the IS Group and the TT Group on their interest in detecting internal control weaknesses.
H2c	There is no difference between participants in the IS Group and the TT Group on their satisfaction with their accuracy in detecting internal control weaknesses.
H3a	There is no difference between participants in the IS Group and the TT Group on their perceptions about their internal control knowledge after being trained.
H3b	There is no difference between participants in the IS Group and the TT Group on their perceptions about the difficulty of learning internal control evaluation.
H4a	On average, participants practicing with the Internet-based intelligent system perceive that it is not difficult to use the system.
H4b	On average, participants practicing with the Internet-based intelligent system perceive that they can learn how to detect internal control weaknesses via the Internet-based intelligent system.

Hypothesis H1 was investigated to examine if learning occurs while users practiced with the system. It examines whether a participant's accuracy in detecting internal control weaknesses improves after practicing with an Internet-based intelligent system. Accuracy of decision-making is examined as a measure of the system's effectiveness (8, 21). In order to examine this effectiveness, participants' improvement in accuracy scores between the subjects who practiced with the intelligent system (IS Group) and the subjects who were taught with traditional techniques (TT Group) was compared. It was hypothesized that, on average, the IS Group's improvement in accuracy scores is not significantly different from the TT Group's improvement.

Hypotheses H2a-H4b are based on the Technology Acceptance Model (TAM). The TAM provides a basis for explaining the determinants of computer acceptance and user behavior (6). The model suggests that computer usage is determined by two criteria: *perceived usefulness* and *perceived ease of use*. *Perceived usefulness* is defined as the prospective users' subjective probability that using a specific application system will increase his or her job performance within an organizational context. *Perceived ease of use* is defined as the degree to which the prospective user expects the target system to be free of effort (6).

RESEARCH METHODOLOGY

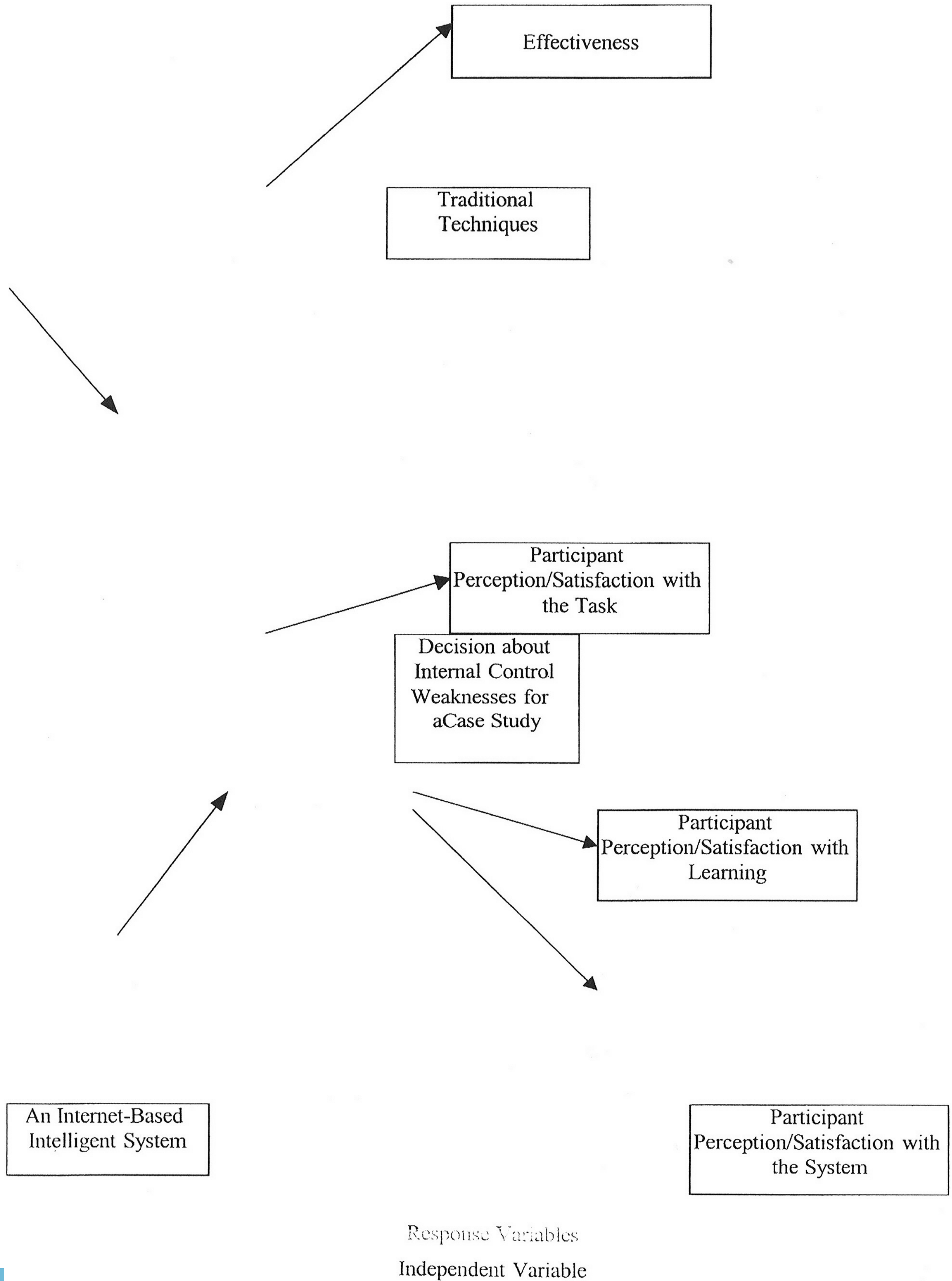
To examine the impact of using an Internet-based intelligent system to facilitate the transfer of the auditor's internal control evaluation knowledge to subjects, an experiment was conducted. The research model used to guide this experiment is illustrated in Figure 1. Two techniques of knowledge transfer were used as values of the independent variable: traditional techniques and an Internet-based intelligent system. The four response variables were (1) Effectiveness, (2) Participant Perception and Satisfaction with the Task, (3) Participant Perception and Satisfaction with Learning, and (4) Participant Perception and Satisfaction with the System.

