Case Study: Encouraging Faculty Adoption of New Grading Software

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I am very honored to be a part of this great organization.

Thank you

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Kay C has received a number of awards for teaching, research, and mentoring, including the Louisiana "Professor of the Year" award from the Carnegie Foundation for the Advancement of Teaching, a CAREER award from the National Science Foundation, the Tulane University "Inspirational Undergraduate Professor" award; the Tulane University President's Award for Excellence in Undergraduate Teaching; the Graduate Alliance for Education in Louisiana Award for Excellence in Mentoring Minority Researchers; the honor to serve as a Teaching Fellow for the National Effective Teaching Institute; and more.

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Introduction

When used properly, technology can be used to improve how educators teach [1] as well as enable new modalities of pedagogical techniques [2]. The successful implementation of technologies relies heavily on an instructor's knowledge of the technology and ability to integrate it into their class [3]. Researchers have studied the barriers and dynamics of technology adoption by faculty members. Some of these barriers include perceived usefulness (or lack thereof), structural constraints (such as technical support), lack of time to learn new technologies, and varying levels of faculty proficiency with technology, among others [4].

With such a wide variety of technological tools and approaches designed to improve the learning experience available on the market today, it is impossible for a higher education institution to support and promote every technology. This means that choices have to be made on the institutional level for what technologies are supported. Institutional support is a major factor in both the deployment efficiencies and effective use of a technology in practice [5] [6].

In his seminal work, Rogers found that for ubiquitous adoption of a technology to occur, a "critical mass" of users must be established to promote adoption by "mainstream" faculty [7]. There are many ways to accomplish promoting the adoption of a technology at an institution. Jacobson suggests that there are best practices that both the institution and early/mainstream adopters of technology can do to remove barriers to technology diffusion [8]. These suggestions include increasing awareness among faculty using new technologies and the benefits of using the technology, increasing the observability and trialability of technology integration on campus, promoting a culture of inquiry into teaching and learning with technology, institutional rewards for those things that the institute purports to value, provide different support infrastructures for early and mainstream adopters, among others.

There are many different types of technology that can be used to improve learning. Providing timely and meaningful feedback to students is an important component of learning [9] [10]. This kind of feedback is often time consuming to provide, which makes it difficult for instructors to implement [11]. A rubric-based grading system has been shown to provide a number of different advantages including transparency and clarity in grading, consistency in grading (especially when multiple graders are involved), and improved student self-efficacy by helping them identify key cognitive skills that they need to develop to perform well on an assignment [12]. However, teachers sometimes consider static rubrics cumbersome and often are not consistent with the best practices of "experts" and adopt a "hodgepodge" grading approach [11].

Gradescope is a web-based tool for grading which was defined to optimize the dimensions of speed, consistency, and flexibility [13]. The use of dynamically-created, reusable rubrics along with reusable comments is meant to provide instructors with tools necessary to give detailed feedback in a time-efficient and consistent manner. AI-assisted grading and answer grouping is

also included to increase grading efficiency. Gradescope can be used for scanned hand-written assignments and so faculty do not need to change the mode of administering homeworks and exams, only the mode of collecting and grading them. This potentially decreases at least one barrier for adoption. Time savings of 30% or more have been reported over traditional workflows by using Gradescope [13]. The benefits described above, along with the recommendation of early adopters were the major motivating factors for deciding to adopt and support this tool at the institute involved in this case study.

This paper is meant to present a case study for an attempt to promote the use of a particular software, in this case Gradescope, at a small, private, undergraduate-focused teaching institution. We will describe the multi-tiered approach to promoting the use of the software including various levels of training and other incentive programs, and the responses from faculty members about the approach taken in order to better understand the effectiveness of the trainings provided and faculty perceptions about the trainings. While the current status of diffusion within the institute is not to the point of ubiquitous adoption at this time, we will relate the current situation to the models from literature and the markers that we are using to transition to different kinds of support and training. Finally, based on the results of this case study, we will give suggestions for how other institutions might use a similar approach to promote the adoption of a technology.

Background

This case study is based around a small (~2,200 students), undergraduate-focused math, science, and engineering teaching institution. There are approximately 190 faculty at the institute with approximately 80% of these teaching within the various engineering and natural sciences departments. The academic year is broken into three main quarters where classes are offered (Fall, Winter, and Spring) and a Summer quarter where few classes are offered.

