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A Systematic Review of Technological Advancements to Enhance Learning

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Abstract
Assessing student learning styles and incorporating thought-provoking activities has been a focus of research for years. Virtual technology and social media are transforming traditional classrooms into training spaces that can be tailored for individual learning patterns and personalized for different skill levels. These technological tools are not only revolutionizing the conventional lecture-based classroom but also beginning to incorporate options such as flipped and blended classrooms. Students in these nontraditional settings are given additional hands-on experience that allows them to become immersed in a variety of subjects. Flipped classrooms in particular use class time effectively by challenging students to prepare prior to class. In return the allotted time provides a place for students to work through problems and encourage cooperative learning. Furthermore, social media is being used to increase subject interest and boost class attendance by improving instructor and student interactions. These techniques challenge students enough to maintain focus while remaining within their capabilities to preserve student curiosity. Learning enhancement using these new teaching styles was assessed through surveys provided at the beginning and end of each experiment. The studies sampled students from a variety of backgrounds and skill sets including military, medical, and college students. Alternative and cost effective approaches are revolutionizing learning to help improve each student's motivation, concentration, and confidence.

Introduction

Advances in modern technology are providing new tools that enhance both the extensive value of interactive education and the focus on motivational factors. These innovations in teaching and technology will be used to raise student expectations and spark excitement for continual learning development. Social media and virtual technology are flipping the traditional lecture-style classroom to boost class attendance, heighten student curiosity, and improve peer interaction.

Traditional instruction methods have demonstrated consistent success. They have also provided a basis for incorporating progressive learning exercises. The National Academy of Engineering (NAE) has identified that the engineers of 2020 need to have strong analytical and problem solving skills while being readily adaptable to advancing technologies in a globally connected world (1). A classroom syllabus typically contains conventional lectures and a group project. It may also contain a business example provided by a guest lecture or case study. These current teaching methods have displayed positive results, but barriers between academia and industry can be made seamless by incorporating both advances in technology and motivational techniques (2). Students will find the transition to be more cohesive after they have completed a curriculum that facilitates superior student understanding.

Initial Assessment: Learning Styles and Motivation

Understanding individual student learning styles and establishing a baseline for the classroom has been proven to increase motivation and improve learning. Each individual's learning style is inimitable because it is a product of individual genetics and life experiences. Every person has the ability to learn, but his/her motivation to learn increases when his/her unique learning style is accommodated. As a result, learning styles have been an interest of study for years. Larkin and Budny (3) evaluated the stimuli that affect each person's ability to perceive, interact with, and respond to his/her learning/working environment. They found that a focus on either learning style or personality type tells students that they are not only cared about but also respected as individuals. Overall, when students feel valued, their sense of self-worth and ability increases dramatically. The awareness and acknowledgement of individual differences is critical to an effective teaching approach.

Student motivation is often overlooked when performance measures are studied. Academic performance can however be enhanced when the factors that influence a student's motivation are initially understood. Students are encouraged to take action when combinations of short-term and long-term goals are incorporated into the classroom. Kirn and Benson [4] addressed the different aspects of engineering student motivation by providing a Motivations and Attitudes in Engineering (MAE) test to Bioengineering (BIOE) and Mechanical Engineering (ME) students. The test assessed the student's perception of his/her present and future abilities to be successful. These students were also given an assessment pertaining to his/her problem solving self-efficacy. The additional assessment evaluated how motivation related to problem solving skills (short-term tasks) is distinct from a student's goal of obtaining an engineering degree (long-term goals). Kirn and Benson [4] found that student perceptions of the present, future, major-related expectancies, and problem-solving self-efficacy are distinct pieces of student motivation. Students who had progressed further in completing their majors had higher expectancies than students who had progressed less, despite being in the same required courses. The research of Kirn and Benson [4] demonstrates how understanding the differences in student motivations across major and degree progression can help better direct instructional change. Even with similar entry requirements to universities, tailoring instructional improvements will motivate students in ways more beneficial for learning.