Independent Variables

Traditional Techniques. With the traditional technique, an overview is given on the importance of internal controls to an organization. Examples of weaknesses and their effect on the organization are also covered. Then subjects are given a case study describing a scenario about a fictitious organization which contains approximately ten internal control weaknesses. The instructor leads the discussion on the internal control weaknesses in the case as well as why such events are weaknesses (i.e., how such events could be harmful to the organization).

An Internet-based Intelligent System for Internal Control Evaluation. In order to study whether an Internet-based intelligent system can be developed to enhance subjects' learning in internal control evaluation, such a system was developed using the ASP technology and the Visual Basic Script language. Once development of the system was complete, an

FIGURE 1
Research Model



experiment was conducted to examine its utility.

Knowledge for the Internet-based intelligent system was acquired via a six-month series of interviews with an expert, who is an auditor in an international firm having more than ten years of experience in evaluating clients' internal control systems. He was asked to identify all potential weaknesses that can occur in the sales and cash receipts cycle of a medium-size merchandising organization. This resulted in a list of 126 internal control weaknesses. The expert was further asked to describe, in detail, the techniques and processes he used to discover each of these weaknesses in a client's internal control system. The reasons for each decision-making heuristic were also acquired in an attempt to develop an Internet-based intelligent system that would be able to emulate both the expert's knowledge and his reasoning behavior.

In order to insure the validity of the system, the expert was asked to review the knowledge captured in the system. Test cases were generated from the manipulation of several cues for detecting potential weaknesses in an internal control system over the sales and cash receipts cycle. The expert was asked to evaluate each test case and detect its potential internal control weaknesses. Reasons for each potential weakness were also requested. Then the system was used to detect the potential weaknesses and offer reasons of such weaknesses as well. The results were then compared. The human expert and the intelligent system identified similar weaknesses for each of the test cases. Where there were discrepancies, the expert reconsidered his responses and agreed that the intelligent system's responses were indeed correct. Interestingly, this illustrates that an intelligent system can sometimes be useful even to an expert (e.g., to double check the expert's reasoning).

As illustrated in Figure 2, in order to practice with the system, a user needs a user ID and a password. The main reasons for requiring the user ID and password are (1) to give access only to an authorized user and (2) to keep track of each user's projects and activities.

