Industry-oriented design of ERP-related curriculum – an Australian initiative

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Abstract *This paper discusses the design of a problem-based learning approach that seeks to embed industrial knowledge in the enterprise resource planning (ERP)-related curriculum of universities. It describes a project that is developing a business reference model for public administration. This reference model is to be implemented in the leading ERP system SAP R/3. Teaching cases are developed through collaboration between universities and industry. The paper argues that this approach is in alignment with the recommendations of key curriculum documents and educational approaches.*

Introduction

There is a need to develop IT students that have business knowledge, and business students that have IT knowledge (Microsoft, 1998a, 1998b; Gartner Group, 1998). A number of efforts to link academic study towards industry needs took place in order to achieve this goal. Professional societies have defined a body of requisite IT knowledge (e.g. ACS Core Body of Knowledge, 1997) and IT societies around the world have called for increased relevance of IT education (British Computer Society, 1999; IEEE, 1999; ACM, 1997; ACM, 1999, Australian Computer Society, 2000). These activities have led to the formation of various collaborative curriculum committees to address this issue (Davis *et al.*, 1997; Lidtke and Stokes, 1999; Longenecker *et al.*, 1999).

Over the last several years, a number of universities internationally have been using enterprise resource planning (ERP) software (SAP R/3, PeopleSoft, Oracle Financials, OneWorld) as a means of providing access to these functioning application systems. Numerous IS conferences have had mini-tracks directly addressing this adoption of ERP into the curriculum (American Conference on Information Systems (AMCIS), 1999; AMCIS, 2000; DSI, 1999; European Conference on Information Systems (ECIS), 1999; ECIS, 2000; ACIS, 1998; International Conference on Information Systems (ICIS), 1998). Gable and Rosemann (1999) give an overview about SAP-related activities at universities. Hawking (1998), Lederer-Antonucci (1998) and Watson and Schneider (1999) discuss success factors for the integration of ERP into the IS curriculum. Scott (1999) analyses different learning styles for their appropriateness regarding ERP. Stewart *et al.* (1999), Watson and Noguera (1999) and Watson *et al.* (1999) reflect their experiences in teaching ERP. Hawking *et al.* (1999) review ERP-

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activities at Australian universities, and show how such curricula address the IS '97 curriculum.

Though the awareness for the need to teach ERP increased significantly over the last years, appropriate literature that goes beyond an explanation of product-specific functionality is still missing. Furthermore, the available material from ERP providers does not target universities' needs. There is a requirement to find a cost-effective means to develop a set of teaching cases designed to overcome this situation.

This paper discusses a project approach using graduate student teams to develop a rich repository of case-based ERP teaching resources by working in collaboration with industry on ERP problems facing the industry partner. In this phase of the project, the learning approach known as problem-based learning is used. The output of these projects is then rendered by graduate students into the teaching case format, which is to be used within the undergraduate program which implements a learning approach known as the inverted curriculum.

The paper presents the curriculum approaches used in the project in the next section, and then discusses the project design, showing how the various curriculum approaches are used. The paper is closed by summarising the benefits to all participants in this collaborative industry-based curriculum development project – the industry partner, the university, the graduate student and finally, the undergraduate student.

Curriculum approaches

The Information Systems-Centric Curriculum Document (1999) (ISCC'99) was the output of a collaborative review process held in the USA, with industry and academic participation. This ISCC curriculum committee sought to identify the skills required in developing and supporting large and complex systems in use within government, industry and defence. It recommends that students should undertake the IT curriculum, which has students' experience, and analyse real application systems from the beginning of their course (Lidtke and Stokes, 1999). This committee identified the skills required for industry, and these are shown in Table I.

Personal skills and interpersonal skills are seen to be as important as the traditional focus on developing technical skills. The ISCC '99 document recommends that all students undertake an industry-based and collaborative project in their final year. They recommend that "students work as team members on an industry development team that has co-project managers from academia and industry".

The ISCC '99 curriculum document also recommends that an inverted curriculum model be used. In this approach, the student experiences the context of the information system, then masters the details and finally returns to a systems view of the deployment of the technology in order to complete their experience.

Industry-defined attributes of an ISCC '99 graduate		
Personal skills	Systemic-thinking skills Problem-solving skills Critical-thinking skills Risk-taking skills	Personal-discipline skills Persistence Curiosity
Interpersonal skills	Collaborative skills Conflict resolution skills	Communication skills (oral, written, listening, and group)
Technical knowledge and skills	Information abstraction, representation, and organization Enterprise computing architectures and delivery systems Concepts of information and systems distribution Human behavior and computer interaction	Dynamics of change Process management and systems development Information systems domain knowledge Use of computing tools to apply knowledge

Table I.
Skills of an industry ready IT graduate (information systems centric curriculum)

The paper next briefly examines the current technical shortages to demonstrate the need to develop ERP related curriculum.