The type of motivation a student receives during his/her education will frame his/her academic engagement, performance, and satisfaction. Dillon and Stolk [5] used a cluster analysis to explore student motivation and examine group-based motivation profiles within academic settings. They applied a self-determination theory (SDT) model to gain insight into students' perceived motivations in a college course environment. They used their results to explore the correspondence between a person's intrinsic motivations and his/her environment. Dillon and Stolk [5] also investigated how interactions satisfy the basic needs of autonomy, competence, and relatedness in regards to influencing a person's observable characteristics. Data was gathered from engineering students enrolled in four different materials courses at three predominantly undergraduate institutions. Participants were surveyed at the beginning and end of their term to assess how various motivations fluctuated throughout the semester. The study results concluded engineering students adopt a range of situational motivations that do not fall neatly into the conventional "intrinsic" or "extrinsic" categories. They found that a large percentage of students simultaneously adopted both external and internal drives to engage in course activities. Several students adopted relatively stable motivations within a single course while others responded drastically over time. Examining both when and how these shifts occur will provide information that instructors can use to revise course activities to maximize internalized motivators.

Collaborative learning offers many benefits to students who are working within groups. These benefits contribute to higher level thinking skills, increased social interaction skills, higher academic achievements, and increased class attendance. Unfortunately, an instructor will typically need to invent a large amount of time grouping students into heterogeneous groups that accommodate their learning strengths. Building on this information, Chang and Lee [6] studied computer-assisted tests for heterogeneous grouping to improve the efficiency of collaborative learning activities. During the study, students participated in a Team-Game Tournament where they transitioned through three phases. Students were divided into heterogeneous groups during the first phase. Learners were then regrouped during the second phase and participated in a tournament to win points. Students were then returned to their original groups for reflection. During the third and final phase Chang and Lee [6] were able to use the results gathered from this study to demonstrate that computer-assisted evaluation can be a valuable tool for computer-supported collaborative learning. The computer-assistance decreased group selection time and utilized classroom time more effectively.

Technology and Techniques that Support Student Motivation

The learning process involves relationships, classroom settings, teaching techniques, learning processes, and feedback. Utilizing a combination of teaching techniques and available technology allows instructors to adjust classroom variables until they are most effective for the audience. Various techniques (e.g., flipped classrooms and blended classrooms) repurpose class time to emphasize the value of education and encourage the development of community learners.

Techniques

Flipped classrooms use digital resources to change the customary way a student completes homework following a lecture-style class. Jiugen et al. [7] noted that the teaching structure of a traditional classroom involves teaching before training while flipped classrooms utilize learning before training. When students learn the concepts before class, teachers are able to interact and explain lessons to the students on a deeper level. As a result, teachers can provide a personalized learning approach that not only guides students through their studies, but also caters to their individual learning needs. Thus, this new teaching method may play a role in enhancing students' interests and improving teachers' effectiveness.

Flipped classrooms challenge students to shift from passive learners to interactive participants. Flipped classrooms educate students by studying the lecture at home and participate in homework under a fixed schedule in school. Chen and Chen [8] addressed classroom shortcomings (such as a lack of student input, the exclusion of a ubiquitous learning platform, and an insufficient emphasis on learning objectives) by preparing weekly schedules and monitoring student progress. This new learning system provided the students with three hours of videos to be completed at home and three hours of classroom hands-on interactions. Chen and Chen [8] also distributed a questionnaire that consisted of 50 close-ended items and 4 open-ended questions to help gauge each student's perception of the new educational system. Overall, most students were satisfied with the results and felt they had benefitted from the flipped classroom. Chen and Chen [8] also found several forms of student engagements had improved, including class attendance, exposed content, and student interactions.

New technology and teaching methods utilize both visual and interactive methods to increase students' knowledge while enhancing the learning experience. Martin et al. [9] applied the benefits of blended learning to help students visualize a step-by-step process when analyzing circuits. During the study, students watched a pre-recorded lecture before each class was actually held. They then used the classroom time to better understand both the circuits and their components before completing the homework.

