GENERATING STUDENT INTEREST IN THE INFORMATION SYSTEMS MAJOR: A STRATEGIC FRAMEWORK FOR THE INTRODUCTORY COURSE

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ABSTRACT

This paper describes an enrollment problem and the solution for the introductory course developed by the faculty members in the Management Information Systems Department at Ohio University's College of Business. The solution is a method of introducing information systems (IS) to students that often leaves them wanting to return to the subject area again in the form of a major or minor. The method is presented as a framework which readers can adopt within their own departments. This framework demonstrates how to introduce information systems as an interesting and fun area of study, provide lasting value, and teach students to teach themselves. The method builds upon existing literature in the areas of information systems, management education, education in higher education, communications, marketing, and psychology.

Keywords: Information Systems, Introductory Course, Project-based Learning, Impression Management

INTRODUCTION

The first course a student experiences in a subject area often has a lasting impact on the student's perception of the subject area and decision whether to pursue the subject area further. While this may seem daunting to professors teaching introductory courses, we suggest that instead this task should be perceived as an opportunity to showcase the subject area and provide students with lasting value. We further suggest that it is an opportunity to share skills with students that they can use for their entire academic and professional careers and not a tight timeframe to cram in a summary of everything the student will need for future courses in the subject area. Hansen suggests that there is a "need for technology educators to document, enhance, and showcase curriculum development study/practice in their field" [11], and this paper is intended to do just that.

As with many other first-time meetings, such as job interviews or blind dates, the first course is a chance to introduce a subject area to students, and this first impression matters [4]. We suggest introducing information with a handshake, figuratively speaking.

This paper describes an enrollment problem and the solution developed by the faculty members in the Management Information Systems Department at Ohio University's College of Business in Athens, Ohio. The solution is a method of introducing information systems (IS) to students which often leaves them wanting to "hire" the major or take it on a second "date." The method will be presented as a framework which readers can adopt within their own departments. This framework demonstrates how to introduce information systems as an interesting and engaging area of study, similar to what a handshake accomplishes in professional situations [4]. The method builds upon existing literature in the areas of information systems, management education, education in higher education, communications, marketing, and psychology.

THE PROBLEM

Information systems programs have suffered from a steady decline in enrollments for almost a decade. This problem exists unnoticed in some programs because it can be hidden by other factors, such as high grade hurdles or lowered acceptance standards. In a similar context, Seymour and Hewitt suggest, "The difficulty for faculty would appear to be that of redefining something as 'a problem' which has long been taken for granted as an appropriate and normal consequence of pedagogy that serves established, and largely unchallenged, student selection objectives" [18, p. 391]. Recognizing something previously taken as status quo, such as small enrollments or dissatisfied students, may be challenging at first as Seymour and Hewitt suggest.

The enrollment problem surrounding information systems programs can be divided into three main issues: lack of visibility, unfavorable perceptions of the subject area, and tense environmental factors. A study of students making the decision to pursue technology-related majors found that they consider the culture of the program itself, information they gather from family and friends, and the experiences

in the first classes, and they decide to leave a major often because of teaching practices [18]. This section discusses how the lack of positive visibility and the unfavorable perceptions of a field held by students and their family and friends can impact students' attitudes toward the introductory course and decisions to study IS.

In terms of the visibility of IS, most students have never heard of information systems before entering college. While most students are toting a laptop, an iPod, and a cell phone, they are blank slates when it comes to defining information systems or discussing their role in a business environment. Thus, any negative perceptions they have of the subject area, they have most likely picked up after coming to campus. In other words, IS faculty, including the authors, have mainly themselves to blame for the negative perception. And why would they see the subject area in a positive light? The typical introductory course in information systems is a schizophrenic experience and does everything it can to look unattractive to students [3, 5, 11, 18]. Students attend lectures on dry IS concepts and then later in the week attend a lab on seemingly unrelated Office productivity tools, which drives students away [15]. Where is the integration? Where is the excitement?

