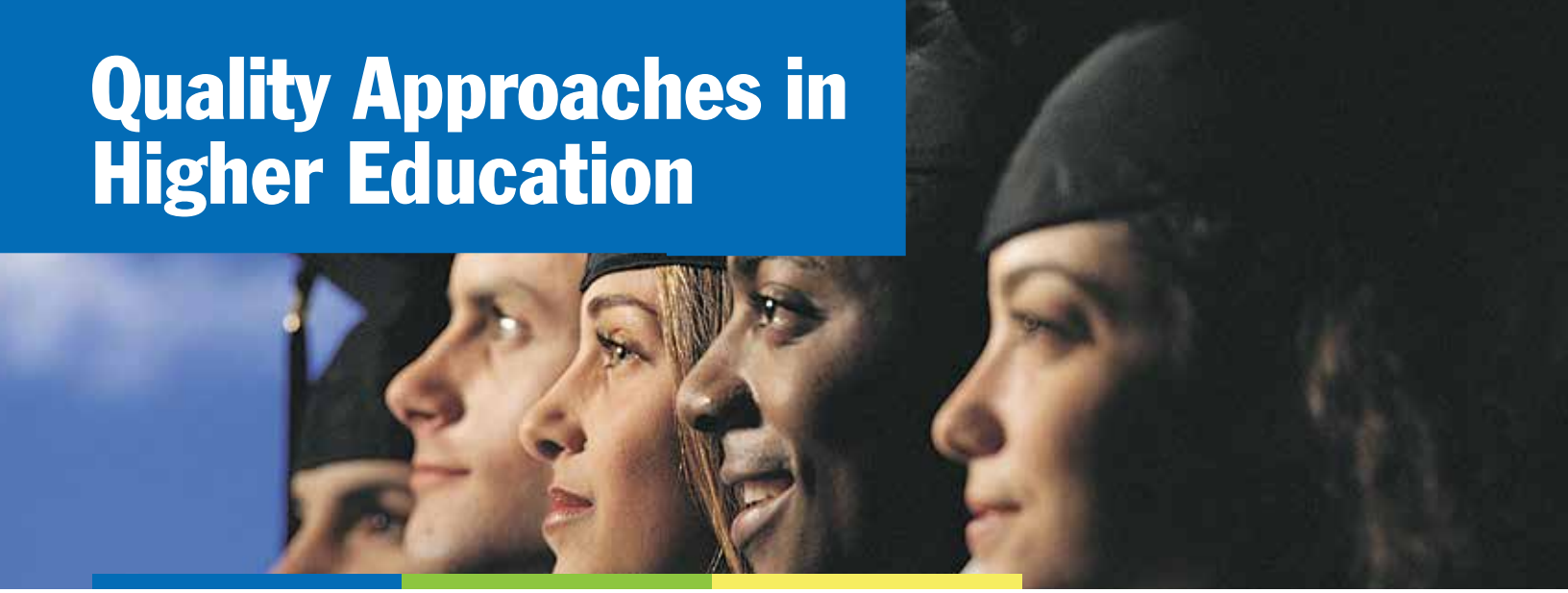
Quality Approaches in Higher Education



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IN THIS ISSUE:

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The Global Voice of Quality™

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The Journal That Connects Quality and Higher Education

Quality Approaches in Higher Education (ISSN 2161-265X) is a peer-reviewed publication that is published by ASQ's Education Division, the Global Voice of Quality, and networks on quality in education. The purpose of the journal is to engage the higher education community in a discussion of significant topics related to improving quality and identifying best practices in higher education; and expanding the literature specific to quality in higher education topics.

Questions about this publication should be directed to ASQ's Education Division, Dr. Elizabeth A. Cudney, qahe@asqedu.org. Publication of any article should not be deemed as an endorsement by ASQ or the ASQ Education Division.

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Note From the Editor

Elizabeth A. Cudney

Elizabeth A. Cudney

As *Quality Approaches in Higher Education* (*QAHE*) enters its fifth year, it is a pleasure as the incoming editor to publish the ninth issue of this journal. The main purpose of *QAHE* is engaging the higher education community in topics related to improving quality, identifying best practices, and expanding the literature specific to quality in higher education. Our goal for the journal is to engender conversations that focus on improving educational practices through the use of quality tools throughout the educational experience.

With the evolving face of education and advances in technology, the topic of quality in higher education is multifaceted and involves improving instructional strategies within the classroom to institutional methodologies and processes. Further, quality of the educational experience plays a key role in student learning, engagement, success, and confidence. The strength of *QAHE* lies in the dissemination of innovative approaches to improving all aspects of the education experience in colleges and universities. The role of quality in academia is to help students learn in the 21st century through innovative approaches and best practices as well as continuous improvement methodologies.

In the interest of keeping up with the changing landscape of research related to quality in higher education, we recently updated our call for papers and author guidelines. These can be found on the journal's website (http://asq.org/edu/quality-information/journals/). In addition, we are pleased to announce that *QAHE* is now ranked in the Cabell's Directory.

This issue is comprised of four articles that focus on student engagement in the classroom, systematic quality improvements, and improving student support. The first article is by Ivan Guardiola from Missouri University of Science and Technology. It takes an innovative approach to increasing student engagement, learning, and critical thinking using a curriculum-evolving project involving a large, unstructured problem of a zombie apocalypse to teach operations research tools and methods. The next article by Michael Kirchner and Lia Coryell from the University of Wisconsin-Milwaukee and Susan Yelich Biniecki from Kansas State University addresses the need for student engagement for student veterans, the role of military and veteran organizations in universities, and the successes and challenges of building program support for a veteran-friendly learning institution. The third article by Raina Dyer-Barr from the University of Illinois at Urbana-Champaign focuses on identifying the successful administration aspects of STEM intervention programs on increasing the recruitment and retention of minority

undergraduates. The fourth article by Rosa Hand, Mary Dolansky, Erin Hanahan, Vinothini Sundaram, and Nancy Tinsley presents a model for a graduate level, interdisciplinary course that utilizes clinical quality improvement in a field project.

These articles highlight how quality approaches can be used within higher education at various levels—from the classroom to systematic institutional levels—to provide unique approaches to student learning and engagement.

I am very excited to have this opportunity to help spread these contributions on improving the quality of higher education that I hope will contribute to more conversations that support higher levels of quality in our colleges and universities.

Elizabeth A. Cudney, Ph.D. *is an associate professor in the Engineering Management and Systems Engineering Department at Missouri University of Science and Technology. In 2013, Cudney was elected as an ASQ Fellow. She was inducted into the ASQ International Academy for Quality in 2010. She received the 2008 ASQ A.V. Feigenbaum Medal and the 2006 SME Outstanding Young Manufacturing Engineering Award. Cudney has published four books and more than 35 journal papers. She is an ASQ Certified Quality Engineer, Manager of Quality/ Operational Excellence, and Certified Six Sigma Black Belt. Contact her at cudney@mst.edu.*

Quality Approaches in Higher Education

Assessing student perceptions of engagement, learning, and critical thinking skills of student projects using pop culture topics.

Curriculum-Evolving Case Study: Using Zombie Theme for Introduction to Operations Research Course

Ivan G. Guardiola

Abstract

Increasing student engagement and participation as well as improving knowledge retention are important to student success/achievement in any mathematically rigorous course. This paper presents the development of a curriculum-evolving project that seeks to achieve higher levels of student engagement, learning, and critical thinking skills. Specifically, the pop-culture topic of "zombies" was used for the purpose of increasing student development with regard to operations research tools and methods. The goal was to develop a semester-long project that was highly correlated to topics covered in the course in an effort for students to demonstrate the implementation of the tools and methods in a systematic way to increase knowledge retainment. A student survey was utilized to quantify the students' perception of the project and the results are presented.

Keywords

Teaching Quality, Learning Outcomes, Operations Research

Introduction

There is substantial evidence that traditional pedagogy, which includes lectures, homework, and team projects, is ineffective to teach topics that are math intensive (Paas, 1992). Paas (1992) continues that relying solely on lectures and problem solving is not the most effective means to teach topics such as mathematics, computer science, physics, or engineering. According to Handelsman, Briggs, Sullivan, and Towler (2005), student engagement is considered an important predictor of student achievement of learning. Handelsman et al. (2005) provides a review of approaches that aim to increase cognitive engagement, critical thinking, and learning in students. In addition, the authors also present the Student Course Engagement Questionnaire (SCEQ) to measure student engagement at the college/university level and conclude that the SCEQ does supply insight into the student perceptions of engagement. However, Prince and Felder (2006) provide a thorough literature review as it relates to the most common approaches, definitions, and methodologies for teaching engineering. Specifically, the multitude of the research presented is given from two very distinctive points of view, which are inductive as well as deductive learning and teaching of engineering. Further, Bransford, Brown, and Cocking (2000) provide a comprehensive survey of psychological research that supports inductive methods. Specifically, Bransford et al. (2000) states that, "All new learning involves transfer of information based on previous learning;" and "motivation to learn affects the amount of time students are willing to devote to learning. Learners are more motivated when they can see the usefulness of what they are learning." Hence, effective education should seek to increase opportunities where students can transfer lecture information and topics, which motivate them to learn. Previous studies have concluded that traditional lecture materials and methods are ineffective; therefore, educators should seek to develop methods in which students can continuously apply the material outside of the textbook problems.

Student engagement, participation, and transfer knowledge is vital to the effectiveness of learning. As students perform poorly on tests, fall asleep during lectures, or as in-class participation decays, many faculty members seek to improve their in-class delivery in a last ditch effort to gain enthusiasm regarding the topic. Some faculties have incorporated social media to enhance learning (Guardiola, Murray, & Cudney, 2011; Griesemer,

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2012). Stodolsky, Salk, and Glaessner (1991) provide an unnerving perception of young students in the K-12 grade levels, which suggests that many students perceive math to be boring. It can be assumed that this view is not dramatically changed at the college level. However, students differ greatly in their individual learning goals and have different expectations regarding their learning efforts (Ainley, 1993). Hence, it is unrealistic to expect all instructors to develop material that is relevant, rigorous, and is also engaging as it is a daunting task (Liebman, 1998).

In this article a curriculum-evolving individual project is presented. The project was developed as a means to assure that students applied the concepts and methods in the field of operations research (OR). Hence, the focus was on transferring the knowledge gained in the classroom into other problems. One of the most difficult aspects of teaching OR is that it is a balancing act between emphasizing general concepts or the mathematical rigor. In addition, OR topics require a high level of critical thinking as students must create mathematical representations from data to represent realistic decision-making processes. Therefore, both conceptual and mathematical correctness are necessary to develop the students' skills of modeling optimization problems. In OR, modeling refers to the development of a correct and relevant mathematical model formulation that seeks to determine the optimum decision, which is not trivial and is in many cases counterintuitive.

This article develops a parallel evolving story that contains relevant problems which allow students to refine their OR skills. Furthermore, the evolving portion allows for small, unique variations from one student to another. The students can still work together; however, their decision situations differ slightly due to the evolution of the project, differences in information, and the randomness created by their decisions as the project evolves from one primary task to the next.

Moreover, the primary research question is: What is the student perception of using pop-culture topics, which are often unrealistic, in their learning? Some students would consider such topics as childish and not take them seriously. Thus, it is important to understand how students perceive these topics as a learning tool. Do students feel like this type of project facilitates their learning of OR concepts and/or techniques? Therefore, a survey was used to gather the students' perceptions regarding learning, critical thinking, and engagement. The premise is that the project is well received by the students, and students perceive the case study as an educational tool.

The curriculum-evolving project (CEP), detailed in the latter section of this paper, was implemented in a traditional Introduction to Operations Research course. This course primarily contains undergraduate engineering students in their junior and senior years, which translates to the third or fourth year of their respective degree programs. It is a course that all students are required to take within the industrial engineering emphasis of the engineering management bachelor's program at the Missouri University of Science and Technology. The survey's results were gathered from the fall 2012 semester in which 21 students were enrolled. The course is only offered once a year.

This paper is focused on the development of an individual case study. The case study is unique to each student in the class. However, due to the similarities the students can work together to determine the best approach to formulation, solution, and analysis. The CEP is not a traditional group case study in which a group of individuals are given the same information and asked to derive one solution. The CEP is comprised of the same general problems; however, randomness in the data and the evolution of the problem results in a case study that seeks to increase the opportunity for students to learn OR tools, methods, and techniques. The students were surveyed for their perceptions regarding this learning experience to gain insight regarding whether the CEP was perceived as an effective general approach toward teaching OR.

