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Learning Business Process Integration: Step by Step Is Only the First Step

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Enterprise Resource Planning (ERP) software systems are critical to corporate deployment of digital processes that are remaking global business competition (McAfee and Brynjolfsson, 2008) and ERP-capable graduates continue to be attractive to industrial employers (Yongbeom, 2006; Boyle, 2006). The popularity of ERP software among companies has prompted business schools to incorporate ERP software into their curricula since the late 1990s (Antonnuci et al., 2001; Boyle, 2007). Business schools have used ERP to demonstrate horizontal integration of multiple business disciplines (e.g., accounting and management) and connect the so-called educational silos that often have been criticized by industry (Crittenden, 2005). While various ERP-related research issues (e.g., teaching effectiveness, curriculum redesign) and teaching pedagogies (e.g., simulating on-going business, configuring an ERP systems) have been studied, little research is available with findings related to the acquisition of business process knowledge through utilization of ERP software. Can students effectively acquire *business process* knowledge by completing hands-on ERP exercises? This question was the motivation of our research.

The emergence of the progressive education movement in the early 20th century connected academic and vocational knowledge (Braundy, 2004) and the idea of "learning by doing" became a familiar education process (Barron et. al, 1998). This is the pedagogy of professional training and it focuses on learning through experience. A corporation implementing an ERP software system would use an experiential learning process. Inexperienced employees would be trained by workshops using step-by-step instructions. In our study, a step-by-step approach was also adopted in developing ERP hands-on exercises for the computer laboratory classroom. Students were given lectures about the "business processes" represented in the ERP system before they conducted hands-on exercises to promote their understanding of business processes involved.

Similar to many schools teaching ERP, our hands-on exercises were developed for the *purchasing cycle* (**PC**) and the *sales cycle* (**SC**), two popular business processes that include the following activities: (1) creating orders, (2) fulfillment (receipt or shipment), (3) inventory changes, (4) documenting goods received or sent (accounts payable or receivable), and (5) payments made or received. The software navigation challenges were minimized through easy-to-follow step-by-step instructions with relevant screen shots. Both PC and SC involve several "work flow" activities that interconnect multiple business functions (e.g., accounting, logistics, management, etc.) integrated within the ERP. This research attempted to investigate students' knowledge about the detailed business processes *before* and *after* they completed ERP exercises.

Employing ERP to Teach Business Process Concepts

The educational aims of ERP software in academics include more than navigation, configuration, and technical flu-

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ency in the system itself. ERP is used to highlight business process integration. But do hands-on exercises using ERP enhance students' understanding of business processes? Step-by-step instructions have been used in science laboratories since the turn of the 20th century. Nevertheless, studies exploring how students process scientific knowledge as a result of step-by-step experimental instructions are not very encouraging (Hofstein & Lunetta, 1982). Our research findings, as presented below, paralleled the experience of science laboratories.

Our hands-on ERP exercises with step-by-step instructions were developed for Microsoft Dynamics, a popular ERP system for mid-sized companies. Quantitative analysis was employed to examine knowledge acquisition involving components and sequences of purchasing and sales business sub-processes at three different time points—*before any ERP exposure*, *after one ERP exercise (PC or SC)*, and *after both ERP exercises*. After completion of all exercises, surveys were given to students asking them to self assess the effect of their ERP experiences on their business process knowledge.

All research subjects were undergraduate students from a business core course, *Introduction to Information Technology*, which is required for all business students. The study was conducted in four summer semester sections with 105 students. All students completed both *PC* and *SC* using Microsoft Dynamics - Great Plains®. Experiments were designed based on sub-processes involved in PC and SC. Students' knowledge about PC and SC were measured by their ability to identify proper sub-processes involved and put them in proper sequential order. All terminologies used in in-class lectures and lab hands-on exercises were consistent throughout the process.