In terms of perceptions of the subject area, the competition can be steep. And when the students complete introductory level courses and must choose a major, perception weighs heavily [18]. Students have been flocking to accounting and finance often because the courses and majors are perceived as safe and full of opportunities. Students desire to feel safe and in control in order to engage in meaningful learning [7]. Other students are attracted to marketing which is often perceived as interesting and fun. In contrast, information systems is perceived as risky, lacking opportunities, tedious, geeky, and boring, which the authors and others suggest is incorrect [8].

In terms of environmental factors, IS was dealt a double hit. First, the dot com bust in the early 2000s, which is when many of the declining enrollments started, gave the field an unstable impression. Second, the decline was only exacerbated by high profile news stories suggesting that outsourcing would eliminate IS jobs.

Could we have constructed more dismal incentives for enrollment?

THE SOLUTION: A STRATEGIC FRAMEWORK

While the enrollment problem may be threefold, we present a solution which maps to two of the issues (lack of positive visibility and unfavorable perceptions of the subject area) and recent reports suggest that the third (environmental factors) may be resolving.

In terms of environmental factors, the reality is that exciting and well paying opportunities await information systems graduates. Ohio University graduates routinely receive multiple offers by fall of their senior year. In many cases graduates earn more than their colleagues in accounting, finance, and marketing. A publication from Arizona State University's business school suggests that there is a shortage of IS experts and that to solve this problem, IS departments need to raise enrollments, companies need to bring IS interns on board, and "students should recognize that IS careers are plentiful and stable" [8]. As early as 1995, IS scholars predicted a downturn in the number of lower-level IS jobs, but a strong upturn in the number of IS jobs which require technological knowledge, business knowledge, and strong interpersonal skills [13]. Today's crop of information systems students deserve these jobs, and IS professors need to show them that they can do it and the jobs are out there.

To address the other two issues, we provide a solution in the form of a strategic framework for the introductory course. The framework focuses on the presentation of the course, the content of the course, and pedagogical methods, all which we believe are important and necessary. Hansen suggests that when conducting curriculum development, a conceptual framework should be developed and used to plan learning activities [11]. While this framework may appear simple, one must keep in mind that it is a dramatic shift from the status quo and should not be undertaken lightheartedly.

Furthermore, this framework is not something that can be implemented and not thought of again. It involves frequent revisions and rethinking of the course. In other words, this is not a "quick-fix" diet; rather, it is a lifestyle change. Hutchings and Saunders suggest that a methodology, such as the framework presented here, is not a "magic wand" that can be waved at curricula, and it does not replace "creativity and experience on the part of the development team" [12].

In times of crisis, it is not good enough to do the same things a bit better. It is also not good enough to add a few jazzy extras, such as online resources or engaging videos. Rather, there has to be a strategic change in the conception of the introductory IS course.

This framework is strategic because of these reasons and the fact that it grew out of strategic initiatives, which are discussed below. To solve the enrollment problem, it is recommended that one adopts these strategic initiatives as well.

1. **Make a good first impression in the introductory course.** One never gets a second chance to make a first impression. Introductory IS should be a positive experience from day one that generates interest in the major.
2. **Reposition the major as business people solving business problems.** Avoid the image of geeks writing code. Most IS jobs do not involve coding, and yet many students equate the major to computer science. The geek perception is an urban legend that persists via word of mouth in spite of the fact that most IS programs deemphasize coding. The profession needs to combat the perception explicitly. One way to combat the perception is to emphasize professional, relevant, interesting, and fun content starting in the introductory course.
3. **Work to raise enrollment without compromising integrity.** The solution is not to lower standards but rather to raise the bar with appropriate content and delivery. Students see intrinsic value in business-oriented content, and innovative pedagogy helps them to succeed. Care for the students' progress should be demonstrated in the content and delivery of the course.
4. **Entice good faculty to teach the introductory course.** Make the course such a positive experience that good faculty will choose to teach it. If the best faculty remain in the upper level courses, then enrollment will continue to decline. Three things can make the course positive for the faculty. First, the content can become genuinely interesting. Second, the pedagogy can be creative rather than laborious. Third, faculty members can be simply amazed at the level of work that even freshmen can accomplish.