The system was designed to be interactive. The knowledge acquired was integrated into the system with step-by-step screens. Each screen requires a user to enter specific information provided in a case study. The order of the screens represents the reasoning behavior of the human expert. Based on the input given by the user, the system infers a recommendation of potential internal control weaknesses. This recommendation identifies significant internal control weaknesses discovered in the situation being evaluated. Figure 2 presents an example of weaknesses found for the dependence between departments.

Response Variables

<u>Effectiveness</u>. Accuracy of decision-making is examined as a measure of the system's effectiveness (8, 21). In order to examine the system effectiveness, participants' improvement in accuracy scores between the subjects who practiced with the intelligent system (IS Group) and the subjects who were taught with traditional techniques (TT Group) was compared.

<u>Participant Perception and Satisfaction with the Task</u>. A post-experiment questionnaire was used to measure the participants' perceptions and satisfaction with the task. Seven-point Likert scales were used in the questionnaire. The following questions were asked to measure their attitude toward the task.

- On a scale of 1 (very difficult) to 7 (very easy), how difficult was it to detect potential weaknesses in the case study?
- On a scale of 1 (very boring) to 7 (very interesting), how interesting was the task you performed?
- On a scale of 1 (very unsatisfactory) to 7 (very satisfactory), how satisfied were you with your accuracy in answering the case study?

<u>Participant Perception and Satisfaction with Learning</u>. The post-experiment questionnaire was used to measure participants' perception and satisfaction with learning internal control evaluation. Seven-point Likert scales were used in the questionnaire. The following questions were asked to measure their attitude toward learning.

- Currently, on a scale of 1 (very poor) to 7 (very good), what is your knowledge about internal control?
- On a scale of 1 (very difficult) to 7 (very easy), how difficult was it to learn how to evaluate internal control?

<u>Participant Perception and Satisfaction with the System</u>. The post-experiment questionnaire was used to measure participants' perception and satisfaction with the system. Seven-point Likert scales were used in the questionnaire. The following questions were asked to measure their attitude toward the system.

- On a scale of 1 (very difficult) to 7 (very easy), how difficult was it to use the Internet-based intelligent system?
- On a scale of 1 (strongly disagree) to 7 (strongly agree), I believe that practicing with the Internet-based intelligent system can help me learn how to detect internal control weaknesses.

Subject

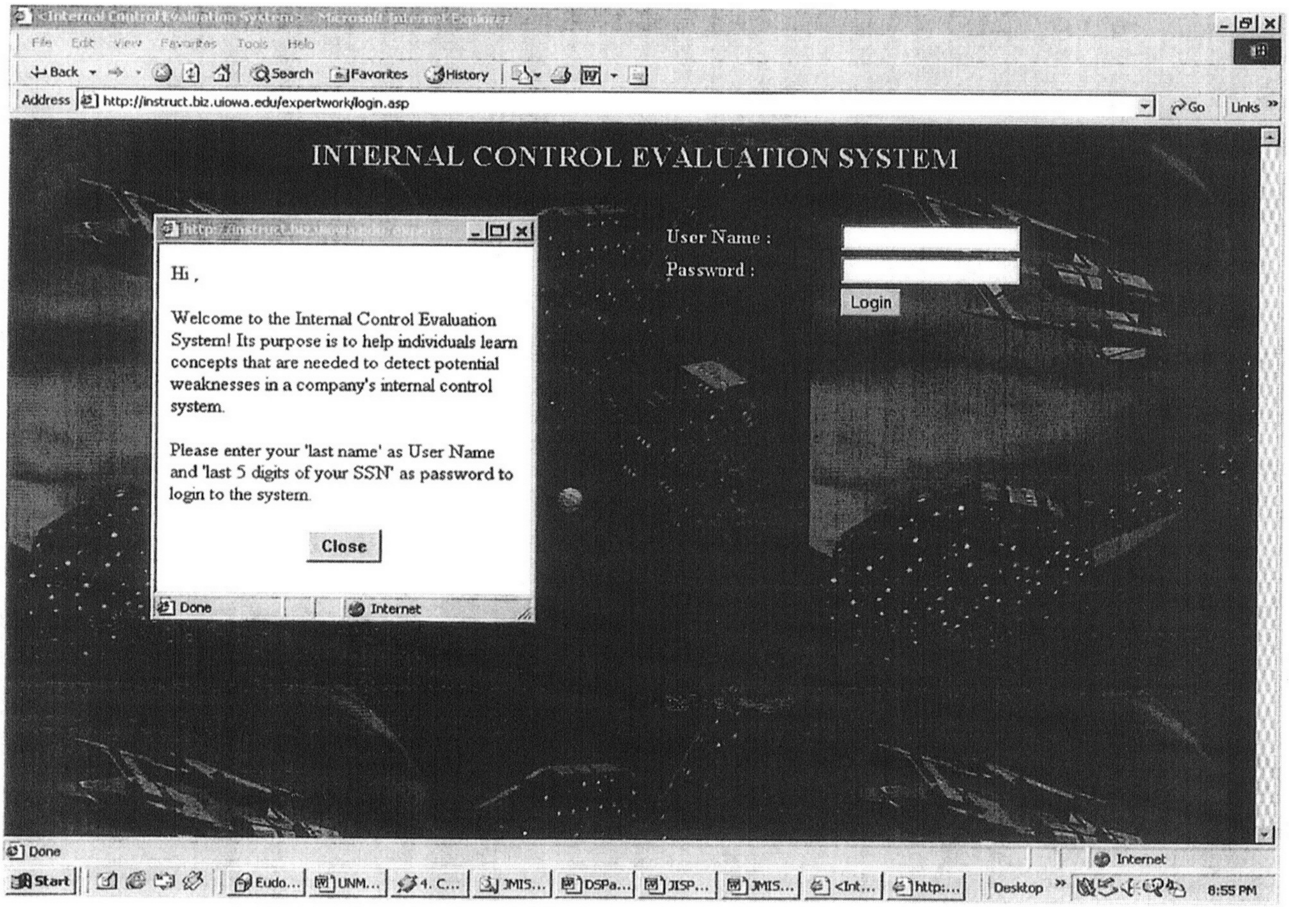
Since the main purpose of this study is to investigate whether an Internet-based intelligent system can be devised to facilitate the transfer of knowledge to novice subjects, using students as the subjects is deemed appropriate. Subjects are students enrolled in the Business College at a university in the Midwest region of the United States. Table 2 presents the demographic information of the subjects.