Measuring Detailed Process Knowledge

Hands-on exercises focused on 15 business sub-processes shown in Table 1. Six were unique to PC and six unique to SC, and two (i.e., sub-processes 7 and 13) were common to both process cycles. One irrelevant sub-process (i.e., 14) also appeared on the list. Students completed the sub-processes involved in PC and SC when they followed the step-by-step purchasing and sales exercises in Microsoft Dynamics—Great Plains®.

While in-class lectures were given to students about business processes before hands-on exercises, business sub-processes were not directly discussed *during* hands-on exercises, although written instructions directed students to perform the process and used the vocabulary of the process. After completing hands-on exercises, students were asked to choose correct *purchasing* sub-processes from items on the list and put them in correct sequence. They were also asked to make choices for business *sales* sub-processes using the same list and put them in correct procedural order. Since question sets primarily addressed declarative and procedural knowledge, two questions were added in an attempt to measure application and synthesis knowledge resulting from interaction with the ERP. Research participants were asked to choose documents needed to either make a payment for an item (in PC) or close a sale (in SC) from the following list: (1) sales order, (2) payment receipt, (3) purchase order, (4) customer address, (5) goods receipt, (6) invoice, (7) inventory item number. In order to answer these questions correctly, students would have to connect document tracking throughout PC or SC with account posting and payments.

Analytical Approach and Results

Student responses for sub-processes and sequences were transformed into normalized scores. Details on the score derivation algorithms, experiment design, and survey questions can be found in Rienzo (2007).

Repeated Measures Analysis of Variance (ANOVA) was used to evaluate significant differences in a calculated within-subjects time factor for sub-process scores. No statistically significant differences were observed for the purchasing sub-processes activity measurements over time. Similarly, no statistically significant differences were seen for either purchasing or sales sub-processes sequences. Only sales sub-processes activities generated statistically significant p values less than 0.05, and even though the sales sub-processes activities showed statistically different results, the amount of difference was very small.

Repeated measures ANOVA was also applied to student choices involving documents needed to either make a payment for an item during PC or close a sale in SC. No significant differences related to ERP hands-on experiences were detected.

In other words, experience with ERP did not significantly change the ability of students to recognize sub-processes involved in PC or SC, nor identify the proper sequential order of sub-processes involved in PC or SC. Our study shows

1.	Create Sales Order	6.	Receive Payment	11.	Receive Customer Inquiry
2.	Create Sales Quote	7.	Check Credit Limit	12.	Create Invoice
3.	Select Supplier	8.	Pay Invoice	13.	Check Inventory Quantity
4.	Review Sales Forecast	9.	Fulfill Order	14.	Update Buyer Employee Benefits
5.	Receive Goods	10.	Match Invoice / Receipts	15.	Create Purchase Order

Table 1. ERP purchasing and sales cycle sub-processes.

little factual knowledge improvement after students completed step-by-step lab hands-on exercises. These results concur with the research involving science labs, science knowledge, and step-by-step lab experimental instructions (Hofstein & Lunetta, 1982).

Research Findings: Step by Step is only a First Step

Step-by-step ERP exercises are inadequate to convey to students business process concepts imbedded in ERP systems. One of the challenges of attempting to use actual business processes in an academic setting to induce conceptual change is generating the four conditions described by Posner et al. (1982) for conceptual change to occur: (a) dissatisfaction with an existing conception, (b) new conception must be intelligible, (c) new conception must be plausible, and (d) new conception must be fruitful. The nearly universal familiarity with purchasing and sales activities should make intelligibility and plausibility readily achievable. Creating dissatisfaction may be problematic because students have well-established prior purchasing and sales frameworks that cause no difficulties for them in their everyday lives. The ERP assignments provide no compelling reason for students to include the added complexity of business processes in what Cobern (1994) would call a worldview of buying and selling. Students are no more or less capable of attending to purchasing and sales responsibilities in their everyday lives after completing the ERP assignments then they were before. Driver (1997) speaks of a "learning demand" in science education—the difference between prior ideas that students bring to their lesson and the nature of the scientific ideas they are supposed to learn. The learning demand for added complexity that can be expected to occur naturally as a result of an experiential encounter with ERP software may be minimal. In addition, knowledge gained during ERP assignments depends solely upon the ability of students to connect purchasing and sales processes described in lecture with their experiences following the directions of the step by step software exercises. That connection is not being made. This disconnect between process models and laboratory experience has been seen in science teaching. Driver (1983) expresses some concern about science instruction that is wholly dependent upon experience:

