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Exploring the difficulties in learning ERP systems from students' perspective: The case of Oracle E-Business Suite ERP

Hung-Yi Chen[a], Yueh-Chin Chen[b*], Hsiao-Chun Wu[b] and Tiffany Chiu[c]

[a]*Department of Information Management, Chaoyang University of Technology, Taiwan*
[b]*Department of Business Administration, Chaoyang University of Technology, Taiwan*
[c]*School of Business, the State University of New York at New Paltz, New Paltz, N.Y., United States*

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A B S T R A C T

This study explores and analyzes students' difficulties in learning an ERP system to help design more appropriate teaching methods and materials. Global enterprises have widely used ERP systems to manage their operations effectively and efficiently. Hence, many business schools have offered courses on ERP systems to sharpen ERP skills for their students. To help design more appropriate teaching methods and materials for ERP learning, one must know students' difficulties in understanding. This study analyzes students' difficulties in learning the Oracle E-Business Suite ERP system through interviews and qualitative analysis. As a result, this study identifies five categories of problems in the various areas of the Revised Bloom's Taxonomy. Their relevant educational objectives can guide the redesign of ERP teaching methods and materials. One of the difficulties belongs to the area of Remember Factual Knowledge. The rest of them are in Understand, Remember, Apply, and Analysis of Procedural Knowledge. Lastly, this study provides some implications for teaching ERP.

1. Introduction

ERP systems have been widely used by global enterprises to manage their operations effectively and efficiently, for the ERP system can integrate applications to support various business processes, such as finance, sales, purchases, etc. For example, the help from ERP for small-medium businesses, like SAP B1 can support essential business functions for a single company. The ERP for business groups, like Oracle E-Business Suite (or Oracle EBS for short) or SAP S/4 Hana, can even support complex business transactions between organizations within an enterprise. As a result, ERP systems have become necessary for the company in the current highly competitive business.

A lot of efforts have been devoted to ERP research, such as the key successful factors for ERP implementation (Jabbarzadeh, 2017; Tarigan et al., 2021). Schlichter and Kraemmergaard (2010) have classified the research topics into nine categories. Moon (2007) has compiled six research topics from the literature. All the two pieces of literature point out that ERP education is a critical issue. Users must undergo appropriate training before operating ERP systems due to the functional complexity of ERP systems.

In addition to company training programs, ERP training delivers through higher education. Each major ERP company has offered resources to assist in training students, such as the Oracle Academy or the SAP University Alliance. As a result, many departments related to business management in universities have included ERP education in their curriculum. By training

* Corresponding author. Tel: +886-423323000 ext.7736. Fax:+886-423742331
E-mail address: jessica@cyut.edu.tw (Y.-C. Chen)

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business management students in higher education, these ERP companies ensure stable human resources for the ERP market.

The literature has proposed many curriculum designs, teaching methods, and training models to guide ERP education (Motahar et al., 2018). A study that takes into account students' difficulties in learning benefits the design of teaching methods or materials (Milne & Rowe, 2002). Although there are many studies for ERP education, research on students' difficulties in learning ERP remains limited. The researchers believe that understanding these difficulties can enable us to design better teaching methods and materials to deliver ERP knowledge and technology more effectively from the perspective of teaching practice.

Through interviews and qualitative analysis, the study explores and analyzes students' difficulties in learning Oracle EBS ERP for the business groups. Because there is little literature on the topic of difficulties in learning ERP, interview questions were designed based on the literature on user training for information systems. After identifying the problems, they were placed in combinations of dimensions on the knowledge and cognitive process scales in the Revised Bloom's Taxonomy. The positioning of difficulties enables teachers to develop teaching methods and materials according to education objectives for a specific combination of knowledge and cognitive process dimensions, which can address students' problems in learning ERP. The study contributes to the ERP education literature by identifying students' difficulties in learning ERP and positioning these difficulties to the Revised Bloom's Taxonomy dimensions. Implications for teaching practice are also provided.

The remainder of the paper is organized as follows. In the literature review section, this study reviews the related literature, including the difficulties of employees in using ERPs caused by the user interfaces of the systems, the difficulties of students in learning ERPs, the Revised Bloom's Taxonomy, and the user training frameworks for software systems. The research method section describes the interview protocol and the method for qualitative analysis. The research results section presents the identified difficulties of students and their positions in the dimensions of knowledge and cognitive process scales in the Revised Bloom's Taxonomy. Finally, the teaching implication section provides guidelines for designing teaching materials and suggestions for creating teaching methods.

2. Literature review

2.1 ERP Usability Issues from The Perspective of Employees

ERP systems cover many business functions, processes, and rules to become a large and complex system. System usability is one of the critical factors affecting the ERP implementation (Scholtz et al., 2016; Topi et al., 2005). The easier the system is to use; the faster employees learn and the easier they accept it. In other words, system usability is also one of the reasons for hindering employees from learning ERP.

From the perspective of employee learning, what usability issues will affect employees using ERPs when implementing the system? Topi et al. (2005) have identified five usability issues for ERPs. The first type is for accessing the required function. For example, employees might need to take a longer time to find the menu items for the functions they need due to the usability of this type of issue. As another example, employees would feel difficulty understanding and memorizing the required operations if completing a business process requires many ERP transactions. They would make cheat sheets to use when operating ERP (Topi et al., 2005). The second type is to enter the transaction data repeatedly. The third type concerns the support for system error states. In some cases, ERPs cannot provide effective error messages and guidelines to employees to guide them in finding root causes and solving problems. Even worse, some error messages could mislead employees. The fourth type is the glossaries used by ERP. The glossaries that appear in the user interfaces might not align with the core business glossaries used in the companies. The last type is the complexity of the system. Because ERPs are too complicated, most employees do not know what happens inside the system, which leads them to find ERPs challenging to understand and use.