The IT market place in Australia

Australia has 30,000 IT vacancies (*Information Age*, 1998), with the USA seeking 200,000 and Germany 90,000 IT professionals (*The Australian*, June 2000). There is pressure being applied to react to the reported shortages of IT personnel by pushing trainees through industry certification courses, particularly when the shortages seem to be in specific areas. Some of these areas are shown below, with ERP-related areas underlined (Australian Government IT Skills Shortage Report, 1998):

- Programming languages including COBOL, Java, Java Script, C++, Delphi, ABAP and Visual Basic.
- Database development environments including ORACLE, Ingress, DB2, and SQL.
- Operating systems including CICS, Unix, and MVS.
- Network operating systems including Windows NT, TCP/IP, Novell, and CISCO products.
- Web development including JAVA and Lotus Notes.
- Specialist development skills in object oriented analysis and design.
- Multimedia involving multi-skilling in Internet and graphics.
- Network administration skills.
- Enterprise-wide systems skills in SAP R/3 implementation and administration, PeopleSoft implementation and administration.

There is pressure being applied to react to these current shortages by pushing trainees through industry certification courses. The British Computer Society in its planning document (1999) states:

> IT education is in turmoil. Vendors and customers have become disillusioned with computer science graduates, regarding them as intelligent people who know nothing of the value to the business. By contrast, academics often regard computer science as a classical subject and lambast the business demand for specific skills as an obsession with trivia, most of which will be out of date by the time the courses are completed.

These sentiments have been echoed in Australia (Queensland Government IT Forum report 1999), and elsewhere. The ISCC '99 document states:

> Current curricula and supporting pedagogy are out-of-date and possibly out-of-touch with the needs of the workplace.

The solution is not to replace university education with industry certificates because the only means of maintaining contact with a rapidly changing technical environment is solid understanding of the fundamentals of the discipline. However, this knowledge must be applied within a practical context in such a way as to develop the interpersonal skills and personal skills expected by industry.

One possible solution to this lack of industry relevance is to develop a more industry-focused teaching approach. In the area of specific skill shortages found in the ERP arena, the approach is to have students experience existing business problems and to develop pragmatic solutions to industry problems.

This project aims to configure a selected ERP solution and document the decisions in the form of process models. The development of these process models and accompanying teaching case documentation exercises the participating students in technical skills (process model tools), functional skills (the actual ERP model being analysed) and generic skills found in consulting. These latter skills are in great demand, and recognised as vital portions of the undergraduate curriculum (ISCC '99, ACS Core Body of Knowledge). SAP R/3 was selected as an ERP solution for this project because it supports over 950 common business processes and e-business scenarios.

Defining the project

Project description

This project is an extension of current activities to integrate ERP software within the IT, business and engineering curricula offerings. This process has led to the establishment of a university alliance of 15 Australian universities and SAPIENT college (the training and education division of SAP Australia). This alliance has active involvement by implementation partners, hardware vendors, system integrators and industry representatives. Similar university alliances have been formed by all main ERP providers.

This project aims to develop an ERP-related process model of an actual business within public administration. There are five phases to this project: developing the as-is model, developing the to-be model, configuring the to-be

model, populating the test application and developing the teaching case documentation.

One task is to compare the source company's model with SAP's reference model and derive a consolidated process model. A separate client of the SAP system on campus has to be configured according to these process models. Thus, these process models serve as a specification of a model company and as an alternative to the somewhat restricted model (IDES) developed by SAP. Another task includes the sanitation and uploading of suitably modified master data into the blank model company. Consequently, students do not only deal with the business applications, but also with related technical (file management) and administrative tasks.

The task of developing a comprehensive, functioning to-be model of the target organisation can span several semesters depending on the original scope selected. The preliminary model(s) will be extended by different postgraduate and upper undergraduate student teams in subsequent semesters. This approach ensures that the models and test application environments remain current, and that meaningful long-term relationships are forged and maintained between universities and industry partners.

Graduate students are executing these phases within a subject called "Projects in process engineering" (Rosemann *et al.*, 2000). This subject has been offered since February 2000 and attracts around 20 business and IT students each semester.

Organized like a consulting project (see also Hawking and McCarthy, 2000), the participating students have to undertake detailed planning of their project phase and conduct interviews in order to design as-is and to-be process models. Existing shortcomings and potential improvements have to be identified. Full project documentation has to be generated. The project progress is discussed in monthly milestone presentations. Students make three presentations to the industry partners and file three reports (an interim report, an as-is report, and a to-be report). The work in these phases is guided by the principles of problem-based learning, and the graduate students employed in these phases develop their generic (soft-skills) as well as technical skills in process modelling.

These graduate students develop an ERP-based reference process model (Rosemann, 2000) that is situated in the public administration domain. This sector was selected because it is a universal industry – every local economy has some element of this industry in close proximity to the university. This industry sector can also provide experience in customer relationship management, virtual marketplaces and electronic commerce. Thus, a detailed study of the use of information systems and information technology within this industry sector has the potential to provide a rich set of teaching cases with relevance for a worldwide educational market.

