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Training Business Students to be End-Used Developers: Are Case Studies the Best Option?

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ABSTRACT

More and more business graduates are being required to develop and implement PC applications for themselves and their colleagues within their organisation. Currently businesses are experiencing problems with this end-user development due to incomplete information, incorrect design procedures and inadequate software knowledge. This paper explores the case study method for training undergraduate business students to be more effective end-user developers and how this relates to problems experienced in industry.

INTRODUCTION

With the increasing number of PCs available in business and the proliferation of relatively inexpensive application (4GL) software, employers are increasingly requiring business graduates to have some knowledge of the concepts of application development (Barker & Monday, 2000; Monday, 2001). Edberg & Bowman (1996) define user-developed applications (UDAs) as 'any computer-based application for which non-IS professionals (end-users) assume primary development responsibility'.

The implementation of UDAs has increased due to the perception that they offer greater user control, increased flexibility, encourage innovation and reduce the workload of the IT department. (Monday, 2001). Christoff (1991) identified that the introduction of 4GL application software represented a 'fundamental change in the way data is processed' and understood that this would lead to end-users developing a greater power in the design and implementation of business applications. Hobbs and Pigott (2001) state that the force behind end user development is that 'the users themselves are in the best position to understand the requirements of the application domain and therefore to create an application tailored to their particular needs'. Consequently it has been noted that UDAs now represent a significant proportion of information systems being utilised in business (McGill, 2000).

However, there is significant evidence that businesses are only just identifying the problems associated with UDAs. Whilst undertaking risk analysis and evaluation, organisations often overlook the risks involved with the proliferation of UDAs (Janvrin & Morrison, 2000). These risks can include incorrect design, inadequate testing, poor maintenance (McGill, 2000), erroneous data structures, insufficient organizational policies and procedures (Christoff, 1991), and lack of familiarity with development methodologies or application software (Panko & Halverson, 1996).

It is therefore apparent that more responsibility is being placed on the end-user developer to be conversant with design methodologies, data modeling techniques, theory related to effective and user-friendly input, output and interface design, the intricacies of application software, and documentation techniques to ensure that the application they develop is robust and useful to the organisation.

The majority of research in this area has focused on the development of spreadsheet applications as these were the most common applications developed by end-users. Panko (2000) has been instrumental in the research into error rates in spreadsheet development over the past two decades. Errors in spreadsheets developed by end-users were located in considerable numbers (Panko & Halverson, 1996) primarily due to the fact that 'user controls do not seem to approach the level of control that professional programmers have found to be necessary in a similar application.' Research shows that approximately 91% of end-users have had experience with spreadsheets whilst as many as 44% of these can contain at least one error (Teo and Tan, 1999; Janvrin and Morrison, 2000).

With the increase in availability of database software with 4GL (application generator) ability, it seems likely that these issues and problems will also be found in the development of small-scale databases. Edberg and Bowman (2000) recognised that 'UDAs represent a considerable risk to organizations since users who create applications frequently have little or no training in development methods'.

Monday (2001) states that feedback over a number of years from local businesses and professional organisations 'highlighted a growing need for business graduates with a greater understanding of the opportunities afforded by 4GLs, and a competency in understanding the business needs and developing small-scale applications for local users' which can be applied to the day to day business problems.

Hobby (1996) highlighted the need for end-users to be given some design and implementation training where PC users were transformed into end-user developers of databases using Microsoft Access. It was identified that building database applications using 4GL software was 'something slightly different from using Word and Excel – actually learning how to design a database properly'.

This paper explores case studies used to assist business students to understand the complexities of database development and contrasts these experiences with those of the author in industry.

THE COURSE

The University offers a range of undergraduate business degrees including majors in Administrative Management, Commerce, International Business and Tourism. Students in these programs are required to undertake an IT literacy course which provides them with a basic introduction to standard PC application software as well as an overview of the use of information systems in organisations.

Recent graduates have sought assistance from tutors in the design and implementation of small-scale databases required in their employment. It was this feedback that lead to the redesign of a course that would provide students with an active introduction to the problems of end-user development of databases.

Graduates highlighted that many of them (and others in their organisations) were required to develop database applications. Mostly these end-users demonstrated little understanding of the concepts of problem solving, information gathering, analysis, design and implementation issues for database applications. They did not recognise the implications of the process of application development, or the quality of the applications developed, for the organisation. (Barker and Monday, 2000).

