IADIS International Journal on Computer Science and Information Systems
Vol. 4, No. 3, pp. 20-38
ISSN: 1646-3692

# THE USE OF ERP-BASED EXERCISES IN MANAGEMENT CURRICULA

Jamshed Mistry. *Sawyer School of Business. Suffolk University. Tel: 617-3051972 jmistry@suffolk.edu*

Diane Strong. *Department of Management. Worcester Polytechnic Institute. Tel: 508-831-5573: dstrong@wpi.edu*

Sharon Johnson. *Department of Management. Worcester Polytechnic Institute. Tel: 508-831-5183 email:sjohnson@wpi.edu*

**ABSTRACT**

This paper describes a model for providing integrative decision-making experiences in the core undergraduate management curriculum through the use of an ERP system. The model uses ERP decision-making modules that are situated in an organizational process and involve students in hands-on decision making using an ERP system. We also present a prototype Oracle-based budgeting decision-making module for a management accounting course, and examine its effectiveness in teaching core concepts. These results provide the foundation for: a) developing Oracle-based exercises throughout the management curriculum that can be used to facilitate student understanding of integrated business processes and b) using integrated data for managerial decision making.

**KEYWORDS**

Enterprise systems, teaching, student learning.

## 1. INTRODUCTION

Organizations use Enterprise Systems (ES), also called Enterprise Resource Planning (ERP) systems, e.g., SAP, Oracle Applications or similar computer systems, to provide an integrated view of their many organizational processes through linked applications built upon a common database. Two-thirds of mid- and large-sized companies are using or implementing integrated enterprise systems (Scott and Shepherd, 2002). As both design and production activities are sourced internationally, the ability to understand and analyze data from an ES is increasingly

important for achieving real-time control of global processes. Companies need employees who are able to use integrated ES data to make decisions (Davenport, 2000), to understand the impact these decisions have throughout integrated processes, and to recognize opportunities for improving integrated process performance.

The use of these ERP systems, which integrate functions and geographically-dispersed facilities, require new knowledge and skills from managers and workers. Yet, management students rarely see integrated computer applications. Management education has not kept pace with the ERP software revolution and the new integrated business information environment. Although many universities have redesigned management curricula to reflect the linkage between functional areas, the role that extensive, shared, real-time information plays in decision-making is relatively new and not easily taught without an ERP system and opportunities for students to experiment with it (Bradford, Chandra and Vijayaraman, 2003; Corbitt and Mensching, 2000).

Two leading vendors of ERP systems, Oracle and SAP, have provided support for academic initiatives to integrate such systems into the management curriculum. In turn, ERP systems can serve as a mechanism for integrating management education. In this paper, we describe a project to introduce an integrated, information-intensive applications software environment into an undergraduate program for management majors. The overall goal of the project is to provide students with an understanding of the value of enterprise-wide organizational decision-making and an ability to work effectively in an integrated organization.

The approach we have developed for teaching enterprise decision-making consists of using Enterprise Decision-Making Modules, supported by the Oracle ERP suite, which are linked together through a common case scenario. These modules engage students in making decisions in the integrated, process-oriented, data-rich environments common in today's organizations (Strong, Johnson, & Mistry, 2004). Each module is situated in an organizational process, e.g., the supply chain and order fulfillment process, and involves students in hands-on decision-making using an ERP system to provide an integrated, process-oriented, data-rich environment typical of modern organizations. Our approach differs from other approaches to integrating ERP systems into curricula because it is designed to teach students to work in an integrated process-oriented curriculum and because it introduces decision-making modules across the curriculum while minimizing the ERP systems knowledge required of faculty and the classroom time devoted to ERP skills.

As a prototype of such decision-making modules, we examine the usefulness of the Oracle ERP Applications suite to teach core concepts in a course on management accounting. Although there is evidence that SAP or Oracle trained graduates may well be able to command higher salaries in the marketplace (Corbitt and Mensching, 2000), it is just as important to ensure that introducing ERP modules into the curriculum does not interfere with the teaching and learning of core functional concepts. The study reported in this paper was designed to address this issue. We argue that before investing in ERP-based curriculum integration, with all the inherent challenges and implementation issues, it is essential to ensure that the ERP-based modules are at least as good as, if not necessarily better than, traditional methods in facilitating student learning of core concepts. Therefore, as a first step, we examine student learning using our first module developed for an introductory management accounting course. We utilized a repeated measures (pre-post) experimental design, with experimental and control conditions to compare student learning of core topics taught with and without an Oracle-based

module. Results provide evidence of the impact of the Oracle-based module on student learning of core concepts.

In the following section, we explore models for integrating management education and our ERP approach. We then present the conceptual foundation utilized to assess whether the ERP modules facilitated student learning. This foundation draws on extant research on technology-based instruction. The methodology and assessment process for the prototype study are then described. Finally, we present the results of our study and a discussion of the contributions of the study and the implications for further research.

# 2. RATIONALE AND CONCEPTUAL FRAMEWORK

Although educators agree that teaching an integrated view of organizations is important, and accreditation standards require business schools to provide integrative experiences, schools are still exploring how best to produce graduates who understand integration (Hamilton, McFarland and Mirchandani, 2000). In this section, we describe approaches used to integrate the management curriculum, and then present our ERP-based curriculum integration model.

## 2.1 Recent Approaches to Integration in Management Education

In business schools, during the 1980s, integration was a strategic issue usually captured in a separate capstone course, typically called Business Policy and Strategy, completed at the end of a student's degree program. Later, efforts focused on developing integrated courses and curricula as organizations realized that operational-level integration is critical for effective cross-functional processes (Garvin, 1995). Capstone experiences usually do not focus on these operational decisions, or explore the role that extensive, shared, real-time information plays in decision-making.

Team teaching is one approach used to deliver integrated courses. In a team taught course, instructors representing different functional areas are teamed together and teach topics related to their area of expertise. A single course may be designed to encompass three or four functional areas (e.g., marketing, accounting, operations management and Management Information Systems). Highly integrated team-taught courses can be successful only if the leader of the instructing team is able to integrate the functional areas or if all members of the team participate in all sessions and are able to collaborate in integrating different functional perspectives. Thus, team-taught courses are resource-intensive, requiring additional faculty time and coordination (Mullins and Fukami, 1996).

