RESULTS OF USING A CONTEXTUALIZED CASE STUDY IN THE SENIOR CAPSTONE COURSE

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ABSTRACT

This paper provides an overview and the results of using a contextualized case study in the information technology senior capstone course. From our findings, we believe that computer science and information systems/technology senior capstone courses should use a contextualized case study to emphasize the role of information technology and its effect on the adopting enterprise. The case study approach in the senior capstone course has proven to help students examine and review the computing technology, its implementation across the organization, and its business process impacts on the information technology infrastructure for successful implementations. The statistical data gathered from three sections of the senior capstone has allowed for proper assessment and evaluation of the course outcomes as well as the evaluation of student achievement of specific components.

INTRODUCTION

Case-based and problem-based learning are proven strategies and effective methods of instruction [2, 15]. Case studies, real or hypothetical, are used in case-based and problem-based learning in accounting, business, computer science, information systems/technology, law, medicine, and psychology to teach the complex, interdependent ideas essential in these fields and the skills needed in everyday practice [7, 8, 9, 10, 12, 15]. Computer science and information systems/technology case studies introduce students to the growing use and benefits of information technology, data networks, computer security, big data, databases, operating systems, et cetera, in today's organizations. Faculty can incorporate computer science and information systems/technology case studies that are included in some course textbooks or write their own when developing lesson plans and course notes that introduce and hone the course and program educational objectives and required concepts. Case studies can be used in online, classroom, or blended courses.

Last year we presented an overview of case-based and problem-based methodologies and the switch to use a contextualized case study in the information systems and information technology senior capstone courses [4]. In this paper we present the results of switching to these methodologies and confirm that the use of case studies introduces the student to the growing use and benefits of information systems. The results of our data collection clearly show the need for faculty to develop and utilize computer science and information systems/technology case studies in the senior capstone course.

BACKGROUND: CASE-BASED AND PROBLEM-BASED LEARNING

In problem-based learning, students are presented with a real-world problem that is ill-defined. They work either individually or in teams to formulate and assess the different solutions, agree on the best solution, appraise the solution, make a case for the chosen solution, and evaluate the lessons learned [11, 13, 14]. Results from Linn and Clancy [3] indicated that case studies are effective in communicating the complex and multi-dimensional decisions inherit in computer science and

information systems/technology problem contexts. Contextualized case studies allow students to learn both content knowledge and problem solving skills simultaneously, thus enabling them to learn to think more effectively and develop needed problem-solving skills [4, 5, 6, 15]. Hmelo-Silver, Duncan, and Chinn [2] argued the effectiveness of problem-based and inquiry learning in knowledge acquisition and transforming students to become lifelong learners.

Computer science and information systems/technology case studies provide a way for creating realistic problem contexts that enable students to see the utility of knowledge and to understand the conditions for its use [4, 5, 6]. Case studies allow for paralleling contemporary real world situations, enabling team learning, focusing on active involvement and assessment, and making students reflect on the lessons emanating from the discussions [1, 4, 5]. The case study approach helps students learn to recognize the important features being studied, the range of information technology problems to which a particular solution can be transferred and applied, and to abstract general principles from them [4, 5].

In case studies, macro-contexts can help in managing the complexity of the presented problems [4, 5, 15]. Macro-contexts are designed with features that make complexity manageable. Macro-contexts features include using a story format, presentation, embedded data, and real-world accuracy [4, 5, 15]. Ill-defined case studies allow students to develop their own thinking and define the scope of the given problem, which represent situations information technology professionals typically face [10]. By applying several theories to the given case study, students recognize that different solutions could be achieved from the various adopted theories and perspectives [10].

THE USE OF CASE STUDIES IN THE SENIOR CAPSTONE COURSE

One of the main outcomes of the senior capstone course is to allow students to demonstrate the mastery of the computer science and information systems/technology content knowledge and problem-solving skills amassed through their course work in the degree program. Many computer science and information systems/technology programs use the senior capstone course as a measure to assess the achievement of the student outcomes, which are statements that describe what students are expected to know or be able to do by the time of graduation. Since most senior capstone courses provide a list of projects that students need to select from, assessing the mastery and achievement of the student outcomes can be difficult. The capstone grading rubrics are more general in nature due to the diversity of the projects, which makes it harder to evaluate the achievement of the program student outcomes [4].

In the last two years the information systems and information technology senior capstone courses at College of Computer and Information Sciences (CC&IS) at Regis University were revised to use only a contextualized case [4]. In the revised capstone course, students are presented with a real-world problem that is ill-defined. Using knowledge acquired in the previous classes, they work on defining the problem precisely, determining the requirements, needs, and providing a solution. Students work individually to formulate and assess the different solutions, appraise the selected solution, and make case for it, as well as evaluate lessons learned [4].