In 2018, approximately 5 years after Gradescope came onto the market, the first adopters of the technology began using the tool in their classes at the institute. These would be considered the "innovators" by Rogers as they represent less than 2.5% of the total faculty at the institute as illustrated in Figure 1 [7]. At the end of the 2018-2019 academic year, institutional licenses for Gradescope were purchased and the process of integrating the software with the current learning management system (LMS) began. At this point, trainings were mainly informational and reference materials were posted online so that faculty could learn the basic mechanics of using Gradescope. These were appropriate for those faculty who might fall into the "early adopter" or "innovator" categories, but there was not enough faculty experience on campus to allow those who may fall into the "early majority" category to evaluate the early adopter's results. According to Ronkowski, being able to examine the results of the early adopters is an important factor to bring the early majority faculty on board with the technology [14]. The inquisitive nature of innovators and very early adopters means that merely exposing these faculty to basic training of what can be done with the technology and availability of helpful tutorials is often enough to get them using the technology. They will likely overcome or overlook minor barriers to adoption on their own.

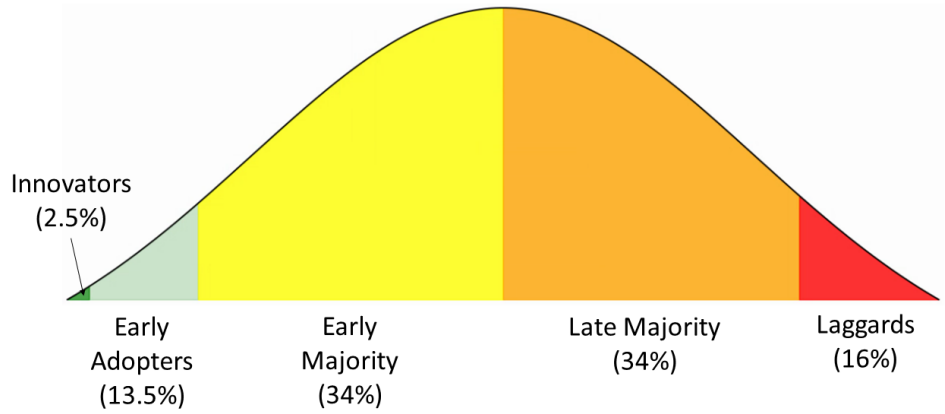

Figure 1: Rogers' five categories of technological innovation

Massy and Zemsky proposed an e-learning innovation adoption curve based on Rogers' categories of technological innovation. Their model shows that adoption rates are slow at the beginning and end of the adoption process and is accelerated after a "critical mass" of adoption has been achieved (Figure 2) [15]. Rogers identified the 10-20% adoption as the "critical mass" point [7]. When the pandemic caused all of the offered courses to move to an online format in the spring of 2020, the number of courses that used Gradescope went from 19 in the Winter quarter to 50 in the Spring quarter (note that the number of courses is related to but not a direct number of faculty using the software as faculty who use the software will often use it in multiple classes). The number of assignments graded in Gradescope jumped from 169 to 552 over this time. This represents an unexpected acceleration of adoption compared to the model of Massy and Zemsky. This means that more faculty became early adopters, but for reasons that are not typically associated with this group.

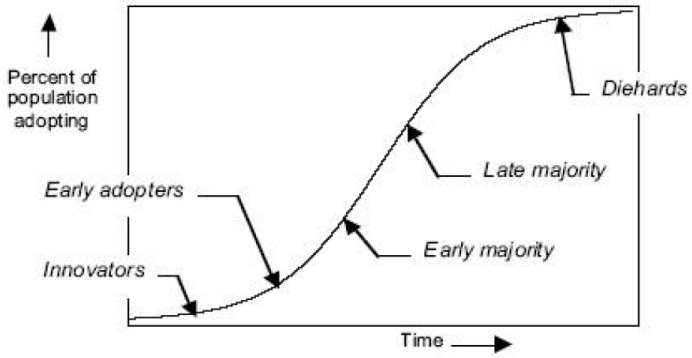

Figure 2: The stages of technology adoption (Massy and Zemsky [15])