The graduates raised concerns as they were being required to build applications using Microsoft software, however they had only been introduced to the software's applications generators or "wizards" in the computer literacy course. It was as these graduates explored the need for more advanced features of the software that they began to understand the potential and the limitations of using only the wizard or basic features of the software.

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Design of the application was also raised as an issue. Although a number of the graduates became proficient in the tools of the software, they had only a limited understanding of design principles in relation to data structure, inputs including data validation, outputs and the interface. Thus the applications tended to fail in terms of 'user friendliness' and failed to achieve the level of accuracy and efficiency expected in data input and output. Winter, Chudoba and Gutek (1997) suggest this is likely to be caused partly by the lack of attention paid to the role of IS literacy in helping the end-user to be efficient and effective.

As a result of these concerns this course was developed at a level for second year undergraduates and is core to the Administrative Management degree program. However, with the proliferation of end-user development, students from other business degrees are recognising the benefit of taking such a course as an elective.

This first semester course concentrates on data management, systems development theory and small-scale database construction using Microsoft Access. The course is taught using case studies written in consultation with business, or based on the industrial experience of the staff working on the program.

Kreber (2001) describes case studies as 'the detailed description of a particular real life situation or problem as it happened in the past or as it could happen in the professional life of the student.' The use of case studies is encouraged in higher education, as it tends to involve students in a more active learning process. This can be seen to be in line with the four phases of Kolb's experiential learning theory as students experience concrete experience, abstract conceptualization, reflective observation and active experimentation. Here students are more likely to 'foster the skills of self-directed learning' (Kreber, 2001). Knoop (1984, cited in Kreber, 2001) introduced a problem-solving model based on Kolb's theory.

This model is distinguished by five steps:

1. Identify the problem
2. Distinguish the problem from the underlying symptoms
3. Generate alternate problem-solving strategies
4. Evaluate the alternatives and select best strategy
5. Develop plan of implementation of best strategy

Students' experiences apply to this model, as they must first determine any information not presented in the case study that they deem necessary to solving the problem they have been presented. This takes place with the use of web-based discussion board available to all students through the course web site. The course coordinator assumes the role of the primary contact person within the business and responds accordingly to student questions allowing some latitude for the students to think about the process they are undertaking. All students have access to the questions asked by other groups or individuals and consequently to the answers given by the 'business'.

By undertaking this process the students identify the problem and determine a strategy for solving the problem based on the information given by the business.

Case studies used in these course alternate between service and manufacturing business sectors as this is where the majority of graduates find employment. The content of the case study centres on the information needs of a small business or one department within a larger organisation. Students are required to understand the corporate structure and information needs of the department as well as the organisation as a whole.

Internal students work in groups as recommended by Gross Davis (1993) and Knoop (1984, both cited in Kreber, 2001). At this time external students must work on the case study individually. The author is currently exploring methods that will allow external students to participate in group work however further research into this area is needed prior to implementation.

INDUSTRY EXPERIENCE

The author has been involved with the design and implementation of small-scale databases for eight years particularly in the mining and fitness industries. As a consultant many problems were experienced in the completion of these projects.

Understanding the Business

Most important is company knowledge: being unfamiliar with the management structure, IT capabilities, budget restrictions, and the key personnel to be involved with the project often caused problems at the commencement of the project. This lack of knowledge involved such issues as identifying the project supervisor, available software (and appropriate version), functional PC specifications, budget flexibility (including allocation for possible hardware and software upgrades) and was there more than one person with the ability to respond to queries. The other issue here was a complete understanding of the processes taking place. As a consultant the author was not an expert in the relevant industries and therefore time was needed to understand the activities being conducted by the business before the systems analysis could take place. When these issues were not resolved early in the project it caused problems throughout the information gathering and design stages of the application.

Time Management and Information Gathering

Many clashes were experienced in the information-gathering phase due to the large number of company personnel who wished to have input into the development of the application. Many projects involved discussions with primary user(s), departmental manager, senior management and business partners. There would regularly be more than 10 staff members involved in the project, most with differing requirements and knowledge of the current system. As a commercial consultant it was extremely important to adhere to project deadlines however this was often impossible due to the personnel rosters used. For example, in the mining industry, contact staff were regularly offsite when information was required and delays of up to 10 days could be experienced.

No detailed project schedule was prepared by either body and this lead to frustration caused by these delays. This led the author to move to the design phase prior to sourcing all of the relevant information causing time delays on the project as incomplete or inaccurate information was included in the logical design and not discovered until well into the implementation phase. Most of these problems were encountered due to the large distance between the organisation and the consultant (sometimes over 3,000km) leading to most of the information gathering and consultation being undertaken via telephone meetings and email discussions. Closer proximity to the organisation or regular onsite meetings may have alleviated some of these problems.