Below we describe each section of the framework and provide literature which supports the suggestions. The entire framework is presented below in Figure 1.

Figure 1
Strategic Framework for Introductory IS Course

Presentation *First Impressions Matter*	Highlight the role of information systems in business
	Demonstrate the relevance of information systems to a business career
Content *Provide Lasting Value*	Use interesting, engaging, and "real" materials
	Provide project-based, problem-solving focused content
	Provide decision-making focused content
	Progressively challenge students
	Provide visual content and demonstrate rather than explain
Pedagogy *Help Students Help Themselves*	Provide a way to learn
	Introduce a problem-solving process
	Teach a way to ensure the quality, integrity, and relevance of content
	Teach a way to explain
	Teach a way to sell ideas

Presentation – First Impressions Matter

As Lee and colleagues suggest, IS programs should be multi-disciplinary and career-driven [13]. The authors and faculty at Ohio agree wholeheartedly with both of these ideas, and as a result, suggest that the role of information systems in a business career should be emphasized and the importance of information systems knowledge should be stressed.

Furthermore, information about their future careers is very important to students, and they are continuously shopping for classes and careers which help them achieve their goals [18]. At the very first meeting (i.e. the introductory course), it is important to present a strong first impression that information systems is a valuable and significant area of study. As the psychology literature suggests, an individual's first impression of something is correlated with how they will behave toward it later [6]. It is also important to make a showing at any events that the school or university hold to showcase what the

school offers in terms of majors and programs. This can be a great opportunity to showcase the area of study in a non-classroom setting, leaving you greater room for creativity and interaction.

Highlight the role of information systems in business
To combat any existing negative perceptions, it is important to demonstrate to the students that they are first and foremost businesspersons and that they are learning business skills. Many of the pieces of the framework work to reinforce this, such as demanding quality deliverables and conducting project-based learning, but verbally reminding students of this provides them with a way to connect what they are doing to a future career. It has been demonstrated that students are more drawn to subjects that have practical applications, and computer science education research has demonstrated that to attract and retain students, especially females, they must provide students with practical applications of what is being learned [2]. The connection to future careers can also be demonstrated by showcasing upperclassmen and recent graduates. Student perceptions can also be influenced by other students, and this gives them an opportunity to interact with these influential classmates and alumni. In other words, use upperclassmen and alumni to "get the word out" that information systems is interesting and can take them far in their careers.

In addition to being businesspersons, they have special knowledge about systems, and faculty should try to highlight the role of information systems in business. Information systems careers are often mentioned as recession-proof careers because the organization cannot function without the systems and individuals with knowledge about them. Information systems professionals are also often involved with making the business comply with regulations, such as the Sarbanes-Oxley Act.

Lastly, the content in the introductory course, discussed further below, is easy to intertwine with other disciplines, such as accounting or marketing. This allows the student to see the connection between their major and IS and see why IS could be a great second major. Framing IS as a second major allows one to recruit promising students from the other disciplines as well, and this further emphasizes the role of IS in business.

Demonstrate the relevance of information systems to a business career
Students perceive professionally relevant content to be more intrinsically rewarding. Think of the rapt attention that students will offer to a speaker from industry who has really been out in the trenches. Students attend to more and work harder on problems that are clearly connected to recognizable business problems. Discuss that the course has been created to provide them with relevant skills based on interactions and recommendations from professionals.

The problems also must be meaningful rather than trivial. For example, creating a rudimentary web site has recognizable business value. However, creating a professional looking web site has intrinsic value. This is described further below.

