Using Complex IT in Specific Domains: Developing and Assessing a Course for Nonmajors

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Abstract—**Recent growth in the use of complex, domain-specific information technology (IT) applications by professionals in a number of non-IT disciplines, such as anthropology, chemistry, and sociology, has led to a demand for second-level IT courses that teach students who are not computer science majors how IT can be used to solve complex problems in specific professional domains. The authors provide and assess a solution to this problem by developing and evaluating a course in which complex IT concepts and tools are taught from the perspective of different disciplines. The course presents IT concepts through case studies of complex and specialized IT systems that are used to solve problems in well-defined domains. In this paper, the underlying ideas and design of this course are described. A pilot implementation of the course, with case studies in anthropology, sociology, and chemistry, is analyzed, and its impact on a variety of student perceptions about IT is discussed. The anthropology case uses a geographic information system with simulation capabilities to examine the expansion of tropical forest farmers and the accompanying deforestation in Central Panama. The sociology case uses advanced features of Microsoft Excel to examine and evaluate possible explanations for the shifts in occupational distribution that have occurred in the United States between 1980 and 1990. The chemistry case uses a molecular modeling system to examine methods for correlating measured physical properties of simple organic molecules with their structures.**

Index Terms—**Action research, computer science, fluency in information technology (IT), information technology education, lifelong learning.**

I. Introduction

LEARNING to use information technology (IT) effectively in individual and organizational domain-specific processes cannot be done in a single step. Such learning requires appropriate introductory concepts, experiences, motivations, and a lifelong commitment to learning. This article describes a framework for developing a second-level course that provides a strong foundation in IT and is embedded in hands-on use of the technology in different complex, research, and information-rich environments for students who are not computer science majors (referred to, in this paper, as nonmajors).

In the following sections, the current situation in connection with funded published research on the development of second-level courses for nonmajors is reviewed. The paper then discusses the rationale that guides the development of the proposed course, a case study development framework, assessment procedures, and the results of a pilot implementation of the course.

Manuscript received October 16, 2000; revised October 16, 2001. This work was supported in part by a grant from the National Science Foundation, DUE 9951418.

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Publisher Item Identifier S 0018-9359(02)01300-6.

II. Current Situation

One can see the depth of concern and the extent and variety of efforts addressing the problem of teaching IT to nonmajors by reviewing the projects in course and curriculum development supported by the National Science Foundation (NSF) in the United States. Listed here are some representative approaches to developing introductory and second-level IT courses for nonmajors (details available from http://www.nsf.gov and searchable based on DUE numbers).

1) *Portable Courseware for Technological Literacy (DUE 7419), B. Fagin, Dartmouth College, Hanover, NH*: As illustrated by quotes from the proposal, the Dartmouth project shares some of this project's goals:
   - "… [T]o reach students who would not normally consider technologically oriented courses, the course…will require no mathematics."
   - "The course will use a hands-on, active approach to learning."

   Different problems are being considered in this course. The use of a few well-developed domain-specific problems are presented and motivated by domain experts, rather than focusing on a multiplicity of "toy" problems. The media used in the two projects are different. The Dartmouth group has worked on the development of a CD-ROM, whereas this project's material will be available on the Web.
2) *Laboratory for Great Ideas in Computer Science (DUE 7400), J. Howland and G.Pitts, Trinity University, San Antonio, TX.* Although aimed at a similar student population, the Trinity project's goal, partially quoted here, differs substantially from the goal of this project: "This new course concept implements a contained laboratory that uses a breadth-first, rather than depth-first, approach to cover a broad range of computer science topics at the introductory level." This project does not aim for coverage of many topics; it aims for a few topics, to be experienced in a rich and motivating environment.
3) *Second Course in Computing for Nonmajors (DUE 7410), J. Waxman, Queens College, City University of New York, New York, NY.* In the Queens College project, what is proposed is "a second course which focuses on

the acquisition and presentation of data and information. For data acquisition, the course gives the student high-level mastery of the Internet. For the presentation of information students will master a multimedia authoring system...." This project's interest is less with the tools and more on their role in problem solving, as demonstrated by case studies and in student projects. It is believed that IT is used not just because it is there and for what it might do, but because students experience how to use it to become successful problem solvers.

