Evaluating the Impact of Teaching Methods on Student Motivation

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Abstract

Educational institutions are consistently looking for ways to prepare students for the competitive workforce. Various methods have been utilized to interpret human differences, such as learning preferences and motivation, in order to make the curriculum more valuable. The objective of this research was to determine the impact of new teaching methods on students' comprehension and knowledge retention within an undergraduate course. New technology and techniques tailored to the student's individual learning preferences were introduced into the course. The teaching methods utilized in the research included: 1) traditional face–to–face lectures, 2) TED-Ed videos, 3) Quizlet, 4) Scoop.It, 5) group project, and 6) homework assignments. The study surveyed students at the beginning and end of a semester to determine the impact on the student's experience. The survey assessed if implementing tools that catered to the student's specific learning preference would have an impact on his/her motivation. An analysis was performed using the Chi-Square test to examine how the student's educational experience improved through the application of the new course tools. The results showed the tools had a positive impact on the student's learning experience. The analysis also suggests that students experienced a change in motivation throughout the semester. This shows that more investigation is required in order to identify causes for the motivational shifts.

Keywords *Quality, Engineering Education, Student Motivation, Learner Preferences, TED-Ed, Quizlet, Scoop.it*

1. Introduction

The bar of success continues to be raised for future engineers to keep pace with developing technology and the global market. As the demand placed on individuals to stay competitive intensifies, educational institutions are aggressively looking for ways to prepare students for their future careers. The National Academy of Engineering (NAE) has identified that the engineers of 2020 need to have strong analytical and problem solving skills while being readily adaptable to advancing technologies in a globally connected world (NSF, 1996). "The National Leadership Council for Liberal Education and America's Promise supported by the Association of American Colleges and Universities issued a report that identifies four essential learning outcomes that graduates should possess: 1) a broad base of knowledge across multiple disciplines; 2) intellectual and practical skills such as teamwork and problem-solving; 3) a sense of personal and social responsibility, including ethical reasoning; and 4) experience applying what they learn to real-world problems." (Furterer, 2007, p. 2). Further, the American Society for Engineering Education (ASEE) reported statistics for the 2005-2006 academic year indicating that engineering graduation and enrollment rates at U.S. universities were not in line with the country's increasing demand (Grose, 2006). The deficit in engineering students does not appear to be due to an inherent lack of interest in the field, but to a lack of exposure to the hands-on aspects of engineering jobs. It is important for educators to consider ways to better prepare students for his/her future role, but also to motivate students to prepare themselves for the transition into the workforce. Current teaching methods have produced positive results, but the transition between academia and industry can be made seamless when motivational techniques and advances in technology are incorporated into the curriculum (Cudney et al., 2011). This study focuses on evaluating the motivation of an undergraduate Engineering Management class as they learn the principles of Quality and Six Sigma. In terms of education, motivation with respect to students refers to intrinsic motivators and extrinsic motivators. Intrinsic motivation refers to a student's fascination with a subject, the perceived relevance of the topic, and sense of accomplishment with understanding the content. Extrinsic motivators include expectations from role models and grades.

Quality management is a methodology that provides tools and techniques to maintain a desired level of excellence. Quality is determined by customer expectations and the goal is to achieve a defect free process (Ficalora and Cohen, 2009; Kanigolla et al., 2013). Similarly, Six Sigma is an improvement methodology focused on meeting customer requirements and stakeholder expectations by measuring and reducing variation (Siddh et al., 2014). Six Sigma uses a five–phase problem solving methodology for increasing productivity and customer satisfaction. These phases include define, measure, analyze, improve, and control (DMAIC). Six Sigma and quality improvement were originally implemented in business sectors, but have been used in manufacturing environments with significant success (Chookittikul and Chookittikul, 2008; Lee and Haider, 2012). Teaching students the problem solving methodology, statistical tools, and quality tools offered within the quality and Six Sigma principles will help prepare graduating students for future employment. "Implementing quality principles and teaching students the principles of quality will lead to flexible learning that increases the effectiveness of undergraduate education and improves the student's future." (Kanigolla et al., 2013, p. 53).

The study was conducted within a course entitled, "Quality". The course is a core undergraduate course in the Engineering Management and Systems Engineering Department at Missouri University of Science and Technology. As a core course, the typical enrollment is 45 students and consists of mainly junior and seniors. In this case study, 2.4% were freshmen, 22.0% were juniors, and 75.6% were seniors. The course is offered every spring and fall semester. The course teaches students the tools and methodologies of quality engineering such as process flow, cause and effect, enumerative and inferential statistics, hypothesis tests, and design of experiments.

"Teaching quality and Six Sigma in a classroom environment typically consists of lectures and the presentation of examples and case studies." (Kanigolla et al., 2013, p. 53). The course was enhanced by tailoring it to the student's learning preferences to increase motivation. The course was modified by adding educational tools including: 1) TED-Ed lessons, 2) Scoop.It, 3) Quizlet, and 4) video solutions. These additional tools enabled students to gain practical knowledge in a manner that appealed to his/her learning preference based on the results of a prior research study (Ezzell et al., 2016). This technique also allowed the instructor to monitor the students' involvement while engaging the students in real-world applications.