In contrast to the typical methods of curriculum integration discussed thus far, we argue that ERP systems provide a foundation for students to understand the integration of different functional areas, because of the integration inherent in the software. The linked databases and web-based information-sharing characteristic of ERP software provide a foundation for enabling students to develop an understanding of the strengths and limitations of integration of functional areas along business processes and of the underlying information systems. This understanding provides the basis for students to develop the ability to use integrated data to frame and inform decision-making.

By the late 1990s, a number of schools recognized the importance of integrating the use of ERP systems in the curriculum. Largely through the support of the two leading ERP vendors,

SAP and Oracle, schools began to participate in academic initiatives permitting them to use enterprise software in various courses. While such ERP systems were recognized as a curriculum integration mechanism in business schools, curriculum changes have addressed technology rather than the new opportunities for linking functional areas and processes (Elam, Murphy, Becerra-Fernandez, & Simon, 1999; Hawking, Ramp, & Shackleton, 2001; Quinton, 1999). The focus has been on using this new technology in individual classes, rather than harnessing its sophisticated capabilities towards curriculum integration objectives.

In describing the challenges of developing an integrated supply chain curriculum, supported by software, Closs and Stank (1999) fault the traditional functional perspective used in management education, claiming that most of academia still operates within the constraints of "functional silos" representing the different areas of management. Faculty in accounting, marketing, finance, operations, and MIS operate independently, often duplicating teaching and research. Structural factors such as historical faculty lines and departments, entrenched courses and programs, and limited availability of integrated teaching material often become barriers to curriculum integration across departments (Closs and Stank, 1999). Current demand for business management graduates capable of functioning in an integrated ERP environment, however, makes it imperative for management education to respond to this need.

## 2.2 Our ERP Approach to Curriculum Integration in Management Education

In contrast to approaches focused on the technology, our approach to ERP-based management curriculum integration employs Enterprise Decision-Making Modules linked together through a common case scenario (Strong et al., 2004) to integrate core courses of the management curriculum, i.e. in managerial accounting, marketing, operations management, and human resource management. The use of Enterprise Decision-Making Modules linked together through a common case scenario is a unique feature of our approach to management curriculum integration that has promising potential for making a significant contribution to management education. The use of linked but self-contained modules emulates how integration is made operational through decision-making in organizations, which supports student learning. The approach also facilitates integration into a series of courses without requiring excessive instructor time and training.

The inclusion of modules into several courses also provides a model for students to understand and experience the power of shared information and to develop a deeper and more sophisticated understanding of integration. Organizational integration is often cited as a benefit of ERP systems and a desired business objective, but has several different dimensions or types (Volkoff, Strong, and Elmes, 2005). In the model we propose, students will experience data integration through the common shared database in ERP systems and business process integration through the linked functions and transactions in ERP systems (Markus and Tannis, 2000). They will experience the integration of sequentially interdependent processes as well as reciprocally interdependent processes (Volkoff, et al, 2005). Sequential interdependence occurs when functions are linked sequentially into a business process, e.g., the linking of market analysis, product and process design, and product launch into a product development process. Reciprocal independence occurs when processes are continuously coordinated, such as the product development process and management planning and control processes. Our model of integrating management courses demonstrates the integration of data

and processes for both sequentially and reciprocally interdependent processes relevant to the management planning and control process and the product development process.

The Enterprise Decision-Making Modules are designed to recognize the functional expertise of faculty, while encouraging collaboration. Developing modules around functional topics for use in traditional courses is consistent with the functional structure in management schools and the expertise of faculty, limiting the need for the difficult structural change needed to team teach or create integrated courses. Business processes are a natural and effective mechanism for linking functional decisions to broader impacts; the ERP data and structures support this link. Across-course integration is achieved by using a single organization as the basis for the case in each module, thereby linking topics and concepts across courses.

While developing modules requires greater knowledge of the ERP software, the delivery of modules is designed to facilitate faculty involvement. Faculty continue to have autonomy over their courses, and need to redesign only sections of existing courses to include these modules. The format thereby optimizes conditions for faculty commitment while minimizing faculty resistance to loss of control over course content. Each decision-making module requires limited classroom hours, and focuses on the decision and associated data, not on the ERP software itself. Our effort is consistent with recent interest in the use of computer-based technology in business education (Holsapple, 2001), and more specifically in the use of ERP-based software to integrate courses across the business curriculum (Bradford et al., 2003; Corbitt and Mensching, 2000; Kumar and Hillegersberg, 2000).

## 2.3 Effectiveness of Technology-facilitated Pedagogy

While the ultimate learning objectives of our ERP-based modules address student's ability to make decisions in an integrated, information-rich environment, the design assumes that the ERP-based approach will also be effective in teaching core concepts. We developed a prototype Oracle-based module to teach budgeting in a management accounting course and examined the effectiveness of using an ERP-based approach to teach core concepts. In this section, we consider issues associated with using technology to facilitate pedagogy, and explore why an ERP-based approach may be effective. We then present our hypothesis for the prototype accounting module.

While ERP-based modules allow students to explore new technology and the modern decision-making scenarios facing organizations, it is critical that such modules not distract from student learning of the core concepts in each functional area in management. Although research on the use of technology in education has existed since the 1980s (Dickens and Harper, 1986), the question of whether technology facilitates learning core concepts has generated significant debate (Boyce, 1999; Bryant and Hutton, 2000).

Consider the situation in accounting. Professional associations of public accountants led the calls for increased attention in accounting education to train students in the use of accounting information systems (Stone, Arunachalam and Chandler, 1996). Many academics responded to these calls by initiating undergraduate curriculum innovations that emphasized the development of accounting systems knowledge and computer-related skills (Williams and Sundem, 1990). Accounting educators however, rarely evaluate the effects of these technological innovations on student learning (Stone et al., 1996). Thus, the benefits of introducing students to technological tools being used in accounting practice (e.g., electronic

spreadsheets) is often debated without assessing the impact of such technology on learning core accounting concepts.

