Shifting Online Curriculum to Incorporate Integrative and Applied Methodologies

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Abstract

Emerging technologies offer the promise of integrating new approaches into the education environment to stimulate learning. Innovative developments are increasing the demand and opportunity to employ cutting-edge strategies rooted in an online platform. While this modality of connection with students offers immeasurable value, it also presents additional challenges for more hands-on, active learning. We intend to introduce several methodologies geared towards enhancing an applied approach to online instruction. These tactics are particularly beneficial when employed in the STEM fields, where demonstrative or investigative techniques in lab activities and project-based learning may be curtailed by newly introduced transitions to a completely online classroom. While experiential learning has always been the standard of excellence in the STEM classroom, in recent years, great strides have been made towards improving remote inquiry-based techniques [1]. We will focus on presenting educational opportunities that support flexible learning while emphasizing planning of pedagogy to promote positive outcomes. We believe these strategies will foster best practices to reinforce content, reach learners in multiple modalities, and secure student success by approaching conventional content in non-traditional ways. This study will highlight preparation for lessons in the online classroom and design and incorporation of specific course and learning objectives. Curriculum will be discussed as it relates to STEM fields, focusing on transferable skills and student achievement. Supporting materials, data, and recommendations will focus on the challenges of divergent student backgrounds and preparedness as we articulate objectives and outcomes of online education.

Keywords: *Online Curriculum, Inquiry-based Learning, Applied Methodology, STEM Education.*

1.   Review of the literature

The implementation of new technologies in online education is has the power to dramatically increase opportunities for learning by including innovative strategies and techniques for online learning platforms. Applied learning, a practical approach that is supported by research to increase student motivation, foster student-centered instruction, and provide real world context, has the potential to be neglected by online learning platforms. An effort must be made in the transition to online learning environments to include applied learning because it represents an opportunity for high-impact cognition, where students explore content and directly apply new knowledge [2]. Rottman and Rabidoux suggest three examples of effective online applied learning in order to strengthen student learning and increase achievement. These three examples include cooperative learning, service learning and simulations. Even more significant during the COVID-19 crisis is that education is not constrained to our classrooms and strategies must be employed to reach beyond traditional means to engage students and challenge them to excel. As we explore these challenges, increasing learner and educator responsibility can provide opportunities to support hands-on, active learning. According to Stavredes, collaboration in problem-based learning in the virtual classroom develops a community of inquiry where learners use critical thinking to engage in discourse and are able to build and integrate knowledge through research activities and multiple perspectives [3]. In public school science classrooms, due to COVID-19 school closures, programs such as SimBio are developing remote lab experiences to ensure continued learning. For example, the focus is on bridging the science classroom to home with hands-on labs or social distancing in the classroom in order to challenge students and continue lab experiences [4]. The pedagogical potential to explore the available tools and information to remain current and incorporate essential investigative lab techniques in the virtual environment is crucial for the online educational environment.

2.   Shifting to online curriculum

Technological advances have been designed to foster online content, but until recent times these resources have primarily been used as supplemental, supportive material. However, recent global events have initiated a sea-change shift to fully online or hybrid format courses, demanding an increased understanding in how to optimize the use of these platforms and a transition in the way these tools are used to facilitate instruction. This shift to the online environment holds the promise of reaching a wider audience base, particularly for the community of English Language Learners (ELLs) where increased clarity and functionality can make a foundational difference in knowledge transition. As institutions of education reassess how to meet the needs of their faculty, staff, and students, the shift to online curriculum will be a significant part of building safe and efficient learning environments. When paired with the experience of the traditional classroom, new technologies have the capacity to round out a more holistic approach to creating the modern educational experience.

Many learning environments have already started the process of adopting online applications and platforms to increase transparency, clarity, and ease of grading. A full integration of these technologies into the educational curriculum, spurred by recent demands for health and safety, will enable both users and facilitators to participate in a more accessible and integrated system. This forced transition is also highlighting areas of need in online education functionality and speeding the processes of mechanistic improvements. This demand is spurring on the development of technologies and promoting the use of beta versions for a number of different platforms that will ultimately act to reinforce learner content and improve the user experience.

3.   Integrating methodologies for an applied approach in the online platform

The online platform has a number of advantages that can assist in meeting the educational goals of a learning environment. Incorporation of course goals should be designed into the course framework from the beginning and mapped to measurable outcomes. These technologies provide a platform where all functional modalities of a learning environment exist in one place. This structured environment requires an increased clarity of course goals and expectations where instructors can define parameters for course products including rubrics and timelines. The online forum has the capacity to promote clear, near-instant contact, where direct, one-on-one interactions are encouraged between instructors and students and can assist in building interpersonal relationships among students as well. This integrated system allows for content delivery in a wide range of modalities in order to reach a broader range of participants, including language learners. This online framework can facilitate new opportunities for content originality, creativity and growth.

4.   Experiential learning in STEM and remote inquiry-based techniques

Technological innovations in recent years have created a myriad of options for addressing course goals. The wealth and volume of these choices can be daunting to educators who are attempting to transition to the learning environment for the first time. Delivery mechanisms including blended, hybrid, asynchronous and synchronous online can be tailored to the course content, level, audience, technical proficiency of both students and instructors, and technologcial availability and support for the institution and/or location. These advancements can be a significant means of crafting an integrated environment that has the capacity to reach a wider student body, including ELLs.

For STEM disciplines, online instruction can be a powerful tool for supplementing or reinforcing content to increase student comprehension. Studies indicate that in introductory or elective courses, students will perform better when the delivery platform includes a face-to-face element like the blended, hybrid or traditional classroom environment. However, for more advanced courses, transitioning to a fully online environment has not been shown to impede student performance [5, 6]. The online platform has been suggested as a way to "close the gap" in minority participation within STEM fields [7]. Online methodologies should be employed to enhance content and support student performance, and a blended or hybrid approach has been identified as more appropriate for the introductory level in STEM disciplines [6,8].

Recent developments in information and communication technology allow for classes to be taught in a variety of ways, and teachers are faced with the challenge of selecting the appropriate delivery mechanism specific for their course content and audience, and to utilize the best available tools to assist with the selected delivery mechanisms. Instructors may offer web assisted, blended, hybrid, asynchronous and synchronous online, or accelerated courses, but the choosing the right mechanism

depends on content, level of the class, technological availability, and technical literacy of the instructor. Technological advancements can be powerful instruments for reaching ELLs if they are used in the proper context.

When designing a course for the online environment or focusing on supplementing course instruction with technological advancement to reach a targeted audience, a myriad of resources exists to enrich course design. Instructors can select a text with a paired online software package targeted to improve student comprehension. Many of these online supplemental packages incorporate strategies to focus on the material the students struggle with the most. Educators can take advantage of online tools like Kahoot or Polleverywhere that combine face-to-face instruction with online quizzes and polling to reinforce content and create a fun, real-time response mechanism for student communication. In the STEM disciplines, courses can be designed to blend face-to-face content delivery with simulated online lab software.

In STEM fields, there are a number of different tools and resources available to enrich course design. Many recent textbook editions will have associated paired online learning platforms that can be recommended for improving student comprehension. Online simulated labs, polls, documentaries, and activities provide a mechanism for students to interact with course content in different and fun ways. Institutions like botanical gardens, zoos, natural history museums, observatories, research stations, and universities have designed collection-specific content to currate a remote experience that increases the participant's understanding in a given field. These exhibits can range from virtual exploration of collections to virtual activities and assignments. Some of these collections promote access to data sets that can serve as the baseline for experimentation and project-based learning. Citizen science projects like iNaturalist or app games (like Gene in Space) that have been developed to help social networks play games to aid in genetic research. By embracing learning games, applications, and tools that are fun, instructors can encourage the use of new technologies to spur on creativity and engagement of participants. In the proper context, these tools will enrich the entire learning environment and increase inclusivity the classroom.

5.   Conclusions and future recommendations

It is essential to develop new methodologies to engage students in the virtual classroom in order to stimulate learning and ensure that innovative active learning is taking place. Numerous intriguing technological advancements are emerging every day leading to a global culture that encourages active engagement and strengthens student performance. Further study is needed to focus on the variety of online methodologies and remote inquiry-based techniques that will lead to engagement incorporating demonstrative or investigative techniques in lab activities and project-based learning. Transforming the virtual classroom is tantamount to student success as educators focus on integrative and applied methodologies for achievement.

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