Stein and Lucas (2011) have explored the usability issues for SAP ERP through experiments with users and experts. There are two most severe usability issues. Firstly, it is difficult for users to find the next step when performing tasks that require many steps. Second, system feedback and information are often not helpful in solving problems. They also report other moderate to severe usability issues.

2.2 Difficulties for Students to Learn ERP

Students have encountered various difficulties in learning ERP. When starting with an ERP system, students find the system very difficult to use due to being unfamiliar with the system (Surendran et al., 2006). Students also find it challenging to understand the cross-functional viewpoint in the business process and the information flow behind the transaction in the SAP ERP (Cannon et al., 2004). Some students think that learning ERP is just an exercise in data entry and do not recognize the business processes and knowledge behind the systems (Seethamraju, 2007b). Winkelman and Leyh (2010) point out that students focus on completing assigned tasks instead of understanding the business processes. During the operation of ERP systems, students gradually improve their ERP transactional competence but struggle to understand the knowledge behind business processes (Seethamraju, 2007a). Moreover, learning ERP operating, reporting, business processes, and theoretical strategy knowledge simultaneously makes students feel more difficult (Seethamraju, 2008). Therefore, students perform better in the operation of the ERP system than in the concept of business knowledge (Laosethakul et al., 2017).

In addition to the difficulties caused by the business processes and knowledge, students who do not have enough technical experience have difficulty recognizing how various components in the system interrelate and interact with each other to

improve the efficiency and effectiveness of business processes (Zadeh et al., 2020).

In short, there are two categories of difficulties for students in learning ERP systems. One is the technical category, such as learning user interfaces, the relationships between system functions and business processes, the integration between system functions, and the operating procedures for system functions. The other is the business processes behind the systems, including business rules and information flow.

In addition, the differences between teaching students and training employees to use ERP systems can be observed. Students' motivation to learn ERP systems and business processes is less than that of employees. Because business processes are part of work, employees know them well. When learning ERP systems, the remaining challenges for employees are familiarizing themselves with the user interfaces and mapping the system functions to business processes. However, students learn the systems because of their curriculums. In addition to the challenges faced by employees, students must understand the business processes and knowledge behind ERP systems. So, the methods and materials for teaching students should be more elaborate than those for training employees.

2.3 Taxonomies of Educational Objectives

Bloom et al. (1956) proposed the Taxonomy of Educational Objectives, also called Bloom's taxonomy, to classify educational objectives. Bloom's taxonomy guides teachers in recognizing the appropriate educational goals for their students. Teachers can then align the teaching and evaluation activities with the selected objectives to ensure the quality of the teaching. Bloom's Taxonomy has been applied to preschool, primary and secondary schools, and higher education.

Anderson et al. (2001) proposed another taxonomy based on Bloom's taxonomy , which is also called Revised Bloom's Taxonomy. There are two dimensions in the revised taxonomy. The cognitive processes consist of six categories in order: Remember, Understand, Apply, Analysis, Evaluate and Create. The Remember category collects the cognitive processes to recall correct information from memory, including recognizing and recalling. The processes in the Understand category can make sense in teaching materials or experiences, including interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. The Apply category includes the cognitive processes of executing and implementing procedures. Executing refers to applying procedures that are already familiar; implementing refers to using new procedures. The cognitive processes in the Analysis category can break down concepts into parts and describe the relationships between the parts and the whole. The checking and critiquing, which belong to the Evaluation category, make judgments based on rules or standards. Finally, the processes in the Create category can assemble various elements to form new things or discover the components of new structures. Generating, planning, and producing are processes that belong to the Create category.

Knowledge is the other dimension in the Revised Bloom's Taxonomy. The knowledge types are factual, conceptual, procedural, and meta-cognitive, from fact to meta-cognition. Factual knowledge refers to the discrete, isolated "bit of information", as described in Anderson et al. (2001). Terminology is one of the subtypes of factual knowledge. Conceptual knowledge refers to the knowledge that organizes a body of information into interconnected, systematic forms. Subtypes of knowledge in this category include classifications and categories; principles and generations; and theories, models, and structures. Procedural knowledge refers to the knowledge of processes. Subtypes in the procedural knowledge include subject-specific skills and algorithms which always lead to fixed results; subject-specific techniques and methods which cannot generate predetermined solutions; and criteria for deciding when to use appropriate procedures. Lastly, meta-cognitive knowledge refers to "knowledge about cognition in general as well as awareness of and knowledge about one's cognition (Anderson et al., 2001)." Subtypes in the meta-cognitive knowledge include learning and thinking strategies; cognitive tasks and why and when to use them; and students' self-knowledge of knowing their strengths and weaknesses in cognition and learning.

The cognitive process and knowledge dimensions can be used to categorize the difficulties in learning ERP systems. For example, being unable to recognize ERP glossaries can be categorized in the space of the Remember of the Factual Knowledge. However, not knowing the reasons for operating failures can be categorized in the space of Analysis of the Procedural Knowledge.

3. Research methodology

3.1 Training Courses and Teaching Methods

(a) Course scope and objectives

The researchers created an ERP training course in Logistics and Supply Chain Management, a 3-credit elective course for undergraduates in the Department of Information Management. Its objectives are to teach business processes and ERP functions about the material, purchasing, and order management in the operations of supply chains. The Oracle EBS ERP for business groups is adopted in the course. Covered ERP applications include Inventory, Purchasing, and Order Management.