Similar debates are taking place about ERP systems and their potential role in teaching the entire management curriculum (Antonucci, Corbitt, Stewart, &Harris, 2004; Bradford et al., 2003; Strong et al., 2004). The questions that arise include: Do ERP systems support or interfere with the teaching and learning of core management topics? How effective are ERP systems in helping students understand process and data integration? How can ERP systems best be used to help students learn to work in integrated, data-rich environments? As schools undertake the challenges of implementing ERP systems into management curricula, future research must evaluate the different methods of integrating technology in the curriculum and assess the impact of such technology on student learning (Bradford et al., 2003; Fedorowicz, Gelinas, Usoff, and Hachey, 2004).

## 2.4 Experiential Learning in ERP-Based Approaches

Emphasizing the paucity of research and ambiguity of findings on the pedagogical benefits of using technology to deliver instruction, Bryant and Hutton (2000) highlight the importance of recognizing the theoretical basis of expectations regarding learning impacts. In response to such calls for theoretically based research on the use of technology in education, we draw on research on experiential learning to provide an explanation for why ERP-based approaches are expected to facilitate student learning of core accounting concepts. In a discussion of the shift in learning paradigms, scholars have noted increasing emphasis on using pedagogical approaches that facilitate understanding or having a "sufficient grasp of concepts, principles, or skills so that one can bring them to bear on new problems and situations" (Barr and Tagg, 1995).

Methods that emphasize experiential or hands-on learning include those that enable students to solve problems and practice making decisions through independent inquiry and analysis of real world projects (Hirsch,1996), the creation of microworlds through the use of simulations and cases (Macy and Neal, 2002), and the use of interactive media (Bartell, 1999). Research on hands-on learning approaches suggests that at the very least these are as effective as traditional teaching methods (Kearsley, 1984), and at best are better, because although people retain 20 percent of what they hear, and 40 percent of what they see and hear, they retain 75% of what they see, hear, and do (Fletcher, 1990).

So, how can technology facilitate the pedagogical objectives of providing opportunities for experiential learning and for knowledge application? Categorizations of educational technology offered by Rebele, Apostolou, Bucles, Hassell, Paquette and Stout (1998) and Bartell (1999) guide our conceptualization of how and why ERP-based approaches can be expected to facilitate student learning. In Bartell's (1999) 5-level typology of multimedia instructional technology (including computer-based tools), each ascending level represents incremental improvements in process and learning, supported by better and fuller exploitation of the technology. Level 1 of the typology includes the simple addition of audio-visual aids to supplement lectures that are designed to focus attention and facilitate recall. Level 5 applications include computer-based tutorials, microworlds, simulation, learning laboratories and other such innovations, which are interactive and employ the speed, storage, retrieval, and processing capabilities of the computer. Applications in this category are expected to facilitate

the mastery of knowledge where mastery means being able to apply knowledge gained to new situations.

Our approach of using an ERP-based module represents the highest level of multimedia technology based instruction (Bartell, 1999) because it is interactive and requires active data-based operations, analytical thinking and application of knowledge. Further, because working with ERP system modules requires students to take action and work through activities, ERP-based exercises should demonstrate the advantages documented for hands-on learning or experiential learning approaches. Thus, we argue that ERP-based modules focusing on accounting should facilitate the learning of core accounting concepts.

To summarize our rationale thus far, we argue that although a strong conceptual case can be made for the benefits and need for ERP-based curriculum integration in management education, it is first critical to demonstrate that such technology-facilitated pedagogy not distract from student learning of the core concepts in each functional area in management. Further, by drawing on the literature from both management education and psychology on experiential learning, we develop our explanation for why ERP-based modules are expected to facilitate student learning, specifically their application of core concepts and knowledge. Because working with ERP system modules is interactive and requires students to actively engage in data-based operations, such exercises should demonstrate the advantages documented for experiential learning approaches.

## 2.5 Conceptual Framework for Assessing Student Learning

Although a compelling rationale can be presented to promote a pedagogical technique or intervention, the ultimate value of any specific method depends on its impact on student learning. Technology-based pedagogical techniques are often evaluated through student feedback and surveys that provide useful information regarding their receptivity to the pedagogical technique and their feedback on different components of the technology, its ease of use, etc. (Becerra-Fernandez, Murphy, and Simon, 2000; Bradford et al., 2002). Another important assessment, the impact of the technology on student learning, which is as least as important as the other measurements, is usually not evaluated.

For any pedagogical innovation, the set of learning outcomes used in the evaluation should be guided by the specific learning objectives and assumptions about the learning process underlying the innovation. For example, in a study of the technology-mediated small group discussion method, an integrative complexity measure of student discussion is used to assess learning outcomes (Yoo, Kanawattanachai, and Citurs, 2002).

In a study of the effect of a web-based tutorial on problem formulation ability, Krovi and Sulek (2001) used a pre-post test assessment of students' modeling ability through their performance on a word problem quiz and programming problem. In other studies (e.g., Evans, 1998), assessments of student performance, as well as questionnaires designed to elicit student evaluation of the use of educational technology, are used. Thus, drawing on the education literature in general, as well as research on management accounting education and technology-facilitated decision-making education, we base our assessment of student academic performance via exams and quizzes on our understanding of student learning processes and outcomes.

In addition to assessment of student performance, educators are also interested in understanding the motivational processes underlying student learning. Bandura's (1986)

construct of self-efficacy has been utilized to document and understand the basis of students' academic performance. Self-efficacy is defined as an estimation of one's ability to perform target behavior successfully, and is conceptualized as particularized self-percepts targeted to the relevant activities and situational circumstances. Self-efficacy constructs have been widely used in the general educational literature, and are being increasingly used in the accounting education literature as well (Christensen, Fogarty and Wallace, 2002; Stone et al., 1996).