Based on the specific case study as mentioned in [4], the following instrument was developed and used in grading the senior capstone in three terms during the 2015 and 2016 academic years.

Criteria	Exemplary	Proficient	Basic	Not Demonstrated	Pts. Earned	Faculty Comments
TECHNOLOGY COMPONENT						
Carlson's Storage Solution (5%) Discuss how Carlson's storage solutions address the IT goals the	Produces a **clear** description of Carlson's storage solution.	Produces an **adequate** description of Carlson's	Produces an **unclear** description of Carlson's storage solution.	**Does not** produce a description of Carlson's storage solution.		

company is trying to achieve.		storage solution.				
Points	5	4 - 3	2 - 1	0		
Pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement (5%) Discuss the pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement it replaced.	**Clearly** and in a **comprehensive** manner discussed the pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement it replaced.	**Adequately** discussed the pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement it replaced.	**Inadequately** and in an **unclear** manner discussed the pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement it replaced.	**Does not** discuss the pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement it replaced.		
Points	5	4 - 3	2 - 1	0		
Big Data (10%) Explore the topic of big data (benefits, detriments, new technologies, tools, etc.)	**Clearly** explores the topic of big data.	**Adequately** explores the topic of big data.	**Inadequately** and in an **unclear manner** explores the topic of big data.	**Does not** explore the topic of big data.		
Points	10 - 9	8 - 7	6 – 3	2 - 0		
Carlson's SSM enables Carlson Companies to deal with future big data needs (10%)	**Clearly** and in a **comprehensive** manner describes how Carlson's SSM enables Carlson Companies to deal with future big data needs.	**Adequately** describes how Carlson's SSM enables Carlson Companies to deal with future big data needs.	**Inadequately** describes how Carlson's SSM enables Carlson Companies to deal with future big data needs.	**Does not** describe how Carlson's SSM enables Carlson Companies to deal with future big data needs.		
Points	10 - 9	8 - 7	6 – 3	2 - 0		
Create an IT initiative that will enable Carlson Companies to meet their future data needs Big Data Initiative for Manufacturing (20%) Create an IT initiative that includes the required 4 items	**Clearly** and in a **comprehensive** manner creates an IT initiative that will enable Carlson Companies to meet their future data needs that includes all **4** items.	**Adequately** creates an IT initiative that will enable Carlson Companies to meet their future data needs that includes at least **3** areas.	**Inadequately** creates an IT initiative that will enable Carlson Companies to meet their future data needs that includes at least **2 or fewer** areas.	**Does not** create an IT initiative that will enable Carlson Companies to meet their future data needs.		
Points	20 - 16	15 - 11	10 – 6	5 - 0		
Develop a data center design of your IT initiative with an Implementation Roll-out (25%)	**Clearly** and in a **comprehensive** manner develops a data center design of an IT initiative with an implementation roll-out.	**Adequately** develops a data center design of an IT initiative with an implementation roll-out.	**Inadequately** develops a data center design of an IT initiative with an implementation roll-out.	**Does not** develop a data center design of an IT initiative with an implementation roll-out.		
Points	25-19	18 - 12	11 – 5	5 - 0		
EFFECTIVE WRITING COMPONENT						
Grammar (5%)	Writing is error-free.	Grammatical errors exist, but do not seriously detract from meaning.	Writing has many grammatical errors that detract from meaning.	Writing has so many grammatical errors as to be virtually unreadable.		
Points	5	4 - 3	2 - 1	0		

Spelling (4%)	Writing is error-free.	Spelling errors exist, but they do not seriously detract from meaning.	Writing has many spelling errors that detract from meaning.	Writing has so many spelling errors as to be virtually unreadable.		
Points	4	3	2 - 1	0		
Sentence Structure (4%)	Sentences are varied and grammatically correct.	Sentences have grammatical errors, but could have been more varied and interesting.	Sentences are simple and lack variety. A number of grammatical mistakes are present.	Sentences are unclear and many grammatical errors in structure make paper unreadable.		
Points	4	3	2 - 1	0		
Word Choice Vocabulary (3%) **Word choice and** vocabulary show **clear understanding of course content**	Word choice and vocabulary show an exceptional understanding of course content. Word choice is well matched to the subject and audience.	Some understanding of course content is shown. Word choice and vocabulary are acceptable.	Word choice and vocabulary do not clearly express ideas or address the assignment.	Word choice and vocabulary are vague and unclear.		
Points	3	2	1	0		
Organization (4%) **Paper is organized and readable; has distinct introduction, body, and conclusion**	Paper is interesting and readable having a distinct intro that grabs the reader's attention; a body that clearly addresses all main points; and a conclusion that ties paper together. Paragraphs flow together with smooth transitions.	Paper is readable and has an introduction, a body, and a conclusion. Some points could have used stronger support, and stronger transitions could have helped paper have better flow.	Paper has limited readability and an inadequate introduction, body, and/or conclusion. Transitions are lacking, and paper is difficult to understand.	Paper is disorganized, has no introduction, body, or conclusion. Work needs to be reorganized and re-done.		
Points	4	3	2 - 1	0		
APA (5%) **Paper follows approved APA guidelines for citations and the reference list.**	Paper includes citations and a reference list that are **always** presented in the correct APA format.	Paper includes citations and a reference list that are **mostly** presented in the correct APA format.	Paper includes citations and a reference list; however, they are **not** presented in the correct APA format.	Paper **never** includes citations and a reference list.		
Points	5	4 - 3	2 - 1	0	**2**	
TOTAL POINTS EARNED or PROJECT GRADE (out of 100 available points)					93	

RESULTS

The following table presents the quantitative results of the data analysis using the above rubric (*n=9*).

	Average	STDEV	Percent
Carlson's Storage Solution (5%)	5.00	0.00	100.00
Pros and cons of consolidating data in central data center facilities versus the distributed data storage arrangement (5%)	4.44	1.67	88.89

Big Data (10%)	8.89	3.33	88.89
Carlson's SSM enables Carlson Companies to deal with future big data needs (10%)	9.11	1.05	91.11
Create an IT initiative that will enable Carlson Companies to meet their future data needs Big Data Initiative for Manufacturing (20%)	19.78	0.67	98.89
Develop a data center design of your IT initiative with an Implementation Roll-out (25%)	20.00	4.06	80.00
Grammar (5%)	4.33	0.50	86.67
Spelling (4%)	4.00	0.00	100.00
Sentence Structure (4%)	3.56	0.53	88.89
Word Choice Vocabulary (3%)	2.78	0.44	92.59
Organization (4%)	3.56	0.53	88.89
APA (5%)	3.11	1.36	62.22
Total (100%)	88.56	7.30	88.56

DISCUSSION

Using the above rubric, the end results were student averages of 88.56 with a standard deviation (SD) of 7.3. What we found interesting is that all answered the Carlson's storage solution question with 100% accuracy, yet the pros and cons of consolidating to a datacenter were answered with only 88.89% accuracy (SD=1.67). All but one students gained knowledge in Big Data with an average score of 88.89 (SD=3.33), and were almost spot on with Carlson's SSM with the average at 91.11 (SD=1.05). What was most impressive is their average score of 98.89 (SD=.67) when asked to present an IT initiative for Big data. However, where we saw things fall apart was in students coming up with a data center design to support this initiative. Here was saw average scores of 80 with a standard deviation of 4.06. When we got into the section of effective writing we saw spelling at 100% and would expect this with all the spell check programs available today. However, sentence structure averaged 88.89 with a standard deviation of .53. Although sentence structure was at 88.89, word choice came in slightly higher at 92.59 (SD=.44) and overall organization of the paper was at 88.89 (SD=.53). Disappointing, however is what we saw in the APA scores. Throughout our computer science curriculum we have students writing papers which reinforce the proper use of APA, yet in this capstone case study, APA scores averaged 62.22 with a standard deviation 1.36! This clearly indicates that we are not getting across to our students in the CS program the need for proper APA citation within research papers and assignments requiring APA format. We also believe this shows that our professors may not be stressing APA as much as they should be.

CONCLUSIONS

This paper provided an overview and the results of using a contextualized case study in the information technology senior capstone course. From our findings we believe that computer science and information systems/technology senior capstone courses should use a contextualized case study to emphasize the role of information technology and its effect on the adopting enterprise. The case study approach in the senior capstone course has proven to help students examine and review the computing technology, its implementation across the organization, and its business process impacts on the information technology infrastructure for successful implementations. The case study exposed the students to the pros, cons, potential ROI, ethical implications on the society, the business settings, and the consideration of the true costs when evaluating information technology solutions. In addition, it allowed the student to understand the different ethical implications and privacy issues raised due to

the use of information technology in the enterprise and their possible effects on ROI. The case study approach exposed the students to the different information technology manager roles and responsibilities. Using a case study approach to the senior capstone has allowed proper assessment and evaluation of the course outcomes as well as evaluate the achievement of the program student outcomes. Further research to this study will compare information systems capstone rubrics to information technology capstone rubrics and identify if the results are similar. Also, the characteristics that each case-study (CIS or IT) possesses and how it impact students' perceptions and performance in the course.

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