Content – Providing Lasting Value

The content of the introductory course should provide lasting value by preparing students for their academic coursework and future careers. A top-level information systems research journal issued a set of guidelines for information systems undergraduate programs and suggested that graduating students should have the following attributes:

- Strong communication skills in order to professionally exchange information
- Understanding of computer applications systems and how and where to apply IS in organizations
- Understanding of information technology and its functions
- Ability to interact with a diverse population and maintain interpersonal relationships
- Ability to plan, direct, and manage people and projects
- Ability to define and solve complex problems
- Understanding of systems development methodologies
- Ability to apply systems theories to view, describe, and define a situation in terms of systems
- Acts appropriately and professionally in business situations [5]

This portion of the framework is intended to not only fulfill, but exceed these guidelines for graduating students. It is recommended that this goal be achieved by first providing interesting, engaging, and valuable content in the introductory course. Norman and Spohrer suggest that students learn best "when engrossed in the topic, motivated to seek out new knowledge and skills because they need them in order to solve the problem at hand" [15, p. 26]. They further suggest that the topics should be focused on realistic, intrinsically motivating problems.

Use interesting, engaging, and "real" materials

The content of the introductory course must be intrinsically rewarding, exciting, fun, and motivating. Learning software tools is not most students' idea of fun. The focus needs to shift to the deliverables that students are producing with the tools. The literature on motivating students suggests that students are motivated to learn when there is a focus on the needs, skills, and interests of the learner [15]. Benson and Blackman suggest that when students are not attracted to a topic, such as research methodology, it may be best to implement activity-based learning [3]. This will be discussed further in a later section.

Exciting and fun are terms not normally associated with the introductory course. The authors depart rather dramatically from a traditional presentation of IS material. However, the approach works. Enrollments are up 300% at Ohio, and students are excited about IS.

Keep in mind that excitement, fun, and relevance are in the eye of the beholder. Students are the ultimate decision makers on choosing a major. The material itself must be intrinsically rewarding. The authors would submit that neither students nor faculty in the current paradigm find a required introductory course particularly exciting or fun. When was the last time that faculty clamored to teach the introductory course? Most faculty tend to avoid teaching the introductory course. The course can be perceived by students and faculty alike as exciting, fun, and relevant precisely because the focus is on interesting business problems and not just on learning software tools.

In any other field, the need to deemphasize the tool and play-up the results would be obvious. For example, chemistry students do not learn how to use Bunsen Burners, they learn how to do chemistry experiments and happen to need Bunsen Burners to heat the chemical solutions. Now that example should leave one wanting. After all, how intrinsically rewarding is chemistry to most people? But what if chemistry were taught with all its examples coming out of some sort of Crime Scene Investigation (CSI) show? Now that would be intrinsically rewarding. The experiments might even be more difficult to pull off because they deal with real rather than sanitized problems.

Provide project-based, problem-solving focused content

A project-based course should solve real problems that a business would have to face. The real business problems form an ideal backdrop to blend theory and practice. Project-based learning has been demonstrated to be effective, and it is often used in business settings. Barak and Dori investigated the learning processes of students completing a project rather than completing a series of traditional instructional problems in order to learn about a topic [1]. While having similar pretest scores, the project-based learning group had superior performance on the post test and final exam as compared to the control group [1]. This was attributed to the fact that the students in the problem-based learning group explored new concepts, examined and validated data, and came up with original solutions, which allowed them to develop a deeper understanding of the topic at macroscopic and microscopic levels [1].

The literature on project-based learning suggests that project-based learning enables students to actively participate in the building of their own knowledge and has strong theoretical support as a successful instructional method [1, 10, 19]. Harry Scarbrough et al suggest that project-based learning depends on two major processes: learning-by-absorption and learning-by-reflection [17]. Learning-by-absorption allows people to assimilate new project information with their prior knowledge, but restricts learning in later phases because of preconceived notions. It is reflection that enables individuals to breakthrough preconceived notions and allows constructive learning to take place in a project-based learning environment [17].