This article begins with an explanation of what a CEP is and how to deploy it. Next, the optimization of the survival project is explained and its components tied to the syllabus topics. Finally, the results of learning, critical thinking, and engagement are provided. In addition, various student quotes are included to demonstrate engagement. The primary research question is to determine whether the student perceives the CEP as a worthwhile and constructive learning tool.

Curriculum-Evolving Project

The goal of the CEP was to supply an opportunity for students to develop their modeling and formulation skills further as they relate to the field of OR. Furthermore, another goal was to increase the students' capability to identify formulation approaches and solution tools correctly. Common topics in an introductory course of OR at the undergraduate level include, but are not limited to: linear programming, duality theory, sensitivity analysis, transportation and assignment, network optimization models, integer programming, and nonlinear programming methods. Hillier and Lieberman (2001) state that these topics supply a good survey of the OR field for upper-division undergraduates. Hence, the syllabus contained the aforementioned topics and in the respective order in which they are listed. Specifically, in Figure 1 the project parts are directly related to the topics contained in the syllabus. The proceeding subsections elaborate on the details of the project sections, which were titled *Fortify or Flee*, *Time to Move*, *There is Hope*, and *When Will it End?*

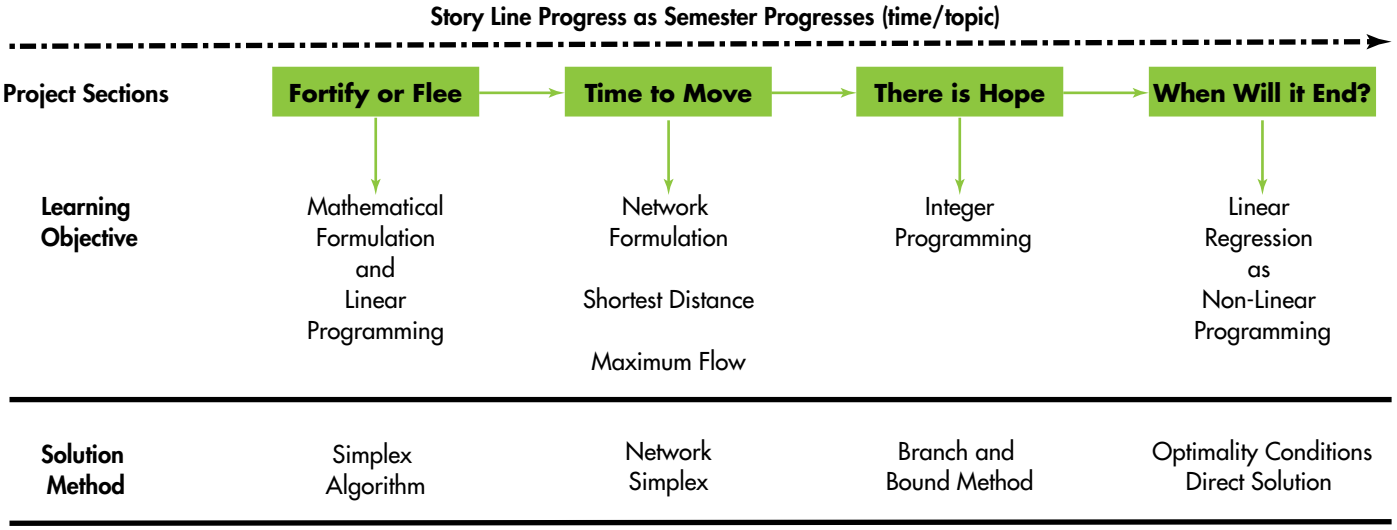


Figure 1: Project Sections as They Relate to Course Material

The Evolving Storyline and Methodology

The story begins with the Zombie Apocalypse taking place all over the world. The students unite as a group within the case. They begin with the entire class roster (e.g., a list of students in the class); however, losses of people are incurred at every stage. The students are given a simple random generator to determine which of their fellow students have fallen victim to the zombies, depending on some conditions explained in the latter part of this section. Thus, they have local and global decisions because each scenario presented asks the individual student to formulate the optimal decision for that stage. However, the overall goal of the student project is to maximize the number of students that survive the entire story. Hence, this global problem is not clearly given or explained and is left as an open problem. This global issue was proposed to determine how students deal with this larger problem and how it affects their conclusions in the smaller stages of the case. Subsections will later explain each stage of the case in detail.

This case study project is unique because the problems are interconnected and influence the subsequent problems throughout the semester. Specifically, a random generator drives the uniqueness of the case for each individual. For example, a student must determine the size of the zombie horde that will attack in the "Fortify or Flee" section. A uniform distribution is used to determine the size of the zombie $N(t_0) + xN(t)$, where $x \sim U(0,1)$, $N(t_0) = 300$, and $N(t) = 200$, where this will result in a horde of between 300-500 zombies. The students are given information about each type of fortification and how many zombies each fortification can eliminate. Each set of five zombies that is not eliminated by the fortifications results in a loss of one classmate from the original individual student's roster. Therefore, if 10 zombies were not eliminated by the fortifications then a loss of two individuals will occur.

Recall that this is unique to each student. Hence, each student may have a different number of zombies attacking as well as the fortification mixture may be different due to this small but significant change as the allocation of resources may result in different fortifications mixtures for each student. The student then must eliminate two students at random from his or her roster (again employing a random number generator). This results in a student beginning the next section of the project with only 17 individuals since he or she lost two from the original 19. Also, since many of the resources available depend on the number in the group, the student realizes that the loss of individuals also results in a loss of other resources. An example of this is the network problem posed in "Time to Move" as the number of individuals getting from the start to end of this section must be maximized; however, the number they begin with is critical to the formulation, solution methodology, and result. The network problem, therefore, results in a certain number of students surviving the journey by formulating a path through the network that optimizes (maximizes) the number of students that reach the end of the network. Similar to the previous case section, the necessary doses of the cure in the "There is Hope" section of the case study is based on the number of individuals still alive. Moreover, the number of students still alive at the end of the "Time to Move" section determines the amount of resources necessary for dosages and the sub-problem of gathering the resources in the "There is Hope" section. Lastly, the case section titled, "When Will it End?" allows the student to make use of the nonlinear programming; however, this problem varies as

the data given to the students is different for each student. The students must determine the best model to predict the decay of the zombie population. The number of people left at this point and the supplies they have weigh on their survival. The more people, the more supplies. Thus, they can last longer until the zombies die off from hunger. In this sense, the students' optimal solutions attained in each section impact the next section and, more importantly, the goal (global consideration) to maximize the number of survivors.

The global view of the problem is to maximize the number of individuals at the end of the semester or story. Students must create a system of systems that takes into account the formulation of the local problem (e.g., case study section such as the Fortify or Flee) and assure that previous formulations relate somehow to the global problem posed, which is to increase the number of students on the roster who have survived all subsections of the case. This problem was left open ended to allow the students freedom to determine the best formulation and solution method. This mechanism was created in a similar fashion in the proceeding sections of the case. The interest here is to see if students are creating a global system problem or only local problems. This concept is visited in the lectures throughout the semester, as local solutions often are not the same as the global solution. Furthermore, it is important to assure that solutions to the local solution (e.g. case study section) result in the best global solution. By requiring the students to formulate both global and local programming models, the true concepts of OR are employed.

Fortify or Flee

The first decision is whether to stay at the university and fortify against a known attack from zombies of known size or to flee to another location. The students are given an individual attack size number. Then they must formulate an optimization problem to determine whether they can weather such an attack. Hence, in this part of the project the students must formulate and solve a common Optimal Mixture Model: Linear Programming Problem, in which the mixture of fortification and defense must be chosen in an effort to take on the large force of zombies. The problem information given included the following:

- Five fortification types are given, each with the following information:
  - Time it takes to build each fortification.
  - Amount each fortification requires in basic resources.
  - The amount of zombies each fortification can repel.
  - The amount of time available until the zombie attack.
- Two fortifications are not optional and must be completed.
- The following trade-off condition is given: If the group does not fortify and the decision to flee is taken, 30% of the group will be immediately lost as they are turned into zombies.
- Instructions regarding the information to be turned in for grading are given.

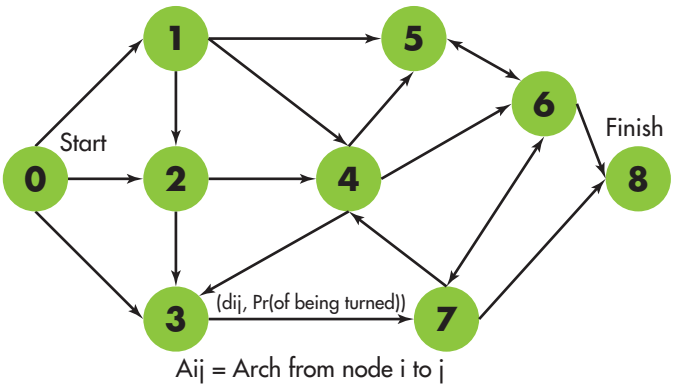
Time to Move

In this section of the project, the course topics have progressed to more complex concepts and solution methodologies, as well as formulation techniques. Thus, as the curricula has increased in complexity so do the corresponding sections of the case study. In this part of the story line, the students must assess their losses and begin a formulation to determine the safest route through a network of roads. The students receive a basic network topology, which is illustrated in Figure 2. The students are given d_{ij}, which denotes the distance between node i to node j. Similarly, P_{ij} denotes the probability of each person being turned into a zombie if he or she takes the arch between node i to j.

The students are not given clear directions regarding any formulation technique, no clear objective, nor solution methodology to be employed. The ideal formulations were to maximize the number of people expected to survive the travel from start to finish. However, students would formulate the problem as a shortest path, critical path problem, and maximal flow problem.

There is Hope

The students are told of a miracle cure that is able to stop the process of turning into a zombie. The students are given information about the recipe and what is required to make such medicine. This problem requires the students to develop a plan to gather the required supplies from nearby towns and storages using the widely-known traveling salesman problem. Secondly, the students are asked to develop a solution regarding the number of doses. Since each student is using a random number generator to determine the levels of supplies at the possible locations, the amounts differ from student to



Distance, d_{ij}, and probability, P_{ij} of turning into a zombie were provided

Figure 2: Simple Proposed Network of Roads

student. Furthermore, the amounts and dose must be integer values. The students must employ their knowledge of mixed integer problems to derive a solution. Their primary objective is to maximize the number of doses given when certain levels of ingredients are available. Hence, the students must employ the pseudorandom number generator to determine which locations are the ones with the highest amounts of supplies. In short, it is a facility location problem or assignment problem, which requires integer decision variables.

When Will it End?

At this point in the course the topics have fully evolved and have extended into an introduction to nonlinear programming methods. Hence, statistical data is given to the students regarding the population of the zombies. The zombie population is starving to death and their numbers are beginning to decrease. The students are given daily zombie population numbers, which are attained through a random number generator. The students' goal is to solve the unconstrained optimization problem.

$$Min\ F(x_i) = \sum_{i=1}^{N} (y_i - y_a(x_i))^2$$

Where, $y_a(x_i) = \beta_0 + \beta_1 x_i + \beta_2 x_i^2 + \in$, which is a quadratic regression model. The goal is for the students to determine the link between optimization and statistical analysis. As most statistics is about deviations, this link makes students aware that OR easily overlaps with other disciplines. The students are asked to parameterize the model based on data. Hence, they are determining the optimal coefficients to the model that minimize the mean squared error.

Software and Methodologies

The students were instructed to employ all available software skills. The course covers the LINDO, LINGO, and Excel solvers to improve these optimization problems. Students were given one lecture in which they were taught to use the pseudorandom number generator, which was developed in the Mathematic 9 software platform. The students were also taught how to extract the results from the generator. An example of this implementation within Mathematica is the *RandomSample[Range[1,20],x]* function, which would supply a random sample in the range of 1-20 of length *x*. Lastly, students received a clear rubric on materials to be completed for grading purposes.

Student Collaboration

The students were encouraged to work together in groups and discuss formulation approaches and solution methods. In each lecture 10 minutes were set aside for students to ask the professor any questions regarding the case, which also facilitated group collaboration. Furthermore, the professor designated 30 minutes a week when students could ask questions or discuss current solutions in the study lounge. These sessions often resulted in more discussion among the students rather than with the professor as students would discuss their individual case details and others would weigh in on approaches or compare solutions. Since each student had a unique case but similar problems, the tools were the same. This was enriching as students often answered each other's questions and would pose questions to the professor on critical approach methodologies or concepts.