TABLE 2
Subjects' Demographics

Subjects' Demographics	Traditional Technique Group	Intelligent System Group
No. of Subjects	16*	18
Average GPA	3.12	3.08
Year	13 Senior, 3 Junior	12 Senior, 4 Junior
Majors	13 Accounting, 2 MIS, 1 Other	14 Accounting, 1 MIS, 1 Other

*Initially there were 17 subjects. However, one subject dropped before the experiment started.

FIGURE 2
Introduction Screen



A list of internal control weaknesses was developed from a review of accounting and auditing texts and input from accounting professors and experienced auditors. These internal control weaknesses were categorized according to basic control activities. Two experienced auditors and two accounting professors were asked to validate the contents and the clarity of the list.

In addition to the internal control weakness list, four case studies (A, B, C, and D) were generated from the manipulation of several cues for detecting potential weaknesses in internal control systems. The scenario in each case dealt with the adequacy of internal control over a company's sales and cash receipts cycle. Each case contained ten potential weaknesses and included background information about the fictitious company. Three experienced auditors and three managers were asked to pilot test these cases to ensure their similarity with respect to the degree of difficulty in detecting the potential internal control weaknesses. Ten MBA students performed pre-tests to validate the clarity of the cases. Then revisions were made to the cases based on feedback provided.