Motivation is a significant factor within education because it encourages students to produce meaningful work and cultivate a desire for life-long learning. "Improving

recruitment and retention of students into the engineering disciplines as well as enhancing their learning experience is a high priority amongst engineering educators." (Husman et al., 2010, p. 1). A students' mind-set towards engineering and motivation for learning influences the ways students approach education. Even though student motivation plays a large role in student success, there is no script for directly inspiring students. According to Husman et al., "Motivation, although clearly an important concept, has not established a set of theories, constructs, and measures within engineering education. Rather, the researcher or practitioner must find their own way through the psychological literature." (2010, p. 1). Several studies have been conducted to determine effective ways to increase motivation.

Examining student behavior and observing when shifts in motivation occur provides information instructors can utilize when revising course activities. Dillon and Stolk (2012) stated that motivation has been used to provide insight into understanding people's actions since psychology shifted from a philosophical to an applied discipline in the mid-1800s. Within their study, Dillon and Stolk (2012) surveyed students at the beginning and end of a class to observe changes in their motivation. The type of motivation a student receives during his/her education will frame his/her academic engagement, performance, and satisfaction. Cluster analysis was employed to explore student motivation, examine group-based motivation profiles within academic settings, and explore the correspondence between a person's intrinsic motivations and his/her environment. Data was gathered from engineering students enrolled in four different materials courses at three predominantly undergraduate institutions. Participants were surveyed at the beginning and end of their term to assess how various motivations fluctuated throughout the semester. The research findings indicated that engineering students adopt a range of situational motivations that do not fall into conventional "intrinsic" or "extrinsic" categories. Further, several students adopted relatively stable motivations within a single course while others varied drastically over time. Examining both when and how these shifts occur will provide information that instructors can use to revise course activities to maximize internalized motivators. This research indicates that using surveys at the beginning and end of each semester can provide insight into fluctuations in student motivation throughout the semester.

Kirn and Benson (2013) studied the various aspects of engineering student motivation using a Motivations and Attitudes in Engineering (MAE) test to Bioengineering (BIOE) and Mechanical Engineering (ME) students. The test assessed the student's perception of his/her present and future abilities to be successful. The test also included an assessment of the student's problem-solving self-efficacy, which evaluated the relationship between motivation with respect to problem-solving skills (short-term tasks) and the student's goal of obtaining an engineering degree (long-term goals). The study found that student perceptions of the present, future, major-related expectancies, and problem-solving self-efficacy are distinct pieces of student motivation. Students who had progressed further in completing their majors had higher expectancies than students who had progressed less, despite being in the same required courses. This research demonstrates how understanding the differences in student motivations can enable appropriate instructional changes.

Building upon the existing research, a survey was employed in this study to measure the student's motivation at the beginning and upon completion of the course. Collecting feedback from the students provided the instructor with information that conveys the level of engagement and motivation of the class. The survey results were considered when evaluating enhancements to the course lesson plan. Specifically, the techniques that were ranked highly by students based on their learning style were selected (see Ezzell et al., 2016). As part of the survey results, student motivation at the beginning of the semester was compared to student motivation at the end of the semester.

The subsequent section presents the research methodology, the approach utilized for evaluating the surveys, and the calculated results. Discussion and recommendations based on the results is provided within the conclusion.

2. Methodology

For this research, data was collected through a pre-semester survey and post-semester survey in the Quality class. The survey data was analyzed to determine the student's motivation at the beginning of the semester compared to his/her perspective upon completion of the course. Students were provided with a variety of instructional tools to accommodate his/her individual learning preference and encourage motivation. The course syllabus included the following teaching methods: 1) traditional face–to–face lectures, 2) TED-Ed videos, 3) Quizlet, 4) Scoop.It, 5) group project, and 6) homework assignments. A description of each currently used teaching method in the syllabus is provided below.