Furthermore, when the content is challenging, project-based learning can help foster learning because students are forced to think constructively and take various portions of their knowledge into practice in order to come up with a real-life solution [14].

Provide decision-making focused content

To make the course decision focused, the authors focus on having students create meaningful deliverables that assist in decision making. For example, the authors have students design a spreadsheet capable of evaluating the Net Present Value of lease versus buy deals on a car. According to a review of project-based learning literature, project-based learning's real-world components allow both instructors and students to see it as an effective and beneficial instructional technique, and the quality of student learning and the ability to apply knowledge and make decisions are strong, which are fundamental skills to possess [20]. Combining project-based learning and decision-focused content instills students with two skill sets and how to intertwine them.

Progressively challenge students

The authors believe that students want to be challenged as long as the professor organizes the proper resources to help them meet that challenge. According to Grant [10], seven features are recommended to foster success in project-based learning. They include:

- Create an introduction to the exercise
- Set a task or motivating question
- Suggest a process through which discovery will occur
- Identify resources to help in the discovery process
- Support to help assess progress, use collaborations in teams, peer reviews, etc.
- Create the opportunity for reflection and application of new knowledge [10]

Through the process discussed below, students are provided with an introduction to the exercise, motivated by the realistic topic, given a process for discovery, and provided with an opportunity for reflection. This transparent learning process also allow students to reflect on what they have learned [3].

This standard structure for each project is important so the students feel in control and stable [7]. What the authors suggest is a progressively challenging pedagogy. By accomplishing the Level 1 and 2 hurdles, students prepare themselves for a comprehensive Level 3 project. One can adopt this structure for each project or adapt it as necessary. However, again, having a structure is very important.

- **Introduction**: Each unit should begin with an introduction to outline the unit. The introduction should also sell the practical value of the unit to the student's future career. Selling the unit achieves buy in and motivation to succeed. Establishing the practical value of the unit also lets students know that the professor cares about their future.
- **L0 Theory**: Following the introduction, the Level 0, or L0, module should cover the theory behind the unit. The theory should be carefully introduced to scaffold on prior knowledge while extending that knowledge much further. For example, one can cover best practice in industry and illustrate it using good and bad examples.
- **L1, L2 Learning by Example**: The Level 1 and Level 2 assignments should introduce learning by example or apprenticeship learning. In their classes, the authors show abbreviated techniques to accomplish each of the tasks required in the assignment. However, the examples used are very different from the assignment so that students have to think about and generalize the concept. Furthermore, the techniques are shown in no particular order. Students need to discover what they need to accomplish and then look up the technique that will help to get them there.
  Frequently, showing before and after examples of the required deliverable also helps. Students are challenged to transform the before into the after using the techniques. For example, one might show a badly designed web site and an improved version of the same. Students are challenged to edit the badly designed site to recreate the improved site.
  The authors expressly avoid the step by step exercises. It has been shown that students will focus on keystrokes rather than concepts when presented with step by step instructions. This model is closer to just-in-time learning found in many MBA programs. It is also a model for life-long learning, rather than learning specific software tools, discussed further below under teaching students to help themselves.
- **L3 Creative Application**: The L3 assignment should have students apply the concepts to a new business problem. Students must analyze the problem, gather requirements, design a solution, and develop the solution. Students should be encouraged to exercise creativity both in their deliverable and in their written support for the deliverable. The problem solving process that students may follow in the L3 assignment is the Systems Development Life Cycle (SDLC), again demonstrating the role of IS in business.

Provide visual content and demonstrate rather than explain

Given this content, it is best to create a visual course. Students are used to visual stimuli, such as movies and video games. Thus, it is important to explain techniques visually in person and on paper. Furthermore, the structures of every deliverable can be described and illustrated so that students know exactly what is expected of them. Again, this lets them focus on the learning of concepts rather than worrying about formatting. Benson and Blackman suggest that having a focused deliverable allows students to understand the materials more clearly and their relevance [3].