Other examples that illustrate the current interest in innovative approaches for IT teaching to nonmajors can be drawn from the recent literature on IT education. Joyce [1], for example, uses a case-building approach in which students learn through writing essays about how an individual (the main subject of their essays) uses a computer to solve a specific problem. This project differs in that several cases are analyzed in one course, each prepared by an expert in the field and involving actual hands-on use of the computer tool used by the expert. Schneider [2] uses a course in computational science as a bridge between science disciplines particularly physical and natural sciences. This project differs in that it is not restricted to a specific group of nonmajors. Gurwitz [3] uses the Internet as a motivating theme of a computer literacy course for nonmajors. Again, this project differs in that it does not try to provide a more advanced understanding of IT concepts and application, beyond the scope of computer literacy courses. For example, it is assumed that the students already have some basic knowledge about word processing and spread-sheet tools, as well as Internet-related skills, which they should have acquired from a basic-level computer literacy course.

The authors submitted a proposal to NSF in late 1998. A support website was developed at NSF's request to supplement the material in the initial proposal. This website contains a video clip (prepared for Internet streaming with software from RealNetworks, Inc., Seattle, WA 98111 USA) that guided NSF reviewers through the different components of the project, including a multimedia case study of an application of spreadsheet, statistical analysis, and database management software in a sub-field of sociology. Now that the project is funded and underway, a new website has been developed to disseminate intermediate results of the project and serve as a document repository and communication hub for the project's participants. The URL for this new Web site is http://ww2.cis.temple.edu/nsflll/. (Note that the end of the URL shows the letter "L" in lowercase three times, not the number "1" three times).

III. Key Project Goals

The project aims at improving students' IT knowledge and skills and, at the same time, studying the impact on students of the new approach to teaching IT being developed through the project. As such, it can be characterized as an action research project [4]–[11], whose main research clients are the students who will be taking the course. The project focuses on three major goals.

1) Providing an understanding of how IT can be used in complex domain-specific problem solving. This concept involves the use of complete case-study examples of complex discipline-specific problems that have IT concepts and complex tools as essential elements of the solution.
2) Providing a foundation for continued learning. This provision involves the development of a thorough conceptual understanding of IT that will remain valid through changes in specific IT systems.
3) Specifying a generic case-study development framework. This specification involves creating an approach that allows others to replicate the course in different institutions, and developing guidelines to enable effective cooperation and coordination in interdisciplinary case development.

TABLE I
PROPOSED COURSE STRUCTURE

Week	Topic
1	Introduction
2	General IT topic 1
3	General IT topic 2
4	Case Study 1
5	Case Study 1
6	General IT topic 3
7	General IT topic 4
8	Case Study 2
9	Case Study 2
10	General IT topic 5
11	General IT topic 6
12	Case Study 2
13	Case Study 2
14	Final project presentations
15	Final exam

IV. Proposed Course

The proposed second-level course uses a case-study approach to lead students through the solution of substantial problems that integrate: 1) domain-specific knowledge and logic; 2) general scientific problem-solving strategies; 3) IT and mathematical methods; and 4) coordinated use of a number of IT tools. Students see how professionals from a number of disciplines use IT to solve problems. Those professionals explain the domain knowledge and logic and, with the IT faculty, discuss the process by which IT is deployed. The goal is to help students become personally involved in IT-supported problem solving as active learners, almost as if they were members of the project teams examined in the case studies. General IT topics are interspersed with the case studies (see Table I). Note that there are two classroom sessions and one lab session per week.