- *Traditional Face-to–Face Lectures:* The course consists of weekly lectures that utilize PowerPoint presentations to teach the students the principles of quality and Six Sigma in a traditional face–to–face setting. The lecture component occurs twice per week for 75 minutes. As this is the traditional approach, it was kept as part of the course. Attendance was not required.
- *TED–Ed videos:* TED-Ed is a website where educators can create and distribute lessons with students. The online website inspires collaboration between educators to develop customized lessons. Users can then distribute the lessons, publically or privately, and track the impact it has on the individual student. This technique was selected because it caters to the visual – spatial, auditory – musical, and interpersonal individuals. Students are able to receive supplementary explanations and examples of the course material by initially viewing a video. Students could explore the subject further by answering questions within the "Think" section, explore additional resources within the "Dig Deeper" section, or converse with classmates within the "Discuss" section (http://ed.ted.com/on/4tiYu2Gv). Use of the TED-Ed lessons was optional; however, to motivate the students to use this tool, one to two test questions were taken from the TED-Ed lessons offered within the section.
- *Quizlet:* Quizlet is a website that provides learning tools for students. These learning tools include 1) flashcards - review the material by shuffling/randomizing, 2) learn mode - track correct/incorrect answers to focus study time on ones the student missed, 3) speller mode - challenge the student to type the auditory message they receive, 4) test mode - randomly generates tests based on the student's flashcard set, 5) scatter – student races against the clock by dragging and matching terms with the correlating definition, 6) space race – the student types in the answer as the term/definition scrolls across the screen. Quizlet is tailored for the logical – mathematical and bodily – kinesthetic learners. This tool helped the students master the course concepts and prepare for exams by playing games (https://quizlet.com/class/1424580/). For example, terms and definitions can be randomly dispersed across the screen and the student has to classify the correct term and definition. The continual movement holds the attention of the kinesthetic learners and encourages him/her to continue participating. Quizlet was also optional; however, one to two test questions were taken from Quizlet on the chapters covered in order to motivate the students to use this tool.
- *Scoop.It:* Scoop.It incorporated the benefits of social networking sites and educational real-world applications. This tool allows students, teachers, and professionals to create and share thoughts on real-world applications. Sharing thoughts and content allows individuals to connect based on similar interests. Scoop.it allows teachers to share real-world applications of the course material and connect the students with subject matter resources. This technique was selected because it provides students with the ability to relate the class material to real-world applications and enables students to connect

course principles to their future career interests. The intent was to make the information meaningful to the students and inspire continual self-directed learning on the topics (http://www.scoop.it/t/six-sigma-by-beth-cudney). Scoop.It was not optional. Each homework assignment had one question requiring students to read and summarize an article on a topic covered that week.

- *Group Project:* The group project component consisted of students working in teams of three individuals to apply the course topics to a real-world, quality-based project. The students are required employ the DMAIC problem solving approach to provide process improvement suggestions and control recommendations to a real-world problem. This aspect of the course was not changed from previous semesters; however, additional structure was added to the semester project guidelines.
- *Homework Assignments:* The homework assignments provided logical and mathematical problems that would reinforce the material taught in the class. In addition, the homework assignments were selected to encourage students to gather information beyond what was taught in the class. The homework assignments were required.

The pre-semester and post-semester surveys were framed by the Motivation Strategies for Learning Questionnaire (MSLQ). The survey is a self-reported instrument that Paul Pintrich and his associates were essential in developing at the University of Michigan (Pintrich et al., 1991). The original MSLQ contained 81 questions and was divided into two main categories: motivation and learning strategies. The different portions within the MSLQ can be used together or can be used individually. Overall, the instrument is designed to be segmental to meet the needs of the researcher or instructor. Only a portion of the original 81 question MSLQ survey was utilized based on their relevance to this research. A specific mixture of 28 questions was selected to focus on the student's value components, expectancy components, cognitive and metacognitive strategies, and resource management.

The questions were categorized into eleven sub-categories, and the results can be viewed in Table 1. A description of each motivation and learning style sub-category is provided next.

- Intrinsic Goal Orientation: "Goal orientation refers to why a learner engages in an academic task. Learners with intrinsic goal orientations possess real interest in the learning process and aspire to increase their knowledge of the subject matter." (Taylor, 2012, p. 4)
- Extrinsic Goal Orientation: "Extrinsic goal orientation describes learner's interest in engaging in a task due to causes outside the individual, such as to demonstrate their ability, to outperform others, and/or to receive some external benefit such as getting good grades, recognition, or a reward." (Taylor, 2012, p. 4)
- Task Value: "Task value refers to an individual's appreciation for a task's relevance. Task value relates to the degree of personal interest a learner has for a given task and includes beliefs about utility, relevance, and importance." (Taylor, 2012, p. 5)
- Self-efficacy: "In general, self-efficacy refers to a person's judgments of their capabilities to perform an action successfully. Academic self-efficacy applies this general definition of efficacy to one's internal belief for executing and succeeding in academic tasks at designated success levels." (Taylor, 2012, p. 5)
- Elaboration: "Elaboration is a learning strategy in which a learner paraphrases or summarizes learning material to help the individual understand the material. This strategy is intended to build internal connections between one's prior knowledge and the new material. This strategy is considered a higher order learning skill because the strategy allows learners to store learned information into long-term memory." (Taylor, 2012, p. 5)
- Metacognitive Self-Regulation: "Metacognition refers to how one thinks about thinking; it encompasses methods of a learner's awareness and knowledge of their cognitive processes." (Taylor, 2012, p. 6)
- Time and Study Environment: "Time and study management involves choosing environments that are conducive to learning (i.e., free from distractions) and effectively scheduling, planning, and managing one's study time." (Taylor, 2012, p. 6)
- Effort Regulation: "Effort regulation enhances the ability of the learner to handle setbacks and failures within the learning process by correctly allocating resources and appropriate effort to increase more successful learning in the future." (Taylor, 2012, p. 6)
- Peer Learning: "Peer learning involves using peers (friends, classmates, etc.) to collaboratively understand course material or information to be taught." (Taylor, 2012, p. 6)
- Help Seeking: "Help seeking can be an adaptive learning strategy that allows a learner to optimize learning by seeking help from local resources such as instructors, peers, tutors, or even additional textbooks." (Taylor, 2012, p. 7)