Current trends in teaching include the incorporation of a "learning-by-doing" approach, particularly with younger students. Introducing flipped classrooms becomes more difficult for students with two or more years of learning in a traditional classroom. These advanced students have adapted to the traditional style of learning and may resist a different style of instruction. Amresh et al. [10] conducted a study with first and second year engineering students to demonstrate how flipped classrooms improve learning while also teaching the principles of programming. Amresh et al. [10] utilized three classroom sections. Two used the flipped model, and the third used traditional practices. Both a midterm and a final exam were administered to evaluate student learning. The assessment summary revealed that students participating in the flipped model had higher average scores. Amresh et al. [10] also administered a survey that captured an increase in students' self-efficacy from pre- ($\mu = 53.3$) to post-scores ($\mu = 71.8$). Thus, flipped classrooms show promise in improving learning. They can, however, be expected to overwhelm and intimidate during the adjustment process.

When introducing new teaching styles, it is imperative that students understand how changes in education will contribute to their long-term development. Changes are commonly met with resistance, but opposition can often be diffused if students have some say in the process. Creating an environment that is engaging and energizing will improve student's understanding of the material and retention rates after transitioning into the work force. Although flipped classrooms require an adjustment period, this learning approach allows instructors to prepare students for problems outside the textbook. Bishop and Verleger [11] addressed the concern that engineering graduates lack the ability to solve real-world problems. Students commonly work on a senior-level end of curriculum problem, but otherwise students are only well trained in solving textbook problems. Textbook problems can be limited, because equations or topics can be easily identified based on the chapter being studied. Flipped classrooms allow students to attend a lecture and complete homework while outside the classroom. They can then participate in activities inside that classroom that will better prepare them for future employment.

Technology

In addition to integrated teaching techniques, such as flipped and blended classrooms, students also need exposure to technology. Technology breaks the mold and prepares students for the world they are about to inherit. Advances in technology, including social media, virtual technology, and phone applications, are used to put the latest information at the students' fingertips. These tools, give an educator the freedom to become a coach, motivator, and advisor.

Social Media in the Classroom

As the size of college classrooms continue to increase, professors are looking for ways to quickly and effectively evaluate a student's understanding of the material. For example, many have begun to use Twitter to ask short questions during lectures in an attempt to improve student engagement and interaction. An added benefit to using Twitter during the lecture, is this tactic prevents students from using smartphones for non-educational purposes. The smartphones instead provide the professors with immediate feedback of any possible learning gaps. Kim et al. [12] utilized Twitter in a college classroom to post questions at unexpected moments between lecture slides. These questions covered essential classroom material, and points were awarded to students on a first-come-first serve basis. This process encouraged students to focus on the lecture and, ultimately, improved student participation and understanding. Kim et al. [12] gave a total of 40 pop quizzes, each worth 80 points. The distribution of student scores was even, and most students reported an increase in concentration. Three exam scores in 2012 were compared to scores recorded in 2011, and there was a significant increase in the statistical results. The Twitter-based smartphone response system is advantageous because almost all university students have smart phones. When utilized in the classroom Twitter has improved student understanding and concentration.

Unlike Twitter, Facebook has been avoided in the educational environment because it has been considered a platform for online social networking only. Faculty members were more likely to use customary professional communication options, such as e-mail, Blackboard, and Moodle. Even though students use Facebook primarily for social interaction, they are becoming more open to using Facebook in the classroom. Kio and Negreiros [13] found that research is abundant at the university level, but produced very little educational use. Therefore, Kio and Negreiros [13] focused their study on the high school level, ages 15 – 18, and utilized two schools in Macao. The teachers included in this study use Facebook to post information on lessons, homework, and class activities to stimulate student discussion. Throughout the study, teachers posted topics at least once each day for eight weeks. At the end of the eight weeks, students were surveyed about not only their experience in the classroom but also their interaction with the Facebook group. Kio and Negreiros [13] found that Facebook allowed teachers to plan, advocate, and lead constructive interaction within the group. Group members became closer and more collaborative with both each other and their teacher. This improved relationship helped advance each students learning experience and academic performance.