Students work on lab projects in connection with the case studies in order to adapt the methods and software used in the case studies to solve real-world problems in the disciplines of their choice. Complementing the case studies are modules describing salient aspects of IT. These modules establish the conceptual and technological context within which applications and continued learning take place. A final project builds on the generic knowledge and skills acquired throughout the course.

Whereas a first IT course for nonmajors provides the foundations for students to use basic IT tools and concepts, this second IT course helps students use IT in their problem solving at the level required by higher level discipline-specific courses. Thus, the second IT course can focus on discipline content instead of repeatedly focusing on developing IT skills.

V. Framework for Creating Case Studies

To achieve the objectives of the course, a framework is needed for creating challenging discipline-specific case studies that are understandable by nonmajors [12]. A key issue is how to express discipline specific problems as instances of more general concerns. For example, search, optimization, hypotheses formation, and validation of conclusions are universal activities, although they may be pursued differently in various disciplines. It is also important to ensure that the case studies have a uniform, consistent structure so that they are coherent to the students who can then better understand those higher level scientific concepts.

It is imperative to identify a case-study topic carefully so that the subsequent effort is fully realized. For example, case studies that are hard to generalize or are only of interest to a small segment of the population will not be useful. The following set of criteria are used for identifying relevant case study topics.

1) Topics should represent problems that can interest and motivate students from different disciplines.
2) Topics should represent true professional problems encountered by non-information systems (IS)–computer science (CS) researchers who use IT as an essential component of their problem-solving strategy.
3) It should be possible to abstract the case study so that students in the proposed course are placed in a situation where they can focus on problem-solving strategies and the role of IT without being distracted by logistic and usage difficulties unrelated to their learning. This abstraction process is important because the students in the proposed course will not necessarily be majors who have the domain knowledge and the motivation to overcome all difficulties.
4) The problem represented by the case study should be such that it requires the use of a major IT concept and related tool. Many complex scientific problems are best solved by paper and pencil or by simple IT tools, such as a word processor. However, problems that require the use of relatively complex IT need to be the focus.

A. Case-Study Content

The goal of the case study is to make concrete otherwise abstract scientific problem-solving techniques. A key tool for showing the process of abstraction is the use of examples. As students move through repeated examples, they draw abstract conclusions about how scientific problems are examined. Therefore, the main tool for implementing a case study is the creation and availability of several high-quality illustrative examples. These examples are rich in context and data and yet allow students to recognize the commonalties of the approach and the similarities in the use of IT across disciplines.

B. Role of IT

The case study should demonstrate that the use of IT is a repeatable experience in which ideas about causes for phenomena can be tested and refined. Moreover, understanding that IT is a tool that allows a natural way of extending how one operates needs to be reinforced. IT should be presented as a tool of choice in a variety of domains and in a number of different contexts (e.g., statistical analysis, visualizations).

VI. Evaluating a Pilot Implementation of the Course

A pilot implementation of the course was conducted in fall 1999 with students in an introductory course on IT. The purpose of this pilot study was to understand opportunities and problems to be addressed in the actual course. The three case studies, described in Appendix A, in anthropology, sociology, and chemistry were taught by three different professors of anthropology, sociology, and chemistry, respectively, in different sections of the introductory course on IT. Four course sessions at the end of the semester were used for each case study. After each case study, students were asked to complete the questionnaire in Appendix B, which contains multiple-choice and open-ended questions, and to participate in a focus group discussion in which they talked about their perceptions of the case study. In addition, one teaching assistant and one researcher (from among the authors of this article) were present at the course sessions and took notes based on their participant observation, which were later compared with the instructor's own perceptions.

A. Summarizing the Quantitative Analysis

Table II summarizes the quantitative answers to the questionnaire in Appendix B, separated by application area. They suggest that students, on average, did not have a good knowledge of IT (Q1), were not particularly interested in taking IT courses (Q2), and were not generally attracted to IT (Q3) prior to taking the course and working on the cases. Regarding the impact of the case study on students' IT perceptions, the answers suggest that the case study: 1) did not have a positive influence on their perception that they should take more IT courses in the future (Q4); 2) did not have a positive influence on their perception that they should pursue an IT career (Q5); 3) had a positive influence on their perception of IT's potential for solving complex tasks (Q6); and 4) had a positive influence on their general perception of IT (Q7). The compilation of answers on Table II also suggests that students, in general, perceived that they learned something but not much about specialized IT applications (Q8) and IT issues in general (Q9).