Results

A basic survey was used to gain insight into the student perceptions, specifically a survey first proposed by Yadav, Shaver, and Meckl, (2010) that has been employed in other studies such as Guardiola et al. (2011) and Guardiola, Dagli, and Corns, (2013). The survey was modified and results are detailed in

Table 1: Perspective of Learning

Learning	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I felt the use of the zombie project was relevant in learning about operations research concepts.	42%	58%	0%	0%	0%
The integration of the zombie project helped me analyze the basic elements of operations research concepts.	53%	47%	0%	0%	0%
I felt that what we were learning in using the zombie project was applicable to the field of operations research.	42%	53%	5%	0%	0%
The zombie project was helpful in helping me synthesize ideas and information presented in the course.	47%	47%	5%	0%	0%
The zombie project allowed me to retain more from the class.	58%	42%	0%	0%	0%
I felt that we covered more content by using the zombie project in the class.	42%	32%	21%	5%	0%

Table 2: Perspective of Critical Thinking

Critical Thinking	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I thought the use of the zombie project in the class was thought provoking.	37%	42%	16%	5%	0%
The use of the zombie project allowed for more discussion of course ideas presented in the class.	63%	32%	5%	0%	0%
The zombie project allowed me to view an issue from multiple perspectives.	32%	58%	5%	5%	0%
The zombie project allowed for deeper understanding of operations research concepts.	37%	47%	16%	0%	0%
The zombie project brought together material I had learned in other engineering courses.	16%	32%	26%	26%	0%
I was able to apply the operations research concepts and theories to new situations as a result of using the zombie project information.	37%	37%	26%	0%	0%

Table 3: Perspective of Engagement

Engagement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The zombie project added a lot of realism to the class.	21%	37%	37%	5%	0%
I was more engaged in class when discussing the zombie project.	32%	21%	42%	5%	0%
The zombie project was more entertaining than it was educational.	11%	16%	47%	21%	5%
I felt immersed in the activity that involved the use of the zombie project.	21%	42%	37%	0%	0%
I took a more active part in the learning process when we discussed/used the zombie project in the class.	26%	47%	16%	11%	0%
I was frustrated by ambiguity that followed when using the zombie project as a reference.	0%	11%	26%	47%	16%
I felt that the use of the zombie project was inefficient.	0%	0%	11%	53%	37%
I found the use of the zombie project format challenging in the class.	5%	32%	37%	21%	5%
Most of the student I know liked the use of the zombie project in the class.	21%	42%	32%	5%	0%
I needed more guidance from the instructor about the use of the zombie project in the class.	16%	11%	21%	47%	5%
The zombie project took more time than it was worth.	5%	21%	26%	32%	16%

Tables 1-3, which contain student survey results regarding their perspectives of the case study. A total of 21 students enrolled in the course, and 19 or 90% of them completed the course in the fall of 2012. The survey was deployed using Blackboard 9.0. All 19 students responded to the survey. The students were requested to participate during the last week of the semester. This allowed for anonymity of the responder and also the capability to gather comments and suggestions.

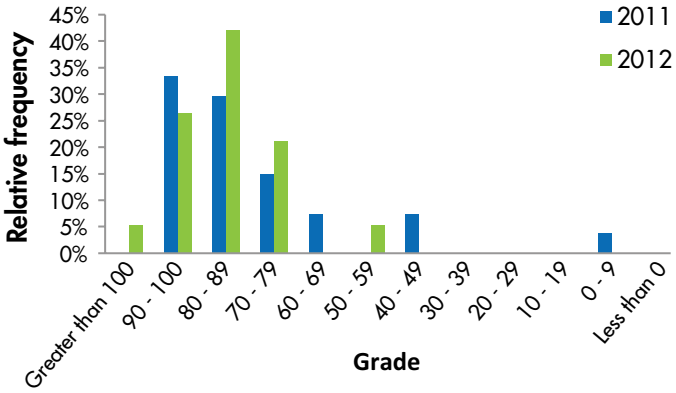
It can be seen by the response that regarding learning, the students generally agreed or strongly agreed that the zombie project allowed them to learn the concepts of the OR field. Regarding critical thinking, the students agreed that the zombie project allowed them to view issues from multiple perspectives and the application of OR concepts and theories. However, regarding engagement, students were diverse in their responses. Specifically, when asked if the zombie project introduced realism, 58% of the students agreed or strongly agreed with the remainder being neutral and only one student stating that it did not. Similarly, when students were asked if this made them take a more active part in the learning process, 73% of students felt

that the project did make them more active. The vast majority of the students did not see the project as inefficient. However, they had mixed opinions when it came to time and value, as many believed it took more time than it was worth.

In addition to the survey, students were given an area for general comments about the course. A few comments are supplied below:

- Student 1: "I like the zombie project and I think a supplement of a smaller assignment based on the material covered after the first test would help learn the concepts."
- Student 2: "I wish that it had been worth more points. It took 4X longer than the homework but was worth less. :("
- Student 3: "Fun Class! Great Class!"
- Student 4: "I liked the zombie project. It allowed students to work together in the class and; honestly, I think that when the class is working together to solve a problem, not only are we engaged in the learning process. We are also more satisfied as students. I picked up a lot more in this class after this project since I found it satisfying to work on it."
- Student 5: "I enjoyed the zombie project. It put concepts in perspective and helped me to remember them by putting them to a story line"

Figure 3 compares the grade distribution of the 2012 course to the 2011 course. Recall that 2012 was the year in which the zombie case was given to the students. The shift in the distribution is clear, as more students seemed to perform better in the course in 2012 versus 2011. In addition, fewer students fell below the 50-59 range in the year the CEP was employed. Note that in 2011 the course syllabus and textbook were also different than in 2012. The 2011 project was a simple case study taken from the text Hillier and Lieberman (2001).



The number of students was used to derive the relative frequency in each category because in 2011 only 19 students completed the course versus 31 students in 2012.

Figure 3: Student Grade Distribution for 2011 and 2012

Conclusions and Recommendations

The development of a project that was put to an evolving story line facilitated student learning of mathematically-rigorous topics. Specifically, the field of OR contains many tools, methods, and approaches, all of which must be employed in the most appropriate way. This approach allowed students to learn the topics to a higher level of complexity. They learned that the initial formulation often requires reformulation. The students were allowed to work together; however, due to differences in the data provided, no solutions were the same and small modifications were necessary to the main formulated models. Furthermore, students were able to discuss which methods were most appropriate and compare results. Lastly, and perhaps the most important outcome, was that students recalled the material more easily as the story helped in retaining their knowledge.

From the educator perspective this was not a daunting task. It took some planning, and assuring clarity in what was asked, and the information provided to the student had to be checked for errors. Overall, through something as simple as a story line, students felt more engaged and came to class with many questions regarding formulation techniques, solution methods, and interpretation of results.

Lessons learned included that undergraduates can deal with ambiguity to a certain degree, however, the old cliché, "practice makes perfect" remains relevant. The goals of assuring that students learned and increased their critical thinking skills were realized as the student perspective regarding these two measures was high, according to the survey. Specifically, the lesson learned from an educator's point or view was that students require practice, specifically opportunities to employ what they have learned from their lectures, texts, or homework into problems that are not always clear. In addition, more preparation was necessary as wording can easily confuse the students. Providing clear expectations regarding what will be graded and how it will be graded would reduce the students' worries. Furthermore, perhaps incorporating examples in the classroom that demonstrate multiple formulations, solution methods, and results should be done to show students how each OR tool can be used with similar data but seek to answer different questions.

Educators seeking to employ such a case study should remember that preparation is key. The educator should assure that ample time is given to the methodologies the students will employ within the traditional lecture period. In addition, the use of a teaching assistant who will monitor student progress may

also facilitate the deployment of such a case study. Furthermore, the educator should not fear making more complex problems, but rather ensure that students have had relevant assignments and lectures to aid their success in solving more complex problems.

The surprise in this case study was that students sought tools not covered in the classroom; they used outside resources to determine additional tools that could be employed. This was observed as one individual formulated a single global problem with sub-problems and solved the complex system using software. In addition, students perceived the use of zombies as a serious educational tool, which was demonstrated by the reply to the survey as large percentages of students saw it as an effective means to learn and increase their critical thinking (see Tables 1 and 2). Overall, the response to the CEP and the pop-culture topic of zombies seems to have captured the interest of the students, and many took it seriously and approached the problem from a unique point of view. Furthermore, the goal was to determine if the students would take such a problem or topic seriously and could rigor/discussion be brought about from the use of such topics in the classroom. It appears from this first deployment that students liked the problem.

Acknowledgements

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Ivan G. Guardiola

Ivan G. Guardiola, Ph.D. *is an assistant professor in the Department of Engineering Management and Systems Engineering, Missouri University of Science and Technology, Rolla, MO, (formerly known as University of Missouri-Rolla). His research is primarily focused in wireless communication systems, complex systems, stochastic modeling, pattern recognition, optimization, and operations research. Guardiola has been with the National Science Foundation (NSF) Science and Technology Centers for embedded networked sensors at the University of California, Los Angeles, as well as the Center for Stochastic Modeling at New Mexico State University. He received a post-doctoral appointment in the Department of Energy National Nuclear Security Administration B&W Pantex Plant in Amarillo, TX, through the NSF-Industry and University Cooperative Research Program Center for Excellence in Logistics and Distribution. He can be contacted at guardiolai@mst.edu.*

Quality Approaches in Higher Education

Establishing quality engagement for student veterans by building program support at all levels.

Promising Practices for Engaging Student Veterans

Michael J. Kirchner, Lia Coryell, and Susan M. Yelich Biniecki

Abstract

Service members transitioning into post-secondary schooling face a new, unfamiliar challenge from previous battles. Student veteran graduation rates are being questioned as are their education benefits. Across the country, student veteran organizations and resource centers are being established, though their contribution on campus for military-students needs to be explored. At the University of Wisconsin–Milwaukee, two graduate students, with support from their academic advisor, began a grassroots operation that led to the formation of a student veteran organization, a military and veterans' resource center, and professional development opportunities for academic staff and faculty to learn more about student veterans on campus. As this paper suggests, the more engaged student veterans are in their campus, the higher the quality of their education experience, thus making them more likely to be retained and earn degrees.

Keywords

Student Support, Career Development

Introduction

For veterans entering or returning to postsecondary schooling, the enrollment process is the first of many obstacles they will face as students. The transition from the close camaraderie of military service and into the civilian world represents a challenging and serious investment for student veterans (Abel, Bright, & Cooper, 2013). Feelings of exclusion, neglect, and extreme frustration are frequently cited by student veterans, many who will eventually drop out of school (Abel et al., 2013). The authors of this article include a combat veteran, a disabled veteran, and a professor in higher education with experience teaching military and veteran students. Based on our practitioner perspectives and experiences, this paper addresses the need for the quality engagement of student veterans on college campuses, the role military and veteran organizations play at universities, our approach to building program support, and the successes and challenges we faced at our Midwestern, urban university while developing a more veteran-friendly learning institution.

Need for Engagement

Since the aftermath of the 9/11 tragedy and subsequent troop deployments, withdrawals, and downsizing efforts in the military, thousands of service members are returning to school ready to use their Post-9/11 GI Bill education benefits (Abel et al., 2013). According to the Department of Veteran Affairs (VA), more than three-quarters of a million veterans have used their earned benefits to enroll in postsecondary courses (Kim & Cole, 2013). Rumann and Hamrick (2009) add that more than 80% of colleges have enrolled veteran students who have withdrawn from the military. Universities across the country are recognizing the significant amount of veteran students struggling with their transition as two thirds of schools have implemented policies regarding tuition refunds or academic transition provisions (Woo, 2006). Evidence is limited regarding which factors impact academic success for student veterans or the role institutions play in supporting this group. In fact, only a small number of colleges claim to understand the primary attrition causes of student veterans as Bain, Kim, Cook, and Sneed (2012) argue only one out of four schools understand why veterans drop out of school. Nationally, graduation data is spotty at best as MSNBC reported 88% dropout rates (Fain, 2013) while the Student Veterans of America

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reported 68% graduation rates; based on the VA's 2010 National Survey of Veterans (Horton, 2013).

Student veterans are a unique population of college students. Sixty-two percent of student veterans are first-generation college students (Kim & Cole, 2013). They average 33 years of age, spend more time working off campus, and are more likely to be married with families (Whiteman, Barry, Mroczek, MacDermin, & Wadsworth, 2013). Many student veterans have already entered or completed a first career, been exposed to diverse cultures, and lived in dangerous environments. When compared to traditional students, they struggle more with academic preparedness, social acculturation, work/life balance, understanding of learning, and emotional/health issues (Fain, 2012). Still, student veterans reported placing greater emphasis on academic areas that they felt were important for academic progress than on campus life and activities (Kim, 2013). This data is important to understand when establishing quality engagement programming for military and student veterans on college campuses.