Leelathakul and Chaipah [14] examined the effects of Facebook activities on 98 students located in Nan province, Thailand in 2011. Facebook groups were used for class discussions between instructors and students in grades 10 and 11. Leelathakul and Chaipah [14] examined the relationship between Facebook activities and GPAs and found individual activity (frequencies of posts and comments) is not linearly correlated with students GPAs. Students who had actively participated in class-related activities, however, tended to have higher GPAs due to an increased confidence they had gained during peer-interactions. Thus, several positive trends were identified when Facebook was used as a supplementary tool in formal education.

These accessible communication options (e.g., Twitter, Facebook, Linked-In) could allow for positive interactions between students and teachers. Yadav and Srivastava [15] noted that some students were more comfortable asking honest questions from behind a screen. They also suggested that social media has helped increase the quality, success, and efficiency of education. This increase can be attributed to a student's ability to access learning tools outside the classroom. Yadav and Srivastava [15] reported that the average Facebook user is 40.5 years old, the average Twitter user is 37.3 years old, and the average LinkedIn user is 44.2 years old. Nevertheless, 52.33% of higher education is somehow influenced by professional social networking media in the form of blogs, wikis, and Slideshare. [15]

Online videos found on various websites including YouTube, are also being used as a platform for self-directed learning. These videos are being used to increase attention to, motivation for, and curiosity in subjects the students are studying by providing an amusing way to learn. In one particular study, Chan et al. [16] analyzed the types of video content the students accessed on YouTube to the principles of animation. YouTube revealed an abundance of information on the subject, but narrowing the selection to the most beneficial results required a basic understanding of the principles of animation. The theories and concepts found during these searches were useful in lectures and demonstrations when students were guided by a knowledgeable instructor. Overall, Chan et al. [16] found that four classes of learning outcomes occurred when digital videos were used for educational purposes: seeing, engaging, doing, and saying.

Social media is being highly utilized in the classroom to help students and teachers interact concurrently without incurring excess costs. Social media provides places for group collaboration, personal inspiration, and peer review. Thus, students have become accustomed to social media in their personal lives. This media can however, be a useful learning tool in a profession setting if students are given the knowledge to adequately evaluate, synthesize, and share resources.

Using Smart Phone Apps

Mobile App Technology (MAT) is being used to re-design and re-blend the way formal education is offered to students today. With an overwhelming majority of students having access to cell phones, this technology is now accepted as a normal convenience. This valuable device offers significant potential to place thousands of educational tools at student's fingertips. Mobile apps have been designed to offer an extensive range of topics (e.g., geography, astronomy, chemistry) to inspire students of all ages. Mobile technology can also be used to encourage a collaborative learning environment in both a formal and informal classroom. Khaddage et al. [17] argued that MAT is here to stay. Thus it should be considered a vital teaching and learning vehicle that can assist institutions in reaching their goals. This cost-effective approach would provide an easy user-interface (with minimal technical support) once installed on mobile devices. Students could then use the app to access information both inside and outside the classroom setting. This new form of informal learning is versatile and will be able to better prepare students for the job market. Even after graduation, mobile technology can be used as a reference tool or to continue education

Before mobile devices became popular, personal digital assistants (PDAs) were used in nursing education as a compact personal tool (which carried multiple references) to use while logging clinical encounters. PDAs have been extensively studied and smart phones are a modern version of this effective teaching tool. Smart phones not only provide the same convenience but many additional features. Phillippi and Wyatt [18] state that 70% of medical students used either PDAs or PDA-like devices while learning. Since the use of PDAs have been consistently associated with high levels of student satisfaction, the use of smart phone applications is expected to have similar benefits and positive feedback. Over time, smart phones have begun to replace traditional PDAs because of their extensive functions. Building on this thought, Phillippi and Wyatt [18] noted that although cell phone functions are designed for leisure activities, they can be adapted to meet educational needs as well. Several apps now even allow students to look up patient records, quickly calculate a patient's body mass index (BMI), search drug side effects, and more. An instructor can also provide students with videos that help him/her prepare before performing a procedure. During the procedure, the instructor can be summoned quickly if an observation is needed. By having all these tools at their finger-tips, students are prepared to accurately answer questions. The additional resources (e.g., texting, apps, and available web access) have helped build confidence and decrease beginner anxiety.