The questionnaire was based on the Likert scale rating and consisted of the categories: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). Instead of following the seven-point scale utilized in the original MSLQ study, this portion of the survey was modified to a five-point Likert scale to provide consistency throughout the survey. The survey was distributed electronically to all students in the course and was optional. The instructor explained the purpose of the survey during class to elicit a high response rate. The collected survey data contained anonymous responses from 41 students (87.2% response rate). The surveys were anonymous to ensure the students felt comfortable providing honest feedback. Respondents are less likely to embellish socially desirable behaviors and underreport socially undesirable ones when the possibility of embarrassment or negative repercussions is removed (Tourangeau and Yan, 2007).

The analysis is comprised of two sections. The first section discusses the percent response of each question to determine the students' motivation at the beginning and conclusion of each semester. By evaluating the number of responses for each question on the Likert scale, the analysis determined whether the students agreed or disagreed to that particular statement. The analysis considered agree as an aggregate of strongly agree and agree; and disagree as an aggregate of strongly disagree and disagree.

The second section analyzed the responses from the beginning and end–of–semester to observe patterns in which the students received motivation from the use of the implemented tools. Individual question comparisons identified the motivation classification the students experienced. To evaluate the responses, the Fishers Exact value (p) from the Chi-Square test of independence was employed. The Fisher's exact values are provided in Table 3.

The Fisher's exact test is a test of statistical significance that can be employed to deliver valid results even when sample sizes are small. The probability (p) value falls between the ranges of 0.0 to 1.0. There is an indication of similarity between the response patterns when the p value approaches 1.0. On the contrary, a lower p value (closer to 0) suggests that there is a difference in the student's motivation at the beginning of the semester when compared to the end of the semester (Hackerott and Urquhart, 1990). The statistical analysis is utilized to recognize areas where the students' motivation changed throughout the semester.

3. Results

The survey results were analyzed to determine the impact the education tools had on the student's motivation. The survey results in Table 1 include the percentage responses based on the Likert scale for the 41 responses from the Quality course at the beginning of the semester. Similarly, Table 2 includes the percentage responses for the 38 responses from the Quality course at the end of the semester. The numerical results and the Fisher's exact test values are tabulated and presented in Table 3.

3.1 First phase

The survey contains eleven sections total. Within each of the sections are items/questions that investigate the student's view of themselves by asking similar questions more than once. The results were considered on an individual question basis and also by taking the mean of

Questions	Percentage responses				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
INTRINSIC GOAL ORIENTATION					
In a class like this, I prefer course material that really challenges me so I can learn new things.	7.32	39.02	43.90	7.32	2.44
In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	24.39	60.98	14.63	0.00	0.00
The most satisfying thing for me in this course will be understanding the content as thoroughly as possible.	7.32	46.34	39.02	7.32	0.00
When I have the opportunity, I choose course assignments I can learn from even if they don't guarantee a good grade.	7.32	34.15	41.46	14.63	2.44
EXTRINSIC GOAL ORIENTATION					
Getting a good grade in this class is the most satisfying thing for me right now.	19.51	46.34	14.63	19.51	0.00
The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	17.07	39.02	17.07	19.51	7.32
I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	26.83	39.02	21.95	12.20	0.00

Table 1: Beginning of Semester Survey Responses in Quality Course

TASK VALUE					
I think the course material in this class is useful for me to learn.	46.34	53.66	0.00	0.00	0.00
SELF-EFFICACY					
I'm certain I can understand the most difficult material presented in the readings for this course.	29.27	48.78	19.51	2.44	0.00
I'm confident I can learn the basic concepts taught in this course.	70.73	29.27	0.00	0.00	0.00
I'm confident I can understand the most complex material presented by the instructor in this course.	24.39	63.41	12.20	0.00	0.00
ELABORATION					
I try to relate ideas in this subject to those in other courses whenever possible.	26.83	56.10	17.07	0.00	0.00
METACOGNITIVE SELF-REGULATION					
When reading for a course, I make up questions to help focus my reading.	4.88	21.95	41.46	21.95	9.76
TIME AND STUDY ENVIRONMENT					
I will attend class regularly even if attendance is not mandatory.	53.66	39.02	7.32	0.00	0.00
EFFORT REGULATION					
When course work is difficult I give up or only study the easy parts (REVERSED).	2.44	4.88	7.32	65.85	19.51