Alterations to Specifications

Changing specifications is the most frustrating problem that a developer has to deal with. Due to the number of people involved from the organisation there were regular in-house arguments that needed to be resolved and often the resolutions were not achieved prior to implementation. The project team regularly made major changes to what exactly was to be included in the application leading to increased development time being required by the consultant.

Software Issues

Software limitations are often the hardest constraint to overcome. The organisation's project team needed a particular task performed that was physically unachievable using the software available within the company. The time taken to describe the software features available or possible alternative methods of achieving the organisation's requests also tended to lead to problems in achieving the deadlines of the project.

PROBLEMS ENCOUNTERED BY STUDENTS

Time Management and Software Issues

Students are challenged by the strict time constraints of the assessment; they have 10 weeks to complete the database task. Aca-

demic staff encourage students to spend the initial weeks advancing their knowledge of the software to be used. No formal software training sessions are held for this purpose. The study program is timetabled such that students should attempt the training theory and examples prior to attending a practical session. It is during these sessions that the students are able to ask questions and discuss alternative features that are available in the software being used. External students are given access to a telephone help line for software-based queries. Whilst undertaking this learning students commenced the information-gathering phase of the system development.

Information Gathering

Even though students are given a large amount of information in the case study presented they are required to determine any important information missing from the documentation and consult directly with the business to uncover the relevant data. It is this area in which the students experience major difficulties. The problems that they encounter include; minimal understanding of the process, requests for unnecessary information, inability to reword questions if inadequate reply received, not asking any questions and not referring to the web discussion board which therefore leads to the making of incorrect assumptions.

The ability to determine which information is actually relevant to solving the problem or issues they have highlighted is another problem that students experience. Students regularly try to include all of the information from the case study and are extremely reluctant to discard inappropriate and unnecessary information.

Group Issues

A problem that appears from this discussion board approach is that the enthusiastic groups ask the relevant questions leaving those students/groups that are less organised to use the responses to other's questions. It is here that the less organized groups lose in the learning process and are unable to take any understanding of the information-gathering phase into other courses or to their ultimate employment on graduation.

Logical Design Issues and Documentation

As the students are learning the features of the software at the same time as they are attempting to design the spreadsheet or database application they have a tendency to launch directly into the physical design and implementation. This tends to cause the most problems in the case of database construction. Students who do not use data modeling techniques to identify the entities and attributes required together with the primary keys and table relationships experience the greatest difficulty with producing a sound, effective and usable application.

The lack of logical design also creates problems as the process is not documented and students tend to get lost in the process and not understand what it is they have created. The unfortunate loss of a file through poor backup procedures leads to much distress for these students as they have no documentation to fall back on to recreate they physical design.

Physical Design Issues

Although much discussion through lecture and tutorial sessions focused on good design characteristics of input and output screens and user-friendly interfaces, some students still chose to implement multi-colour or fashion colour screens without any thought to the amount of time the user may spend looking at these screens. Occupational health and safety issues were discarded in favour of 'a unique look'.

Those students who communicated with the business tended to produce more user-friendly interfaces. A large number of students, however, chose to make assumptions about many of the design issues (eg report layout, data entry procedures and workflow issues) and therefore their applications lacked the features required by the business.

Testing and Implementation

Misuse of or lack of validation and GUI controls were the major weaknesses across the assignments. None of the databases proved to be totally robust and user-friendly however several achieved a good level of development.

Finally, students experienced problems due to the lack of testing of the application. In the production of the database students tended to enter the data after the construction of the tables and therefore did not test the input screens for functionality and user-friendly design. Applications were therefore not tested for validation techniques, meaningful error messages, usability and effective macros. A number of the students commented that the wizards were not capable of achieving the full requirements of the users, however the case studies were all tested prior to the delivery to ensure that the wizards were sufficient for the development of these applications.

DISCUSSION

Understanding the Business

The case studies used in this course exposed the students to the problems faced with not knowing or understanding the business type they are assessing. The lack of knowledge of the business processes particularly in the manufacturing industries initially causes the students major concerns as they not only have to understand the nature of the business but also the problem necessary to be solved. At the completion of the course many students have commented about what they have learnt not only about problem solving issues and the use of the software application but also about the business they were assessing.