Without a doubt, e-Learning is becoming one of the most important applications used in the classroom today. Advances in wireless technology allow mobile learning to begin anywhere, any time, and in multiple forms. Mobile learning expands the scope of learning beyond the conventional classroom. Tan and Liu [(19)] discussed the use of a Mobile-Based Interactive Learning Environment (MOBILE) in elementary school classrooms in Taiwan. This technology allows students to download learning materials, reminds students of deadlines, stores learning records for teacher reference, and encourages the user to browse materials for diverse learning activities. Tan and Li [(19)] used a questionnaire to examine the effectiveness of the study, and they concluded that learning via MOBILE is better than traditional education. Results gathered from the questionnaire revealed that students like to use MOBILE to learn, and this technology increased the students' interest.

Technology Enhanced Motivation in a Real-World Application

In a world where everyone is trying to do more with less, the military is using a visionary concept to reduce instructor-led training and, instead, use a collaborative problem-solving exercise that blends institutional, operational, and self-development training into one. This new style of instruction will provide educational experiences that are tailored to each individual's unique abilities, characteristics, and needs. Spain et al. [(20)] stated that each soldier, sailor, marine, and airman brings a unique set of characteristics and experiences to the classroom. They have different task proficiencies (both inside and outside their mission rolls), different operational leadership experiences, and different sustainment skills. Spain et al. [(20)] suggest that the "one-size-fits-all" approach needs to be reevaluated and modified to incorporate adaptive training. Adaptive training will help effectively educate thousands of individuals at a high standard of performance while maintaining tight financial, resource, and time constraints.

The U.S. Army is comprised of individuals with diverse backgrounds and skill sets in both physical and mental aptitudes. According to Bink and Cage [(21)], however, information presented during Initial Military Training (IMT) is often presented by a single drill sergeant to large groups. The program is developed to assure the "average" individual can meet the given standard. Historically, matching effective training techniques to multiple soldiers with different military and education backgrounds was difficult. This study, however, conducted an initial assessment of each individual and provided supplemental training tools based on being either a low-performing or high-performing individual. After three weeks the soldiers were reevaluated and demonstrated how adapting training to individual soldiers could enhance training effectiveness.

Similar to military training, the education system at universities is commonly presented by a single instructor to a large group of students. Utilizing collaborative learning teaching methods such as flipped and blended classrooms supports students as they achieve a higher level of thinking. Forming a team with fellow classmates and working on real-world problems aids one another to clarify ambiguity and build confidence. This exercise increases the student's awareness of the concepts and also refines social skills needed for working in future diverse groups. When compared to working alone, students are able to achieve more when aided by peers and teachers.

In contrast to conventional, lecture-based training, videogames are being designed to provide "adaptive training" that can be tailored to suit each individual trainee's skill level and progression. These video games are designed to provide an optimal level of difficulty, but remain within the given trainee's capability. This is done in an effort to foster a "manageable" challenge. Various researchers have suggested that performance improvement may be linked to the trainees' prior gaming experience and other individual personality differences. Bauer et al. [(22)] developed an initial questionnaire to assess each participant's openness to experience, conscientiousness, and neuroticism. After completing the questionnaire, participants engaged in six missions in a video game–based training task each lasting seven-minutes. Bauer et al. [(22)] concluded that individuals with higher characteristics of openness to experience and neuroticism performed better over the course of training. These results suggest that adaptive training can reach its greatest performance improvement when the trainee's personality is suited to the proper instruction presentation.