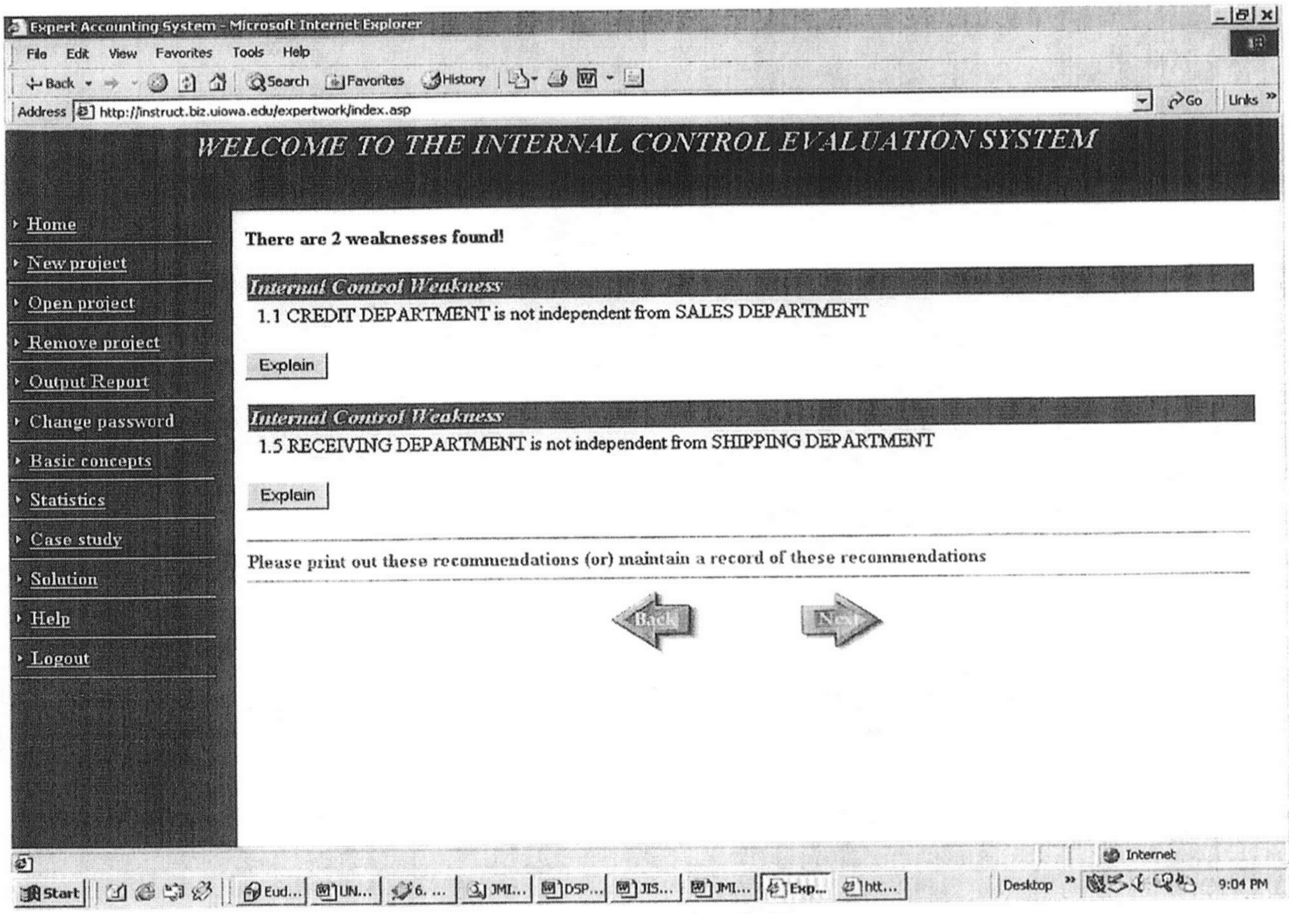
Experimental Task

In order to examine the homogeneity of the subjects' internal control knowledge, prior to the experiment, subjects in both groups were given a pre-test. The pre-test consisted of a case (Case A) describing a scenario in an organization on the policies and procedures in the sales and cash receipts cycle. From this case, subjects were asked to identify ten weaknesses. A questionnaire was also given to measure their perceptions about the task performed as well as their attitudes about their internal control knowledge.

The experiment was conducted in an isolated, controlled environment provided by the college laboratory. Subjects in the Traditional Technique (TT) Group were taught the technique of internal control evaluation via a whiteboard and PowerPoint presentation. Subjects in the Intelligent System (IS) Group were instructed to practice with the Internet-based intelligent system for internal control evaluation.

After the experiment, subjects were given a post-test also consisting of a case (Case D) describing a scenario in an organization on the policy and procedure in sales and cash receipt cycle. As with the pre-test, subjects were asked to identify ten weaknesses from the case. Then a questionnaire was given to measure their perceptions about the task performed as well as their attitudes about their internal control knowledge. Further, additional questions were added to examine subjects' satisfaction with the intelligent system.