(b) Course modules and outlines

The course contains the following four modules, and its outlines are exhibited in Appendix 1:

- Basic operations and concepts: the system architecture, user interfaces and navigations, user and employee creations, and concepts of the multi-organization model.

- Inventory Management application: creating and maintaining items; transacting items.
- Purchasing application: creating and using suppliers; inquiries and quotations; item auto-sourcing; requisition; internal requisitions; and pay on receipts.
- Order Management application: processing standard orders.

(c) Training materials

Based on the business firm's most frequently used ERP functions and over a decade's experience teaching various ERP versions, the researchers have created their own ERP lecture notes and a practice book according to the official ones. Oracle offers student and practice guides for each ERP application for implementors. So, according to the course objectives, appropriate chapters were selected from the student guides of Essential(Rao & Saravanan, 2010a, 2010b), Inventory (Salvini, 2010a, 2010b), Purchasing(Mitchell et al., 2010b, 2010c), and Order Management(Mitchell et al., 2010a, 2010c) of Oracle EBS ERP to compile lecture notes. Moreover, a practice book was compiled for the course, which contains 31 units in total. Chapters in the corresponding activity guides were selected and rewritten in Chinese, while English glossaries were kept for students to learn. The contents of each practice unit contain three parts: the tasks covered by the unit, the required data, and finally the step-by-step instructions with screenshots of essential results.

(d) Learning assessments

Practice units and comprehensive tests were provided to assess students' learning. Students were asked to exercise a practice unit after the instructor had lectured the necessary business processes and knowledge and demonstrated the practice unit. Comprehensive tests were held at the end of a module or at mid-term and final examinations. In a comprehensive test, students were asked to complete complex business scenarios, such as back-to-back order processing, in a limited time. Students were allowed to refer to the practice units, which could be found in the provided practice materials.

(e)Teaching methods

Hands-on experience is a very critical learning activity in engineering and technology education. Students can learn the knowledge and principles embedded in hands-on exercises (Ssemakula & Liao, 2006) and can enforce their practical skills (Makasiranondh et al., 2010). Hence, there are several practice units for each topic. In each topic, the instructor explained the required business processes and knowledge for a practice unit at first. The practice unit was then demonstrated to the students by the instructor. Finally, students were asked to complete the practice unit by themselves. During the practice, the instructor would discuss with the students their questions.

3.2 Interview Protocols

Motivated by improving the researchers' ERP-training course and fine-tuning the own-designed materials and teaching method, this study conducts students' interviews to receive feedback regarding their learning difficulties. Three criteria are utilized to select qualified participants for the interviews: Firstly, all of these participants have taken fundamental management courses, such as managerial accounting and operations management courses, in their first or second years of university. Secondly, they must actively interact with the lecturer in the class and be willing to share their learning situation. Thirdly, they are willing to participate in the interviews. Accordingly, five participants were selected from the students enrolled in the class, two men (coded as M1 and M2) and three women (coded as F1 to F3).

Each participant was interviewed three times with semi-structured questionnaires (except that Participant F3 only attended the third interview for personal reasons). We conducted the first interview three weeks after the semester started to explore the attitudes of participants toward the system's usability and their difficulties in using the system, given that participants had been with initial experiences in using the ERP system. The second interview was conducted one week after the midterm examination. It was to learn about the difficulties faced by the participants and the ways to overcome them from the processes by which the participants solved hands-on questions in the midterm examination. The third interview was held one week before the final examination to understand the difficulties that participants faced in mapping business processes and system procedures and problem-solving processes after errors occurred when they used the system.

3.3 Interview Questions

This study employs the end-user training framework proposed by (Bostrom et al., 1988) and (Sein et al., 1999) to design the interview questions exploring the potential students' difficulties in learning our ERP course. Considered constructs include individual differences, target systems, training methods, trainee mental models, and training outcomes. The interview questions are designed based on the variables in each construct, which can be provided upon request.

3.4 Qualitative Data Analysis Methods

This study adopts the Grounded Theory framework proposed by Tie et al. (2019) to analyze interview transcripts. In the initial coding phase, the researchers used the Descriptive Coding and Dramaturgical Coding techniques (Saldaña, 2013) to encode the participants' attitudes, recognition, feeling, and actions. Then, codes with common characteristics were grouped to generate Categories of codes. Intermediate coding followed as the next phase. Lastly the researchers used the Axial Coding technique to refine category names and arrange codes in the categories based on the selected theme of the difficulties in learning ERP systems and the theory of the Revised Bloom's Taxonomy (Anderson et al., 2001).

4. Research results

As the results of our analyses, this study identifies five categories of difficulties in learning the Oracle EBS ERP system (as exhibited in Table 1). Details of each category are given as follows.

Table 1
Categories of difficulties in learning the Oracle E-Business Suite ERP system and the areas where they belong in the Revised Bloom's Taxonomy

ID	Categories of Difficulties	Areas in the Revised Bloom's Taxonomy (Knowledge, Cognitive Processes)	Category Definitions
1	Recognize and recall English glossaries	(Factual, Remember)	Feeling difficult to recognize and recall the English glossaries in the ERP system.
2	Understand the system procedures	(Procedural, Understand)	Feeling difficult to understand relationships between system operating steps and the parameters used in these steps.
3	Remember the system procedures	(Procedural, Remember)	Feeling difficult to summarize and describe system procedures.
4	Operate complex system procedures	(Procedural, Apply)	Being worry of missing steps or details in complex system procedures, which results in incorrect results or errors.
5	Identify the causes of operating errors	(Procedural, Analysis)	Being unable to identify the causes of operating errors, and further find solutions to rectify these errors.