This problem-based approach also develops graduates with good technical and generic skills, in areas identified as in short supply. The technical skills identified as being in short supply are discussed next. This section provides justification for focusing on developing material in the ERP domain, both for

addressing the current critical shortages, as well as providing a rich learning context for under-graduate students. The concepts of problem-based learning and its differences from case-based learning are presented next.

Problem-based learning

Monash Engineering School (2000) states:

> Problem-based learning is an approach that requires students to learn through engagement in a real problem ... In problem-based learning, they will spend a significant amount of their time learning – by identifying what they need to know, finding out, teaching each other and then applying their new knowledge. Thus, the primary aim of the exercise is the learning, not the completion of the project. The project is the means to this end.

Bentley *et al.* (1999) and Ellis *et al.* (1998) believe that problem-based learning is well suited to the teaching of information systems. What is required is a set of realistic application systems that represent organizations' structures and functions, and that require extending in functionality.

The framing of the project as developing models based on interaction with an industry partner is thus a commitment to the problem learning approach. Graduate students are learning about how to work with an industry partner, how to use a modelling tool, how to integrate disparate solutions from sub-groups, how to report back to the industry partner and how to achieve business benefit for the partner.

This approach is different to case-based learning, in that reflective questions are set in case-based learning, and much of the learning resources have been unpacked for the student. They need to demonstrate how to apply their knowledge, rather than interact with an unstructured real-world environment, and determine what knowledge needs to be used and how to apply that knowledge to obtain a real-world outcome.

The grounding of skill development in such a rich and commercially aware environment allows for greater student understanding and immediate application in the employment market, thus addressing a criticism being currently leveled at university technology and business education. Thus, the development and implementation of a curriculum utilizing this ERP solution forms the basis of sustained change in curriculum design.

Developing the teaching cases

On the completion of each process model, different teams develop a teaching case, or configure a working system. There will be teaching cases for the modelling process, the implementation process and for exploitation within the core IT curriculum units of networks database technology, systems development and program development. Thus, this approach is developing a portfolio of case-based learning exercises for other students to use in ERP pre-requisite units, and also provide the platform for the development of the inverted curriculum material required in first year programs.

Benefits for the participants

This project allows students to understand common business functions and appreciate a process view of organizations. The configured application system provides the context for subsequent systems development within the IT curriculum, where students learn to extend system functionality through developing additional specialist systems, or seek to extend the basic system with enhanced reports and screens. Students are able to study the process and component models inherent in the application, thus having real-world representations for database design. Students can also analyse the network and computer systems design, to apprehend the application of theory to practice in these domains. They can participate in the modelling exercises leading to the creation of the business model, thus gaining skills in process engineering. Furthermore, they will learn key consulting skills within the design of the business process model. Since the model is implemented in the world's leading ERP system (SAP R/3), it addresses critical skills shortages in this area.

The development approach used in creating the process models and implementing the functioning application system requires close collaboration with the ERP provider, implementation partners and industry partners. This coupling brings benefits to each industry partner. For the ERP vendor and the implementation partner, graduates will be more readily employed. For the development companies, graduates will have deeper knowledge of business principles and processes. Students will have specific knowledge of the problems inherent in that area.

Conclusion

This paper described a project which has three key outputs:

(1) the development of a reference model for public administration;

(2) its implementation in the leading ERP system SAP R/3; and

(3) the development of teaching cases on the modelling process and implementation.

The first output is the product of graduate student teams working in collaboration with industry partners using the problem-based learning paradigm. The second phase provides the platform for the execution of the inverted curriculum experience using ERP systems within the undergraduate program. The third is the set of teaching cases.

This development of the ERP environment utilized a problem-based learning approach. The teaching cases are developed using both case-based learning and problem based learning paradigms in order to implement key recommendations of the ISCC '99 curriculum document – the use of an inverted curriculum model within the undergraduate curriculum. These cases are written to allow the student to experience the context of the information system, then master the details and finally return to a systems view of the deployment of the technology in order to complete their experience.

The reference model development is currently underway. Additional funding is sought to fully implement the model in SAP R/3 and to develop further teaching cases based on the reference model. The modelling exercise is costly, and beyond the funds of a single university. Collaborative curriculum development (Stewart and Rosemann, 1999) seeks to forge links between university academics throughout the SAP university alliance, thus reducing curriculum development costs while increasing quality and penetration of appropriate curricula. This increased collaboration (Rosemann *et al.*, 2000) and the extension of the project towards other industries are the main objectives for the future work.

These industry-based business process models and fully implemented working information systems provide a common platform for lecturers in specialist areas to develop problem-based learning experiences. There is an integration of knowledge across disciplines, as students incrementally gain exposure to differing aspects of ERP. This leads to a deeper understanding of organizational processes and the links of technology with those business processes. This provides for the development of an integrated view of the discipline, and closer coupling with industry needs. The orientation of the curriculum towards problem-based learning is a paradigm shift for many lecturers, from content mastery to applying theory to practice.

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