Table III summarizes the results of a correlation analysis of the quantitative answers provided for questions Q1 to Q9. Because the quantitative answers were given based on a Likert scale (see Appendix B), the correlation analysis technique used was Spearman's. The coefficients were calculated based on a two- tailed test.

In Table III, the focus is on the relationship among variables Q4 to Q9, which store information related to the impact of the case study on students, and between them and variables Q1 to Q3, which describe student perceptions about IT prior to taking the course and the case study. The correlation links indicated in Table III are those with chance probability lower than 1% (i.e., $P < 0.01$). They suggest the following.

TABLE II
SUMMARY OF QUANTITATIVE ANSWERS

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Anthropology (N=12)	2.08	1.33	1.33	1.75	0.75	2.58	2.58	2.20	2.00
Sociology (N=18)	2.06	1.44	1.53	1.94	1.22	2.44	2.39	2.17	2.44
Chemistry (N=14)	1.50	1.36	1.64	1.93	0.93	2.92	2.77	2.31	1.92
Mean	*1.88*	*1.38*	*1.50*	*1.87*	*0.97*	*2.65*	*2.58*	*2.22*	*2.12*

Range: 0 - 4 (Mid scale = 2)

Q1. I already had a very good knowledge of Information Technology (IT) prior to taking this course.

Q2. I intended to take as many IT courses as possible in college prior to taking this course.

Q3. I was generally very attracted to IT issues prior to taking this course.

Q4. The case study made me feel like I should take more IT courses in the future, even if I don't pursue a career in IT.

Q5. The case study made me feel like I should pursue an IT career.

Q6. The case study improved my perception of IT's potential for solving complex tasks.

Q7. The case study improved my general perception of IT.

Q8. I learned a lot from this case study about specialized IT applications.

Q9. I learned a lot from this case study about IT issues in general.

TABLE III
SIGNIFICANT CORRELATION COEFFICIENTS

	Q4	Q5	Q6	Q7	Q8	Q9
Anthropology (N=12)		Q2,Q3			Q9	Q8
Sociology (N=18)	Q2,Q3					
Chemistry (N=14)	Q6	Q2	Q4			

P < .01 and Coeficient > .6

Q1. I already had a very good knowledge of Information Technology (IT) prior to taking this course.

Q2. I intended to take as many IT courses as possible in college prior to taking this course.

Q3. I was generally very attracted to IT issues prior to taking this course.

Q4. The case study made me feel like I should take more IT courses in the future, even if I don't pursue a career in IT.

Q5. The case study made me feel like I should pursue an IT career.

Q6. The case study improved my perception of IT's potential for solving complex tasks.

Q7. The case study improved my general perception of IT.

Q8. I learned a lot from this case study about specialized IT applications.

Q9. I learned a lot from this case study about IT issues in general.

1) In the sociology application, the impact of the case study on the students' perception that they should take more IT courses in the future (Q4) was significantly correlated with their predisposition to take IT courses (Q2) and how attracted they were to IT issues prior to taking the course (Q3).
2) In the chemistry application, the impact of the case study on the students' perception that they should take more IT courses in the future (Q4) was significantly correlated with their perception of IT's potential for solving complex tasks (Q6).
3) In the anthropology application, the impact of the case study on the students' perception that they should pursue an IT career (Q5) was significantly correlated with their predisposition to take IT courses (Q2) and with how attracted they were to IT issues prior to taking the course (Q3).
4) In the chemistry application, the impact of the case study on the students' perception that they should pursue an IT career (Q5) was significantly correlated with their predisposition to take IT courses (Q2).
5) In the anthropology application, the impact of the case study on the students' perception of the degree to which they had learned something about specialized IT applications (Q8) was significantly correlated with the impact of the case study on the students' perception of the degree to which they had learned something about IT issues in general (Q9).