A number of researchers have indicated that PC-based games may provide an effective approach to education. Although, it is still undetermined which identifiable features of games encourage continual learning or motivation. Video games use a first-person perspective to allow players to feel immersed in the environment. This experience removes boundaries so the player can better experience what to expect in the real-life situations. Belanich et al. [(23)] suggest that players can use this perspective, to obtain a better understanding of the information because it is conveyed in three different ways: attempting the task (procedural), observing the game environment (episodic), or the player could be provided printed or spoken text (factual). The rationale behind training through games is that the act of playing a game will motivate the learner to continue playing. The training can be adjusted by controlling the amount of challenge, controlling the event outcome based on player's actions, encouraging the player's curiosity by allowing the player to uncover something new, and developing the fantasy that the players are engaging in a real activity. Belanich et al. [(23)] asked twenty-one participants to play a "basic training" military game, which included Army background information. The assessment suggests that PC-based training would be more effective for learning procedures than for learning facts. Belanich et al. [(23)] concluded that the training game should be both instructional and motivational to reach optimal effectiveness.

Virtual technology provides a low cost and generally effective option for delivering training, particularly in situations where consistent skill maintenance is required. Consequently, the use of virtual reality (VR) is increasingly being developed for the use of training. Stanney et al. [(24)] focused their study on a student's ability to transfer information learned in a virtual environment to an equivalent real world task. A wide range of virtual systems are currently available, including systems that fully immerse to systems that are barely more than computer-based instruction. With so many VR learning options available, it is important to understand which optimal training strategy must be supported. The proper training experience is critical so the student can learn to effectively utilize the new skills in real life situations. Stanney et al. [(24)]

conducted two studies to evaluate the efficiency of the training framework transfer to the student. The first study taught ship handling in a virtual environment. The second study involved the task of navigating a land-based route while flying a helicopter. The results of learning via VR were then compared to students who were taught in a classroom setting. Stanney et al. [24] concluded that a variety of training media would lead to a more robust knowledge transfer than would a single form of training. Stanney et al. [24] noted that VR systems must include sensory cues surrounding the actual task, similar to those found in real world operational settings, before their potential can be fully realized. This study provided system developers with the insight necessary to replicate sensory cues surrounding actual tasks within a virtual setting.

Outcomes and Benefits of New Approaches

Tsai et al. [25] noted that both learning and retention increased by as much as 100% when students were actively involved in a lecture, discussion, or self-study. The curriculum was enhanced when suitable technology was applied, hands-on approaches were incorporated, and clear personal feedback was provided. Tsai et al. [25] adapted a variety of pedagogical approaches including active learning, interactive learning with real-time responses, modeling activities, and group activities in the study. Students' learning preferences were summarized after these activities were applied. Activities including active learning, e-learning, games, group activities, tutorials, videos, and pop quizzes were conducted in the class. Based on their experiment, it was concluded that tutorials (68%), videos (64%), and lectures (56%) were the most positive preferences. Online forums (36% not effective) and games (16% not effective) were the most negative. Furthermore, no students indicated the lectures were ineffective, and 96% of students requested more information on how the class concepts could be used in real-life applications. Overall, these results indicate that students do enjoy the interactive learning approach, but there should still be some individual time allotted for students to master basic techniques individually.

Group Collaboration

Group collaboration is valuable when aiming to achieve a common learning goal and is becoming more available with the use of virtual learning environments. Modern technology is bringing students together to collaborate across large distances. In addition, new technology and web-based education has changed old learning paradigms into a new opportunity to learn "anywhere and anytime". During their study Wan et al. [26] established a new student user profile. This profile included abilities, knowledge, and learning preferences. A recommendation process connected either people or organizations based on their personal preferences once the data had been entered into the system. Social science research has revealed that people build social relationships with each other, and these relationships may help them locate either information or services more effectively. Wan et al. [26] found that a collaborative group-learning environment in which students could express their thoughts, voice their opinions, and share their experiences had a positive outcome.

Thus, incorporating teamwork and communication skills into the core curriculum of all engineering and technology programs is essential for success. McDonald [27] emphasizes that it is clearly important that faculty consider incorporating teamwork in their courses through assignments and laboratory experience. By sharing ideas with classmates, students develop a better understanding of the concepts being taught while keeping each other accountable. McDonald [27] also explained that, in cooperative learning, students work together to maximize both their own learning and group members learning. Collaboration improves not only the student's knowledge and memory but also his/her confidence in both themselves and the class. A class of junior electronic students were divided into groups of two to four students. These students kept journals throughout the semester on their impression of group collaboration. At the end of the course, the students completed an evaluation that contained 21 short discussion questions. The results indicate the cooperative learning method was well received by the students. In particular, the students reported learning to discuss problems, share responsibility, and are more conscientious about completing tasks when they know other students are depending upon them. One student reported that "…At first I was quite scared to get up in front of a group of people, but towards the third week of class it really didn't bother me anymore." [(27)] This is a great example of how groups can empower the participants, and how groups are no longer restricted by location with the advances in technology.

There are many benefits associated with collaborative learning, but there are also times where great effort may be required to be successful. Difference in personalities is positive in a team dynamic because it will foster creativity while generating feasible solutions. Although, contrasts in opinion need to be addressed when a breakdown in communication begins to occur. Project preparation should include equipping students with best practices to help avoid a bad situation. Best practices should include establishing clear goals and outlining a team working agreement. All team members should have clear expectations of their contributions to the project before work begins. Throughout the process, building trust and maintaining open communication will assist the group in being effective.

Continual Learning through Self-Directed Learning

Self-directed learning is an important element in encouraging life-long education for students. This type of learning allows the teacher to be a guide in the learning process instead of an instructor. Because minimal work has been conducted on the effectiveness of self-directed learning, Harding et al. [(28)] designed an experiment for undergraduate engineering students to strengthen a student's self-directed learning readiness and motivation. Class time was largely devoted to team-based projects, and three surveys were given to measure student perceptions throughout the experiment. Harding et al. [(28)] suggested that students enrolled in the project-based learning course viewed their learning as driven by their own personal curiosity. Project-based learning appears to cause students to be more focused on learning as a means of furthering their personal growth instead of influencing grade-oriented motivations. New academic teaching methods such as project-based learning are needed to influence and encourage life-long learning outcomes in engineering.

Self-directed learning allows learners to decide what to learn and to what depth they want to explore the subject at hand. It requires that students be allowed to outline, manage, and evaluate their own learning. This process helps students break out of the mold of using a syllabus and learn about topics they feel are of most importance. Building on this method, Vashe et al. [(29)] explained that self-directed learning readiness (SDLR) is defined as the degree to which the individual possesses the attitudes, abilities, and personality characteristics necessary for SDLR. Because SDLR is present in all individuals, Vashe et al. [(29)] conducted a study to explore changes in a students' readiness for self-directed learning as he/she experienced class curriculum. Changes in academic performance were monitored to determine whether the change is correlated with opportunities to participate in self-directed learning. A hybrid curriculum involving problem-based learning, SDL, practical lectures, and traditional lectures was provided throughout the study. An initial questionnaire was provided as a baseline, and following the experiment, there was a clear indication of a significant increase in SDLR among students using this hybrid curriculum. The results gathered also indicate that academic performance as the curriculum and SDL progressed.

Self-directed learning skills are needed for survival in college courses, and are also valuable in preparation for professional careers. Fellows et al. [(30)] based their study on a model to increase self-directed learning amongst freshman. The instruction was organized in a manner that provides intellectual challenge that is appropriate and relevant to the student's life experiences in an effort to maintain their interest. Self-directed students will frequently branch out and work collaboratively with either other learners or other specialists. This collaboration helps encourage group relationships. The modules that Fellows et al. [(30)] described teach students the necessary skills of time management and study skills while those students are adjusting to a college environment. These skills will be put to use when students schedule their study time, and begin setting both short-term and long-term goals. These skills must provide students with a positive experience before they are accepted. A before and after assessment is also needed to monitor each modules effectiveness so that the teaching style can be adjusted to meet each student's needs. Study skills were found to be effective when used repeatedly throughout the semester. Overall, the modules had a positive impact and were gratifying to the students.

Resistance to Change and Risk of Failure

Change is inevitable in all organizations, including education systems. Even though it is exciting to implement new technology and techniques, modifications to the status quo can be met with resistance. Resistance often forms when the alteration is not perceived as necessary. These feelings can be initiated by either students experiencing the new style of learning or from faculty opposing changes to the curriculum. Students and faculty alike have become comfortable with how the standard lecture style teaching is carried out. For the benefits of new techniques to take root, the transition phase would require extra work from everyone involved. An extensive list of sources to resistance has been identified, in which most emphasize individual level explanations. These explanations include a professionals' denial to accept any information that is not desired, the tendency to perpetuate old ideas and behaviors, the perceived cost of change, a reactive mind-set, feelings of resignation, and the belief that obstacles are inevitable.[31] Throughout the conversion process, individuals will embrace these changes on different levels. In general, people's motivations for a certain behavior can range from amotivation (or unwillingness), to passive compliance, to active personal commitment.[31] Motivation is the driving force for change and can be cultivated. The stages of change have been the carefully examined through numerous influential studies such as Lewin's (1951) classic three-stage analysis of the change process. According to the theory, change unfolds through the sequence of unfreezing, changing, and refreezing behavior. This template has been used extensively for change at the organizational and individual level.[31] It is important to note that not all changes are equal, and they will not have the same impact. Despite the abundant options for revamping the education system, changes need to be kept simple and gradual. The business case for change needs to be related to issues that people care about to have adequate support from faculty and students. Feeling autonomy, that is having a sense of volition, choice, and willingness, makes it more likely for individuals to internalize the responsibility for the change process and to integrate new behaviors.[31] Initially understanding the most common reasons for resistance provides the opportunity to plan an initial strategy. The initial strategy can then be used to address these factors and make the process more seamless.

Even the best instructional programs result in limited gains if the teachers find them difficult to implement or antithetical to their established practices.[32] Teaching techniques should be evaluated on their probability of success and impact on students before proceeding with implementation. Researchers and educators who advocate new programs must be aware of the ways in which programs change with each teacher as he or she works to construct a new practice.[32] Teachers generally rely strongly on their history and experience with success in education when selecting new approaches. Instructors need to take primary ownership of the curriculum modifications and be program advocates for students to be inspired. Even though new techniques may not be met with outright resistance, there is a risk that the new programs may not be carried to final implementation. A strategy is being developed to carefully select the correct tools to achieve optimal education improvements.

Conclusion and Future Work

Learning process improvements are continuously under development to increase motivation and encourage a passion for self-directed learning. The education process will never end, and preparing students for both the present and future is an unlimited opportunity. This review of best practices summarizes findings of recent research around the world, and will be utilized to improve courses across University X campus.

The objective of future research is to apply the correct type and amount of modern technology to obtain the maximum learning experience for students. Most education systems are familiar with emerging teaching practices, but have not considered how to optimally apply all options. Future work includes a study addressing this issue. Within the study, an initial survey has been provided to students to analyze student personality traits and learning styles. The variety of educational approaches will then be dialed in to reach the stakeholder requirements. Throughout the allotted time period, a tailored syllabus will allow students to experience different teaching techniques (e.g., flipped classroom, hands-on activities, and social media) to build on concepts explained in class. A final survey and assessment will evaluate student involvement, understanding, and material retention. This feedback will then be applied to future classes.

This detailed process will help mitigate the risk of losing valuable time on unproductive tasks. Instead of targeting the bulk of students, this new approach personally tailors the class to the university's customers: students and employers. An improved education system launches students into a successful future by promoting academic engagement, encouraging success, and improving the overall student learning satisfaction.

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