In the following transcripts, the notation M1-I1 represents the first interview of the male participant M1; the notation F2-I2 indicates the second interview of the female participant F2.

4.1 Recognizing and Recalling English Glossaries

Students did not recognize some of the English glossaries in the user interfaces of the ERP system and the business knowledge behind these glossaries. They had to translate English glossaries into Chinese when using the ERP system with English user interfaces. Language conversion bothered them in operating the system, as M1-I1 mentioned:

> "Because English and Chinese sometimes…they just…Can I say it is hard to decide? Frankly, it would help if you were good at English. When translating from English to Chinese, you might suddenly not know which one (UI element) to click." (07:33)

Moreover, the inconsistency made the students feel troublesome when the instructor explained business processes with Chinese glossaries while the glossaries in the practice book were written in English. As F1-I2 mentioned in the interview:

> "It's just that sometimes I see these things that the instructor teaches in class, like purchases and shipments, and other things... Maybe it's because the notes are all written in English, and there are not so many explanations, so I may not be able to connect it with the instructor's class content." (10:58)

Interestingly, Oracle EBS ERP provides the Chinese user interface. But students were afraid to use it because they needed to translate English glossaries while listening to lectures. They worried about not being able to keep up with the pace of the class. As F1-I3 mentioned:

> "Our ERP system provides the Chinese version. It can change to the Chinese version (user interfaces). But because you (the instructor) use the English version, I'm afraid to change to the Chinese one. Because my English is not very good, I am afraid that if I can't translate them, I may have more trouble, so I use the English version all the time." (04:04)

Students looked up and annotated the English glossaries in their practice books and lecture notes to respond to the challenges caused by the English glossaries in the ERP system. As mentioned by M2-I3:

> "Add something to the practice book?... the easiest way is to add Chinese, just translate some English into... some English into Chinese, and then maybe use a highlighter to paint and draw to determine where they are because sometimes it's easy to miss them." (01:08)

After recognizing English glossaries, students improved their understanding of handouts but still did not have much confidence. When asked to explain the document on the internal purchase process between two organizations within the same enterprise, F1-I3 mentioned the following:

> "Explain? I'll see if I can understand. (Start to translate the document)" (10:29)
>
> "Order process for creating internal sales in purchasing... Import order process in order management... Picking, packing, shipping... Is this the customer side?" (11:02)

In summary, students need more time for English-Chinese bidirectional translations because they are unfamiliar with English glossaries in the ERP system, which causes them difficulties in learning the ERP system. Translations occur in two scenarios. First, the instructor teaches in Chinese with written English materials when lecturing. Second, when operating the ERP system, students use English user interfaces. Finally, the English-Chinese bidirectional translations increase the extrinsic cognitive load (Guo; Sweller, 1994) and increase the difficulty of learning the ERP system.

The difficulty in recognizing and recalling the English glossaries can be positioned in a dimension of the Revised Bloom Taxonomy. ERP English glossaries are factual knowledge; recognizing and recalling these glossaries are the Remember cognitive process in the Revised Bloom's Taxonomy. Accordingly, the difficulty can be assigned to the (Factual, Remember) tuple area.

4.2 Understanding System Operating Procedures

The category indicates that students cannot easily understand the relationships between steps and the usage and effects of parameters when using the ERP system.

The operating procedures in ERP systems embed business processes and rules. Users need to know these embedded processes and rules to operate the systems. Otherwise, although step-by-step operating guides are provided, users cannot understand the relationships between steps or the meaning and effects of the parameters in these steps. For instance, when a user wants to create an item in the Oracle EBS ERP system, the following process and rules are required to know:

- Inventory organization structure: an enterprise can have many factories, which are called inventory organizations.
- Inventory application functions feature item attributes and their levels of control. An inventory organization can control some attributes; a master inventory organization can centrally control others.
- Item assignments: items defined in a master inventory organization must be assigned to its subordinated inventory organizations using these items.

Students could not describe the relationships between steps and the effects of parameters in these steps when they operated the ERP system. For example, given documents for references, the student F2-I3 was asked if she could understand the procedure of creating a new item. She mentioned:

> "I know it's about creating items. But I don't know why I have to enter something in these steps, and then tick it or something else." (10:18)

The reasons that students cannot understand the knowledge behind system operating procedures are twofold. The first is the Chinese-English bidirectional translation. Students expected the instructor to explain more the relationship between steps so that they can understand the procedures better, as conversion between the student F1-I2 and the interviewer:

> Student: "It's just that sometimes I see these things that the instructor teaches in class, like purchases and shipments, and other things... Maybe it's because the notes are all written in English, and there are not so many explanations, so I may not be able to connect it with the instructor's class content." (10:58)
> Interviewer: "What do you mean not so many explanations?" (11:24)
> Student: "That means why I take this step. Or, it is possible to say, the instructor can explain why I take this step before the next step." (11:28)

The second reason is the complexity of the knowledge behind the system's operating procedures. Given the example of the procedure for creating items previously mentioned, students were required to know the process and its rules to understand the procedure. Hence, students had to take much time to digest these concepts that were explained in Chinese. As the student M1-I3 mentioned in the interview:

> "The trouble is... If you want to be familiar with this course, it will take a lot of time, whether in English or not. Even if it (the system interface) is displayed in Chinese, you still have to understand what it does if you want to operate it." (20:36)

The difficulty of understanding system operating procedures is mainly related to the Procedural knowledge and the Understand cognitive process in the Revised Bloom's Taxonomy. According to the taxonomy, the business processes and rules embedded in the system operating procedures belong to the Procedural knowledge. Whether students can understand the relationships between operating steps and the usage of parameters belongs to the Understand cognitive process. Therefore, the study positions the difficulty in the area of the (Procedural, Understand) tuple in the Revised Bloom's Taxonomy.