Importance of Quality Engagement

Quality in higher education relates to the development of a "standards framework" of the educational process for students on college campuses (Shah, Lewis, & Fitzgerald, 2011; Newton, 2006). Barkley (2010) defines student engagement as "a process and a product that is experienced on a continuum and results from the synergistic interaction between motivation and active learning" (p. 8). Beyond the college classroom, engagement through participation in campus activities, organizations, and with other students is an important part of the college experience. Students who are engaged on campus are more successful with their education attainment (Schlossberg, 1989). Additionally, social and academic engagement in a new environment contributes to a sense of purpose and self-awareness for student veterans (DiRamio & Jarvis, 2011). The bond soldiers develop while serving is lost as service members transition to an environment where autonomy is favored over a shared foundation. When returning to civilian life and college, the interdependency and cohesiveness created and nurtured in the military unit become less prevalent and can create a sense of loss and an identity crisis for returning military and student veterans (DiRamio & Jarvis, 2011). The challenge of this transition may become the most significant barrier student veterans face and impacts the quality of education received.

We believe quality engagement includes assisting student veterans in developing post-military identities and easing the transition process from military service to postsecondary schooling. In the past, veterans have downplayed [or neglected] their military status to avoid rejection or stigmatization from civilian students (Rumann & Hamrick, 2009). Quality engagement for veterans must include meaningful, population-specific opportunities to participate in the culture of higher education in a manner that meets the unique needs of the student and their families. These opportunities provide a manner in which the student can develop his/her new sense of self while maintaining an important component of his/her character.

Universities have immense room for growth in the area of quality engagement. For example, Cook and Kim (2009) note that only 4% of institutions of higher education provide a veteran-specific orientation while many student veterans report frustrations with the enrollment process and other higher education systems (Cate, Gerber, & Holmes, 2010). Military and veteran student organizations and campus support centers are a critical safety net for the transition process soldiers undergo while adjusting to student and civilian life. By engaging in campus activities the student veteran is enabled to re-establish his/her sense of purpose and worth.

Schlossberg's theory of marginality and mattering describes how feelings of mattering are important to student success because mattering helps them to feel more connected to others and the institution (Schlossberg, 1989). During their enlistment, members of the military have a clear purpose and meaning in both their unit and mission. They understand the overall impact when not performing their job swiftly and accurately. When a student veteran transitions to a college environment, he may feel that he does not matter. When an individual changes roles or experiences a transition, such as a student veteran entering or returning to college, the potential for feeling marginal arises (Schlossberg, 1989). The need to increase support during the transitioning phase is exacerbated by the lack of knowledge veterans have regarding the postsecondary education system.

Building Program Support

We found that the process of building support for student veterans was critical at all levels of the organization, including administration and faculty, as well with both student veterans and the general student population. Program planning approaches for adult learners (Caffarella & Daffron, 2013) as well as a systems approach to engagement (Senge, 2006) were important frameworks we considered. Our aim was to approach the planning table strategically and transparently (Cervero & Wilson, 2006). Although all stakeholders were important in moving ideas forward, after reflecting on the process, we view support from upper administration and student veterans themselves as important cornerstones for the engagement effort.

Middle administration was not against the idea of additional support for student veteran initiatives, but in the era of scarce resources; budget cuts; and pressures for time, space, and resources, the student veteran initiatives did not immediately rise up the priority list in 2011. Schnoebelen (2013) lists the appointment

of a senior administrator to lead support programing for student veterans in her best practices. Traditionally, involving upper administration is not considered for this level of initiative at our university; however, we asked to meet with the Vice Chancellor of Student Affairs to discuss our concerns from a student perspective. In meeting face to face with the Vice Chancellor we were able to humanize the student veteran population. We emphasized our current volunteer peer mentorship roles for the hundreds of military and student veterans at the University of Wisconsin-Milwaukee (UWM). The Vice Chancellor's support initiated a domino effect. Once upper administration became involved, mid-level administrators and department directors began allocating time to meet with student veteran representatives and respond to their concerns.

Obtaining support from the administration was important in gaining stakeholder support, but gaining trust from the student veterans was even more critical. Student veterans were instrumental in pushing for an increase in student veteran support on campus and a more military-friendly climate. Marketing and outreach programming as well as the constant presence of student veteran leaders on campus helped develop a level of trust, which we argue is important for military students.

We began by requesting a welcome and information table at every new student orientation program, 21 total in the first year. In addition, we created a military- and veteran-specific welcome packet that every student veteran received in the mail from the admissions department prior to the start of the semester. The student veteran organization hosted an open house at the Military and Veterans Resource Center (MAVRC). Our presence and the persistence in the marketing of these initiatives were important for visibility, outreach education, and the symbolism of peer veteran leadership. Veterans Day, Memorial Day, and other events throughout the year also presented opportunities for student veteran programming and recognition. Later in the development of the initiative, student military and veteran organization functions also served as platforms for building support and outreach.

Establishing and Strengthening Student Military and Veteran Organizations

Once we gained initial commitment from campus administration for military and veteran student initiatives, we began to explore ways to establish and strengthen student military and veteran support structures. Two growing options for supportive military and veteran student services are student organizations and campus resource centers specifically identified for military and student veterans, which we view as important connectors for quality engagement. Each entity offers opportunities for students to engage on campus and build support networks. Rumann and Hamrick (2009) note more than 80% of colleges have enrolled veteran students who have withdrawn from the military. Universities across the country are recognizing the significant amount of veteran students struggling with the transition as two thirds of schools have implemented policies regarding tuition refunds or academic transition provisions (Woo, 2006).

Student Veterans of America

Military and student veterans have the opportunity to engage in campus life as a member of their university's student veteran organization, likely a Student Veterans of America (SVA) chapter. As Summerlot, Green, and Parker (2009) suggest, many of these organizations are created because of student veterans taking action in response to their need to identify with others like them and to enhance their overall college experience. Today, with more than 950 SVA chapters spanning all 50 states (Student Veterans of America, n.d.), many student veterans have the opportunity to connect with and support other military-affiliated classmates. Additionally, military and student veterans involved with these chapters have scholarship opportunities, employment assistance, and are part of a national organization with government support (Student Veterans of America, n.d.). SVA chapters offer veterans a chance to recreate the camaraderie they had while they served and ease the transition process through peer support and education. We recognized the lack of cohesiveness student veterans had on campus and the importance of connectedness that soldiers share (DiRamio & Jarvis, 2011) and believe SVA student organizations are contributing to an increase in enrollment, retention, and college completion rates. Thus, in February 2012, we registered our SVA chapter as a student organization at UWM. Within months, the organization grew to more than 50 enrolled members and quickly became the largest student organization on campus.

As part of the development process, we created a plan of action within a graduate-level program planning class. First, a needs assessment survey began fostering a sense of community and togetherness by engaging student veterans in the program development process (Merriam & Daffron, 2013). The interdependence nurtured in the military remains an important cultural aspect for student veterans (DiRamio & Jarvis, 2011) as we received quality feedback from a significant number of respondents. The survey was emailed to 1,024 students and had a 17% response rate. As veterans are a protected class, we were limited to students using military education benefits. The challenges and needs identified from the survey became the foundation for our SVA chapter's mission statement and goals. Of the 175 respondents, 57% claimed balancing other responsibilities with school was one of their three largest issues in school, while 46% admitted that connecting with other students was one of their three biggest

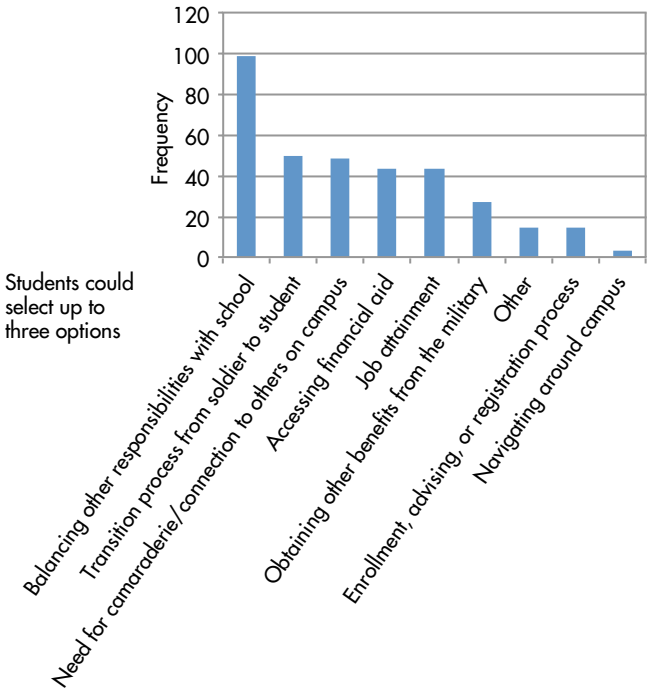

Figure 1: Biggest Challenges Identified by Student Veterans

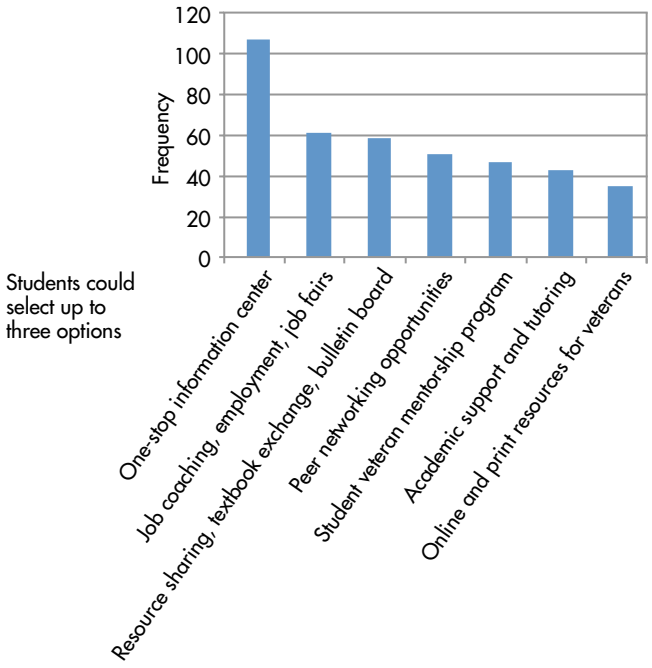

Figure 2: Most Beneficial Services and Programs From a Potential Veterans Resource Center

challenges in the classroom. Figure 1 articulates the variety of challenges expressed by student veterans. These responses helped inform our entry points to building student veteran engagement.

We realized a need to change our marketing angle for the new organization and focused on the cost-benefit value of participating in our initiative to engage students. Our efforts emphasized "How can we help you?" rather than "How you can help us?" The survey included information about a portion of our students struggling and perhaps motivated respondents through problem-centered engagement (Knowles, 1980). Respondents felt shared ownership by our acknowledgement that survey results would be used to guide support for UWM student veterans in the immediate future. As Knowles (1980) argued, adults are most interested in participating in learning when there is an immediate relevance to their work or personal lives. The inclusive approach and explanation for the purpose of the survey likely enhanced response rates. Lastly, we were familiar with the use of recognition in military culture. Ribbons, awards, ceremonies, and challenge coins are some of the ways that the military recognizes a service member's worth and contribution. Graduates of the fall 2013 class received "honor cords" and were acknowledged during the ceremony. Immediate response from both student veterans and campus administrators has been favorable. Recognition continues to be a great motivator for engaging military and student veterans in meaningful activities and services on campus.

In the first year alone, SVA at UWM was recognized as Student Organization of the Year by Student Affairs, and student veteran leaders were recognized with certificates for their contributions toward enhancing student life and campus leadership. SVA student leaders and administrators were invited to Washington, D.C. to be recognized as one of the first institutions to sign a pledge vowing to support veteran-friendly campus initiatives. While the organization has a mix of new and returning chapter leaders, the rapid growth exemplifies student veterans' need and desire to be actively engaged and accepted on campus.

Military and Veteran Resource Centers

Our Military and Veterans Resource Center (MAVRC) serves as another critical point of engagement for students. The purpose of MAVRC is to advocate for student veterans, identify internal and community support services, increase campus awareness of needs and issues facing student veterans, increase enrollment, and improve retention and graduation rates through support services (Abel et al., 2013). As seen in Figure 2, student veterans identified an array of needs. MAVRC serves as a connector for the needs identified as well as facilitates engagement.

Centers provide a bridge for both civilians and soldiers to better understand the dynamics of college and military service. Civilians can visit the center to have questions answered about the students they are working with or to volunteer to help

veterans address professional or classroom issues. Service members have a meeting area throughout the day to engage with their peers who understand the issues and challenges that stem from transitioning from combat to the classroom. The center offers a chance for student veterans to experience again the bond they shared with other service members when serving.