To get a picture of the rate of adoption, Figure 3 shows the average number of courses per term at the institute that used Gradescope each academic year. From AY 2018-19 to AY 19-20 there was a fourfold increase in the number of classes that used Gradescope as the technology was adopted and introduced to the faculty by the Learning & Technology Department at the institute. This can largely be attributed to the innovators trying things out in their class. A 64.5% increase

in the number of classes that used Gradescope happened during the pandemic. In AY 2021-22 there was a modest 14% increase in the number of classes that used Gradescope which is much more in line with the slow growth predicted by Massy and Zemsky as the early adopters begin using the technology. This also demonstrates that some of those who adopted Gradescope during the times with pandemic restrictions reverted back to more traditional techniques for collecting and grading assignments after those restrictions were lifted. This is the context in which the case study is taking place. This may mean that while there are larger numbers of faculty that have had some experience with the technology, there may also be additional barriers to adoption for those faculty that tried to use the software without the typical motivation factors that stem from a poor experience using it during the time of the pandemic.

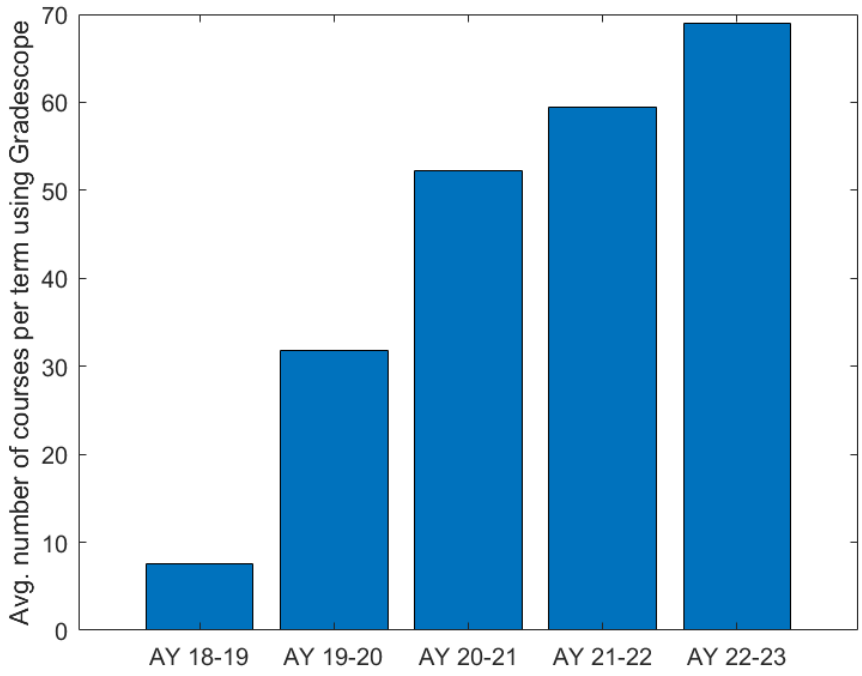

Figure 3: Average number of courses per term that used Gradescope for each of the academic years from 2018-2023 (excluding Spring and Summer 2023).

Methods

Methods to Encourage Faculty Adoption

This case study centers around efforts starting during the end of the AY 2021-22 to accelerate the diffusion of Gradescope on campus. The use of best practices from literature was leveraged when creating the support to faculty adoption. The institutional support included financial incentives to attend information and training sessions, providing professional development opportunities for Learning & Technology staff to better support faculty, hands-on workshops to familiarize novice users to the tool, and advanced training sessions for early adopters to share best practices and innovative uses of the tool.

In the summer of 2022 three professional development opportunities were developed and offered related to Gradescope. These were a basic Gradescope training workshop, and advanced users Gradescope workshop, and a "Technology in the Classroom" panel session for new faculty onboarding. The institute provided a stipend of $100 for faculty to attend either of the first two workshops. The instructional design team within the Learning & Technology department created the basic training workshop which would walk participants through the minimal steps required to create an assignment, upload student work, grade student work, and view the results. Developing this workshop also helped the instructional design team gain experience with Gradescope so that they could better support faculty who chose to adopt this technology in the future. This basic workshop was specifically designed for those who had never used Gradescope before or had tried to use it but did not feel comfortable with it. These would be faculty members that could be classified as in the early majority category that may be willing to adopt new technology but have hesitations. This would be a key group of users that need to be converted for the critical mass to be achieved.