4.3 Recalling System Operating Procedures

The category indicates that the students feel challenged in summarizing the documents of the operation procedures. ERP operating procedures have more steps for complex business processes than for simple ones (Topi et al., 2005). For instance,

when users execute the internal requisition process between inventory organizations in Oracle EBS, the Purchase and Order Management applications involve and exchange data. Unfortunately, the complexity makes it difficult for students to brief the procedure documents, though they have already operated these procedures.

Students were asked to recall and describe the given, English-written document of the internal requisition process between organizations in the interviews. The recall task requires them to access declarative knowledge in long-term memory composed of semantic and episodic memories (Tulving, 2000). However, the students were not able to fully recall the semantic memory. As a result, they tried to guess the operating procedures in the documents. As M2-I3 mentioned in the interview:

> "Internal procurement..., according to my impression... Requisition?... Poor English is a kind of disadvantage." (09:21)
> (The participant was trying to brief the document)
> "... After the application is completed, do the previous process, and then approve it, and then import it? Feeling weird...pack, ship...and receive...?" (10:23)

Students could recall part of episodic memory, in addition to semantic memory, when recalling operating procedures. And they used these episodic memories to discuss each other. For example, the student who accompanied the participant M2-I3 reminded him of the internal requisition process:

> "It will create an internal requisition here. And after the Requisition is approved, it (the system) will have a window, and then there will be an Approve (button). After approval, it (the internal requisition) will be converted into a sales order, and then this is it." (11:11)

In summary, recalling procedural knowledge is a difficult task for students. Students do not use the business process models lectured in the class to arrange procedure steps into chunks with a large amount of information (Eylon & Reif, 1984) and to organize these steps into a comprehensive schema to aid in recalling (Bower et al., 1969). Hence, they are forced to use fragmentary semantic and episodic memories to speculate on the document's content.

The study positions the difficulty of recalling system operating procedures in the area of (Procedural, Remember) tuple in the Revised Bloom's Taxonomy. The reasons are two-fold. First, given that students have performed these procedures before, the activity of briefing procedure documents belongs to the Remember cognitive process. Second, the system procedure is a kind of Procedural knowledge in the Revised Bloom's Taxonomy.

4.4 Exercise on Complex System Operating Procedures

The complex and lengthy operating procedures make some difficulty for students. Students are afraid of missing specific steps or details in the procedure, which leads to incorrect results. Complex business processes require multiple applications to collaborate. For instance, the back-to-back order processing in the Oracle EBS ERP requires Purchase and Order Management applications to work together:

1. A sales order is booked in the Order Management application.
2. The corresponding purchase order needs to be created in the Purchase application. The items are then received in a warehouse in the Purchase application.
3. The sales order is fulfilled in the Order Management application.

Facing complex procedures, students worried about missing steps. The way to overcome this difficulty was to annotate steps or details that were easily overlooked in the practice book. As mentioned in the interview (M2-I2):

> "Highlighter?" (06;20)
> "I am very careless and easy to overlook. That's why hands-on exams are sometimes poorly done. Some small details may need more obvious markings." (06:26)

Students believed that practicing not enough causes missing steps when operating complex procedures. And practicing more should decrease the chances of missing steps. As mentioned in the interview (F2-I2):

> "Because the steps…they just can't be missed. If you miss some of them, you will miss something. So, I think you just need to look carefully." (05:48)
> "The main reason is insufficient practice" (06:12)

In addition to annotating the crucial steps in the practice book and practicing more, providing step checkpoints is another practical method. The expected system output or states are provided at checkpoints after a procedure stage. Students believed that they can identify what causes errors sooner with the help of checkpoints, as mentioned by M1-I2:

> "If you use a checkpoint today, it means step 1, step 2, step 3, and then start to check. If there are errors or problems during the inspection, you can check the first three steps. It's speedy. But if it is to do five steps and has done the inspection. And suddenly, there is an error. Then, you have to go back and recheck all steps to see what is wrong. So, I think the checkpoint is easier if you want to find the problem by yourself sooner." (10:38)

Checkpoints could indicate what to check in a range of steps of a procedure, which made students know where to be more careful, as mentioned in F2-I2:

> "I think a checkpoint is when you stop at one place and tell us where we should note. Then, it will be clearer. You finish steps 1, 2, and 3 and stop when demoing the system. Then, you can remind us what we should pay attention to in the three steps. That will be much clearer." (07:24)

Students worry about missing steps or entering incorrect values that cause incorrect system outputs when performing complex procedures with the practice book as a reference. The process of operating the system belongs to human-computer interactions. From this point of view, missing steps or incorrect entries are the error type of slips in the performing stage of the Execution Gulf in the Norman's Action Cycle (Norman, 2013). The reasons for the slips might be action-based or memory lapse. A checklist can increase the correctness of behavior and reduce errors, especially for slips or memory lapses (Norman, 2013). A checkpoint can be seen as a kind of checklist. So, providing checkpoints in a complex and lengthy procedure can help students reduce mistakes.