B. Summarizing the Qualitative Analysis

The main sources of qualitative data in this study were the open-ended questions in the questionnaire distributed to students (available in Appendix B), participant observation notes taken by one teaching assistant and one researcher during each case, notes based on the focus-group discussion involving one researcher and the students at the end of each case, and the instructor's own perceptions. The triangulation of the data coming from these different sources suggests positive and negative aspects of each case, which are summarized in Table IV. For the sake of realism, Table IV uses terms similar to those provided by the students when describing their perceptions.

An analysis of Table IV suggests that the case studies had a positive impact on students' perceptions about IT's potential for supporting specialized tasks (PA1, PA2, PS1, PS2, PC1). However, they evoked negative student perceptions regarding the relevance of this type of knowledge for their chosen majors or careers, particularly in the anthropology and chemistry cases (NA1, NA3, NC1, NC2). In these two cases, difficulties with

TABLE IV
MAIN POSITIVE AND NEGATIVE ASPECTS OF CASES AS PERCEIVED BY STUDENTS

	Positive aspects
Anthropology	PA1: New computer software and new info. about maps development
	PA2: Saw how computers can be used to trace human history
	PA3: Well organized lectures and labs
Sociology	PS1: Illustrated IT and gave me an idea of what IT can do & IT's potential
	PS2: Good use of data to find trends
	PS3: Informative
	PS4: Ease of using Excel
	PS5: Learn the job market that is arising & the way it may be in future
	PS6: It showed us the future of the job industry
Chemistry	PC1: Amazed at how computers work to make difficult tasks easier
	PC2: Made me aware of IT courses to stay away from
	PC3: Liked working with Alchemy in the lab
	PC4: Interesting to use Alchemy in relation with Internet
	Negative aspects
Anthropology	NA1: Not relevant to career/major
	NA2: Material itself was very dry
	NA3: I am just not interested in this
	NA4: Doesn't seem to be applicable to other fields of study
	NA5: Needs to be generalized, show how applied to a wide range of fields
	NA6: Computer glitches that need to be worked out
Sociology	NS1: Did not sound interesting at all
	NS2: It was somewhat boring and slow
	NS3: Calculations were tedious
	NS4: Complicated math
	NS5: Accountant like dullness, need more dynamic involvement from class
Chemistry	NC1: Case study did not relate to me leaving me clueless
	NC2: Irrelevance to major, satisfies no requirement, waste of time
	NC3: Waiting long for results and didn't know what to do with them
	NC4: Software was somewhat confusing
	NC5: Computers were slow

using features of the computer systems (NC3, NC4) and their malfunction (NA6, NC3, NC5) were also mentioned as negative aspects, even though students also reported enjoying working with the systems (PA1, PC3, PC4). In the sociology case, the computer system was seen as simple and easy to use (PS4), and no malfunctions were reported. However, the case itself was seen as using complex and boring concepts and methods (NS1, NS2, NS3, NS4, NS5).

VII. DISCUSSION AND FUTURE RESEARCH

The data analysis summarized in Section VI suggests that the case studies had a positive impact on how students who are not particularly interested in IT perceive IT in general, and how IT can be applied to complex and specialized tasks. Although the students generally perceived that they learned something from the case studies, the results also suggest that the case studies did not have a positive impact on the students' willingness to pursue an IT career or take other IT courses. One plausible explanation for this attitude is that subjecting nonmajors to complex and specialized IT applications increases their respect for IT's potential, but does not give them confidence to become specialized IT users themselves. It is quite possible that the degree of technological and domain complexity in the case studies led the students to believe that using IT was too difficult for the tasks that they may have to accomplish in their chosen fields of study.