Table 1 (Cont.): Beginning of Semester Survey Responses in Quality Course

Even when the course materials are dull and uninteresting, I manage to keep working until I finish.	21.05	68.42	10.53	0.00	0.00
PEER LEARNING					
When studying for this course, I often try to explain the material to a classmate or a friend.	14.63	43.90	31.71	9.76	0.00
I try to work with other students from this class to complete course assignments.	17.07	56.10	19.51	4.88	2.44
When studying, I often set aside time to discuss the course material with a group of students from the class.	7.32	21.95	43.90	21.95	4.88
HELP SEEKING					
Even if I have trouble learning the material for a class, I try to do the work on my own without help from anyone (REVERSED).	7.32	46.34	19.51	17.07	9.76
I ask the instructor to clarify concepts I don't understand well.	17.07	58.54	14.63	9.76	0.00
When I can't understand the material in a course, I ask another student in the class for help.	21.95	58.54	7.32	7.32	4.88
ADDITIONAL QUESTIONS					
I am confident in graduating.	75.61	21.95	0.00	2.44	0.00
I take responsibility for my own learning.	58.54	36.59	4.88	0.00	0.00

Table 1 (Cont.): Beginning of Semester Survey Responses in Quality Course

I always go above the class requirements to make sure I have a firm understanding of the class material.	9.76	43.90	34.15	12.20	0.00
I expect to be able to apply what I learn in this class to practical applications in my future employment.	48.78	43.90	7.32	0.00	0.00
I find using clickers/text message inputs useful in keeping my focus on the lecture during class.	4.88	24.39	39.02	24.39	7.32
I expect my knowledge and understanding to be checked regularly in this class.	12.20	58.54	21.95	7.32	0.00

Table 1 (Cont.): Beginning of Semester Survey Responses in Quality Course

the questions within the sub-categories. For example, intrinsic goal orientation has four questions. The class score for intrinsic goal orientation would be determined by summing the four questions and calculating the average. Questions marked as "reversed" are negatively worded statements, and were inverted before calculating the average.

The beginning of semester survey responses showed the students believed the course material would be useful for his/her education and development (100% agree). The students also indicated that they felt confident they could learn the basic concepts taught in the course (100% agree), and were even certain they could understand the most complex material presented by the instructor (87.8% agree). The student's responses indicated they were looking for material that aroused their curiosity, even if it was difficult to learn (85.37% agree). In addition, when the course materials seemed dull or uninteresting, the students believed they would manage to keep working until they finished the assignments (89.47% agree). At the beginning of the semester, a majority of the students were confident in graduating (97.56% agree) and took responsibility for their own learning (92.68% agree). The students also responded that they planned to attend class regularly even if attendance was not mandatory (92.68% agreed).

The survey results also identified areas where the students would encounter challenges. The student responses indicated that a slight majority (53.66%) of the individuals would go above the class requirements to make sure they had a firm understanding of the class material. The survey also indicated that 53.69% agreed that understanding the course content as thoroughly as possible would be the most satisfying thing for them.

When evaluating each motivation and learning strategy sub-category as a whole, the initial survey indicated 100.00% of the students showed an appreciation for the course's task value and relevance. The students also choose environments that are conducive to learning within the time and study environment category with 92.68% in agreement. Furthermore, the students positively evaluated their own capabilities with 89.02% evaluation within the category of self–efficacy. A slight majority of the class (62.60%) agreed that they had an interest in engaging in the course material due to causes outside of themselves (extrinsic goal orientation).

The pre-semester survey also reported that students selected reduced scores within effort regulation (48.40% agree), peer learning (53.66% agree), and intrinsic goal orientation (56.71% agree). These statistics indicate that only a minority of the students are able to handle setbacks and failures during the learning process. Conversely, a slight majority of the students involve peers to collaboratively understand course material and possess a real interest in increasing their knowledge of the subject matter.

The end of semester survey indicated the students felt confident they mastered the basic concepts taught in the course (84.21% agreed), took responsibility for their own learning throughout the semester (86.85% agreed), and kept working even when they felt the material was uninteresting (89.47%). Upon completion of the semester, 73.69% of the students felt doing well in the class was important to be able to show their accomplishment to their family, friends, employer, or others. A majority of the class was comprised of seniors, and 86.85% felt confident that they would graduate.

At the end of the semester, 31.58% of the students agreed that the most important thing for them was to improve their overall grade point average. When given the opportunity, 47.37% of the students chose course assignments that he/she could learn from even if it did not guarantee a good grade. Furthermore, when the students were asked about their preference for working with fellow students, 50.00% agreed that they tried to explain the material to a classmate or friend, and 34.21% often set aside time to discuss course material with a group of students from the class.

The end of semester survey indicated the students continued to place high importance on time and study environment (89.47% agreed), task value (86.84% agreed), and self–efficacy (75.44%). There was also an increase in the percent of students (89.47% agreed) that felt comfortable seeking help from fellow students or the instructor.