While the needs assessment we distributed did not ask why a resource center was important, it seems reasonable to expect that respondents recognized the significance of having a safe place to go and connect with other military and veteran students. The request for a resource center was validated once it opened at UWM during the summer of 2012. In the first year of tracking visits, more than 4,000 walk-throughs were documented. David Tucek, a student veteran work study mentor, believes MAVRC is important because it is the only place on campus with a consistently high population of military and student veterans who are readily available to help and support each other (D. Tucek, personal communication, June 4, 2013). Being able to identify with a peer group while attending school can influence and bolster academic success (DiRamio & Jarvis, 2011). MAVRC further supports veterans by hosting speakers, outreach programming, study sessions, and peer-to-peer mentoring opportunities. Veterans can participate in job coaching, receive counseling services, and become connected to trained campus liaisons who can better address their unique needs.

Challenges

Progress toward creating an inclusive, welcoming campus for student veterans has not been without obstacles. Our experiences point to potential quality practices; still, we recognize each institution of higher education operates within a unique context and successful engagement initiatives for student veterans will vary. Our conceptualization of quality continues to develop as we learn from our military and student veterans.

In an interview, Wendy Lang, director of Operation College Promise, cautions about the lack of a one-size-fits-all response for the challenges student veterans face (Schnoebelen, 2013). Many student veterans who participated in the needs assessment at our institution expressed frustration about the difficulty of making connections with other students. However, their personal lives and responsibilities impede their efforts to engage in extracurricular activities on campus. The needs assessment supports the notion that veterans, throughout their post-secondary schooling, receive less peer support than their civilian counterparts (Whiteman et al., 2013). Whiteman et al., (2013) indicates that civilian students receive more emotional support, which leads to reductions in psychological distress. Anecdotally we have found that consistent peer support increases student veterans' trust and comfort level while engaging in activities on campus. Campus support systems have the potential to reduce the gap in emotional support veterans currently face as compared to civilian students, although further research is needed to gauge impact.

We have encountered unexpected cultural challenges with roots based in military culture. Part of the transition process to civilian culture is learning to engage in language and discussion topics that are sensitive and appropriate to anyone who may enter the center. Many accepted environments in the military can be boisterous and ones in which language and storytelling are not monitored or restricted. Redirecting inappropriate language and discussion topics is an ongoing task for MAVRC staff. We want our student veterans to feel comfortable interacting with others in a familiar way while maintaining a welcoming and safe environment for all. We have found that using the military code of conduct as a guide has helped address this sensitive issue in terms that are familiar and trusted.

Conclusion

While work to become a truly veteran-friendly campus continues at UWM, steps taken have generated momentum toward meeting the needs and challenges of our student veterans. Graduation remains a common goal for both veterans and the universities serving this population. To develop the support services that student veterans require in order to achieve success, more research is needed on ways to engage the military community. Table 1 provides a

Table 1: Proposed Standard Operating Procedures for Student Veteran Engagement in Higher Education

Issue	Strategies and Recommendations
Generating support	Identify and connect student veterans, faculty, staff, and senior leaders willing to partner.
Outreach and marketing	Establish continuous presence and visibility through orientations, flyer displays, pamphlet distribution, and social media.
Identifying needs	Develop a survey with student veterans and program planner, offer incentives, and explain the purpose and importance to participants.
Military and veteran specific programming	Partner with departments, student groups, and community organizations.
Establishing a Student Veterans Organization	Identify an advisor with a vested interest in supporting veterans.
Opening a Veterans Resource Center	Identify and support a director who is an expert on veteran's issues; establish full-time center hours.

summary of recommendations for standard operating procedures focusing on fostering student veteran engagement.

Our efforts to increase the quality of student veteran engagement opportunities at UWM will be measured and assessed by monitoring retention rates and grade point averages, tracking the number of students utilizing MAVRC services as well as the number and types of MAVRC supportive programming offered, and increases in enrollment rates of student veterans. In fact, institutions that purposefully plan for and address the challenges student veterans face attract larger numbers of veterans (Abel et al., 2013). While some colleges have taken great strides to be more veteran-friendly, research and increased awareness are necessary before campus administrators can feel confident about their ability to serve this population.

Military and student veterans bring valuable experiences to the classroom and the campus as a result of their experiences in foreign countries and cultural immersion (Hassan, Jackson, Lindsey, McCabe, & Sanders, 2010). The opportunity to learn from this population enhances the quality of the campus culture and diversity that universities strive to achieve; therefore, the quality engagement of student veterans may impact the quality engagement in higher education for other student populations. With greater understanding and quality practices, universities will be able to better attract and retain student veterans, and, in turn, increase revenue dollars from military education benefits, a point that speaks to the bottom line when working with administration pressured to meet very real budget deficits.

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Michael Kirchner

Michael J. Kirchner, B.S. *is director of the Military and Veterans Resource Center (MAVRC) at the University of Wisconsin-Milwaukee (UWM). Previously, Kirchner served six years in the Army National Guard, including one year in Baghdad, Iraq. He is co-founder of the Student Veterans of America: UW-Milwaukee chapter and has a master's degree in Administrative Leadership. Kirchner is currently a doctoral student in the Urban Education Program at UWM with interests in leadership and leader development. Contact him via email at kirchne3@uwm.edu.*

Lia Coryell

Lia Coryell, B.S. *is a United States Army veteran and co-founder of the Student Veterans of America (SVA): UW-Milwaukee chapter. Prior to her involvement in SVA, Coryell taught for more than 20 years as a middle school teacher. Her work includes developing a program to assist veterans transitioning out of service and mentoring students struggling with the post-secondary education experience. Coryell has bachelor's degrees in both Recreation and Secondary Education, as well as graduate work in Library Science Research and Adult Education. She is an active member of the Paralyzed Veterans of America and is a top bow-shooter with the Paralympic Military Sports Program. She can be reached at lcoryell@uwm.edu.*

Susan M. Yelich Biniecki

Susan M. Yelich Biniecki, Ph.D. *currently serves as assistant professor in the Department of Educational Leadership at Kansas State University (KSU). Yelich Biniecki earned her Ph.D. from the University of Wisconsin-Milwaukee in Urban Education with concentration on adult and continuing education. She has over 20 years experience as an adult educator, program planner, and administrator with organizations such as the Institute of World Affairs, the U.S. Peace Corps, AmeriCorps, and the Military of the Republic of Poland. As part of her current responsibilities, Yelich Biniecki teaches adult education courses for military officers and spouses enrolled in the KSU adult and continuing education master's program at Fort Leavenworth. She can be reached at: susanyb@k-state.edu.*

Quality Approaches in Higher Education

INVITED ARTICLE

Understanding drivers for success of STEM intervention programs

Research to Practice: Identifying Best Practices for STEM Intervention Programs for URMs

Raina Dyer-Barr

Abstract

Focusing on STEM intervention programs aimed at increasing the recruitment and retention of minority undergraduates traditionally underrepresented in STEM, this paper explores the perspectives of STEM Intervention Programs (SIP) administrators. Fifty-six SIP administrators from 10 large public, research universities were interviewed on what "works" to enable the successful administration of these programs, especially in terms of how they aid in the recruitment and retention of historically and traditionally under-represented minority (URM) undergraduates in STEM. The findings suggest that for the SIP administrators in this study, exhibiting a focus on student-centeredness, community building, and collaboration as well as sustaining these efforts is an integral part of effectively administering intervention programs targeting the recruitment and retention of URM undergraduates in STEM. In addition, this paper advocates for more research in support of SIPs.

Keywords

STEM, Student Support, Best Practices

Introduction

The importance of scientific gains to the United States' national and international position in a global economy has recently led to an adamant call for the production of more postsecondary and advanced degrees in the science, technology, engineering, and math (STEM) fields (National Academy of Sciences, 2011; National Science Board, 2010). The quality of STEM education in the United States, especially with respect to the low participation of racial minorities in these fields, (National Academy of Sciences, 2011; National Science Board) has been identified as cause for concern. Despite comprising more than 30% of college-aged adults (18-24), underrepresented minority (URM) groups (Blacks, Latina/os and Native Americans) continue to represent a severely lower percentage of students earning postsecondary and advanced degrees in STEM fields (DePass & Chubin, 2008; James & Carlson, 2012). In order to meet the challenge the nation faces of remaining competitive with other scientifically and technologically advanced countries, it is imperative that all members of the citizenry are utilized to adequately populate the STEM workforce (National Academy of Sciences, 2011; National Science Board, 2010). To this end, the United States can no longer fail to develop and nurture the talents of all of its citizens (BEST, 2004; Change the Equation, 2014; IHEP, 2009; Miller, 2011; National Science Board, 2010; Strayhorn, 2010).

Over the past several decades, various strategies have been devised and implemented to address the lack of diversity in the STEM fields (National Academy of Sciences, 2011; Tsui, 2007). At the postsecondary level in particular, STEM Intervention Programs (SIPs) have emerged on the campuses of virtually all four-year institutions of higher education not only as a means to foster, support, and sustain the interest of students in STEM, but also largely in a concerted effort to address the historical and perpetual underrepresentation of minority groups in STEM majors, as STEM graduates, and in the STEM professions (Tsui, 2007). Through a variety of services and activities including mentoring, tutoring, academic advising, and providing research opportunities, these intervention programs seek to increase the representation of URMs in STEM fields. Such programs improve the likelihood that they enter these fields, are retained through degree completion, and ultimately pursue advanced degrees in STEM fields and/or enter the STEM workforce (Strayhorn, 2010; Tsui, 2007).

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Although these types of interventions have been in existence for years now, some even decades, there is little research confirming their actual efficacy, particularly with respect to their efforts to successfully recruit and retain URMs in STEM or significantly decrease their underrepresentation in these fields (BEST, 2004; Leggon & Pearson, 2006; Tsui, 2007). Through a qualitative research approach, this work explores the perspectives of SIP administrators in an effort to understand what "works" in the administration of these interventions in terms of meeting the primary goals of recruiting, retaining, and graduating URM students in STEM. Garnering the views of those who design, implement, and direct these programs and the activities and services they provide will contribute to the research literature and provide insight on the efficacy of these programs and their benefits in support of URMs in STEM.

Literature Review

Programs designed to increase the representation of minority groups in STEM fields have been in existence for decades, and over the past 20 years have been rapidly growing in number. While most STEM intervention programs at the undergraduate level generally support students in the form of social, financial, and academic assistance and resources (George-Jackson & Rincon, 2011; IHEP, 2009), the types of services and programs they offer vary widely. Despite this variance, the main goal of SIPs is generally to support students. In that respect, SIPs tend to be student-centered, largely focusing on the academic, personal, and social support of students, which has been noted as integral to success among undergraduates in general, and even more so among underrepresented students (National Academy of Sciences, 2011; Reason, Terenzini, & Domingo, 2006; Tinto, 2012). Moreover, in their efforts to support students (particularly URM students), SIPs recognize the importance not only of establishing and maintaining a community that fosters students' sense of belonging (National Academy of Sciences, 2011; Tinto, 2012), but also of collaboration among academic and student affairs administrators to ensure that students are being supported in the most effective and efficient manner (National Academy of Sciences, 2011; Tinto, 2012).

Despite the proliferation of STEM intervention programs on many university campuses, and some notable gains in the participation of URMs in STEM fields, the percentage of URM students graduating in STEM continues to be significantly less than that of their non-URM counterparts (Change the Equation, 2014; James & Carlson, 2012; National Science Board, 2014). Consequently, SIPs have been plagued by questions around their actual efficacy, subsequently placing their continued existence into question. One of the most common critiques of SIPs is that their design and implementation have not typically been guided or informed by research, but rather have been implemented in a piecemeal style that has relied heavily on anecdotal information and intuitive approaches by those with a particular stake or interest in increasing the numbers of underrepresented students in STEM (DePass & Chubin, 2008). The consistent failure to use research to inform the design, implementation, and continuous improvement practices of SIPs is problematic largely because it is unknown what effects, if any, these interventions actually have. Yet, these programs continue to be developed, implemented, and funded despite the fundamental lack of empirical evidence of their efficacy and an absence of formal evaluations to assess their actual effectiveness (DePass & Chubin, 2008; Fleming, 2012; Leggon & Pearson, 2006; Ream, Lewis, Echeverria, & Page, 2014; Tinto, 2012).

As enrichment experiences like those provided via SIPs can have a significant impact on students' educational and career goals and choices, it is important to understand in a more systematic- and empirically-based way how and why SIPs are successful. In particular, it is important to identify the SIPs' components or mechanisms that are integral to increasing efficacy and URM participation in STEM. Currently, researchers remain unsure about what, if anything, these programs are doing that is or can be effective in significantly changing the tide of underrepresentation of minorities in STEM. However, the potential of these interventions to be a serious mitigating factor in the recruitment, retention, and completion of URMs in STEM majors as well as increasing their representation in the STEM professoriate and the STEM workforce, is a prime reason to conduct further serious, empirical research on this issue.

Data and Methodology

This research consists of an analysis of qualitative data collected as part of a larger study that explores the experiences of underrepresented undergraduates in STEM fields at 10 large, public research universities as well as the factors that affect their participation in STEM (STEPUP, 2011). The data used in this work is comprised of in-person interviews conducted with SIP program directors and administrators at these aforementioned institutions in 2009, 2010, and 2011. These administrators and program directors administered a variety of programs ranging from living learning communities, summer research programs, bridge/transition programs, and first-year experience programs. These programs offered student support services (such as mentoring, tutoring, and advising), and leadership and professional development, all with the end goal of increasing the recruitment, retention, and completion of underrepresented students in STEM.

The 10 institutions were all large, public, four-year, research institutions with very high research activity. Eight of the 10 institutions were primarily residential, while two were primarily nonresidential. Undergraduate enrollment ranged from 22,000 to 43,000, and comprised of between 7% and 13% URMs and between 42% and 52% women (IPEDS, 2012).

For the purposes of this research, secondary analysis of the data was restricted to first-time interviews with administrators, faculty, and staff affiliated with SIPs specifically targeted toward URM students (as opposed to other groups underrepresented in STEM, such as women). Therefore, a total of 56 interviewees met these criteria and were used as part of this research (See Table 1 for a profile of the participants).

The specific analysis for this study involved reviewing the interview transcripts for the 56 interviewees, using open-coding to organize data into "chunks" (Rossman & Rallis, 1998, p.171), and subsequently bringing meaning to these chunks of data by further categorizing them into themes.

Findings

The data analysis resulted in three major themes with respect to what administrators believed worked in their efforts to administer effective and successful SIPs for URMs: student-centeredness, community building, and collaboration.

These themes extend beyond the typical academic services and resources that are provided via most SIPs (e.g. tutoring, advising, research opportunities, etc.). These administrators consistently indicated that they believed these specific actions made a real difference in the effectiveness of their SIPs and in helping URM students in STEM, especially with respect to their retention and degree completion efforts.

Student-Centeredness

SIP administrators in the study noted the importance of ensuring that all aspects of the SIP were completely student-centered in order to successfully direct their programs and services in a manner that works for the URM students. These administrators explained that placing their focus on students in every way possible was one of the most important things they could do as administrators of SIPs for URMs. In describing more fully what it meant to have an absolute focus on students, these administrators discussed the importance of building relationships with students and getting to know them not only academically, but also personally and socially. One administrator noted the importance and effect of relating with students on these various levels by stating:

> So, the program isn't just academic, and I guess that's what I really want to stress, because I feel like sometimes in the programs that I have been talking to, they're so worried about helping the student be academically successful. And unless you know that the students are coming from multiple backgrounds, where academics is what's keeping them—but they have children at home, or their parents are not working and they're paying their parents' bills or something—unless you learn the root of that student and learn how to develop them as a person, then academics is always gonna be secondary. So, we try to do both of that. I think that's the reason the program is successful, because we know each student by name…We don't forget one. They come in and see us all the time…they can just come in here and hang out…To them, I'm home…I think it's all about making that student feel like they have someone here.

This administrator not only highlights the importance of getting to know the students that they serve, but also how making this relationship building with students an integral part and priority of the SIP benefits the targeted students and contributes to the overall success of the SIP. In fact, the administrators in this study seemed to be keenly aware of the critical effect of their efforts to practice being student-centered for both the continual wdevelopment and improvement of the SIP, as well as the success of the students they serve. One administrator stated:

> Well, I think [we] are really focused on needs assessment and really looking to our students and the experience

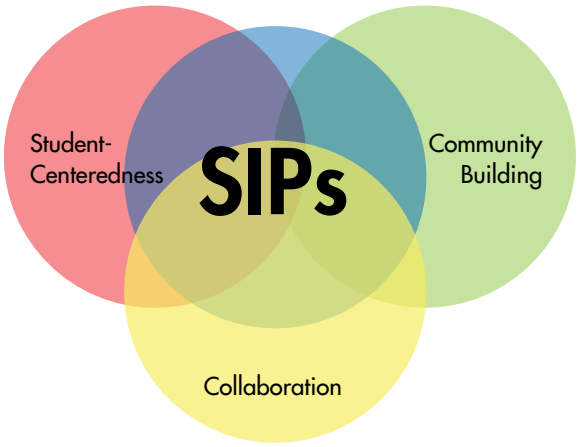

Figure 1: Model for Successful SIPs for Underrepresented Minorities

Table 1: Profile of Participants (N=56)

	N	%		N	%
Female	21	38%	Male	35	62%
African American	25	45%	Bachelor's	6	11%
Latino	2	3%	Master's	17	30%
Asian American	1	2%	Ph.D. (in progress)	6	11%
Native American	1	2%	Ph.D. (earned)	19	34%
White	27	48%	Did not indicate	8	14%

Source: Project STEP-UP, 2013

> they're having and sort of what they tell us in terms of, you know, continuing to evolve the program and add new components. So a big example of that is a few years ago when we started the program after we noticed that we had these 40 sophomores who were doing a lot for the program and the first-year students, but sort of what are they gaining from a professional development standpoint and academically from the program? And so, that's why we really try and spend some time monthly with them, focusing on their specific needs.

This administrator's statement highlights how he or she assessed student needs to better programs and services and ultimately utilized a continual improvement model for the SIPs based on student participants and their changing needs.

As another example of being completely student-centered, one administrator spoke to the importance of prioritizing the needs of the targeted SIP students over everything else, even against the larger goals of the specific department or college related to increasing the numbers of underrepresented students in STEM. This administrator explained:

> When I look at the needs of diversity in a college like [ours], my approach is always systemic. So, I'm…you know… not as interested in a numbers game. You know, get me 10 of these and 15 of these, you know, so we can match up our numbers needs with somebody's idea of what the right quotient of brownness is in a place. If the environment isn't there to support students and their educational goals and needs in a culturally appropriate manner, it seems to me that you've wasted your time.

Overall, many of the administrators provided accounts of their efforts to administer SIPs that were absolute in their student-centeredness. These administrators indicated that they accomplished this goal by building academic and personal relationships with the students, advocating for them in all aspects of their education, taking time to understand their needs, and subsequently making it a priority to meet those needs.

Community Building

Another theme that emerged among these administrators as something that works in successfully administering SIPs for underrepresented students was having a strong focus on, and a commitment to, being and providing a supportive community for students. In particular, many of the administrators in this research discussed the necessity of underrepresented students having a solid academic and social community as they entered and progressed in STEM fields. One administrator noted the important role of SIP administrators in facilitating the establishment and maintenance of a community for underrepresented STEM students, stating:

> A lot of our students that are in our program are very good students. They were the leaders at their high schools. They're high achieving. They're coming to [this university], so you know they did well. But when they get here, they're very much in the minority, so we have found that there's a disconnect between who they hang out with socially and who they hang out with academically… So, we're really developing a social academic community to build confidence and to make relationships and things. And we're already pretty motivated, which helps.

This administrator highlights the importance of SIPs engaging in community building to provide a support system and ultimately aid in the persistence and completion of URMs in STEM.

Moreover, the SIP administrators in this work were also explicit about the positive effects that providing a supportive community had not only on the larger goals of the SIPs (e.g. improved retention and completion rates among URMs in STEM), but also on students' future career choices and goals. One administrator pointed out:

> I think people have preconceived ideas of what your capabilities might be by just looking at you. And, unless they have other types of experience they tend to go with those expectations and act on them. So, many times students are guided out of areas that they should not be guided out of. So, over the course of my summer program because students did not have knowledge about some of these areas we were able to better inform them. So, how you make decisions, who helps you facilitate those decisions and what they do in the facilitation process, I think is very, very key. And I think too often individuals who would be mentors may be well intended but because of their perspectives tend to give information that might not be the best for the individual. So, one of the things we try to do with our STEM programs is to make sure that these students are only provided information where they are supported in what is it they want to do. And, assuming they get certain parts. I mean you have to have obviously the academic part. But to provide that level of support that many times that is all they need because they need someone to tell them yes you can do this. I mean too often they hear well you know maybe you should try something else. So, hearing that they can do it plus interacting with other students who look like them who are similarly situated they develop again that community support. I think that has been again a major accomplishment of the program in terms of helping with success.

Ultimately, SIP administrators in this study were adamant about the role of community building as a critical aspect of SIPs for their success and effectiveness in serving URMs in STEM.

Collaboration

Both formal and informal collaborative efforts were another component of SIPs that the administrators in this study said were important to their success in serving URM students in STEM. In particular, these administrators discussed a range of collaborative activities that they were involved in to ensure that students not only received the services, programming, and information that they needed, but also received them in the most efficient and timely manner. One administrator of a SIP targeted at URM students in the applied health sciences was explicit about the role of collaboration in efficiently administering the intervention, stating:

> We've worked a lot with a lot of the other programs on campus. So, for example, the Office of Minority Student Affairs…we met this summer, because the students that I service they service also. So, it's an issue of dislocation of services, and how can we not duplicate but learn that students can receive different information from multiple people, and it's okay to have an army around them. So, we work together to make sure that the language and the services that we provide are more streamlined for the student. So, instead of having two meetings with me and saying the same thing again, sometimes we'll have joint meetings where the student sees all three of us in a room, and that lets them know that we're all supporting them.

This administrator highlights how collaboration contributes to the effectiveness of SIPs for URM STEM students by allowing for the easier dissemination of information, services, and programming, which, in turn, impacts students' experiences and outcomes.

Other administrators discussed the importance and benefits of collaborating with faculty for the intervention in general and student participants in particular. One administrator explained:

> Across the departments, we have a core group of people that would do anything to support these initiatives. I've been working with one faculty for the seventeen years that I've been here, every year. And if I don't do something with him then he seeks me out and wants to know what can he do? He travels to HBCUs. He has sat on committees of undergraduate students at HBCUs that he's been trying to recruit. He sat on their committees, and then once they've finished their degrees, he's transitioned them here into his program. I have faculty members that do that.

Likewise, another administrator was also clear about the important role of collaboration in the administration of SIPs for URM students, succinctly stating, "I think we have a lot of work to do quite honestly. And I'm not sure if the program can work in a vacuum to accomplish our goals. I think it involves a lot of, as you mentioned, collaboration with other units, with our faculty and with the student culture." Furthermore, this administrator also discussed the benefits that accrue to URM STEM students as a result of SIPs being involved in multiple collaborative efforts:

> It is a very nice partnership that we have with the Engineering Library where we are able to coordinate tutoring resources and mentoring resources for all engineering students. It is our hope that through my engagement with that we have a lot of our students that are marginalized, either students of color or first generation college attendees or even international students that are marginalized and we hope that they can feel a little bit more supported here in the College … I'm in touch with the cultural centers. I think that's kind of important. Collaboration there is more in terms of information sharing and in terms of getting our students visible on the southern part of our campus, as well, although it's very hard. But we want to make sure that the students connect with them, as well.

Ultimately, the SIP administrators in this study credit initiating, facilitating, and being actively engaged in collaborative efforts, particularly those with the best interest of students at their core, as a critical and necessary component of effectively and successfully administering the intervention and its programs and services to URM students in STEM.

Suggestions for Best Practices

This work reveals that administrators of SIPs which target URM undergraduates have concrete ideas about best practices and what works in the administration of their interventions and in ways that are particularly effective for the students they serve. The findings of this study demonstrate that these administrators recognize and practice student-centeredness, community building, and collaboration as a means to effectively aid in the retention and completion of underrepresented students in STEM. Specifically, these SIP administrators articulated the important role that taking these actions played in not only the academic achievement and success of URM STEM students but also in their connection and engagement with STEM and the individual institutions.

Thus, this work provides several examples of best practices for administrators of SIPs aimed at supporting underrepresented students to utilize. Administrators can practice student-centeredness in multiple ways including getting to know students, helping them to feel welcomed at the institution, and addressing not only their academic needs, but also personal and social needs. Similarly, administrators can actively establish and maintain communities to further provide the means for students to become integrated and feel a part of the institution. Finally, recognizing the importance of collaborating and actively engaging in collaborative efforts with various institutional entities to provide URMs the necessary academic, personal, and social support they need is an integral role of SIP administrators working with underrepresented students in particular.

Moreover, the three themes uncovered in this work support existent research findings that are the foundation for some of the most successful SIPs in terms of facilitating the entrance of URMs into doctoral programs. In fact, there are several factors that have been identified as effective in increasing the participation of URMs in STEM: enhancing substantive knowledge and technical skills; offering support at all levels—financial, academic, professional, and social; facilitating the creation of networks and sustaining them; and providing bridge experiences focused on facilitating successful transitions from one educational milestone to the next and on helping students become socially and academically integrated (Maton & Hrabowski, 2004; Maton, Hrabowski, & Schmitt, 2000). The three themes that resulted from this research are well aligned with the established practices that have been deemed effective and successful for SIPs targeting the retention and completion of URMs in the STEM fields. In accordance with these findings, it would be prudent for SIP administrators of interventions that specifically target URMs in STEM to make student-centeredness, community building, and collaborative efforts a priority and integral part of the administration of their SIPs.

Conclusion

This work provides other avenues and areas of exploration for future research as we continue to build the research knowledge on how and why SIPs work or are successful for URM undergraduates. However, the identification of effective components of SIPs, some of which are described in this work as student-centeredness, community building, and collaboration, is only the first step—effectively and continually implementing these components is equally as important to a quality approach to identifying best practices for intervention programs that support students. With the addition of this work and other research on educational interventions, SIP administrators can begin replicating and employing the factors that are determined to work, especially the non-academic factors that supplement the academic work of these programs. Furthermore, effective implementation in the form of the institutionalization of the SIPs themselves is also important. More commitment from the institution to the intervention and its mission and goals is needed to establish SIPs as an integral part of the fabric of the institution and its goals and commitments (e.g., Tinto, 2012). To aid with institutionalization, SIPs should incorporate regular and frequent evaluations not only to sufficiently engage a continual improvement model for the intervention, but also to use the results of these formal assessments as evidence of their effectiveness year to year and across programs. These assessments should include the benefits achieved by the SIPs for the targeted students, as well as the institution. Ultimately, the goal of future efficacy research on SIPs for URMs should be to identify the best practices to determine the effectiveness of the specific intervention as well as to quantify them and subsequently replicate them in other programs to increase their overall effectiveness and their sustainability. Future efforts to inform the development and implementation of effective SIPs must be guided by rigorous and systematic research and evaluation to sustain these much needed intervention efforts for targeted students.

Note: This article is updated from the conference paper, "What Works in STEM Intervention Programs (SIPs) for Underrepresented Minority Undergraduates: Perspectives from SIP Administrators," presented at the *2013 ASQ Advancing the STEM Agenda Conference* at Grand Valley State University, Grand Rapids, MI.

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Raina Dyer-Barr

Raina Dyer-Barr, Ph.D., *recently completed a post-doctoral research position with the STEM Trends in Enrollment & Persistence for Underrepresented Populations (STEP-UP) project, a federally-funded project housed at the University of Illinois at Urbana-Champaign that investigates the participation and experiences of underrepresented undergraduates in the science, technology, engineering, and math (STEM) fields. Her current research interests are aligned with issues of students' underrepresentation, access, and retention/completion in higher education in general, and the STEM fields more particularly. She can be contacted at rdyer@illinois.edu.*

Quality Approaches in Higher Education

Developing partnerships between academic and clinical faculty to teach quality improvement.

Quality Comes Alive: An Interdisciplinary Student Team's Quality Improvement Experience in Learning by Doing—Healthcare Education Case Study

Rosa K. Hand, Mary A. Dolansky, E. Erin Hanahan, Vinothini M. Sundaram, and Nancy Tinsley

Abstract

Quality Improvement (QI) and patient safety are recognized as important aspects of medical and nursing curricula; however, little literature has discussed implementing an interdisciplinary approach to these topics. Literature from all disciplines also lacks the perspective of students on methods for teaching these topics. This paper describes an interdisciplinary graduate-level course on quality improvement which incorporates real-life implementation of a QI project in a clinical setting. One student team's experience in the clinical QI project is presented as a case study to demonstrate how the tools taught in the course were implemented in the field project. In addition, challenges faced by the students and student reactions to the course are discussed. Overall, this paper presents a model for academic and clinical faculty to partner and teach QI to interdisciplinary teams.

Keywords

Quality Tools, Partnering, Teams, Hands-on Learning, Training

Introduction

Healthcare professional students in the 21st century are learning new skills as a part of their training, including quality and safety practices (Dolansky, Singh, & Neuhauser, 2009; Silow-Carroll, Alteras, & Meyer, 2007). Medical, nursing, and public health professionals are explicitly exposed to QI methods and are challenged to work as a team to change the culture of the healthcare system and promote patient safety (DesHarnais & Nash, 2011). Methods that were once a business strategy used only by corporations are now leading the way toward a safer, more accountable healthcare system (Silow-Carroll et al., 2007).

Patient safety and QI results are increasingly published (particularly with the advent of the *SQUIRE Guidelines* (SQUIRE Development Group, 2008)) and some strategies for incorporating QI into medical and nursing education have been published (Ogrinc, Nierenberg, & Batalden, 2011). The Association of American Medical Colleges and the Lucien Leape Institute have recognized the need to incorporate patient safety into medical education (Association of American Medical Colleges, 2001; Lucian Leape Institute, 2010). Despite this, a survey of medical students showed low knowledge and confidence in the areas of QI and patient safety, with previous coursework in these areas being associated with improved knowledge (Blasiak Stokes, Meyerhoff, Hines, Wilson & Viera, 2014). Physicians, particularly those in primary care specialties, are increasingly required to participate in QI activities for maintenance of certification.

Previous work describes steps individual disciplines have taken at varying points in the educational pathway to incorporate QI and patient safety into their curricula. For example, nursing programs use the resources of the Quality and Safety Education in Nursing Institute to include QI and safety in all aspects of learning (Beischel & Davis, 2014). The University of Chicago has implemented a quality and safety residency track, which

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includes completing a QI project at each resident's outpatient clinic. This program shows improved pre-/post-knowledge for participants versus their peers in another track of the program (Vinci, Oyler, & Arora, 2013). However, these programs all teach the disciplines independently, with the exception of a program in England in which nursing, pharmacy, and medical students collaborate on patient safety in medications using a case-based approach (Hardisty, Scott, Chandler, Pearson, & Powell, 2014).

Therefore, the pool of literature lacks descriptions of how QI can be taught in a multi-disciplinary manner and incorporated in additional disciplines such as public health. In addition, the literature reports few student perspectives on methods of education in this arena. The student experience in learning about and applying QI methodologies is important in understanding the future of QI and how educational curriculums can better serve students pursuing this field of study. The purpose of this paper is to present a combined didactic/experiential model for interdisciplinary healthcare QI education, with an emphasis on the student experience. This paper will describe the course structure and provide a specific example of the application in a field project conducted by the authors as part of the course. The model can be used by practitioners and faculty as they consider how to incorporate QI teaching into their education of many disciplines of medical professionals.

Course Structure

The *Continual Improvement of Healthcare: An Interdisciplinary Course* was developed to give graduate-level healthcare professional students (medicine, nursing, health administration, nutrition, and others) the ability and confidence to use QI methods within their professions and contribute to continual improvement in healthcare. The course structure consists of 10, three-hour classes over the course of 15 weeks and an opportunity to apply the skills acquired in class to a hospital-based QI initiative. The first half of each of the ten classes includes a national quality issue such as value-based purchasing. The second half of the class covers the QI process action components that use the Institute for Healthcare Improvement (IHI) Open School Quality Modules (Institute for Healthcare Improvement, 2013). The IHI Open School Modules are web-based, multi-media mini-courses on different QI topics. Students watch videos, read accompanying material, take quizzes, and are directed to other resources for additional information. Required modules for this class were: QI 101: Fundamentals of Improvement; QI 102: The Model for Improvement: Your Engine for Change; QI 103: Measuring Improvement; QI 104: The Life Cycle of a Quality Improvement Project; QI 104 The Human Side of Quality Improvement; QI 106: Mastering PDSA Cycles and Run Charts as well as Patient Safety Module 100: Introduction to Patient Safety (Institute for Healthcare Improvement, 2013). Application of the concepts occurs in two phases. Students first apply the basic tools of QI by completing a personal improvement project guided by an online workbook (Neuhauser, Myhre, & Alemi, n.d.). After gaining confidence in applying rapid cycle QI concepts to a personal project, students then apply the concepts to a clinical QI field project.

The semester during which the authors were students was the 19th semester for the course. It is offered yearly in the fall. Ten students (one each of medical student and nutrition graduate student, two nursing Ph.D. candidates, along with six Master's of Public Health students) were enrolled in the class and three teams were formed, each with a unique project.

Academic Practice Partnerships

The academic clinical partnership is a key strategic relationship in the course structure. It is designed to support the students' application of improvement science in the real world of healthcare delivery. The experiential approach exposes the students to the operational issues faced by interdisciplinary improvement teams as they strive to continuously improve patient safety, quality, and efficiency. The knowledge of improvement can seem straightforward when learning it in the classroom setting. However, when applied to the healthcare environment, students learn to understand and manage the complex aspects of creating successful organizational change including the influence of organizational culture.

Setting up the field projects requires the clinical sponsors to find leadership to coordinate student learning. In the summer prior to the academic year, hospital-based sponsors submit potential student QI projects and list available data to support the projects. Preference is given to projects that have available data and provide the necessary resources for student teams. Projects are chosen based on feasibility of integrating students into existing teams. Once projects and sponsors are chosen, clinical sponsors of these projects are oriented to the student assignments. Students in the course are assigned to clinical QI projects using an online survey, which assesses a student's project interest and levels of experience with healthcare, improvement, research, and discipline. The goal is to create interdisciplinary student teams with sponsors who lead clinical improvement projects.

Course Schedule and Assignments

During each week of the semester, the students are given assignments to guide the application of the QI content into the clinical QI project as shown in Table 1. QIKat Assessments are short

Table 1: Course Tools, in Order of Introduction, and Their Purpose

Week Assigned/ Taught	Tool/Assignment	Description/Purpose
1-10	IHI Open School Modules (Institute for Healthcare Improvement, 2013)	Introduce model of improvement and QI tools.
1 and 15	QIKat assessments (Ogrinc, Headrick, Morrison, & Foster, 2004)	Example: Improvement opportunities where students suggest a measure, aim, and solution in order to improve the problem presented.
5	Seven-step meeting process (Batalden & Stoltz, 1993)	Outlines a formal meeting structure including use of an agenda in order to run efficient meetings.
5	Organizational readiness assessment	A series of questions to determine a team's readiness for change. If a team is not ready, those areas can be addressed before beginning change to increase likelihood of success.
7	Industry assessment	Determine standards and best practices used by other facilities.
5	SMART aim statement (Institute for Healthcare Improvement, 2013)	Create a SMART project aim based on the problem identified.
8,15	Team Learning and Development Inventory© (Lingham, 2004)	Determine areas in which teams are strong and weak so communication and efficiency can be improved.
10	Process map	Determine the sequence of events and decision points for an action to occur.
10	Fishbone diagram	Determine the root cause of a problem by identifying contributing factors.
7	Control chart	Systematic way of displaying data over time to determine if a true change has occurred or if it is due to chance.
8, 15	Personal reflection	Determine how students viewed the course and interdisciplinary teamwork.

scenarios that students must consider how to improve; providing a measure, objective, and suggested solution, and were used in this course as a pre-/post-test of knowledge at the beginning and end of the semester. The student teams are taught to use the seven-step meeting process and establish team ground rules (Scholtes, Joiner, & Streibel, 2003). The first field project assignment is a readiness assessment of the clinical partner team. The goal of the assessment is to determine the adaptive culture of the team, and it covers items such as support from senior leadership, resources needed to complete the project, the presence of an overall quality culture, customer focus, history of successful projects, ability to obtain data, and the absence of blaming behaviors. Another assignment is the industry assessment to determine standards and best practices related to the problem targeted by the QI project. Students also complete observations and collect data at the clinical site to begin defining and determining the cause of the problem, which is guided by process flow and fishbone diagram assignments. Students present the data to the clinical team and together develop an improvement plan using a SMART (specific, measurable, attainable, relevant, timely) aim and idea for the improvement. The student team, with the support of the clinical sponsor, implements the change using concepts from the psychology of change (Batalden & Stoltz, 1993) and Diffusion of Innovation theory (Rogers, 1983). Data are collected and control charts (Amin, 2001) are created to determine if a change was made as a result of their plan. Students also develop a timeline to guide the project accomplishments. During all phases of the project, information is presented to the sponsor team as well as to the instructors and other student teams.