Existing research has also provided support for Bandura's (1986) assertion that judgments of capabilities that are more task-specific are better predictors of related performance than are more generalized judgments. For example, focusing on academic performance in the area of mathematics, Pajares and Miller (1997) demonstrate that math self-efficacy beliefs are more predictive of problem-solving performance than are more general self-efficacy assessments. This focus on domain-specific self-efficacy is also evident in the MIS literature on computer related competence (Compeau and Higgins, 1995; Dishaw, Strong and Brandy, 2002), and in the accounting education literature (Christensen et al., 2002; Stone et al., 1996). Thus, for each study in a different task domain, new measures of self-efficacy must be developed for that domain. In this study, we have developed a self-efficacy measure that covers two core management accounting concepts, budgeting and variance analysis (see Appendix B) and another self-efficacy measure that covers the use of the Oracle e-business suite software. Thus, drawing on the education literature in general, as well as research on accounting education and MIS education, we argue that in addition to assessment of student academic performance via exams and quizzes, it is also necessary to understand the basis of student learning processes and outcomes. Because the construct of self-efficacy has been widely used towards furthering such understanding, we include it in our assessment and documentation of student learning, along with more typical measures of student learning outcomes.

## 3. RESEARCH DESIGN AND HYPOTHESES

The primary objective of our study is to determine if the use of Oracle applications to teach selected accounting concepts resulted in an improved understanding of these concepts and an increase in students' sense of self-efficacy. More specifically, the objectives of the study are (a) to investigate whether ERP software facilitated student learning of accounting concepts, and (b) to examine the role of self-efficacy in achieving such learning. We use a pre-post experimental design with a control condition that permits us to test the pedagogical method of interest – i.e., the use of Oracle-based modules to teach accounting concepts. This aspect of the design addresses the limitations pertinent to the lack of control groups in previous studies in the accounting literature (Stone et al., 1996). Thus, the repeated-measures experimental design enables us to test the primary hypothesis that student learning for a topic learned through Oracle-based modules is as good as, if not better, than for a topic learned without Oracle.

Based on the literature documenting advantages of experiential learning approaches, our first hypothesis focuses on student learning or performance. Based on prior research suggesting that hands-on learning approaches are likely to be more effective than lecture and discussion methods (Barr and Tagg, 1995; Fletcher, 1990; Kearsley, 1984), our hypothesis is as follows:

**H1**: Student knowledge of accounting concepts will show a greater increase for a topic taught with the Oracle ERP software (budgeting) than for a topic taught without the Oracle ERP software (variance analysis).

Based on the emphasis on domain specific assessments of self-efficacy in the accounting education and MIS literatures, we include a measure of self-efficacy in the content domain (in this case, managerial accounting) as well as a measure of self-efficacy in technology. Further, the repeated measures design of the study enables us to examine changes in these domain specific areas of self-efficacy through the course of the term. Therefore, since students in the target course learn accounting concepts as well as the use of the Oracle eBusiness suite, our hypothesis is as follows:

**H2**: Students' self-efficacy for accounting concepts and for ERP system use will be higher at the end of the term than the beginning.

Our study is also designed to investigate the relationship between self-efficacy and actual student learning (i.e., quiz performance). Based on studies documenting the relationship between self-efficacy and student learning, our third hypothesis focuses on the relationship between self-efficacy and student learning. Generally, studies suggest that self-efficacy is associated with more effort, better use of learning strategies, and test performance (Christensen et. al., 2002). Based on this research, our hypothesis is as follows:

**H3:** Students' self-efficacy will be associated with student performance.

The sample and the procedure used to collect data are described in the next section, followed by the results of the analysis used to test the hypotheses.

## 4. METHOD

We use a pre-post experimental design with a control condition that permits us to test the pedagogical method of interest – i.e., the use of Oracle-based modules to teach accounting concepts. This aspect of the design addresses the limitations pertinent to the lack of control groups in previous studies in the accounting literature (Stone et al., 1996). Thus, the repeated-measures experimental design enables us to test the primary hypothesis that student learning for a topic learned through Oracle-based modules is as good as, if not better, than for a topic learned without Oracle.

The sample consisted of 57 students enrolled in two sections of an undergraduate course on Managerial Accounting taught by the first author. Both sections were taught by the same instructor and in the same manner. Budgeting and variance analysis were selected as the two topics to be utilized in the experiment designed for this study because management control methods (e.g., flexible budgeting and variance analysis) are at the core of some of the financial modules in Oracle. We utilized a repeated-measures experimental design to compare students' learning of an accounting topic learned through an Oracle module to a topic learned without Oracle. For each topic, students also completed a case analysis as an out-of-class assignment, as the instructor emphasizes the case study method for teaching management accounting topics. In each case, students were required to complete similar tasks. The primary difference between the learning requirements for the two topics was the method used by students to prepare the case analysis. Students completed the budgeting case using an Oracle-based module, while they completed the variance analysis case using either Excel or manual calculations (i.e., without the use of an Oracle-based module).

The budgeting module used in the experimental condition required students to use and analyze data from a budgeting case using an Oracle module. In the Oracle module, students were asked to calculate the revenues and expenses (variable and fixed) associated with various products so that they could develop and formulate a master budget. After they had completed the mechanical aspects of formulating the budget in the Oracle ERP system, the students were required to analyze various "what if" scenarios. Thus, they were asked to examine the budgetary implications of changes in profitability, changes in sales prices, changes in variable and fixed expenses, etc., and make recommendations to determine the options available to the firm to reach the desired objectives.

In the control condition the students were asked to analyze a case on variance analysis. In this case, the students were first asked to prepare a flexible budget as a precursor to conducting revenue and cost variances in order to compare actual results with previous results and budgeted results. This case however, was not analyzed through the Oracle ERP system - the analysis completed by each student was done using excel or manual calculations. Thus, each student analyzed the case and made recommendations without the aid of the Oracle ERP system. While case analysis has some elements of active learning because students are applying material in a case environment rather than only a lecture/quiz format, the Oracle ERP system facilitates exploration and what-if analysis, thus supporting student's analysis and synthesis capabilities.

## 4.1 Assessment of Learning

Students' actual comprehension and learning of budgeting and variance analysis topics was assessed through a quiz with ten items, five questions on each topic (see Appendix A). Thus, each student received two scores, one representing their learning of budgeting concepts and one representing their learning of variance analysis. Each score represented the number of correct answers on the five questions, resulting in a scale of 0 to 5 for each student learning score. In addition, there were two self-efficacy measures, which were collected twice, once near the beginning of the course (pre-test) and once near the end of the course (post-test). Thus, there were four measures for assessing student learning, two scores representing their performance on the budgeting and variance analysis sections of a quiz, and two self-efficacy scores – one for technology self-efficacy and one for accounting self-efficacy. Each of these four measures was collected twice.