> The slogan "I do and I understand" is commonly used in support of practical work in science teaching. We have classrooms where activity plays a central part. Pupils can spend a major portion of their time pushing trolleys up runways, marbles are rattled around in trays simulating solids, liquids and gases, batteries and bulbs are clicked in and out of specially designed circuit boards. To what end? In many classrooms, I suspect, "I do and I am even more confused".

An ancient Chinese proverb states:

> I hear … and I forget
> I see … and I remember
> I do … and I understand

Perhaps an appropriate modification for ERP step by step exercises is:

> I hear … and I forget
> I see … and it doesn't mean very much to me
> I do … and I do not remember specifics, but I know this thing is complex

ERP business software may have to be coordinated in a larger teaching and learning system to significantly impact detailed knowledge of business purchasing and sales processes.

Student Self Assessment Indicates Increased Awareness

Although there was no evidence that students understood the components of business purchasing and sales processes more clearly as a result of experiencing ERP software, self assessment indicated learning. After completion of both ERP assignments, students were asked to respond to a statement that ERP assignments increased their understanding of business purchasing and sales processes. There were seven Likert scale responses ranging from "Strongly disagree" to "Strongly agree." Separate questions addressed perceived understanding of purchasing processes and sales processes, but results were very similar for both. About 86 percent of responses were in the "somewhat agree" to "strongly agree" segments (scores 1 to 3). Comments provided with surveys indicated an awareness of architecture, complexity, and coordination that students had not realized before engaging in ERP software exercises.

Results in this study are similar to those obtained from science laboratory assessments in science education. The laboratory is an important vehicle for the teaching and understanding of scientific processes. Through the laboratory students are exposed to the way scientists work and think. Introduction of ERP software in business curricula is intended to show students how business processes work and interact. Many research studies conducted during the 1970s and 1980s showed no differences in standardized test scores between students who received laboratory instruction and those who did not, particularly when laboratory instructions were step-by-step recipes (Hofstein & Lunetta, 1982). Attempts to assess the real benefits of science laboratories have moved beyond standard scientific knowledge content to include attitude. Improved attitude toward science is one benefit of science laboratories touted by its proponents (Hofstein & Lunetta, 1982). Student self-assessment convincingly showed that students considered the ERP helpful in their comprehension of business processes even if the modest transfer of knowledge and comprehension did not produce detailed component and sequence knowledge. Student judgments that ERP exposure is beneficial to their business awareness have appeared regularly in the literature (Wagner et al., 2000; Nelson & Millet, 2001; Davis & Comeau, 2004).

Path Forward: Further Study Issues

Step-by-step exercises using ERP may not help students acquire detailed knowledge about business processes but it does introduce students to complexities they did not see prior to their hands-on experiences, and it helps them develop an appreciation for the role that ERP plays in optimizing and controlling business

processes. In their study of how people learn, the Committee on Developments in the Science of Learning (Bransford, 2000) described these key findings: (1) students must be engaged or they will not understand what they are taught, or not use what they learned when they are finished with their classes; (2) students must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in a ways that facilitate retrieval and application; and (3) a "metacognitive" approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them. Step-by-step instructions cannot accomplish these goals, but they can lay a foundation upon which other experiences can build. Incorporating step-by-step exercises within a larger decision making framework is needed to embed business process concepts into student thinking. Using ERP as a tool for business decision making may be necessary to produce the environment needed for engagement and deeper understanding in context. It is hard to imagine an introduction to ERP that does not begin with step by step, but no academic institution should let it end there.

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