3.2 Second phase

Within the second phase a comparison of the survey responses between the beginning and end of semester was performed to determine if students sustained the same level of motivation. The Fisher's exact test was utilized to compare each beginning survey question with its corresponding end of semester survey question. The *p*-values for the Fisher's exact test were calculated and are shown within the last column of Table 3.

The results were initially compared to understand the student's interest and excitement for increasing their knowledge on the subject matter at the beginning of the semester compared to the end of the semester. The data indicates there was no similarity between the initial and final survey for students desiring course material that challenged them to learn new things (p-value = 0.135). The results also indicate the students had a decrease in desire for course material that aroused their curiosity when it was difficult to learn (p-value = 0.133). However, students had a similar response pattern when asked if understanding the content as thoroughly as possible would be the most satisfying thing for them (p-value = 1.000). The students also responded in a similar manner when asked if given the opportunity, he/she would choose course assignments that they could learn from even if it did not guarantee a good grade (p-value = 0.938).

The student's self-efficacy was also compared at the beginning of the semester with the end of the semester. The student's internal beliefs for executing and succeeding in the academic tasks changed from the start to the end of the semester. The students felt less confident that they understood the most difficult material presented in the course (p-value = 0.053). The results also indicate there were no similarities between the student's initial confidence in mastering the basic course concepts when compared to the end of the semester (p-value = 0.000). Furthermore, the student were less certain they mastered the most complex material presented in the course and the responses showed no similarities with a p-value of 0.041.

Finally, the students were surveyed on their ability to handle setback and failures throughout the semester by utilizing resources to increase their success. The results indicated there was a decrease in effort students gave when studying difficult material. There was no similarity between the initial survey and the final survey when the students were asked if they gave up or only studied easy parts when the course work became difficult (p-value = 0.153). However, there was a strong similarity when students were asked if they continued to keep working on the course materials even when they became dull or uninteresting (p-value = 1.000).

4. Conclusions

Overall, the students displayed a continuous desire to learn the course material, and believed the material was beneficial for their career development. Even though the new tools catered to the student's individual learning preferences, the tools did not necessarily inspire an increase in motivation. The results of the surveys indicated there was a decrease in the percent of students eager to go above and beyond the course requirements to make sure they had a firm understanding of the material. There was also a decrease in the number of students that felt achieving a good grade or improving their grade point average was critical. On the contrary, there was an increase in the number of students that wanted to do well in the class to show their ability to family, friends, employers, or others. A majority of the class was entering into their final semester, and there was an increase in the percent of student that felt confident in graduating. The analytics clearly suggest the students experienced a change in motivation throughout the semester. This shows that some aspects of the course require more investigation in order to identify causes for the motivational shifts.

5. Recomendations

From the results, it is unclear if the implementation of the new teaching tools in the Quality course helped increase the student's motivation throughout the semester. Since a large percentage of the students are in their senior year, it would be beneficial to incorporate topics

Questions	Percentage responses				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
INTRINSIC GOAL ORIENTATION					
I believe the class material really challenged me and taught me new things.	13.16	55.26	21.05	2.63	7.89
This class provided material that provoked my curiosity to investigate topics beyond the course requirements.	13.16	52.63	31.58	2.63	0.00
The most satisfying thing for me in this course was trying to understand the content as thoroughly as possible.	7.89	44.74	39.47	7.89	0.00
When I had the opportunity in this class, I chose course assignments that I could learn from even if they didn't guarantee a good grade.	5.26	42.11	39.47	10.53	2.63
EXTRINSIC GOAL ORIENTATION					
Getting a good grade in this class will be the most satisfying thing for me right now.	18.42	34.21	23.68	13.16	10.53
The most important thing for me right now is improving my overall grade point average. Therefore, my main concern is getting a good grade in this class.	15.79	15.79	44.74	13.16	10.53

Table 2: End of Semester Survey Responses in Quality Course

Doing well in this class is important to me because it will show accomplishment to my family, friends, employer, or others.	10.53	63.16	13.16	10.53	2.63
TASK VALUE					
I think the course material in this class is useful for me to learn.	23.68	63.16	10.53	2.63	0.00
SELF-EFFICACY					
I'm certain I understood the most difficult material presented in this course.	7.89	63.16	18.42	10.53	0.00
I'm confident I mastered the basic concepts taught in this course.	21.05	63.16	15.79	0.00	0.00
I'm certain I understood the most difficult material presented in this course.	7.89	63.16	18.42	10.53	0.00
ELABORATION					
I tried to relate ideas in this subject to those in other courses whenever possible.	18.42	55.26	18.42	5.26	2.63
METACOGNITIVE SELF-REGULATION					
When reading for this course, I made up questions to help focus my reading.	2.63	34.21	28.95	26.32	7.89
TIME AND STUDY ENVIRONMENT					
I attended class regularly.	52.63	36.84	7.89	2.63	0.00
EFFORT REGULATION					
When the course work became difficult, I either gave up or only studied the easy parts.	0.00	10.53	23.68	52.63	13.16