## 4.2 Procedure

The pre-test measures were collected during the middle of the term, a week or so before the target topics were to be introduced. A quiz was administered to students to assess their existing understanding of budgeting and variance analysis, prior to any exposure to these topics in the course. Ten questions on budgeting and variance analysis were included in a twenty-question quiz. This quiz was worth five percent of the student's overall grade in the term. Students also completed the two self-efficacy questionnaires. After the pre-test measures were collected, students completed an ERP foundation module, which was designed to introduce the students to the basic navigational features and functional modules in the Oracle ERP system. In the following week, students were introduced to budgeting (the experimental topic condition), and then were required to complete the Oracle-based module on budgeting.

Following this, students were introduced to variance analysis and then required to complete a non-Oracle-based module on variance analysis (the control topic condition). Finally, at the end of the term, the post-test measures were administered to all the students. These post-test measures consisted of the final quiz, which included the same ten questions on budgeting and variance analysis that were part of the first quiz, and the two self-efficacy questionnaires.

# 5. RESULTS

First, we present results testing our hypothesis of greater improvements in the experimental versus control condition (see Table 1). This is followed by the results examining whether self-efficacy scores improved from pre- to post-test (see Table 2). Then, in the final section (see Table 3), we present results on the relation between self-efficacy and actual student performance (quiz scores).

## 5.1 Effectiveness of Oracle-Based Exercises on Student Learning

In the first set of analyses, the focus is on determining if there were improvements in the students' actual learning of accounting concepts by the end of the term, especially for those concepts learned through the Oracle-based module. Descriptive statistics on the pre- and post-test scores are presented in Table 1.

Table 1. Descriptive Statistics and ANOVA Results on Budgeting and Variance Analysis

**Panel A: Descriptive Statistics**

| Topic | Pre-test (n=56)* | Post-test (n=56) | Across tests (n=56) |
|---|---|---|---|
| Budgeting (Oracle-based exercises) | 1.86 (.093) | 3.36 (.143) | 2.60 (.087) |
| Variance Analysis (without Oracle) | 1.70 (.116) | 2.70 (.120) | 2.20 (.087) |
| Across topics | 1.80 (.079) | 3.02 (.094) | |

*Note: N=56 because one student did not take the quiz. Numbers in cells represent means and standard error

**Panel B: ANOVA results**

| Variable (within Ss) | Df | SS | MS | F-value | P value |
|---|---|---|---|---|---|
| Test (pre, post) | 1 | 85.02 | 85.02 | 111.38 | 0.000 |
| Error (Test) | 55 | 41.55 | 0.76 | | |
| Topic (budgeting, variance) | 1 | 9.45 | 9.45 | 12.50 | 0.001 |
| Error (Topic) | 55 | 41.55 | 0.76 | | |
| Test X Topic | 1 | 4.02 | 4.02 | 5.53 | 0.022 |
| Error (Test X Topic) | 55 | 39.98 | 0.73 | | |

A 2 (Test) x 2 (Topic) repeated measures analysis of variance, with Test (pre-test, post-test) and Topic (budgeting, variance analysis) as within-subject factors, was used to test the hypotheses of greater gains on the topic learned through the Oracle based module. As predicted there was a main effect for Test, $\underline{F}$ (1, 55) = 111.38, $\underline{p}$ = .000, with students scoring higher on the post-test than on the pre-test (pre-test $\underline{M}$ = 1.8, post-test $\underline{M}$ = 3.0). Further, as predicted, there was a main effect for Topic, $\underline{F}$ (1, 55) = 12.5, $\underline{p}$ = .001, with students scoring higher on budgeting (the experimental condition) than on variance

analysis (the control condition) (budgeting M = 2.6, variance analysis M = 2.2). More importantly, the Test x Topic interaction effect was significant, F (1, 55) = 5.5, p = .022, thus supporting our prediction of greater learning of concepts through Oracle compared to learning of concepts without Oracle.

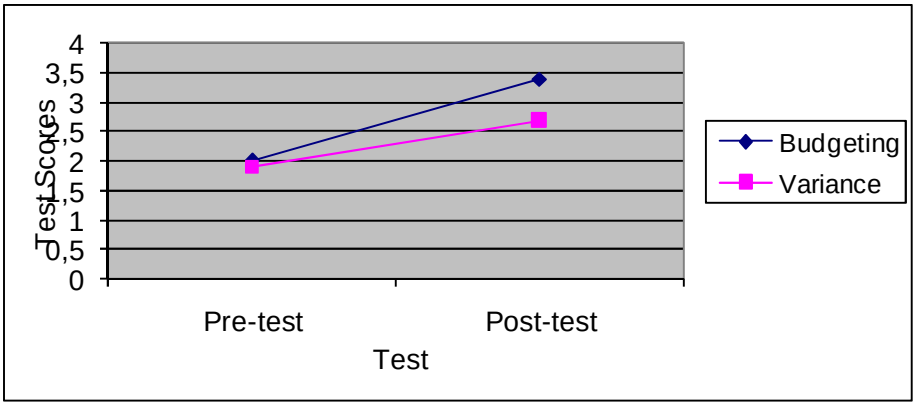


Figure 1. Topic and Test Interaction for Budgeting and Variance Analysis Scores

Paired sample t-tests on pre-test and post-test scores for budgeting and variance analysis further support these results. Paired sample t-tests comparing pre-test scores on budgeting and variance analysis show no significant differences, t (56) = 1.03, p = n.s. The paired sample t-test comparing post-test scores on budgeting and variance analysis, however, is significant, with post-test scores on budgeting significantly higher than post-test scores on variance analysis, t (56) = 3.7, p = .001. These results indicate that students improved their learning of the topic of budgeting (taught through Oracle) to a greater extent than their learning of variance analysis (taught without Oracle). Table 1 presents the relevant descriptive statistics, while Figure 1 presents a visual representation of the Test x Topic interaction effect. Thus, students began with a comparative level of understanding of both topics at the middle of the term (as reflected in comparable scores on the quiz for each topic at the pre-test time). Although scores on both topics improved by post-test time, scores on budgeting were significantly higher than the scores on variance analysis at post-test time. These results suggest that Oracle-based modules can be successfully utilized in teaching management accounting topics.