This study found the difficulty of exercising complex system procedures is in a Revised Bloom's Taxonomy area. Knowledge required for operating the procedures is a kind of Procedural knowledge; the behavior of operating ERP systems belongs to Apply cognitive process. Therefore, the difficulty is found in the (Procedural, Apply) area in the taxonomy.

4.5 Identifying the Errors Causing the Complex Procedures to Fail

Students could not quickly identify the reasons why complex procedures fail. For example, students only knew that some steps were missed or incorrect entries. As for where the slips occurred, they could not decide or even make a guess. Unable to identify the reasons for the errors makes students confused, as mentioned by M1-I3:

> "Exactly. For example, for this kind of (item) assignment, I made the wrong assignment myself, and I don't know if the steps are wrong. … (Explaining the operating details). I don't know if I do something wrong in some steps? Or am I in the wrong order? I am quite confusing, and this is a difficulty." (05:57)

Redo was the only action for students to correct the procedure. Students repeated the procedure from the first step, following the instructions in the practice book, when they could not identify mistakes. As F3-I1 mentioned in the interview:

> "I just don't know where I am wrong, and then I have to start all over again." (07:37)
> …
> "Yeah, because I don't know where I go wrong, it's often like this. Because these two (ERP systems) are really hard to find (errors), I really have to start all over again. It seems to be fine if I start all over again, but I just don't know what's wrong." (07:45)

ERP procedures embed business processes and rules. When errors occur in operating procedures, business processes and rules can be used to identify possible reasons for errors. However, students did not use the skill. Instead, they thought that processes and rules only describe concepts and could not help identify what was wrong in the procedure. Students believed that the steps in the practice book provided more information so that the chances of finding mistakes were better. For example, when asked if the business process flow chart helped identify errors in procedures, M1-I3 mentioned the following.

> "This (internal requisition business process) likes to tell you the steps: creating, passing on, then receiving, approving, and receiving. That's all. But it (the process) won't tell you where your wrong inputs are. In my case, I'd go through the practice book instead." (18:43)

Identifying errors in operating ERP systems differs from debugging computer programs. Generally, many debug tools are available for students in program development, such as Java or Python (Fitzgerald et al., 2010). For example, students can use a step-by-step tracing tool to debug Java programs. On the contrary, debug tools are very limited for students when operating ERP systems. However, students can only rely on error messages, system states, or incorrect calculation results to determine the root causes of procedural errors.

With this limitation, data flow in business processes might be the only clue to identifying the root causes of procedural errors. Even though students know error messages, they still cannot identify reasons as experts adopt a system view to analyze the procedure errors (Vessey, 1985) because of the difficulty in understanding the business processes. Therefore, redoing the failed procedures by following the step-by-step instructions in the practice book is the only action for students.

The difficulty is found in the (Procedural, Analysis) area of the Revised Bloom's Taxonomy because identifying the root causes of procedural errors is an Analysis activity of the cognitive process. Knowing how to operate procedures requires Procedural knowledge.

5. Implications for teaching

Through the in-depth interview results above, this study induces the following guidelines for redesigning the training materials and improving the teaching method to eliminate students' potential learning difficulties with the Oracle EBS ERP system.

5.1 Guidelines for Designing Teaching Materials

Guideline 1: Decompose a complex procedure into several small practice units and illustrate their relationships

Understanding the business processes and their rules in complex operating procedures can be challenging for students. To

alleviate it, decompose the procedure into several small practice units. Also, illustrate and visualize the range covered by each practice unit in the complex procedure. In this way, when students operate a lengthy, complex ERP procedure, they can more easily understand the business stage of a practice unit and the contextual relationships among the practice units. For example, practice units are labeled for material transactions in the material transaction model in Oracle EBS ERP, as shown in Figure 1. This mapping guides students to what the practice unit needs to execute a specific material transaction. Another example, the auto-sourcing procedure, illustrates the entities and their relationships and labels the practice units that have to do with them, as shown in Fig. 2.

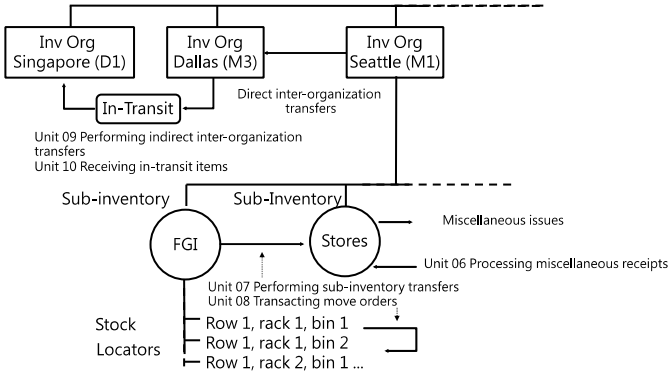


Fig. 1. Labeling material transactions with the corresponding practice units to guide students in choosing the correct procedures to complete business processes. The figure is modified from Salvini (2010b).