Pedagogy – Help Students Help Themselves

The goal of this section of the framework is to create a pedagogy that helps students help themselves. As information systems professors, we cannot teach

them about every type of system that exists or will exist in the future. As a result, we need to teach them how to learn and make sense of the technology and systems as they are developed and implemented in their future organizations. Providing them with this valuable skill will take them much further and give them much greater satisfaction than simply teaching them the current tools and features. This is also why students should be provided with a toolbox of techniques rather than step by step instructions, as discussed above. Again, the project-based learning literature suggests that project-based learning enables students to actively participate in the building of their own knowledge [1, 10, 19].

The goal is active "exploration, construction, and learning rather than passivity of lecture attendance and textbook reading" [15, p. 26]. Strategic initiatives need to be supported with innovative pedagogy. The old pedagogy of step by step exercises is not generating interest in the major. Nor we would argue is it very effective. Other disciplines, most notably accounting and finance, abandoned step by step exercises in favor of challenging problems years ago.

Provide a way to learn
The authors suggest that the techniques that support learning by example should be utilized rather than step by step learning. Learning by example has two benefits. First, students better master the material because they focus more on concepts than keystrokes. Second, learning by example models the real world where perfect solutions are rarely found for the problems at hand. Learning to work off of analogous solutions is much more realistic.

Introduce a problem-solving process
As Grant suggests, processes help students learn [10]. The authors recommend introducing the Systems Development Life Cycle (SDLC) as a problem solving process [9]. The SDLC encourages thoughtful reflection and design before taking action. The SDLC helps ensure that the design is on target. The authors' experience is that most students will not redesign a deliverable once completed even if they become aware that it does not meet the design goals. Therefore, it is important to empower students with a tool that promotes good design the first time round.

Teach a way to ensure the quality, integrity, and relevance of content
The little known field of analytical design promoted by Edward Tufte [21] is a primary driver for the ideas of quality and integrity in design. The entire pretext of the field is that information should be designed to serve the cognitive task at hand. That sounds obvious, but in practice leads to some very interesting principles that can be applied life-long in the construction of deliverables. For example, students learn how to standardize and deflate numbers used in comparisons over time. Faculty are amazed at the quality of the content that students can produce when taught analytical design principles. The authors recommend promoting these ideas as well.

Teach a way to explain
In the spirit of teaching concepts rather than tools, the authors recommend teaching a way to explain difficult concepts using a critical thinking methodology rather than just teaching PowerPoint as a tool. Considering the number of PowerPoint presentations that students will make in their business careers, and the generally poor quality of these presentations—one will be doing the students, their colleagues, and the business world a valuable service.

Teach a way to sell ideas
In the same spirit of teaching concepts rather than tools, we teach a way to sell ideas to an audience using a proven marketing technique called SPIN (Situation, Problem, Implication, Need) [16].

CONCLUSIONS

This paper has presented a strategic framework for introducing information systems to undergraduate students in a business school. The authors sincerely hope that this information can be used by professors in the field to boost their enrollments and interest in the major and its courses. The enrollment problem has been cited by various information systems academic associations as a major issue for the field, and the authors believe that the introductory course should be tackled foremost and head-on to combat this problem.

It is important to remember that the introductory course can be used as a great first impression and stepping stone to a major, minor, or double-major in information systems. The faculty at Ohio University have combined this introductory course initiative with other department initiatives, including a curriculum-wide overhaul. The goal of the entire process was to increase enrollments and student satisfaction, and very positive results have been demonstrated. It is believed that changing the perceptions of and demonstrating the usefulness of IS is the first major step to getting students interested in the major. The enrollment change does not happen overnight, but with constant effort and dedication the changes will have a positive affect.