## 5.2 Improvements in Self-Efficacy

Because the course was designed to familiarize students with accounting concepts as well as with the use of Oracle, we expected improved ratings of self-efficacy on both accounting and technology measures. Descriptive statistics on students' self-efficacy on accounting and technology use are presented in Table 2.

Table 2. Mean Ratings on Accounting and Technology Self-Efficacy Measures

| | Pre-test (n=57) | | Post-test (n=57) | |
|---|---|---|---|---|
| | Self-Efficacy *Accounting* | *Technology* | *Accounting* | *Self-Efficacy Technology* |
| Mean | 3.4 | 1.9 | 7.8 | 6.4 |
| Std. Dev. | 1.7 | 1.8 | 1.5 | 2.1 |
| Minimum | 0.3 | 0.0 | 3.2 | 0.0 |
| Maximum | 7.0 | 8.1 | 9.9 | 9.9 |

As is evident from Table 2, average scores increased from pre- to post-test on both self-efficacy measures. Further, paired sample t- tests were performed to determine the significance of the increase in scores. The paired sample t-test for the accounting self-efficacy measure was significant, $t$ (56) = 15.69, $p$ = .000, indicating that students' had increased self-efficacy on accounting by the end of the term. Similarly, the paired sample t-test for the technology measure was also significant $t$ (56) = 14.04, $p$ = .000, indicating that they had improved self-efficacy on technology by the end of the term.

## 5.3 Relationship between Self-Efficacy and Student Learning

In the analyses presented thus far, the impact of using Oracle-based exercises was analyzed by examining students' quiz scores and their self-efficacy scores separately. Here we present analyses of the relation between self-efficacy scores and the quiz scores. Since we conducted assessments of self-efficacy and students' actual learning (as represented in quiz scores) at two times, before and after the Oracle-based intervention (pre- and post-test times), we were able to examine the relative contributions of pre- and post-test self-efficacy scores for accounting content, and for technology, as well as pre-test quiz performance to students' final quiz scores at the end of the term (post-test quiz scores).

Regressions on the post-test quiz total scores (i.e., combined scores on the budgeting and the variance analysis items) with pre- and post-test self-efficacy scores and pre-test quiz scores (representing students' prior or existing knowledge of accounting concepts) were performed (see Table 3). The regression model was significant $F$ (5, 51) = 2.78, $p$ = .027, with beta scores for pre-test quiz scores marginally significant ($p$=.08), indicating that performance on the pre-test was related to performance on the post-test.

Table 3. Regression of Accounting Self-Efficacy Scores on Quiz Scores

| | TOTAL SCORES AT POST-TEST QUIZ |
|---|---|
| *Pretest Quiz Scores | 0.376, 2.8, (.08). |
| *Ave. Scores on Acct.Self-Efficacy at Pretest | -0.216,-1.62, (.11). |
| *Ave. Scores on Acct.Self-Efficacy at Post-test | 0.318, 2.22. (.031). |
| *Average Scores on Tech.Self-Efficacy at Pretest | -0.109,-0.84,(ns). |
| *Ave. Scores on Tech.Self-Efficacy at Post-test | -0.203,-1.38,(ns). |
| Model R square<br>Adjusted R square<br>F (probability) | 0. 21<br>0.14<br>2.78,(.027). |

Note: * First entry is the standardized Beta coefficient. The second is the t value, and third is probability value (in parentheses).

Although, the beta value for Accounting self-efficacy scores at pre-test time was not significant (p =.11), the negative value indicates a negative relationship of pre-test accounting self-efficacy with post-test quiz scores. This result is consistent with the findings in the literature that students who are optimistic in their self-assessments tend to score lower, while those who are pessimistic tend to score higher on final quizzes or exams (Christensen et al. 2000). Interestingly, the accounting self-efficacy scores at post-test time were significantly associated with final post-test scores (p = .031), with positive beta values for the relationship between self-efficacy and quiz scores at the end of the term. This suggests that by the end of the term, students' self-efficacy ratings became more realistic and as a result were positively related to their final quiz scores.

The Pre-test and Post-test Technology self-efficacy scores were not significantly related to post test quiz scores. The non-significant results on the technology self-efficacy measures are not surprising because the student learning measures used were not measures of technological knowledge or competence in using the Oracle modules. These results indicate a student's confidence in their ability to use that technology does not affect their learning of accounting concepts.

## 6. CONCLUSION

Results supporting the effectiveness of using Oracle ERP applications to teach accounting concepts make a significant contribution to the literature on management education. With reference to management education, the results reported in this study extend theoretically-derived scholarship to evaluate the effectiveness of technology-based education in accounting (Bryant and Hunton, 2000; Christensen et al., 2002).

The results of this study are also significant in the context of increasing interest and investment in ERP-based curriculum integration in business schools. Most universities have struggled with the financial and personal costs (e.g., faculty time investment) involved in implementing such programs and have made only limited progress (Bradford, et. al., 2003). Because of the costs and challenges of implementing ERP-based curriculum integration, it is essential to first ensure that the ERP-based modules are at least as good as, if not necessarily better than, traditional methods (e.g., use of Excel spreadsheets) in facilitating student learning of management concepts in core functional areas. Our study documenting improved student learning is an essential first step before investing in cross-functional curriculum integration on a large scale.

Further, our investigation of the relationship between self-efficacy and quiz performance also makes an important theoretical contribution to accounting education in the context of recent interest in understanding how self-efficacy contributes to academic performance in accounting courses. Focusing specifically on the relationship between accounting self-efficacy and quiz performance at multiple points in time, our results extend existing research (Christensen et al., 2000; Stone et al., 1996). Results of our study indicate that although students may make unrealistic self-efficacy assessments at the beginning of the course, they make more realistic self-efficacy assessments by the end of the term, such that there is a positive relationship between self-efficacy and test performance by the end of the term. This is consistent with the findings in the literature that students who are optimistic in their self-efficacy assessments tend to score lower, while those who are pessimistic tend to score higher

on final quizzes or exams. The non-significant results on the technology self-efficacy measures indicate that while technology may well serve as a useful mechanism for learning accounting concepts, a student's confidence in their ability to use that technology does not affect or interfere with their learning. This result is important for our longer-term objective of using ERP-based exercises to integrate across the management curriculum. Such an approach will be more effective if the technology itself, which is complex, does not interfere with student learning, especially for those with low technology self-efficacy.