Table 2 (Cont.) : End of Semester Survey Responses in Quality Course

Even when the course materials were dull and uninteresting, I managed to keep working until I finished them.	21.05	68.42	10.53	0.00	0.00
PEER LEARNING					
When studying for this course, I often tried to explain the material to a classmate or friend.	2.63	47.37	15.79	26.32	7.89
I worked with other students from this class to complete the course assignments.	10.53	52.63	26.32	7.89	2.63
When studying for this course, I often set aside time to discuss course material with a group of students from the class.	2.63	31.58	34.21	26.32	5.26
HELP SEEKING					
Even if I had trouble learning the material in this class, I tried to do the work on my own without help from anyone (REVERSED).	13.16	60.53	21.05	2.63	2.63
I felt comfortable asking the instructor to clarify concepts I didn't understand well.	26.32	50.00	23.68	0.00	0.00
When I couldn't understand the material in this course, I would ask another student in the class for help.	15.79	50.00	21.05	10.53	2.63
ADDITIONAL QUESTIONS					
I am confident in graduating.	60.53	26.32	10.53	0.00	2.63

Table 2 (Cont.) : End of Semester Survey Responses in Quality Course

I take responsibility for my own learning.	42.11	44.74	10.53	0.00	2.63
I always went above the class requirements to make sure I had a firm understanding of the class material.	18.42	23.68	42.11	13.16	2.63
I expect to be able to apply what I learn in this class to practical applications in my future employment.	31.58	47.37	13.16	5.26	2.63
Clickers should be implemented next semester.	23.68	15.79	36.84	13.16	10.53
My knowledge and understanding was checked on a regular basis to maintain my focus.	23.68	63.16	10.53	2.63	0.00

Table 2 (Cont.) : End of Semester Survey Responses in Quality Course

	Questions	Survey Response					Fisher's exact p-value
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
Survey		5	4	3	2	1	
Beginning Survey	In a class like this, I prefer course material that really challenges me so I can learn new things.	3	16	18	3	1	0.135
End Survey	I believe the class material really challenged me and taught me new things.	5	21	8	1	3	
Beginning Survey	In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	10	25	6	0	0	0.134
End Survey	This class provided material that provoked my curiosity to investigate topics beyond the course requirements.	5	20	12	1	0	
Beginning Survey	The most satisfying thing for me in this course will be understanding the content as thoroughly as possible.	3	19	16	3	0	1.000
End Survey	The most satisfying thing for me in this course was trying to understand the content as thoroughly as possible.	3	17	15	3	0	
Beginning Survey	When I have the opportunity, I choose course assignments I can learn from even if they don't guarantee a good grade.	3	14	17	6	1	0.938
End Survey	When I had the opportunity in this class, I chose course assignments that I could learn from even if they didn't guarantee a good grade.	2	16	15	4	1	
Beginning Survey	Getting a good grade in this class is the most satisfying thing for me right now.	8	19	6	8	0	0.187
End Survey	Getting a good grade in this class will be the most satisfying thing for me right now.	7	13	9	5	4	
Beginning Survey	The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	7	16	7	8	3	0.047

Table 3: Survey Responses in Quality Course with Fisher's Exact Test Value

End Survey	The most important thing for me right now is improving my overall grade point average. Therefore, my main concern is getting a grade in this class.	6	6	17	5	4	
Beginning Survey	I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	11	16	9	5	0	0.114
End Survey	Doing well in this class is important to me because it will show accomplishment to my family, friends, employer, or others.	4	24	5	4	1	
Beginning Survey	I think the course material in this class is useful for me to learn.	19	22	0	0	0	0.019
End Survey	I think the course material in this class was useful for me to learn.	9	24	4	1	0	
Beginning Survey	I'm certain I can understand the most difficult material presented in the readings for this course.	12	20	8	1	0	0.053
End Survey	I'm certain I understood the most difficult material presented in the reading for this course.	3	24	7	4	0	
Beginning Survey	I'm confident I can learn the basic concepts taught in this course.	29	12	0	0	0	0.000
End Survey	I'm confident I mastered the basic concepts taught in this course.	8	24	6	0	0	
Beginning Survey	I'm confident I can understand the most complex material presented by the instructor in this course.	10	26	5	0	0	0.041
End Survey	I'm confident I understood the most complex material presented by the instructor in this course.	3	24	7	4	0	
Beginning Survey	I try to relate ideas in this subject to those in other courses whenever possible.	11	23	7	0	0	0.498
End Survey	I tried to relate ideas in this subject to those in other courses whenever possible.	7	21	7	2	1	
Beginning Survey	When reading for a course, I make up questions to help focus my reading.	2	9	17	9	4	0.000
End Survey	When reading for this course, I made up questions to help focus my reading.	1	13	11	10	3	
Beginning Survey	I will attend this class regularly even if attendance is not mandatory.	22	16	3	0	0	0.938