Lastly, the authors encourage readers of this article to contact them with any questions or feedback.

REFERENCES

1. Barak, M. & Dori, Y.J. (2004). Enhancing undergraduate students' chemistry understanding through project-based learning in an it environment. *Learning*, 117-139.
2. Barker, L.J., Garvin-Doxas, K., & Roberts, E. (2005). What can computer science learn from a fine arts approach to teaching? *ACM SIGCSE Bulletin*, 37(1), 421-425.
3. Benson, A. & Blackman, D. (2003). Can research methods ever be interesting? *Active Learning in Higher Education*, 4(1), 39-55.
4. Chaplin, W.F., Phillips, J.B., Brown, J.D., Clanton, N.R., & Stein, J.L. (2000). Handshaking, gender, personality, and first impressions. *Journal of Personality and Social Psychology*, 79(1), 110-117.
5. Couger, J.D., Davis, G.B., Dologite, D.G., Feinstein, D.L., Gorgone, J.T., Jenkins, A.M., Kasper, G.M., Little, J.C., Longenecker, H.E., & Valacich, J.S. (1995). Is'95: Guideline for undergraduate is curriculum. *MIS Quarterly*, 19(3), 341-359.
6. Doughtery, T.W., Turban, D.B., & Callendar, J.C. (1994). Confirming first impressions in the employment interview: A field study of interviewer behavior. *Journal of Applied Psychology*, 79(5), 659-665.
7. Entwistle, N.J. & Ramsden, P. (1983). *Understanding student learning*. London: Croom Helm.
8. Farquhar, E. (2008). What job shortage? Firms go begging for high-tech talent. *Knowledge@W.P. Carey*, http://knowledge.wpcarey.asu.edu/article.cfm?articleid=1574#.
9. Frost, R.D. & Pike, J.C. (2004). A revolutionary approach to introductory mis: Professional, project based, decision focuses, visual, and engaging. *Issues in Information Systems*, V(2), 454-460.
10. Grant, M.M. (2002). Getting a grip on project-based learning: Theory, cases and recommendations. *Meridian: A Middle School Computer Technologies Journal*, 5(1),
11. Hansen, R.E. (1995). Five principles for guiding curriculum development practice: The case of technological teacher education. *Journal of Industrial Teacher Education*, 32(2), 30-50.
12. Hutchings, T. & Saunders, D. (2001). Curriculum methodology: A case study in large-scale curriculum development. *Active Learning in Higher Education*, 2(2), 143-163.
13. Lee, D.M.S. (1995). Critical skills and knowledge requirements of is professionals: A joint academic/industry investigation. *MIS Quarterly*, 19(3), 313-340.
14. Meyer, D.K., Turner, J.C., & Spencer, C.A. (1997). Challenge in a mathematics classroom: Students' motivation and strategies in project-based learning. *The Elementary School Journal*, 97(5), 501-521.
15. Norman, D.A. & Spohrer, J.C. (1996). Learner-centered education. *Communications of the ACM*, 39(4), 24-27.
16. Rackham, N. (1988). *Spin selling*. New York: McGraw-Hill.
17. Scarbrough, H., Bresnen, M., Edelman, L.F., Laurent, S., Newell, S., & Swan, J. (2004). The processes of project-based learning: An exploratory study. *Management Learning*, 35(4), 491-506.
18. Seymour, E. & Hewitt, N.M. (1997). *Talking about leaving: Why undergraduates leaves the sciences*. Boulder, CO: Westview Press.
19. Siegel, C.F. (2000). Introducing marketing students to business intelligence using project-based learning on the world wide web. *Journal of Marketing Education*, 22(2), 90-98.
20. Thomas, J.W. (2000). A review of research on project-based learning. *The Autodesk Foundation*,
21. Tufte, E. (2001). *The visual display of quantitative information*. 2nd ed. Cheshire, CT: Graphics Press.