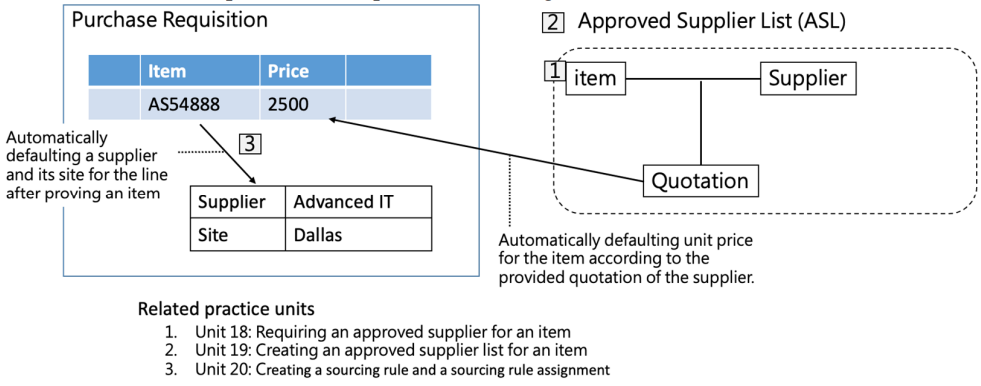


Fig. 2. The configuration procedure of the auto-sourcing function in Oracle EBS ERP is expanded into sequential practice units to assist students in understanding the contextual relationships between these practice units.

Within a practice unit, divide its contents into sections properly and illustrate the data flow between these sections. For example, a practice unit is divided into three sections according to the parent-child relationships between entities in the customer data model in the Oracle EBS ERP, as shown in Fig. 3. The first creates a customer and their accounts; the second creates the addresses; the final section creates customer sites and sets up their site purposes.

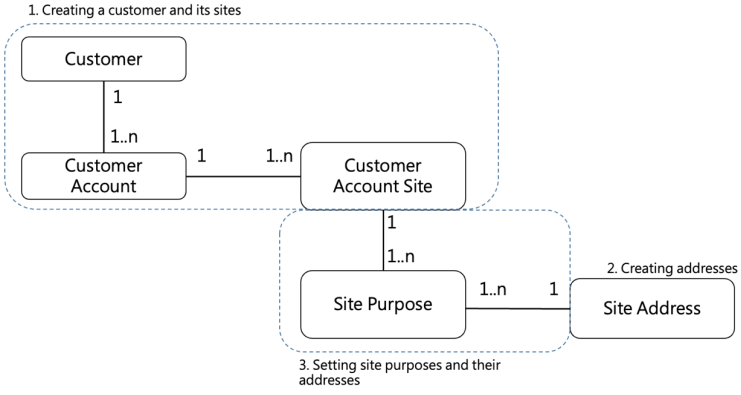
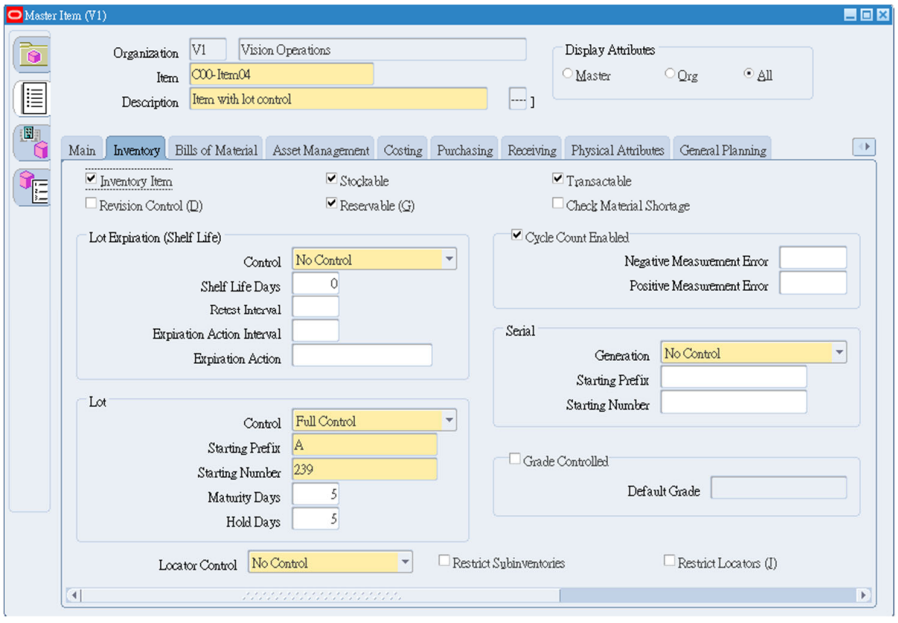


Fig. 3. The contents of a practice unit are divided into several sequential sections according to the parent-child entity relationships in the customer data model to reveal to students the data flow between the sections.

Guideline 2: Provide checkpoints in a lengthy, complex procedure.

The other two difficulties students face are exercising complex procedures and identifying the causes of procedural errors. Checkpoints are very suitable for human-machine interactions to reduce slip errors in operating procedures and identify causes of procedural errors. The contents of a practice unit are divided into several sections according to the stages of the procedure. Then, a checkpoint is set up at the end of each section to inform students what the system status should be. Checkpoints establish tags in the task space that make students learn their position in the space (Tidwell et al., 2020). In addition, checkpoints show boundaries to identify procedural errors. The procedure can be stopped to identify the causes of a procedural error when the system status is not consistent with the situation described at the checkpoint. The required checking range of steps covers only steps after the previous successful checkpoint. Students will no longer have to repeat the entire procedure.

For example, a checklist is provided for creating items after an item has been created. At the checkpoint, the checklist informs students of the correct status of the important fields, screenshots, and possible exceptions caused by incorrect settings, as shown in Fig. 4.



Checkpoint

1. Item attributes
   - (T)Main

   [ ] Apply the Finished Good template
   - (T)Inventory

   [ ] Activate the attributes of Inventory, Stockable, and Transactable

   [ ] Lot Control: Full Control
2. Item Assignments

   [ ] Assign the item to Inventory Organizations M1 and M2

Fig. 4. A checkpoint is provided after an item is created.