## REFERENCES


Antonucci, Y. L., Corbitt, G., Stewart, G., & Harris, A. L. 2004 Enterprise Systems Education: Where are We? Where Are We Going? *Journal of Information Systems Education* 15 (3), pp 227-234.

Bandura, A., 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Barr, R. B., & Tagg, J. 1995. From teaching to learning – a new paradigm for undergraduate education. *Change Magazine* 27 (6), pp 12-25.

Becerra-Fernandez, I., Murphy, K. E., & Simon, S.J. (2000). Integrating ERP in the Business School Curriculum. *Association for Computing Machinery: Communications of the ACH* 43 (4), pp 19-41.

Bradford, M., Chandra, A., & Vijayaraman, B.S., 2003. Integrating Oracle ERP into the Business Curricula. *The Review of Business Information Systems*, 6 (4). pp. 17-25.

Bartell, S. M. 1999. A marriage of learning and doing: Multimedia and the public budgeting laboratory. *Public Administration Quarterly*, Vol. 23. (1). pp 77-103.

Becerra-Fernandez, I., Murphy, K. E., & Simon, S.J., 2000. Integrating ERP in the Business School Curriculum. *Association for Computing Machinery: Communications of the ACH*, 43, (4) pp 19-41.

Boyce, G., 1999. Computer-assisted teaching and learning in accounting: pedagogy or product? *Journal of Accounting Education*, 17, pp 191-220.

Bradford, M., Chanda, A. & Vijayaram, B.S. 2003. Integrating Oracle ERP into the Business Curricula. The *Review of Business Information Systems*, 6 (4), pp 17-25.

Bryant, S., & Hutton, J., 2000. The use of technology in the delivery of instruction: Implications for accounting educators and education researchers. *Issues in Accounting Education*, Vol. 15, (1), pp 129-162.

Christensen, T. E., Fogarty, T.J., & Wallace, W.A., 2000. The Association between the Directional Accuracy of Self-efficacy and Accounting Course Performance. *Issues in Accounting Education*, Vol. 17, (1) pp 1-26.

Closs, D. J., & Stank, T. P. 1999. A cross-functional curriculum for supply chain education at Michigan State University. *Journal of Business Logistics*, 20 (1), pp 59-72.

Compeau, D.R., & Higgins, C.A., 1995. Computer Self-Efficacy: Development of a Measure and Initial Test. *MIS Quarterly, 19*, pp 189-211.

Corbitt, G., & Mensching, J., 2000. Integrating SAP R/3 into the College of Business curriculum: Lessons learned. *Information Technology and Management*, 1, pp 247-258.

Davenport T. H., 2000. The future of enterprise system-enabled organizations. *Information Systems Frontiers*, Vol. 2, pp 163-180.

Dickens, T., & Harper, R. 1986. The use of microcomputers in Intermediate Accounting: Effects on student achievement and attitudes. *Journal of Accounting Education*. Vol. 4, pp 124-146.

Dishaw, M. T., Strong, D.M., & Bandy, D.B., 2002, Extending the Task-Technology Fit Model with Self-Efficacy Constructs. *Proceedings of the Americas Conference on Information Systems.* Dallas, TX, pp 1021-1027.

Elam, J., Murphy, K., Becerra-Fernandez, I., & Simon, S. 1999. ERP as an enabler of curriculum integration. *Paper presented at the 3rd annual SAP Asia Pacific Institute of Higher Learning Forum, Singapore.*

Evans, P., 1998. Educators' forum: A self-learning project with undergraduate accountancy students using videos and computer technology. *Issues in Accounting Education*, Vol. 13. pp 729-746.

Fedorowicz, J., Gelinas, Jr., U. J., Usoff, C., & Hachey, H. 2004. Twelve Tips for Successfully Integrating Enterprise Systems Across the Curriculum. *Journal of Information Systems Education* 15 (3), pp 235-243.

Fletcher, J.D., 1990. Effectiveness and cost of interactive videodisk instruction in defense training and education. *Institute for Defense Analysis*, pp 23-72.

Friedman, M. 1981. The effect on achievement of using the computer as a problem-solving tool in the intermediate accounting course. *The Accounting Review*. LVI, (1). pp 137-143.

Hamilton, D., McFarland, D., & Mirchandani, D., 2000. A decision model for integration across the business curriculum in the 21st century. *Journal of Management Education* 24, (1) pp 102-126.

Garvin, D. A. 1995. Leveraging processes for strategic advantage. *Harvard Business Review*, September-October pp. 76-90.

Hawking, P., Ramp, A., & Shackleton, P. 2000. IS '97 Curriculum and Enterprise Resource Planning Systems. *Business Process Management Journal*, (7) 3, pp 225-233.

Helmi, M., 1986. Integrating the microcomputer into accounting education: Approaches and pitfalls. *Issues in Accounting Education*, (5), pp 102-111.

Hirsch, E. D. 1996. *The schools we need and why we don't have them.*1996. New York: Doubleday.

Holsapple, C. W. 2001. Technological delivery of Business education. *Information Technology and Management*, 2 (4), pp 361-362.

Kearsley, G. 1984. *Computer-based training: a guide to selection and implementation*. Reading, MA: Addison-

Wesley.

Krovi, R., & Sulek, J. 2001. The Effect of a Web-based Tutorial on Problem Formulation Ability. *Information Technology and Management* 2 (4), pp 419-442.

Kumar, K. & Hillegersberg. 2000. ERP Experiences and Evolution. *Communications of the Association for Computing Machinery*, 43 (4), pp. 23-26.

Macy, G., & Neal, J. C. 2002. The dialogic case method: Building a micro world in the classroom. *Organization Development Journal* 20 (3), pp 31-41.