FIGURE 3
System Outputs
Experimental Materials



EXPERIMENTAL FINDINGS

Because there was no direct control of the assignment of subjects to each group, a t-test was performed on the pre-test's accuracy score to gauge the homogeneity of subjects' internal control knowledge between the Traditional Technique (TT) Group and the Intelligent System (IS) Group. Although the mean of accuracy score in the TT Group was a little bit higher than the mean of accuracy score in the IS Group ($\mu_{TT\ Group}$ = 58.59 vs. $\mu_{ISGroup}$ = 52.78), at an alpha level of 0.05, no significant difference was found between the groups' initial levels of internal control knowledge (P-Value=0.55).

In order to examine the effectiveness of the system in facilitating knowledge transfer (H1), an improvement (i.e., quiz 2 score less quiz 1 score) in participants' accuracy score between the TT Group and the IS Group was compared. An ANOVA was employed to test hypotheses about the group means for participants' accuracy scores in the TT Group versus participants in the IS Group. Table 3 shows the results of testing Hypothesis H1.

TABLE 3
Analysis of Variance (Accuracy Score)

Treatments				*Count*		*Average*
Intelligent System				18		27.08333
Traditional Techniques				16		1.5625
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5517.004	1	5517.004	4.341527	0.045264	4.149086

Hypothesis H1 examined whether there was a difference in an improvement between these two groups in detecting potential internal control weaknesses in the case given. The results show that participants in the IS Group could detect internal control weaknesses significantly more accurately than could participants in the TT Group ($\mu_{TT\ Group}$ = 51.5625 vs. $\mu_{ISGroup}$ = 27.08333). The test confirms that, at an alpha level of 0.05, there was a significant difference in participants' accuracy in detecting an internal control weakness between participants in the TT Group versus participants in the IS Group (p-value=0.045).

To examine participants' perception and satisfaction, t-tests were employed to test hypotheses about the group means for the following response variables: (1) Participant Perception and Satisfaction with the Task (H2a, H2b, and H2c), (2) Participant Perception and Satisfaction with Learning (H3a and H3b), and (3) Participant Perception and Satisfaction with the System (H4a and H4b). The major findings for the attitudes of participants in both groups are summarized in Table 4, which shows means and p-values of the t-test results pertaining to the hypotheses.

TABLE 4
Experimental Findings for H2a-H2b

Ha	Response Variables	TT Group			IS Group			P-Value
		Before	After	Imp.	Before	After	Imp.	
H2a	Task Difficulty	2.13	3.87	1.74	1.83	3.56	1.73	0.660
H2b	Task Interesting	3.81	3.73	-0.08	3.56	3.5	-0.06	0.748
H2c	Satisfaction with Accuracy	3.00	4.40	1.40	2.56	4.11	1.55	0.520
H3a	Internal Control Knowledge	3.50	4.07	0.57	2.83	4.22	1.39	**0.017***
H3b	Difficulty of Learning		3.67			3.39		0.490
H4a	Difficulty of the System					5.28		**0.00002****
H4b	Usefulness of the System					4.22		0.480

*represents significance at alpha = 0.05
**represents significance at alpha = 0.01

Regarding hypotheses H2a, H2b, and H2c tested to examine participants' attitude toward the task between the two groups, their responses to the questionnaires reveal the following.

- Task Difficulty – participants in both groups perceived that the task was a little bit easier in the post-test compared to the pre-test. However, there is no significant difference from the responses between the two groups.
- Task Interesting – participants in both groups perceived the task to be less interesting in the post-test compared to the pre-test. However, there is no significant difference from the responses between the two groups.
- Satisfaction with Accuracy – participants in both groups were more satisfied with their accuracy in the post-test compared to the pre-test. However, there is no significant difference from the responses between the two groups.

The results imply that the use of the system to transfer knowledge was as good as the knowledge transfer via a traditional technique regarding the perception and satisfaction of the participants on the task.

Concerning hypotheses H3a and H3b tested to examine participants' attitude on learning internal control evaluation, their answers to the questionnaires reveal the following.

- Internal Control Knowledge – participants in both groups gain more confidence toward their internal control knowledge after being trained. However, the increase in confidence level in the IS Group is significantly higher than the TT Group ($\mu_{TT\ Group}$ = 0.57 vs. $\mu_{ISGroup}$ =1.55). The t-test confirms that, at an alpha level of 0.05, there was a significant difference in participants' attitude toward their internal control knowledge between participants in the TT Group versus participants in the IS Group (p-value = 0.017).
- Difficulty of Learning – this question was asked only after the participants in two groups were trained (i.e., no pre-test data). Interestingly, on the average, participants in TT group perceived that it was a little bit easier to learn the internal control evaluation than participants in IS Group perceived. However, the result is not surprising, considering that it is expected that participants in the IS Group had to spend more effort in working with the system than participants in the TT Group. The t-test reveals no significant difference on participants' attitude about the difficulty of learning between two groups.