Guideline 3: Provide lists of English glossaries used in ERP systems

Recalling and recognizing English glossaries is one of the difficulties in learning ERP systems for non-native English-speaking students. It is recommended to provide the explanations in the local language to the English glossaries used in the business processes and ERP system procedures. With the English glossary list provided at the end of each practice unit, students would have a specific learning scope of the glossaries used in the practice unit.

5.2 Suggestions for Improving Teaching Methods

Business and system knowledge are two domains of knowledge involved in learning ERP systems for students. Examples of knowledge in the business domain are purchase, order processing, and accounting processes. User interfaces, system configurations, and operating procedures are examples of system domain knowledge.

Suggestion 1: Rearranging the business domain knowledge takes precedence over system one. The reasons are two-fold. First, students might use other ERP systems different from what they learned in school. Although ERP systems are different,

embedded business processes and rules are pretty similar if these ERP systems are made for the same industry sector, such as the manufacturing sector. Having good business domain knowledge can accelerate the students learning of the ERP system. Next, the system domain knowledge depends on the business one. Some system procedures require certain pieces of business knowledge to understand them. Students, for example, need to know Material Requirement Planning (MRP) to understand the operations of setting forecasts, safety stocks, and batch order quantity in the ERP system procedure for material planning.

Suggestion 2: The lecture clearly explains the relationships between business and system domain knowledge. For instance, extra system configurations and operations (system domain knowledge) are added to the material sourcing process (business domain knowledge) to automate the sourcing process. Explaining their relationships could enhance the students' understanding of these system configurations and operations.

Suggestion 3: The lecture clarifies how business tasks are transformed into system procedures and how they work to accomplish the business tasks. It will help students understand the system's operation, make it easier for students to memorize operating procedures, understand the timing of using system functions, and cultivate the ability to debug programs.

6. Conclusion

This study has explored and analyzed the difficulties in learning the Oracle EBS ERP system through qualitative analysis. It provides a unique opportunity to listen to and understand students' difficulties directly. Through the in-depth interviews, the researchers identified five categories of learning difficulties: recognizing and recalling English glossaries, understanding system operating procedures, recalling these procedures, exercising complex system operating procedures, and finally identifying the errors causing the complex procedures to fail. These difficulties are positioned in the various spaces of the Revised Bloom's Taxonomy that consists of dimensions of the cognitive process and the knowledge. The difficulty of recalling English glossaries is placed in the Remember of Factual Knowledge. The remaining four difficulties belong to Understand, Remember, Apply, and Analysis of Procedural Knowledge. The positioning can assist instructors in redesigning the training materials and improving teaching methods to enhance the effectiveness of teaching ERP systems. Finally, this study offered some guidelines for designing teaching materials and suggestions for teaching methods.

However, the limitations of this study are given as follows:

1. The number of participants interviewed. Although the number of participants is not many, multiple interviews for each participant have been conducted to explore the difficulties in learning an ERP system deeply.
2. The interviewees of this study are students of non-native English speakers; whether the study results can be applied to students of native English speakers needs further confirmation.
3. The Oracle EBS ERP system is used in this case study; whether the findings can be applied to other companies' ERP systems requires further research.

Future studies can use quantitative research to investigate the generalizability of the findings. Furthermore, how do the identified difficulties in learning ERP systems affect learning motivation or self-efficacy? Studying these questions allows us to design better teaching methods and materials, thus improving the effectiveness of ERP teaching.

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Appendix

Appendix: Outline for the course of Logistics and Supply Chain Management

Chapter Titles and Corresponding Practice Units in the Practice Book
Essentials Module
Ch1 Basic operations for the Oracle EBS ERP
U01 Logging in to and navigating the Oracle Applications; U02 Running reports
Ch 2 Fundamentals of system administrations
Ch 3 The multi-organization model and share entities
Inventory Application Module
Ch 4 Defining inventory organizations
U03 Creating sub-inventories; U04 Creating stock locators.
Ch 5 Inventory items
U05 Defining items
Ch 6 Material transactions
U06 Processing miscellaneous receipts;
U07 Performing sub-inventory transfers;
U08 Transacting move orders;
U09 Performing indirect inter-organization transfers;
U10 Receiving in-transit items.
Purchasing Application Module
Ch 7 Introduction to procurement-to-pay cycle
Ch 8 Suppliers
U11 Setting user as a buyer;
U12 Creating a supplier with two sites;
U13 Creating items for practices in Purchasing Application.
Ch 9 RFQ and Quote
U14 Creating a supplier list;
U15 Creating a catalog RFQ;
U16 Creating a catalog RFQ from an RFQ.
Ch 10 Auto sourcing for items
U17 Creating the status of an approved supplier list;
U18 Requiring an approved supplier for an item;
U19 Creating an approved supplier list for an item;
U20 Creating a sourcing rule and a sourcing rule assignment.
Ch11 Purchase Requisitions
U21 Creating a purchase requisition;
U22 Creating a requisition template;
U23 Using the supplier Item catalog to create a requisition;
U24 Creating and transact an internal requisition.
Ch 12 Purchase orders, receiving, and accounting payables
U25 Creating a standard purchase order;
U26 Creating a blanket purchase agreement and blanket release;
U27 Paying on Receipt; U28 Creating a contract purchase agreement;
U29 Using auto-create to create purchase orders.
Order Management Application Module
Ch 13 Order to Cash Lifecycle with Standard Items
U30 Creating a customer;
U31 Performing order-to-cash cycle with standard items.