Table 3 (Cont.): Survey Responses in Quality Course with Fisher's Exact Test Value

End Survey	I attended class regularly.	20	14	3	1	0	
Beginning Survey	When course work is difficult I give up or only study the easy parts (REVERSED).	1	2	3	27	8	0.153
End Survey	When the course work became difficult, I either gave up or only studied the easy parts. (REVERSED)	0	4	9	20	5	
Beginning Survey	Even when the course materials are dull and uninteresting, I manage to keep working until I finish.	8	26	4	0	0	1.000
End Survey	Even when the course materials were dull and uninteresting, I managed to keep working until I finished them.	8	26	4	0	0	
Beginning Survey	When studying for this course, I often try to explain the material to a classmate or a friend.	6	18	13	4	0	0.019
End Survey	When studying for this course, I often tried to explain the material to a classmate or friend.	1	18	6	10	3	
Beginning Survey	I try to work with other students from this class to complete course assignments.	7	23	8	2	1	0.865
End Survey	I worked with other students from this class to complete the course assignments.	4	20	10	3	1	
Beginning Survey	When studying, I often set aside time to discuss the course material with a group of students from the class.	3	9	18	9	2	0.721
End Survey	When studying for this course, I often set aside time to discuss course material with a group of students from the class.	1	12	13	10	2	
Beginning Survey	Even if I have trouble learning the material for a class, I try to do the work on my own without help from anyone (REVERSED).	3	19	8	7	4	0.139
End Survey	Even if I had trouble learning the material in this class, I tried to do the work on my own without help from anyone. (REVERSED)	5	23	8	1	1	
Beginning Survey	I ask the instructor to clarify concepts I don't understand well.	7	24	6	4	0	0.144

Table 3 (Cont.): Survey Responses in Quality Course with Fisher's Exact Test Value

End Survey	I felt comfortable asking the instructor to clarify concepts I didn't understand well.	10	19	9	0	0	
Beginning Survey	When I can't understand the material in a course, I ask another student in the class for help.	9	24	3	3	2	0.455
End Survey	When I couldn't understand the material in this course, I would ask another student in the class for help.	6	19	8	4	1	
Beginning Survey	I am confident in graduating.	31	9	0	1	0	0.086
End Survey	I am confident in graduating.	23	10	4	0	1	
Beginning Survey	I take responsibility for my own learning.	24	15	2	0	0	0.366
End Survey	I take responsibility for my own learning.	16	17	4	0	1	
Beginning Survey	I always go above the class requirements to makes sure I have a firm understanding of the class material.	4	18	14	5	0	0.284
End Survey	I always went above the class requirements to make sure I had a firm understanding of the class material.	7	9	16	5	1	
Beginning Survey	I expect to be able to apply what I learn in this class to practical applications in my future employment.	20	18	3	0	0	0.232
End Survey	I expect to be able to apply what I learn in this class to practical applications in my future employment.	12	18	5	2	1	
Beginning Survey	I find using clickers/text message inputs useful in keeping my focus on the lecture during class.	2	10	16	10	3	0.121
End Survey	Clickers should be implemented next semester.	9	6	14	5	4	
Beginning Survey	I expect my knowledge and understanding to be checked regularly in this class.	5	24	9	3	0	0.370
End Survey	My knowledge and understanding was checked on a regular basis to maintain my focus.	1	22	12	2	1	

Table 3 (Cont.): Survey Responses in Quality Course with Fisher's Exact Test Value

that would relate the subject matter to their future employment or specific area of interest. Incorporating the student's individual interest would help them feel actively involved in the course development process.

In addition, a key limitation in the study was the lack of a control group. The course is offered once every semester and there is only one section. An observational study approach could be used by tracking individual student use of the different teaching methods. This would enable the results to clearly link the changes in motivation with the six teaching methods.

There is a need to inspire more self–directed learning that will compel students to research beyond the course content. The students would benefit from material that is more challenging and holds their attention until the end of the semester. Incorporating more hands-on activities, Scoop.It articles, or a certificate in Six Sigma would increase the student's active participation in the course.

6. Future Research

Further research would benefit from incorporating questions into the survey that identify specific causes for the change in the student's motivation. Since a majority of the class was seniors, it would be beneficial to include questions to determine the number of semesters each individual has remaining until graduation. It would also be valuable to know if the students had secured employment for after graduation at the time of responding to both surveys. In addition, it would be advantageous to have more than two surveys offered throughout the semester. Multiple surveys would identify the timeframe when changes in motivation begin to occur.

Due to the small sample size (41), class rank was not analyzed as a part of this research. However, since this is an ongoing study, future analyses should consider class rank.

The current analysis was performed using an anonymous survey. Future studies could gain from utilizing analytics software to correlate the student's motivation throughout the semester with his/her grade. In addition, the survey could be extended into additional undergraduate and graduate classes. Student motivation may change between subject areas and semesters.

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