In parallel to the basic training sessions, advanced training sessions were developed to engage with the early adopters in an effort to promote innovation and best-practices with the tool that they would then share with others in a "train-the-trainer" model [16]. One of the very first faculty adopters of the technology on campus was tasked with creating and running this workshop. This provided faculty with a peer that they could talk to for additional advice after the workshop and demonstrated many novel ways that Gradescope was currently being used in the classroom. Some of these novel uses include using it to grade presentations, using memes for grading, and generic rubrics to aid novice graders (undergraduate graders using Gradescope). Sharing these ideas as well as tips and tricks helps develop a community of users that other faculty can get help from or evaluate certain practices before adoption.

The faculty panel for new faculty did not specifically focus on the use of Gradescope particularly, but it was a chance to let new faculty know that this is an option for them to use and where to find help if they wanted to adopt this for their classes. This was mainly meant to preemptively remove barriers to adoption before these new faculty members started developing their classes.

Methods of Data Collection

While usage data (similar to what was presented in the Background section) is used to help judge the effectiveness of the approach taken, more time is needed to see the full impact of these trainings and increased support from instructional designers on diffusion rates. To better understand the adoption data that has been collected, surveys were sent to training participants after the school year had started to better understand how they intend to use or are using the information from the trainings. While intentions to behavior changes do not always correlate strongly to actual behavior changes, articulating specific things they intend to do does increase the likelihood of the intentions being realized [17]. The relevant questions in the survey were:

- Even before participating in this workshop, I planned to use Gradescope in at least one of my courses during the upcoming year. (1: strongly disagree; 2: disagree; 3: neutral; 4: agree; 5: strongly agree)
- After participating in this workshop, I plan to use Gradescope in at least one of my courses during the upcoming year. (1: strongly disagree; 2: disagree; 3: neutral; 4: agree; 5: strongly agree)
- Which factors were important motivators for you to attend the Gradescope session?
- If this workshop is offered again in the future, I would encourage a colleague to attend. (1: strongly disagree' 2: disagree; 3: neutral; 4: agree; 5: strongly agree)
- What, if anything, from the session have you shared with a colleague, or what are you most likely to share with a colleague?

Results and Discussion

A total of 40 faculty members completed either the basic or advanced workshops in the summer of 2022. There were 34 faculty that attended the basic training and would be potential new adopters and 6 faculty attended the advanced training and are likely early adopters and Gradescope champions on campus. This represents approximately 21% of the faculty and most of the departments on campus had at least one person from their department attend. With such good attendance, converting some of these faculty into users could go a long way towards achieving a critical mass of users on campus.

As shown in Figure 3, the growth in the average number of classes per term using Gradescope did increase slightly more after the trainings than the jump between the previous quarters. Table 1 shows raw usage numbers for the number of courses using Gradescope, the number of students (not unique students) using Gradescope, and the number of assignments that use Gradescope. The comparison is being made between the Fall quarters and Winter quarters before and after the training session. The Fall quarter after the trainings saw the largest numbers ever at the institute in all three categories. There was a slight decrease in the number of classes using Gradescope during the Winter quarter between AY 21-22 and AY 22-23, but the number of students and number of assignments increased which may mean that sections of the same course taught by the same instructor may have been combined into a single Gradescope course. The overall usage of Gradescope on campus clearly increased, which is the important point. The Spring quarter data has not yet come in and so no comparisons can be made at this time.

Table 1: Comparison of Gradescope usage before and after trainings

Term	Fall		Winter	
Academic Year	21-22	22-23	21-22	22-23
Number of courses using Gradescope	60	82	60	56
Number of students using Gradescope	1226	1790	1368	1378
Number of assignments using Gradescope	684	977	700	830

The increased usage in the Fall quarter is consistent with the results of the workshop participant survey. Seventeen faculty (response rate of 42.5%) completed the survey. While the population of respondents is not representative of the entire faculty population because they already self-selected into the training sessions and those who responded to the survey were probably more likely to be adopters, those who responded were the target population for the trainings. Namely, we were targeting the early adopters or the very first early majority faculty who would be most likely to convert to being users in order to get to the critical mass. The results of this survey represent what motivates those who could be turned into champions of the technology in their departments and foster a quicker dispersion. Future work will have to be done to identify specific barriers for faculty who are more hesitant to adopting a new technology (late majority).