Regarding hypotheses H4a and H4b, because these questions related to participants' attitude toward the system, only participants in the IS Group were asked to respond to them. The score was compared to a score of 4 (a neutral response on the 7-point Likert scale). Participants' answers to the questionnaires reveal the following.

- Difficulty of the System – on the average, participants in the IS Group felt that it is not difficult to practice with the system ($\mu_{Neutral}$ = 4 vs. $\mu_{ISGroup}$ =5.28). The t-test confirms that, at an alpha level of 0.01, there was a significant difference in participants' attitude toward the difficulty of using the system between participants in the TT Group versus the neutral response (p-value=0.00002).
- Usefulness of the System – participants in the IS Group slightly agreed that the system was useful. However, this is not significantly different than the neutral response toward the system's usefulness.

CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH

This research is an initial investigation into the use of an Internet-based intelligent system to facilitate the transfer of an auditor's internal control evaluation technique to subjects. The scope of this research study may limit the generalizability of the results in several aspects. First, this research concentrates only on the evaluation of controls commonly found in the sales and cash receipts cycle. Second, it investigates internal control systems commonly found in the merchandising industry, but is not expected to handle novel (uncommonly different) accounting systems. Third, the knowledge of the intelligent system developed for this study is based primarily on one auditor who is a partner of an international accounting firm. The resulting system closely represents his reasoning about internal control evaluation. Thus, the system's knowledge may be firm-specific or expert-specific.

The research findings demonstrate that subjects who practiced with the system (IS Group) learned more and had more confidence about their internal control knowledge compared to subjects in another group (the TT Group). The IS Group also expressed that the system was not difficult to work with. These findings indicate that it is feasible and beneficial to use the Internet-based intelligent system as a substitute or supplement to traditional techniques for transferring the internal control evaluation knowledge to a novice.

This study provides contributions to both organizations and practitioners. First, the system helps subjects not only learn the technique of internal control evaluation, but also makes them feel more comfortable learning such a technique. The system addresses issues of flexibility, quality of learning, and teaching efficiency. Subjects are able to work through problems as needed to familiarize themselves with the techniques integrated as the knowledge of the system. Second, the system helps monitor the performance of the subjects. It keeps track of how many times and for how long each subject practiced with the system. All of the statistical data gathered provides guidance on the relationship between a subject's effort and the improvement in his/her performance. Third, the system helps facilitate the circulation of expertise to a wide number of subjects with the least constraints (if any). The system will result in a new way to increase the efficiency and effectiveness of transferring knowledge, thus saving time and resources.

The limitations of the study point to directions in which the research presented here can be extended by future investigations. Future research might include the intelligent system over a longer period of time (e.g., conducting additional sessions one week or month after the first three sessions). Another research avenue might investigate, in more detail, the useful functions incorporated into the system. For instance, it would be interesting to examine any differences in users' performance if one group is allowed to see the explanation capability of the intelligent system, while another group is not.

In addition, a researcher might try to incorporate additional transaction cycles, industries, or other auditing functions into the intelligent system. They might even attempt to develop additional intelligent systems by acquiring expertise from an internal auditor instead of an external auditor. They could also try to acquire expertise from multiple auditors and then conduct experiments similar to the one reported here.

Other research may examine if the layout of the contents (i.e., grouping internal control weaknesses according to the nature of transactions versus grouping them according to the basic internal control concept) can lead to differences in users' performances. It would also be interesting to study the feasibility of integrating such a system into a company's database so that the data could be retrieved directly from the source instead of having the users input such data.

Along that same line of research, a study could examine if there is a way to integrate the system into an accounting information system so that any weaknesses could be detected automatically while an accountant is processing the data. Finally, researchers might investigate whether it is feasible to increase the usefulness of the system by developing it as a template for other types of knowledge. Then other study could be conducted to examine the value of the system for other types of knowledge, which also requires interactive learning.

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