Time Management and Information Gathering

The students do not tend to experience the problems inherent in the information gathering phase of the process as most of the information is disseminated through the case study documentation and the discussion board. One way that students might experience this problem would be to remove the discussion board from the available facilities thus making each group responsible for their own information gathering. Although this would simulate the process more accurately this is generally not considered a viable option in the teaching area of large groups of students where the same questions would be presented numerous times.

Students are not given inaccurate information or time delays due to intra-organisation conflicts however, they are only given the information they ask for and this can sometimes lead to the introduction of poor or incomplete information. Occasionally, due to onshore and offshore teaching commitments, students are unable to contact the business which, in part, simulates the situations experienced by the author in the inability to contact key project personnel due to roster issues. Although the students only experience delays of 3 to 4 days maximum it impacts on their time management quite considerably as they tend to delay starting the assignment until quite close to the due date rather than managing their time as they would in industry.

Software Issues

Case studies are carefully produced to ensure that all the tasks required to be completed or implemented are achievable with the software being utilised. As this is not always the case in business students are not exposed to these issues. The course aims to give the students some awareness of the limitations of the software (as experienced by non-IS professionals) and therefore they tend to appreciate these limitations without actually experiencing them fully.

CONCLUSIONS

Although there is still room for refinement of the case study delivery of this course, students are rising to the challenge of dealing with "real-life" business problems. Issues relating to equity between internal and external students as well as those who do not have access to the web-based discussion forum must be addressed to ensure that all students are achieving the learning outcomes of this course.

Some students are relying heavily on other groups or group members to lead the way without understanding the importance of the system development phases. It is these students who present only partially completed or poorly designed applications and as such further research is required into better ways to deliver the case study approach.

The aim of this course is to help students to recognise the importance of the steps required to achieve a good quality software application even though they are non-IS professionals. It also seeks to encourage students to recognise the implications of their actions and choices for the organisation and not just their immediate needs. Emphasis, thus, is not purely on building a good quality, robust software application but in presenting a more holistic view of user and organisational needs.

ONGOING RESEARCH

This research forms part of a wider research program being conducted by Sandra Barker and Ann Monday into the delivery of this software-based information systems course in the Administrative Management degree program.

REFERENCES

Barker, S. and Monday, A. (2000) Business Students in Information Systems: Wizards or Apprentices?, *Proceedings of the Australasian Computing Education Conference*, Melbourne, Australia, December

Edberg, D.T. and Bowman, B.J. (1996) User-Developed Applications: An Empirical Study of Application Quality and Developer Productivity. *Journal of Management Information Systems*, 13, 1, 167-185

Hobbs, V.J. and Pigott, D.J. (2001) Facilitating end user database development by working with users' natural representations of data, *Proceedings of the IRMA Conference*, Toronto, Canada, May

Hobby, J. (1996) Degrees of Excellence, *Computer Weekly*, 02/08/1996, 32

Janvrin, D. and Morrison, J. (2000) Using a structured design approach to reduce risks in end user spreadsheet development, *Information and Management*, 37, 1-12

Kreber, C (2001) Learning Experientially through Case Studies? A Conceptual Analysis, *Teaching in Higher Education*, 6, 2, 217-228

McGill, T.J. (2000) User Developed Applications: Can End Users Assess Quality?, *IRMA International Conference: IT Management in the 21st Century*, Alaska, 106-111

Monday, A. (2001) The Reality of Teaching Large Groups of Local and International Busienss Students to Develop End-User Applications, *Proceedings of the IRMA Conference*, Toronto, Canada, May

Panko, R.R. Survey of Developers, [accessed on line 17/7/00 at: http://panko.cba.hawaii.edu/ssr/tables/dvelprs.htm]

Panko, R.R. and Halverson, R.P. Jr. (1996) Spreadsheets on Trial: A Survey of Research on Spreadsheet Risks, *Proceedings of the Twenty-Ninth Hawaii International Conference on System Sciences*, Maui, Hawaii, 326-335

Ross, J. and Ruhleder, K. (1993) Preparing IS Professionals for a Rapidly Changing World: The Challenge for IS Educators, *Proceedings of the 1993 Conference on Computer Personnel Research*, 379-384

Teo, T.S.H. and Tan, M. (1999) Spreadsheet development and 'what-if' analysis: quantitative versus qualitative errors, *Accounting, Management and Information Technology*, 9, 141-160

Winter, S.J., Chudoba, K.M. and Gutek, B.A. (1997) Misplaced resources? Factors associated with computer literacy among end-users, *Information and Management*, 32, 29-42