Ten of the 17 faculty respondents indicated an increased likelihood of using Gradescope in at least one of their classes after completing the training. Six of the remaining respondents were already planning on using Gradescope before the workshops with only one respondent indicating that they were equally not likely to use Gradescope before and after the training. The reason cited by this respondent was not being satisfied with the tool itself and the way that the feedback was presented to students. It was their expectation that the students would not review the feedback that he/she would give them in the platform. Having data about how student use the feedback and review rates of feedback from Gradescope users may be an important addition to the training to convince the late majority adopters in the future. This faculty member may not be aware of how many students on campus are currently using Gradescope in their classes and could be helpful for other faculty who are similarly minded to know this information.

One of the other survey questions was dedicated to better understanding the motivations to participating in trainings. Participants were asked to pick as many responses that they considered important reasons for attending the training from a list of responses seen in Table 2 (note the reference numbers are included for ease of reference in this paper). The lowest number of responses selected by an individual faculty member was 2 and the largest number was 7. The order of selection was also tracked to understand the relative importance of the possible factors. The total number of times that the factor was selected by the respondents and the number of times that the factor appeared in the top three responses of a respondent are also included in Table 2.

Responses 3, 4, and 5 were the most cited factors for attending the trainings. Responses 3 and 4 were also the most often found in the top three responses. This speaks to the willingness of these faculty to learn new technologies, which would be expected from early adopters. It also speaks to the pinch point of the time it takes to provide meaningful feedback and the desire to overcome this challenge, which is one thing Gradescope touts as a strength. The timing of the training is also important as it allowed faculty time to make plans to incorporate Gradescope into their classes thoughtfully, as is indicated by the large number of faculty that selected Response 5.

Responses 9 and 10 were each only selected once which may indicate that not many of the participants are yet motivated to innovate or use novel techniques in their classroom. Response number 2 was the fifth most chosen factor. Since this has been shown to be an important factor

for early majority faulty to start adopting the technology, once the critical mass of faculty is achieved, emphasis should be placed on getting faculty to share more of their successes with using Gradescope. This is why we also asked the free response question, "What, if anything, from the session have you shared with a colleague, or what are you most likely to share with a colleague?" Twelve of the 17 respondents gave responses to this question and range from general impressions of the time savings that they experienced using the system to new techniques they learned in the training (like using Gradescope to grade things like lab reports that they had not thought to use it on before).

Table 2: Summary of responses to survey question "Which of the following factors were important motivators for you to attend the Gradescope session? Select all that you consider 'important.'"

Ref. #	Possible Factors	Total Responses	Top 3 Responses
1	The possibility of grading more consistently across student work	9	7
2	Had heard good things about Gradescope from a colleague	8	7
3	The chance to learn something new	11	10
4	The possibility of spending less time on grading tasks	14	10
5	Because it's summer, faculty actually have time to attend sessions like this	10	6
6	The promised supplemental pay	7	6
7	Wanting to stay up to date with educational technologies	6	3
8	The opportunity to chat/network with colleagues at the session	4	1
9	To learn how to better take advantage of Gradescope's features	1	0
10	I am already a Gradescope user, but I wanted to see what others are doing so I can use it more effectively	1	0

Three respondents mentioned specific interactions that they had already had with colleagues about helping them use Gradescope. One even said, "I am encouraging the department to use this as a grading resource for at least one of the competitions that we host." This shows that this particular faculty was thinking beyond their own classes and saw enough value in the software to save time that they would be willing to work to convince other colleagues of the benefits of using the tool. It is these interactions that lead to diffusion and shows the importance of trainings like these that inspire early adopters to innovate and champion. As more faculty begin to use Gradescope on campus, it will be important to highlight and study the experiences of a wide range of faculty and students as these will likely be important to motivate mainstream faculty to try Gradescope themselves. It is important for the trainings to adapt with the different kinds of faculty that will be the next to adopt a technology while still encouraging innovation of those that were early adopters.

While this case study was done at a particular institution and for a particular technology, there are a few key ideas that are transferable to other institutions and other technologies. First, it is important to pay attention to literature on technology diffusion to design appropriate techniques for the different stages of adoption. Misunderstanding what is motivating faculty to adopt a

technology and the barriers to adoption that they are facing can cause stagnation into the diffusion process. Different kinds of faculty have different motivators and barriers which need to be addressed differently. Second, identify the innovators that are working on technologies that solve particular problems at the institution. Using innovators to motivate early adopters that will broadly affect mainstream faculty will lead to faster diffusion. Finally, tracking and documenting progress is important. Reflecting on what is working and what is not as well as identifying new trends that can be addressed will make the institutional support more effective. Reflecting on what was done has given a much clearer direction to achieve the larger goal of using technology to improve the learning experience for everyone on campus.