In addition, reflection narratives are completed to assess individual and team progress and improve interdisciplinary team work. Another assignment includes the completion of didactic lessons on leadership and a teamwork assessment tool—the Team Learning and Development Inventory © (TLI) (Lingham, 2004). The TLI provides a framework for team members to develop an awareness of the elements of team function in order to improve. Team members answer the 30 inventory questions twice; first, when reflecting on real interactions with their team and then using a framework of ideal interactions (based on what

they would like their team functioning to be). Teams strive to improve on the areas with the largest gap between real and ideal.

Case Study

The student authors of this paper were matched to a project on improving patient satisfaction in the ambulatory clinics of University Hospitals Case Medical Center's (UHCMC) new freestanding cancer hospital, Seidman Cancer Center. As described in the proposal presented to the author team, the overall project goal was to improve patient and staff satisfaction. The ambulatory clinics of Seidman contain four hallways of patient exam rooms, with different physician teams occupying the hallway each day of the week. Lower than desired patient satisfaction had been identified in recent Press-Ganey surveys, leading to the request for students from the class to collaborate on a QI project to improve patient satisfaction and throughput. The ambulatory clinic and hospital management teams had completed their own studies on patient wait times prior to the authors' arrival and determined that patient wait time had an impact on the satisfaction scores. The clinic/hospital management team (leadership team) that worked with the authors on the satisfaction project included the ambulatory clinic manager, the director of infusion and ambulatory clinics, patient access (scheduling) manager, business operations manager, and the chief medical officer, who also practices as a surgical oncologist.

Specific examples of how the author team implemented the course tools in their project are presented in Table 2. The root cause of the long patient wait times was determined to be providers not being aware that patients had entered the room or how long they were waiting. The change that was developed to solve this problem was to have providers track the arrival and departure of each provider in and out of the exam room. This would help increase provider awareness of patient wait times. The industry assessment showed that long waiting times do cause a decrease in patient satisfaction but the amount of time the physician spends with the patient can mediate this effect (Feddock, Bailey, Griffith, Lineberry, & Wilson, 2010). While no industry standard for waiting time has been established, ten minutes is the time after which patient satisfaction decreases (Feddock et al., 2010) and was established as the goal in this project.

While the author team project did not create a noticeable change in patient wait times, members were able to implement all of the course tools and were a highly successful interdisciplinary team, as shown by their TLI results. Students were able to apply the concepts and tools taught in class to a real world project. The experiential aspect of the course highlighted the challenges of improvement and working on a diverse team. No formal evaluation from the sponsor team was completed at the end of the project; however, feedback to the student team indicated that the sponsors were appreciative of the input from an outside party and felt that the lessons learned prepared them for success in future QI initiatives. The industry assessment and throughput data may be helpful for future QI initiatives on the same patient satisfaction problem.

Based on student course evaluations and change in QIKat scores, the course succeeded at achieving its objectives. The

Table 2: Author Team's Application of the Tools in Case Study QI Experience

Tool/Assignment	Specific Application in the Example Project/Course
IHI Open School Modules (Institute for Healthcare Improvement, 2013)	Positive comments were received on course evaluations regarding the integration of the IHI modules and the field experience.
QIKat assessments (Ogrinc et al., 2004)	Used as pre-/post-course assessments, during the semester the authors were enrolled, mean pre-scores were 8.6 and post-scores were 13.5 (range 0-15).
Seven-step meeting process (Batalden & Stoltz, 1993)	Used to run efficient meetings with the sponsor team and show what could be realistically completed in the semester team handbook reference.
Organizational readiness assessment	Determined that the sponsor team was ready overall to change but there were some weaker areas. Determined that clarification was needed as to the perception of the customer: Was it the physician/provider or the patient?
Industry assessment	Determined that wait times are defined many ways, and longer wait times are associated with poor satisfaction. However, this can be mediated if the physician spends significant time with the patient once he/she arrives.
SMART aim statement (Institute for Healthcare Improvement, 2013)	"Decrease patient's solitary wait time in the exam room to no longer than 10 minutes prior to first provider entering the room."
Team Learning and Development Inventory (Lingham, 2004)	The author team reported small differences between the actual and ideal experiences in all four categories, indicating optimal team cooperation and efficiency.

QIKat assessment scores increased from class one to the end of the semester, showing that students began with low scores but did gain knowledge of QI methods. Students gave the course an average rating of 4.3 out of 5 on overall quality and an average rating of 4.4 out of 5 in meeting the stated objectives. As stated by the students, the strengths of the class included the IHI Open School and field project. One student stated, "This course provided real time exposure to the challenges faced in a healthcare work environment and how to implement change. The structure and hands-on interaction with UHCMC staff and the on-line tutorials provided realistic skills on how to meet these challenges." The main weakness identified by students was the limited time in a semester to complete the field project. Finally, one student stated that they will "use the skills gained in this class personally and professionally from here forward."

Applying Knowledge to Real-Life: Facilitators and Barriers

The field project allowed the students to put the methods of QI into practice. The hands-on experience helped the students understand the difficulties of implementing an improvement plan and managing change and why only 20-30% of projects succeed (Smith, 2002).

There were many aspects of the field project that facilitated success. The student team was truly interdisciplinary, including a Registered Dietitian Nutritionist (RDN) and two Master of Public Health (MPH) students with different tracks. All of the student team members had research experience, but were new to QI. This mixture of perspectives helped with the execution of the class project. In addition, the team was successful because of the match between expectations and actual team functioning as evidenced by their TLI scores and because of their use of the team tools introduced in the course.

There were barriers that impeded the success of the project. The sponsor team, while interdisciplinary with management buy-in, lacked involvement from the front-line staff. Engaging and educating front-line staff is challenging and resource intensive, but absolutely critical when promoting patient safety and quality (Pronovost, Berenholtz, Goeschel, Needham, Sexton, Thompson & Hunt. 2006). As a result of this, the change developed by the authors and leadership teams was not implemented successfully. The author team needed to stress the importance of facilitating change management (engage, educate, execute, and evaluate) with the front-line staff and encourage participation of the front line from the very beginning. An overall theme during the project was a discrepancy in expectations between the student and professional teams. The professional team expected the students to put forth more hours than was expected by the students based on the course timeline. The students, however, handled the expectations professionally and used the QI tools discussed in class, such as timelines, SMART aims, and the seven-step meeting process, to engage in productive discussions and keep the project as realistic as possible.

Finally, some concepts from the course were difficult for the student team to implement because they were not considered the project leads. For example, as mentioned above, buy-in from all stakeholders (leadership and front-line) was stressed in the coursework, but was difficult for the students to enforce. There was no front-line provider on the QI team, resulting in a lack of buy-in for the change. Although the student team tried to lobby for a front-line provider to be involved in selecting the change to be implemented, the professional team felt that this would be an imposition on the providers' time and preferred not to invite them to take part.

Other work has shown positive outcomes and experience ratings from students engaged in QI work, for example at the University of Connecticut School of Medicine, second-year medical students worked in groups on continuous quality improvement (CQI) projects on diabetes mellitus at community-based primary care practices. The rate of documentation of performances of foot and eye exams increased significantly from the baseline to the six-month mark, and students left with an understanding of the importance of clinical outcome measures. These results showed that student-driven CQI projects can improve quality of care, and input from students should be utilized to optimize CQI experiences and outcomes. (Gould, et al. 2002)

In a course similar to the one described here, senior nursing students learned QI with geriatric medicine fellows, with an emphasis on learning how to work together as a team, understanding the QI process, and being able to identify roadblocks during the QI process. Roadblocks identified by these students were similar to those described here: short course duration, coordination of student schedules, and lack of buy-in at the clinical site; however, the students were positive about the experience and found the experiential learning to be effective. (Dotson & Lewis, 2013). Along with being relatively unique in its focus on interprofessional education, this course fulfills all three parts of the organizational framework introduced by Wong, Levinson, and Shojania for QI activities in medical education: formula curricula, education activities related to specific skills, and a real-life experience in QI.

Implications for Future Education

With the combination of the IHI Open School and the application of QI concepts into the field project, the students gained

a clear understanding of the importance and significance of QI and patient safety. The academic clinical partners also benefited from the project, gaining an outsider's perspective on their processes and QI team structure. Students are able to apply the concepts in the project and beyond in their careers. Facilitators and barriers to improvement in healthcare identified by students included clear goals, roles, expectations, and opportunity for bi-directional feedback.

Clinicians who have the opportunity to work with students engaging in QI courses are encouraged to do so, to adequately train the next generation of providers who will need these skills. In addition, facilities engaging in academic clinical partnerships should consider QI opportunities for their students for a mutual benefit of all parties. In addition, QI training should be offered to a range of health professionals in an interdisciplinary manner, rather than limited to physicians and nurses. Those engaging in QI work can consider the resources presented here as a baseline for developing their work and trainings.

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Rosa K. Hand

Rosa K. Hand, MS, RDN, LD, *is senior manager, Dietetics Practice Based Research Network, Academy of Nutrition and Dietetics, Chicago IL, where she oversees the network and its research projects. She also serves as adjunct faculty at Case Western Reserve University in Cleveland OH, and mentors students and dietetic interns. Hand was part of the student team described in this paper during her master's work at Case Western. She is a member of Phi Beta Kappa. Contact her via email at rhand@eatright.org.*

Mary A. Dolansky

Mary A. Dolansky, Ph.D., RN, *is an associate professor at the Frances Payne Bolton School of Nursing, Case Western Reserve University, Senior Fellow in the Veterans Administration Quality Scholars program Louis Stokes Cleveland VA, and director of the QSEN Institute (Quality and Safety Education for Nurses). She has co-published two books on quality improvement education. She has taught the interdisciplinary course described in this paper for the past 10 years and was chair of the Quality and Safety Task Force at the school of nursing. She is co-director of the VA Transforming Primary Care Center of Excellence to implement and evaluate a longitudinal interdisciplinary curriculum for medical residents and nurse practitioner learners. She can be contacted at Mary.dolansky@case.edu.*

E. Erin Hanahan

E. Erin Hanahan, MPH, *is a senior research program coordinator II at the Johns Hopkins Medicine Armstrong Institute for Patient Safety and Quality. She is the project manager for the Enhanced Recovery After Surgery project and the AHRQ ACTION III coordinator. While working on her master's at Case Western Reserve University she was a member of the student team described in this paper. Through the Armstrong Institute, Hanahan is certified in patient safety and serves as a comprehensive unit-based safety (CUSP) coach for hospitals around the country. Her email address is Ehanaha1@jhmi.edu.*

Vinothini M. Sundaram

Vinothini M. Sundaram, MPH, *is an epidemiologist at the Cleveland Department of Public Health in the Office of Communicable Disease Surveillance and Epidemiology. She has several years of experience in the field of healthcare research and public health. While pursuing her master's degree at Case Western Reserve University she was a member of the student team described in this paper. Along with epidemiology and health policy, her interests include quality improvement, health disparities, public health, and community outreach and education. She may be contacted via email at vsundaram@city.cleveland.oh.us.*

Nancy Tinsley

Nancy Tinsley, MBA, RN, *is the vice president of the clinical operations for University Hospitals of Cleveland. Her work focuses on strategic planning, clinical program development, and performance improvement. She is a Fellow in the American College of Healthcare Executives and adjunct faculty at Case Western Reserve University teaching the course described in this paper. She earned numerous recognitions in her field, including Beta Gamma Sigma, Honor Society for Business Excellence, and Sigma Theta Tau, Nursing Honor Society. Tinsley holds several community leadership positions including Ohio Regent for the American College of Healthcare Executives. Contact her at Nancy.Tinsley1@uhhospitals.org.*

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   - Make the opening interesting; use the opening and/or background to answer the "so what?" question.
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Book examples:

Veenstra, C., Padró, F., & Furst-Bowe, J. (eds). (2012). *Advancing the STEM agenda: Quality improvement supports STEM*. Milwaukee, WI: ASQ Quality Press.

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Journal article examples:

Dew, J. (2009). Quality issues in higher education, *Journal for Quality and Participation* 32(1), 4-9. Retrieved from http://asq.org/pub/jqp/past/2009/april/index.html

Plotkowski, P. (2013). Guest commentary: Real-World engineering education: The role of continuous improvement, *Quality Approaches in Higher Education*, 4 (1), 2-4. Retrieved from http://rube.asq.org/edu/2013/05/best-practices/quality-approaches-in-higher-education-vol-4-no-1.pdf

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National Science Board. (2012). Science and engineering indicators 2012. Arlington, VA: National Science Foundation. Retrieved from http://www.nsf.gov/statistics/seind10/.

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