The correlation analysis suggests some interesting trends. One obvious and expected trend is a strong positive correlation between the degree of students' interest in IT prior to being exposed to the case studies, and their degree of interest in taking more IT courses in the future and pursuing an IT career. If this correlation were negative, the case studies would be turning off previously interested students, but the data indicates that they are not. Another observation is a strong positive correlation between the students' perception of the degree to which they learned about specialized IT applications and about IT issues in general. That is, the specialized case studies seem to have served the purpose of advancing the students' general understanding of IT issues.

The results of the qualitative analysis reinforce these findings. They also provide hints on possible explanations for these findings and ways to improve the overall impact of the cases on students' perceptions and learning. For example, the negative student perceptions regarding the relevance of this course to their chosen major or career suggests that this type of course may not be appropriate as a core (i.e., nonelective) course. The occurrence of computer problems resulted from the complexity of the anthropology and chemistry computer systems and related installation problems, which should be eliminated in future implementations of the course. The perceived complexity of the topics can be addressed by dedicating more time to the demonstration of the computer systems and how they relate to the concepts and theory discussed in the lectures.

The conclusions drawn in this paper are only preliminary because they are based on a study in which case studies were inserted at the end of an introductory course on IT, which, in the future, will be a prerequisite for the course being developed. Nevertheless, they provide a basis for taking some further action. A fundamental problem with a course that involves a number of instructors, especially from different disciplines, is how to achieve conceptual integration and convey to students a clear understanding of what they are expected to learn and what they are expected to do in order to succeed. Here are some of the steps that will be taken to cope with this issue.

1) A single faculty member, the course coordinator, will take responsibility for the course and have other IT and non-IT faculty participate as guest lecturers on the case studies and on specific IT modules. The course coordinator will, in a manner agreed upon with the other participants, act as host and commentator for the other participants. In different terms the role of course coordinator will be rotated among co-principal investigators in an effort to arrive at a course format and assessment that is not totally dependent on the personality of the course coordinator.
2) A common template will be used for all of the case studies. The case studies will still represent real-world problems that will further engage the interest of students.
3) General tools such as databases, spreadsheets, and statistical systems will be discussed in the context of case studies or their role in the technological infrastructure used in the course. The instructors will demonstrate how the ideas underlying these tools have broad application and are central to solving problems across disciplines.
4) Students will need to commit substantial time to the course, and they will need to feel that the investment is worthwhile. Students will be given a clear understanding of the goals of the course and, where possible, they will participate in the process of achieving these goals. Lab exercises and projects will take a more professional form that will enrich the students' portfolios of demonstrable accomplishments. This focus on shared goals and demonstrable accomplishments helps establish a unifying approach for the course.
5) Emphasis will be placed on a capstone project in order to provide students with the opportunity to explore a problem in more depth.

Obviously, other unanticipated problems will also arise as the instructors begin to teach the course. One area in which potential problems may arise is in the development of domain-specific case studies where, as noted in previous studies of nonmajor courses [13], the views of the domain experts about what is an interesting (or even acceptable) topic may not match that of students outside the experts' specific disciplines. For example, a student majoring in anthropology may see a case study on computer applications in molecular biology research as too dry to be meaningful.

Another potentially problematic area is that of evaluation because certain variables can add uncertainty to findings based on assessments of the long-term impact of the course on students. For example, a longitudinal analysis may reveal that the expected long-term impact of the course on nonmajors' interest in IT topics cannot be clearly traced back to the course, because it may be that only students who already had an interest in IT topics took the course. Therefore, some experimental controls will have to be used in the study; however, these should not interfere with pedagogical goals.