Conclusions

In this paper we documented an attempt to promote the adoption of an online grading tool at a small teaching-focussed institution. The literature predicted a slow adoption process at the early stages and was experienced in this case study as well. After an anamolous time with the pandemic, multi-tiered sets of trainings were designed to target early adopters to reinvigorate the diffusion of the technology. With this approach the extent of usuage increased significantly with nearly 20% of the faculty on campus receiving additional training on using the technology. The trainings also promoted a wider sharing of resources on campus. Documenting the current state of technology diffusion and analyzing the motivations and barriers of training participants gives clearer direction to promote the technology effectively to the mainstream faculty. It is recommended for other institutions to use literature and case studies like this one to create their own strategies to promote technology diffusion and avoid stagnating.

References

[1] I. Garcia-Martinez, J. M. Fernandez-Batanero, D. Cobos Sanchiz and A. Luque de la Rosa, "Using Mobile Devices for Improving Learning Outcomes and Teachers' Professionalization," *Sustainability,* vol. 11, no. 24, 2019.

[2] F. Concannon, A. Flynn and M. Campbell, "What campus-based students think about the quality and benefits of e-learning," *British Journal of Educational Technology,* vol. 36, no. 3, 2005.

[3] R. Hammer and D. Kellner, "MULTIMEDIA PEDAGOGY AND MULTICULTURAL EDUCATION FOR THE NEW MILLENNIUM," *Religious Education,* vol. 95, no. 4, pp. 474-498, 2000.

[4] D. L. Butler and M. Sellbom, "Barriers to Adopting Technology for Teaching and Learning," *Educause quarterly,* vol. 2, no. 1, pp. 22-28, 2002.

[5] H. L. Fuller, "First teach their teachers: Technology support and computer use in academic subjects," *Journal of Research on Computing in Education,* vol. 32, no. 4, 2000.

[6] S. L. Johnson, "Community college leadership in the age of technology," *Leadership Abstracts,* vol. 10, no. 5, 1997.

[7] E. M. Rogers, Diffusion of innovations, 4th ed., New York: The Free Press, 1995.

[8] M. Jacobson, "Examining Technology Adoption Patterns by Faculty in Higher Education," in *Proceedings of ACEC2000: Learning Technologies, Teaching and the Future of Schools*, Melbourne, Australia, 2000.

[9] P. Kopfer, "Teachers' perspectives on dealing with students' errors," *Frontiers in Education,* vol. 7, 2022.

[10] A. Havnes, K. Smith, O. Dysthe and K. Ludvigsen, "Formative assessment and feedback: Making learning visible," *Studies in Educational Evaluation,* vol. 38, no. 1, pp. 21-27, 2012.

[11] J. H. McMillan and D. J. Workman, "Classroom Assessment and Grading Practices: A Review of the Literature.," Metropolitan Educational Research Consortium,, Richmond, VA, 1998.

[12] K. Ragupathi and A. Lee, "BeyondFairness andConsistency in Grading: TheRoleofRubricsinHigherEducation," in *Diversity and Inclusion in Global Higher Education*, C. S. Sanger and N. W. Gleason, Eds., Singapore, Palgrave Macmillan, 2020, pp. 73-96.

[13] A. Singh, S. Karayev, K. Gutowski and P. Abbeel, "Gradescope: A Fast, Flexible, and Fair System for Scalable Assessment of Handwritten Work," in *L@S '17: Proceedings of the Fourth (2017) ACM Conference on Learning @ Scale*, Cambridge, MA, 2017.

[14] S. A. Ronkowski, "Faculty adoption of instructional technology: Making the strange familiar," in *(IASTED) Paper presented at Computers and Advanced Technology in Education Conference*, Cancun, Mexico, 2000.

[15] W. F. Massy and R. Zemsky, Using IT to Enhance Academic Productivity, Washington D.C: Educom, 1995.

[16] A. J. Lane and C. G. Mitchell, "Using a Train-the-Trainer Model to Prepare Educators for Simulation Instruction," *The Journal of Continuing Education in Nursing,* vol. 44, no. X, pp. 1-5, 2013.

[17] T. L. Webb and P. Sheeran, "Does Changing Behavioral Intentions Engender Behavior Change? A Meta-Analysis of the Experimental Evidence," *Psychological Bulletin,* vol. 132, no. 2, pp. 249-268, 2006.