Markus, M. L & Tannis, C. 2000. The Enterprise systems experience – from adoption to success. In Zmud, R. W. (Ed.) *Framing the Domains of IT Management: Projecting the Future through the past.* Cincinnati, Oh: Pinnaflex Educational Resources, Inc.

Mullins, J.W., & Fukami, C. V. 1996. Stage 4: The Raging Debates. *Journal of Management Education* 20, (4) pp 446-461.

Pajares, F., & Miller, D.M. 1997. Mathematics self-efficacy and mathematical problem-solving. *Journal of Experimental Education*, 65 (3), pp 213-228.

Quinton, A. 1999. Organizing, planning, and implementing SAP R/3 into an undergraduate business curriculum. *Paper presented at the 3rd annual SAP Asia Pacific Institute of Higher Learning Forum, Singapore.*

Rebele, J.E., Apostolou, B.A., Bucles, F.A., Hassell, J.M., Paquette, L.R., & Stout, D.E. (1998). Accounting education literature review (1991-1997), Part II: Students, educational technology, assessment, and faculty issues.

*Journal of Accounting Education* 16 (2), pp 179-245.

Scott, F & Shepherd, J. 2002. *The Steady Stream of ERP Investments*. AMR Research; New York, NY.

Stone, D., Arunachalam, N.A., & Chandler, J.S. 1996. Cross-cultural comparisons: an empirical investigation of knowledge, skill, self-efficacy and computer anxiety in accounting education. *Issues in Accounting Education* 11 (2), pp 345-367.

Strong, D. M., Johnson, S. A., & Mistry, J. J. 2004. Integrating Enterprise Decision-Making Modules into Undergraduate Management and Industrial Engineering Curricula. *Journal of Information Systems Education* 15 (3), pp 301-313.

Volkoff, O., Strong, D. M., & Elmes, M. B. 2005. Understanding Enterprise Systems-Enabled Integration. *European Journal of Information Systems*, 14 (2), pp 110-120.

Williams, D.Z, & Sundem, G.L. 1990. Grants awarded for implementing improvements in accounting education. Issues in accounting education. *Issues in Accounting Education*, 5 (2), pp 313-329.

Yoo, Y., Kanawattanachai, P., Citurs, A. 2002. Forging into the wired wilderness: A case study of a technology-mediated distributed discussion-based class. *Journal of Management Education* 26 (2), pp 139-164.

## Appendix A

### Budgeting and Variance Analysis Items on Quiz

True/ False Questions

____1. A just-in-time manufacturer does not need a sales budget.

____2. The production budget is prepared before the sales budget because the firm cannot estimate what it will sell until it has some idea of what will be produced.

____3. The longer the time period covered by a budget, the more useful the budget will be for controlling operations.

____4. The process of focusing attention on only the most significant variances between actual expenses and revenues and budgeted expenses and revenues is known as management by ideals.

____5. As a general rule the sooner a variance is isolated, the greater its value in cost control.

Multiple Choice

Place the correct answer for each of the following questions in the blank provided at the left. There is only one correct answer for each question.

The following data refer to questions 6-7:

GNJ Company sells a single product for $10. The variable cost is $4 per unit and GNJ pays a 20% sales commission. Fixed costs are $10,000 per month including $3,000 depreciation, and the firm maintains inventory at twice-budgeted sales needs for the following month. The following budgeted data are available, in units:

| | | |
|---|---|---|
| Inventory on hand, February 1 | | 8,000 |
| Budgeted sales – February | | 4,000 |
| | -- March | 4,500 |
| | -- April | 4,100 |

____6. Budgeted income, total for February and March is $ _____.

____7. Budgeted inventory at March 31 is _____ units and $ _____.

____8. Scotch Company manufactures vinyl car roofs. The standard materials cost of the vinyl used per Model S top is $54 based on 12 square feet of vinyl at a cost of $4.50 per square foot. A production run of 2,000 roofs in August 1998 resulted in usage of 25,000 square feet of vinyl at a cost of $4 per square foot, a total cost of $100,800. The materials usage variance resulting from the above production run was:

a. $4,800 (unfavorable).
b. $5,400 (unfavorable).
c. $7,200 (favorable).
d. $5,400 (favorable).

____9. In a given period, Topper Company purchased 10,000 units of materials at $392 each. The standard cost of this material is $400 per unit. A total of 16,200 units was issued to complete a job for which the standard materials allowed amount of 16,000 units. Which of the following statements is true?

a. The materials usage variance is $39,200 unfavorable.
b. The total materials variance for materials actually used is $40,000 favorable.
c. The materials price variance is $80,000 favorable.
d. The standard cost for materials used is $6,350,400.

____10. If estimated manufacturing overhead (based on 100,000 direct labor-hours) is $200,000 plus $3 per direct labor-hour, actual production is 40,000 units with standard labor per unit of two hours, and actual fixed overhead is $198,000 while actual variable overhead is $244,000 then:

a. budgeted overhead at the actual level of production is $500,000.
b. standard overhead applied to production is $440,000.

c. the overhead volume variance is $40,000 (unfavorable).
d. the overhead budget variance is $2,000 (favorable).

# Appendix B

### Accounting Self-Efficacy Questionnaire

For each of the following questions, please indicate whether or not (circle Yes or No) you are able to perform the task. If you answer YES, please rate your confidence about your judgment by circling a number from 1 to 10, where 1 indicates "Not at all confident", 5 indicates "Moderately confident", and 10 indicates "Totally confident."

| | | | Not at All Confident ^ | | | | Moderately Confident ^ | | | | | Totally Confident ^ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q-1 | I can determine the cost of a particular product or service by using cost allocation methods to allocate costs. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-2 | I can determine the cost of a particular product or service by applying Activity Based Costing. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-3 | I can calculate the break-even volume in an organization using cost-volume-profit analysis techniques. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-4 | I can describe the overall process of a job-order costing system. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-5 | I can describe the differences between absorption costing and variable costing. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-6 | I can describe what is meant by "different costs for different purposes." | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-7 | I can provide examples of how management control systems affect production planning. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-8 | I can provide examples of how management control systems affect budgeting. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-9 | I can provide examples of how management control systems affect variance analysis. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q-10 | I can provide examples of how management control systems affect performance evaluation. | Yes ….. No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |