

An Investigation of Student Impressions of the Case Study Teaching Method

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Abstract

Case studies are used extensively in medical, law, and business schools to help students understand how theory applies to actual events or situations. This work explores the impact of the use of case studies in an environmental engineering laboratory, introductory engineering course, introductory biology seminar course, and upper level biology course. Motivations for implementing the cases include determining how case studies teaching impacts students' ability to carry out a scientific investigation (from hypothesis to data analysis to discussion of results) and if the results correlate to students' learning style preferences. This work is part of a continuing funded investigation of the use of case studies with the potential to contribute to the body of knowledge related to the use of learning styles assessments in educational practice across a variety of disciplines. The full study includes quantitative and qualitative assessments in the form of surveys, focus groups with students, and evaluation of student work (lab reports or oral presentations) for quality and content by two external reviewers. Student learning styles (active/reflective, sensing/intuitive, visual/verbal and sequential/global) were also assessed using the Index of Learning Styles Survey (ILSS) by Felder and Solomon. Data was collected at three different institutions: a public, land-grant minority serving institution, a private minority serving liberal arts college for women, and a private, predominantly white liberal arts college. A control group of students experienced a traditional laboratory or seminar and an intervention group experienced case studies to cover the same content. For this work, institutional survey data collected over two years assessing student impressions of the case study method were evaluated to determine if the responses vary by institution type. Early data reveals some interesting demographic trends and possible reasons for the behavior are discussed.

Introduction

Many millennial generation students indicate an interest in taking classes that increase engagement, use technology, and demonstrate relevance for how their class content applies to real, societal contexts.¹ This education research study is a collaborative effort to investigate how to improve STEM laboratory instruction at three different institutions. These institutions are North Carolina Agricultural and Technical State University (NC A&T), a public, land-grant minority serving institution; Bennett College, a private minority serving liberal arts college for women; and Elon University, a private, predominantly white liberal arts college. The goal of the work is to assess the use of the Case Study Teaching in the Sciences Method to improve STEM laboratory and seminar instruction. The participating universities capture demographic groups and institution types that can be explored as well. The Case Studies in the Sciences Teaching Method is a pedagogy which promotes the use of interactive "stories" which link societal contexts to the skills being taught to engage students in STEM courses.²⁻⁵ Therefore, for this

investigation, cases were used to introduce real world topics and show how the analytical skills being learned in the lab or seminar apply to the “story” with the goal of elevating the learning experience from traditional “step-by-step” cookbook style of laboratory and lecture-based seminar courses.

This educational research may be categorized as an exploratory education study that compares the results for the use of cases in a biology laboratory course, biology seminar course, an engineering laboratory course, and a general engineering seminar course. The research evaluates connections between student learning styles, participants’ impression of the case study teaching method, demographics, and institutional type. The full study includes qualitative and quantitative assessments to evaluate participant’s learning style preferences, perspectives on the value and effectiveness of the methods, learning gains, and critical thinking and seeks to identify trends that emerge among the demographic groups represented by the participants. This work is part of a continuing funded investigation of the use of case studies began in 2010 which has the potential to contribute to the body of knowledge related to the use of learning styles assessments in educational practice across a variety of disciplines.

Hypothesis

Data in this portion of the investigation was analyzed for specific interactions between student impressions and institutional type. The expectation was that the data would reveal institutional differences and that those trends would correlate to student responses to the case study impressions survey.

Methodology

Each course used two cases. “A Case in Point: From Active Learning to the Job Market,” published at the National Center for Case Studies Teaching in the Sciences (NCCSTS), served as the common case to acquaint students to the NCCSTS pedagogy. Each participating faculty member also selected a second case that matched a lab or interactive hands-on module corresponding to content typically covered in their course. NC A&T developed a case to present to the students the concepts of e-waste and risk assessment. The case was designed to teach student about disposal practices in the US versus third world countries for E-waste and discuss environmental ethics and justice. In this case, students assume the roles of engineers and scientists sent to investigate illnesses in workers exposed to hazardous e-waste. Using a method to randomly generate data for the occurrence of illnesses in workers who wear protective equipment versus workers who do not wear protective equipment, the students must predict the probability of illnesses occurring in the workers. As part of their laboratory report, the students must perform statistical analysis on the data collected for the workers and provide a discussion of their data using the case as the basis to predict the safe or unsafe e-waste handling practices at the facilities where the workers recycle e-waste. Elon developed a case for an introductory engineering course which covers a variety of topics and hands-on projects that do not

immediately seem related, and thus seeks to link a service-learning project to 3D modeling and printing. The first part carries students on a journey to understand the need for and to plan a service-learning project. The story begins with two students frustrated by their experience of facilitating an engineering design challenge with elementary school children. The case then directs students to use provided resources to plan and engage in a meaningful service-learning project. The second part continues the story of one of the disgruntled students experiencing a breakthrough when the needs addressed by the service-learning intervention are well-defined and when the student discovers a shared interest in 3D printing with one of the elementary school children. Students are then challenged to use engineering tools (hand graphics, CAD, and 3D printer) to design and fabricate a replacement for a broken piece to a block puzzle. The case study that was implemented at Bennett and used in the upper level Biotechnology course from NCCSTS database was “From Cow Juice to a Billion Dollar Drug, with Some Breakthroughs in Between”. This case study gives a historical timeline about the production of human insulin. This case study helps students to understand the different methods used to synthesize or isolate insulin from pigs and cows to bacteria. Students are asked to give a summary of an assigned section and then explain their answers to the questions in the case study with the class. This case study helps to solidify many of the concepts discussed in lecture. This case study is done the week before the lab on bacterial transformation and protein purification, two methods used in synthesizing human insulin.

Qualitative and quantitative measures were assessed to determine whether the case studies can increase student learning and address the various learning styles represented in the laboratory course. Surveys were used to query their impression of the case studies method used in laboratory and seminar courses. Focus group interviews were also conducted to capture student qualitative responses.

A survey instrument used in Yadav et al (2010) was modified to query students’ responses to the case study method. The modified survey consisted of 22 questions related to use of cases and student impression of the case study method. The questions are shown in Table 1. This assessment used a 5-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.⁶

Table 1. Case Studies Impression Survey Questions

1	I felt the use of case studies was relevant in learning about the course concepts
2	The case studies helped me analyze the basic elements of the course concepts
3	I felt that what we were learning in using the case studies was applicable to my field of study
4	The case studies were helpful in helping me synthesize ideas and information presented in the course
5	The case study allowed me to retain more from the class.
6	I felt that we covered more content by using the case study in class
7	I thought the use of the case studies in the class was thought provoking.
8	The use of case studies allowed for more discussion of course ideas in the class
9	The case study allowed me to view an issue from multiple perspectives
10	The case study brought together material I had learning in several other courses
11	The case study added a lot of realism to the class
12	I was more engaged in class when using the case study
13	The case studies was more entertaining than it was educational
14	I felt immersed in the activity that involved the use of case studies
15	I took a more active part in the learning process when we used the case studies in class
16	I was frustrated by ambiguity that followed when using the case study
17	I felt that the use of case studies in the course was inefficient
18	I found the use of case studies format challenging in the class
19	Most of the students I know liked the case studies
20	I needed more guidance from the instruction about the use of the case studies in the class
21	The case studies took more time than it was worth
22	The case studies allowed for a deeper understanding of the course material

Table 2. Case Studies Impression Survey Questions Grouped By Theme

Learning	Questions 1, 3, 5, 10, 15
Synthesis and Analysis	Questions 2, 4, 7, 9, 22
Classroom Environment and Instruction	Questions 6, 8, 12, 14, 18
Negative Impression	Questions 13, 16, 17, 20, 21

Results and Conclusions

Figures 1 – 4 show graphical comparisons of the case studies impression survey results by theme over a two year period for a total of 151 student participants. The trends that emerge show there are differences in student responses according to institution in this early data.

Of particular interest are the Elon student responses. Figure 1 shows that students at NC A&T and Bennett reported that they learned more than students at Elon in 2014/2015. However, in the following academic year, the responses of the study participants regarding learning rose significantly, surpassing the learning reporting by students at Bennett. This same trend presents in the responses to the synthesis and analysis questions shown in Figure 2. These observed improvements correspond to slight increases in the Elon students' impressions of the classroom environment and instruction (shown in Figure 3).

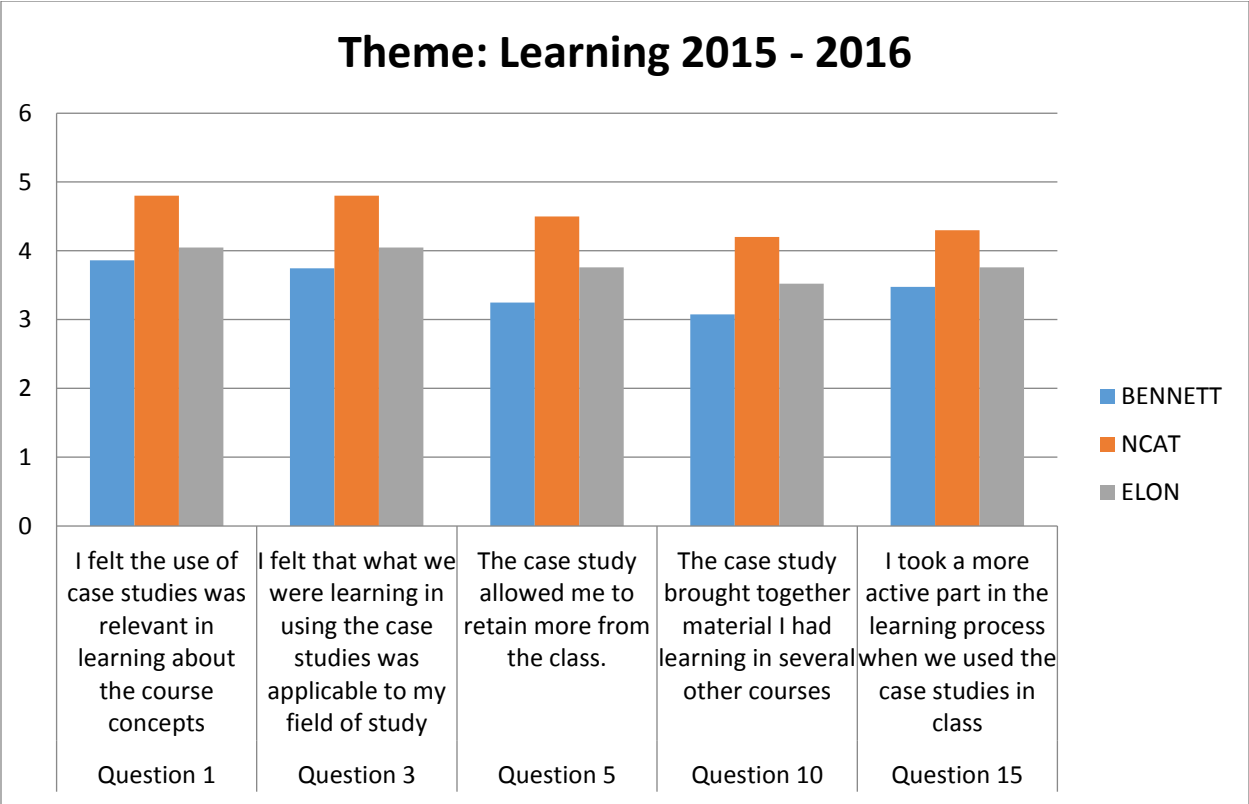
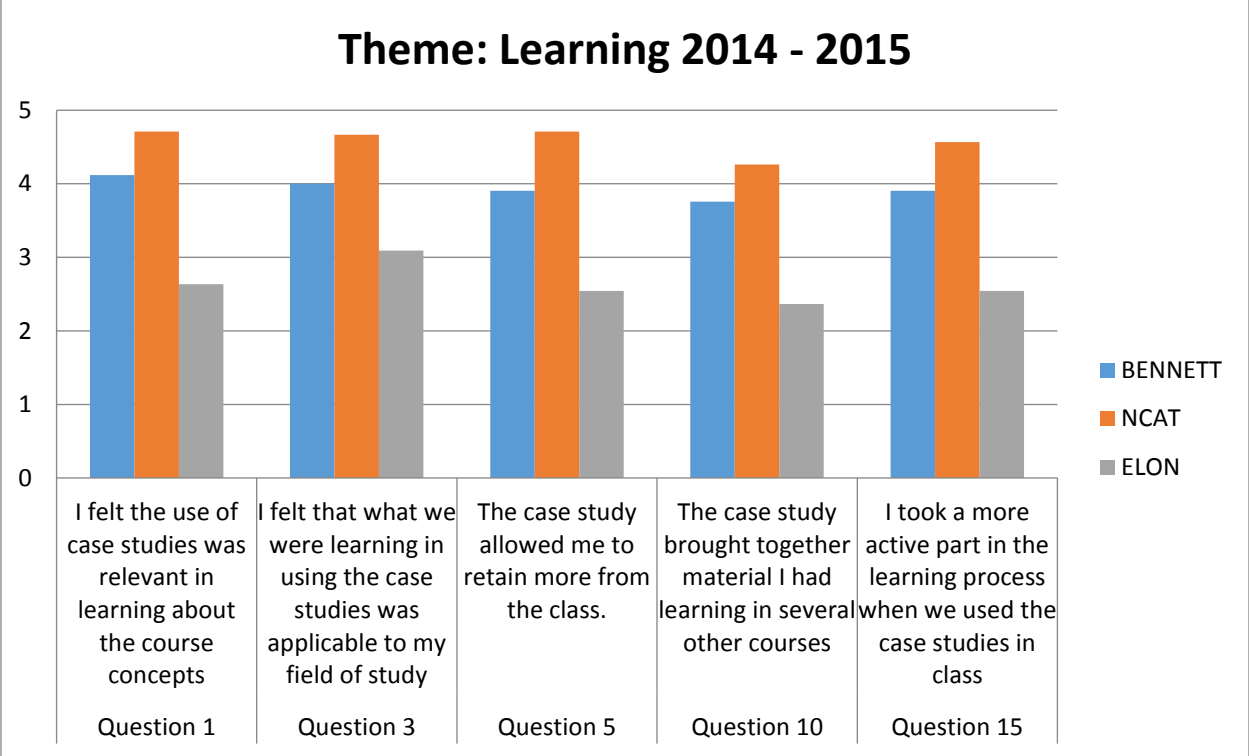


Figure 1. Case Studies Impression Survey Results for Learning Themed Questions

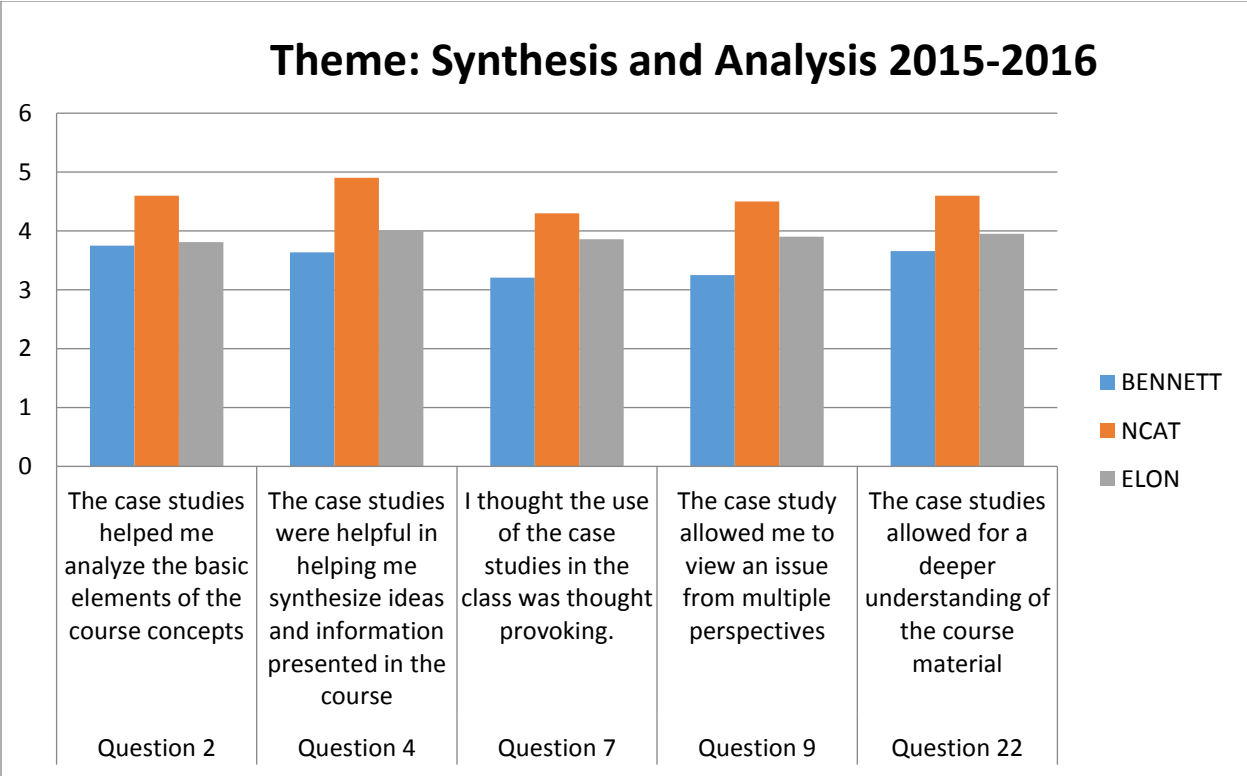
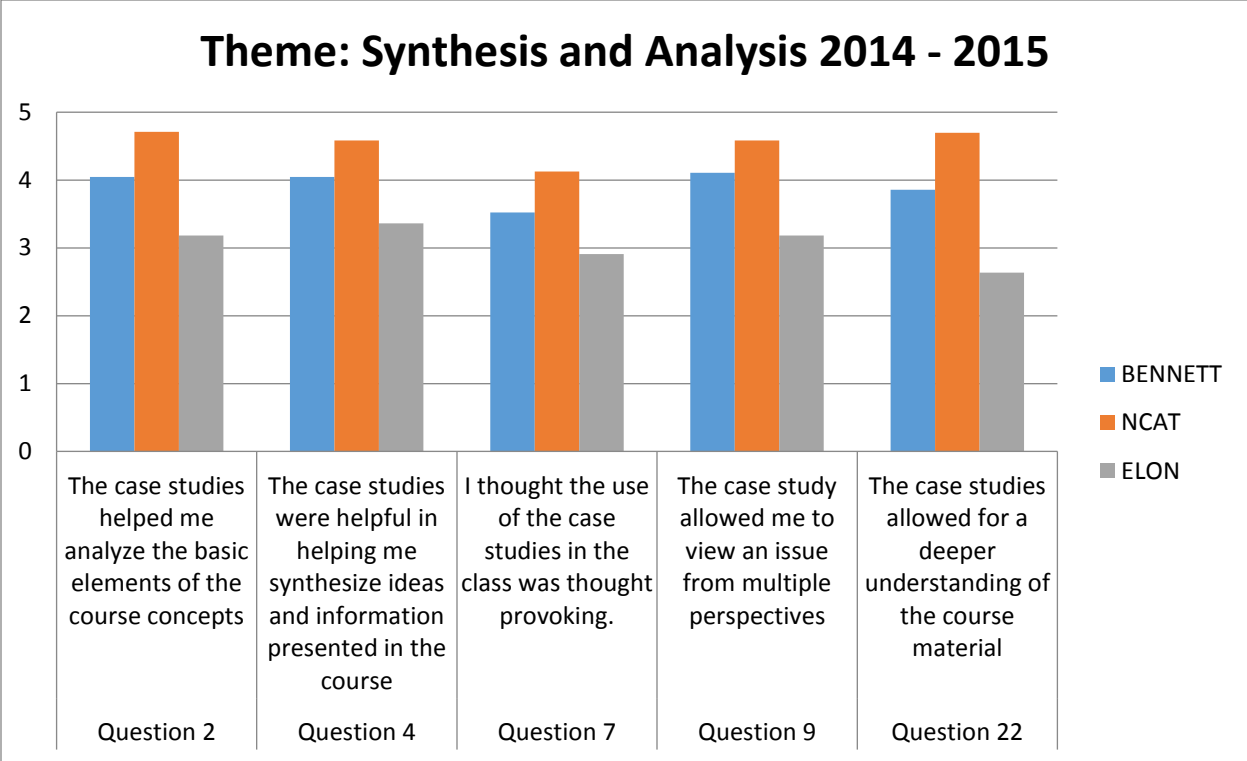


Figure 2. Case Studies Impression Survey Results for Synthesis and Analysis Themed Questions

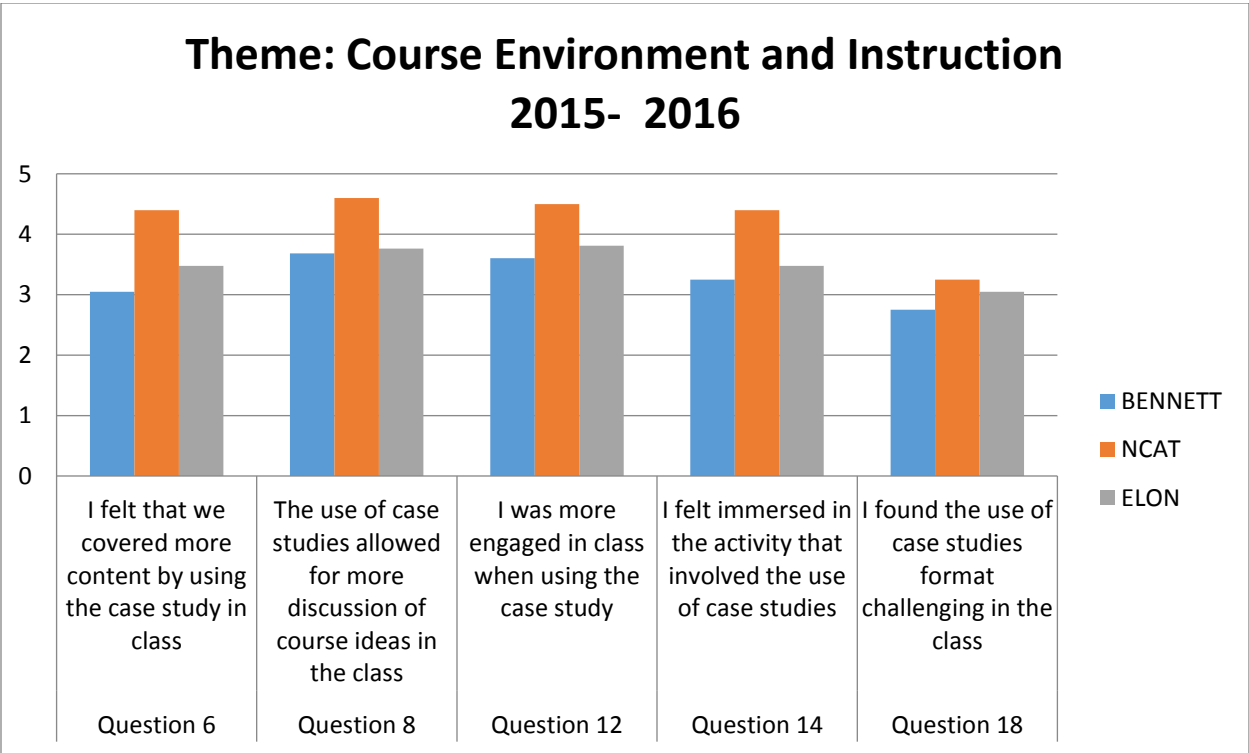
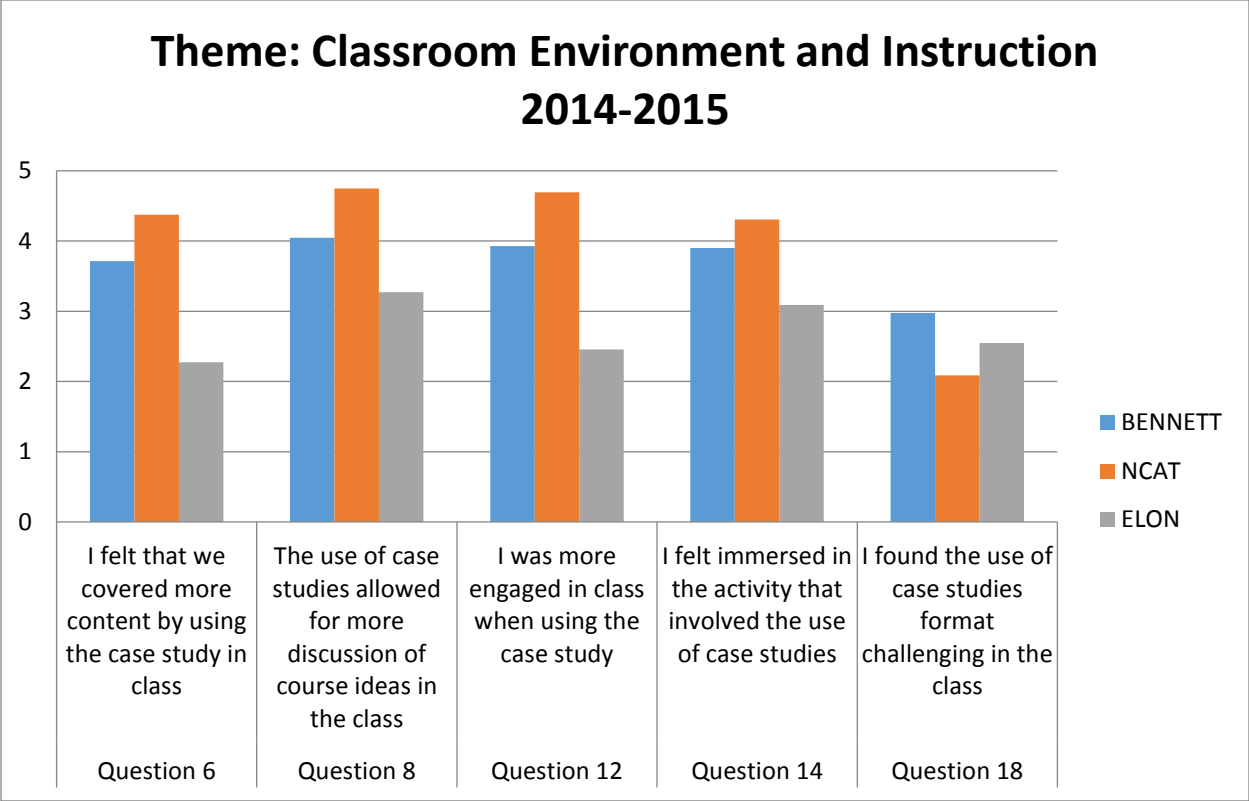


Figure 3. Case Studies Impression Survey Results for Classroom Environment and Instruction Themed Questions

However, Elon students' negative impressions of the case study teaching method remain strong and are noticeably more negative than those of students at NC A&T and slightly more negative than Bennett students as shown in Figure 4.

Conversely, the Bennett and NC A&T student responses show distinctly different trends. Responses from Bennett dipped slightly or remained unchanged in each of the four themed areas over the two academic years. In other words, students who participated in the second year reported that they learned less, were not as able to synthesize and analyze course concepts, and were less pleased with the classroom environment and instruction, but held about the same negative feelings. The NC A&T student responses remain relatively unchanged in each of the four themed areas over the two academic years highlighted.

When comparing institutions, it was observed that the NC A&T student responses in both academic years are noticeably different than those of Bennett and Elon students for nearly all of the questions in each of the four themed areas. Recall that both Bennett and Elon are liberal arts institutions although they serve two different student populations. This suggests that students at liberal arts institutions respond similarly to the method.

The results also brought into question the consistently and disproportionately more negative impressions of the case study method among Elon students despite reporting that they learned more, were better at synthesizing and analyzing, and fairly happy with the classroom environment and instruction. Recall that the study participants at Bennett and Elon were biology and engineering majors, respectively. Science, technology, engineering and mathematics (STEM) courses are widely regarded as anomalies at the liberal arts institution, so there is likely a strong expectation for traditional teaching and learning methods in those classes and some level of discomfort with and dislike of anything non-traditional.

The observed increases in learning and synthesis and analysis among Elon students show that these feelings of discomfort and dislike can be reversed. The key is for STEM instructors to embrace and include instructional approaches other than lectures. The improvements in learning and synthesis and analysis occurred after the Elon engineering professors revised the course that most students take before enrolling in the one in which this study is administered. The prerequisite course went from being mostly lecture-based in 2014 to almost completely projects-based in 2015. The projects were hands-on, team-based, and directly related to real-world applications. Therefore, students in the 2015/2016 study group were less resistant to embrace the case study pedagogy and had a greater appreciation for the deep learning that can occur when course content is directly related to real world contexts and not mostly lecture-based.

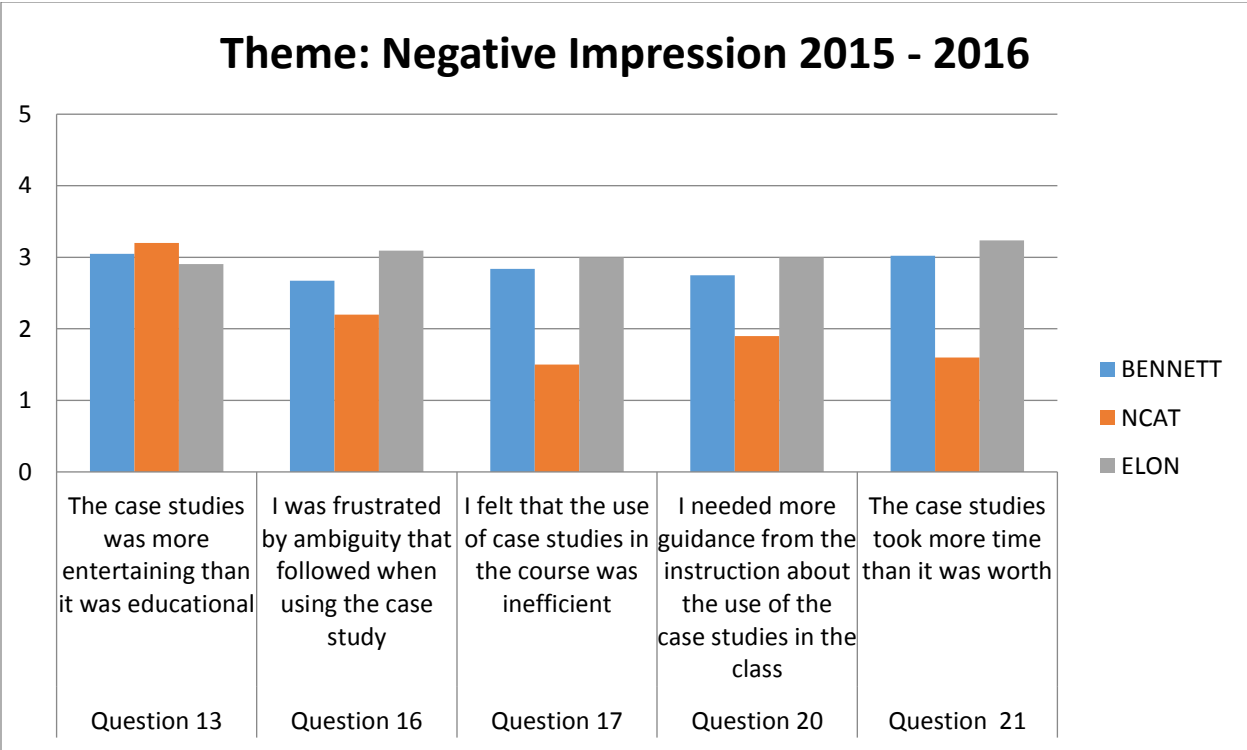
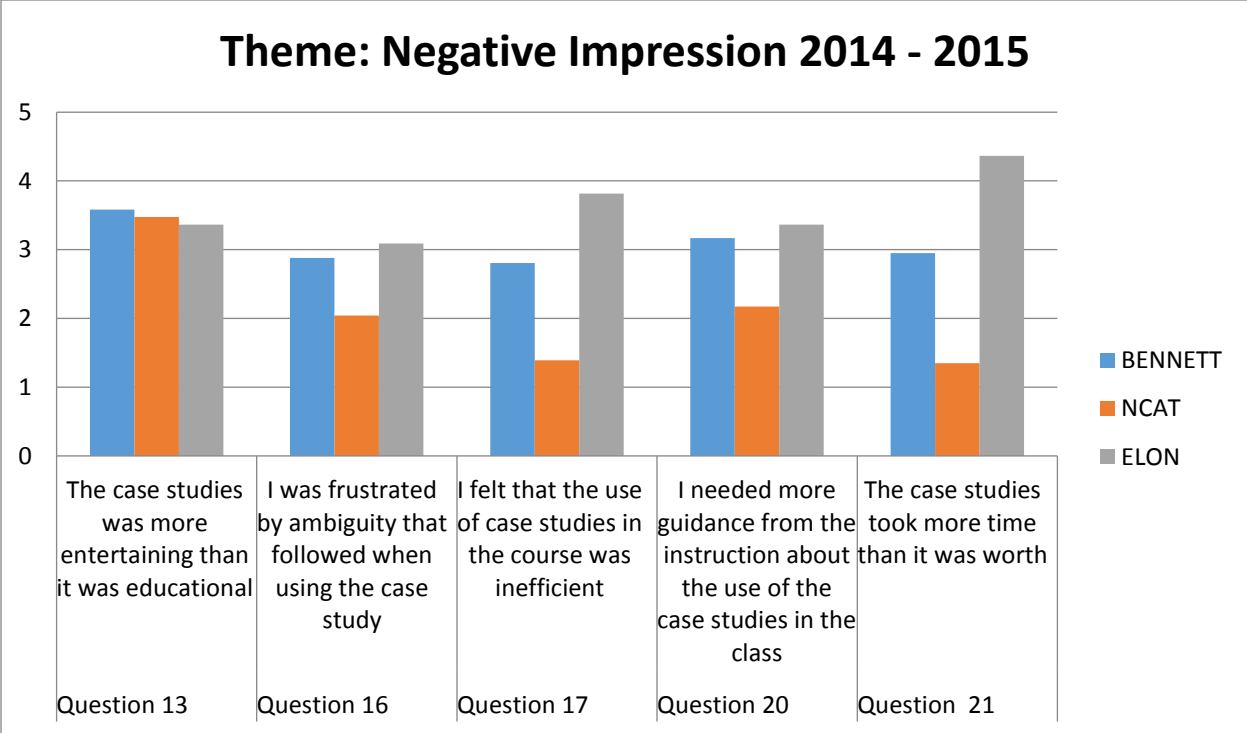


Figure 4. Case Studies Impression Survey Results for Negative Impression Themed Questions

Acknowledgements

This work was funded by the National Science Foundation Division of Undergraduate Education (DUE) award numbers 114010, 1431302, 1431410, and 1431446. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. Special thanks to laboratory graduate students Verol McLeary, Niya King, Janie Locklear, Tameka Coly, and Benard Chola.

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