Appendix A
Case Study Descriptions

A. *Modeling Human Behavior Over Time and Space: Deforestation in Tropical America*

This case study examines the expansion of tropical forest farmers and the accompanying deforestation in Central Panama during the time period from 9000 to 2000 years ago through the use of simulations carried out in a Geographic Information Systems (GIS) environment. The question addressed is whether the human groups inhabiting Central Panama were behaving in an evolutionarily sound fashion; that is, did they make decisions that tended to maximize their returns for effort expended? The archeological and ecological data used in this case study comes from 15 years of research in Panama. It includes maps of the 20 000-km^2 study area, showing elevations, hydrologic features, and soils; rainfall and temperature data for various locations; and a database of archeological site information with location, age, size, and function. The principal software tools are Idrisi (Clark Laboratories, Worcester, MA 01610-1477 USA) and ArcView (ESRI, Inc., Redlands, CA 92373-8100 USA).

B. *Occupational and Age Cohort Consequences of the Industrial Transformation, 1980–1990*

This case study examines and evaluates possible explanations for the shifts in occupational distribution that have occurred in the United States between 1980 and 1990. There are two general explanations. First, because industries differ in their occupational distributions, patterns of industrial growth and decline will produce changing occupational distributions. Second, changes in the organization of work within an industry because of technology and new organizational forms create occupational shifts. The question is how to assess the relative importance of the two explanations. Data used in this case study are the 1% public use sample of the 1980 and 1990 U.S. censuses. The principal software tool used is Excel (Microsoft Corporation, Redmond, WA 98052-6399 USA).

C. *Exploring Structures of Organic Molecules by Computational Methods*

This case study examines methods for correlating measured physical properties of simple organic molecules with their structures. Students use the laws of physics and appropriate computational methods to predict the structures and properties of simple molecules (the answers being checked by reference to suitable data bases, e.g., NIST, Beilstein). The calculations are performed with the aid of commercially available software, such as Alchemy (Alchemy Software, Wesley Chapel, FL 33543 USA), HyperChem (Hypercube, Inc., Gainesville, FL 31601 USA), Spartan (Wavefunction, Inc., Irvine, CA 92612 USA), and Gaussian94 (Gaussian, Inc., Carnegie, PA 15106 USA). The calculations explore paths permitted by the physical constraints to produce a minimum-energy arrangement of the nuclei within the molecule and, thus, generate a global minimum structure. Comparison of the energies of structures so produced allows predictions of (at least relative) physical properties, which can then be compared to those found in databases of chemical and physical properties.

APPENDIX B
QUESTIONNAIRE USED IN THE COURSE IMPLEMENTATION

For questions 1–9, the following scale was used in the first part of the questions.

( ) Strongly disagree ( ) Disagree somewhat ( ) Neither disagree or agree
( ) Agree somewhat ( ) Strongly agree

Demographics:

Sex: ( ) Male ( ) Female
Age: ______
First language: ( ) English ( ) Other ______________

Attitudes Toward IT Prior to Taking the Course

1) I already had a very good knowledge of Information Technology (IT) prior to taking this course.
2) I intended to take as many IT courses as possible in college prior to taking this course.
3) I was generally very attracted to IT issues prior to taking this course.

Case Study Impact on Attitudes Toward IT

4) The case study made me feel like I should take more IT courses in the future, even if I don't pursue a career in IT. Why? (Explain your answer.)
5) The case study made me feel like I should pursue an IT career. Why? (Explain your answer.)
6) The case study improved my perception of IT's potential for solving complex tasks. Why? (Explain your answer.)
7) The case study improved my general perception of IT. Why? (Explain your answer.)

Case Study Impact on IT Knowledge

8) I learned a lot from this case study about specialized IT applications. Why? (Explain your answer.)
9) I learned a lot from this case study about IT issues in general. Why? (Explain your answer.)

Positive and Negative Aspects of the Case Study:

10) What were the main positive aspects of this case study?
11) What were the main negative aspects of this case study?

ACKNOWLEDGMENT

The authors would like to thank D. Dalton, D. Elesh, M. Manduwalla, and T. Ranere for bringing a truly multidisciplinary flavor to this project, A. Chawarpatil and L. Pongan for their excellent work as student assistants, and the students who took the course, for completing questionnaires and providing valuable insights during interviews and focus group discussions.

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