Commentary

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Artificial Intelligence and STEM Higher Education Environments

Lawrence O Flowers*

Associate Professor of Biology, Department of Biological and Physical Sciences, Saint Augustine's University, United States

***Corresponding author:** Lawrence O Flowers, Associate Professor of Biology, Department of Biological and Physical Sciences, Saint Augustine's University, 209 Penick Hall Raleigh, NC 27610, United States

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ABSTRACT

Artificial intelligence (AI) refers to computer systems or computer-controlled robots and machines capable of executing specific, sophisticated tasks consistent with human-level language processing, knowledge acquisition, analysis, pattern detection, image recognition, and algorithm production. Artificial intelligence platforms can make decisions and predictions, solve problems, and create unique content such as images and videos. The range of artificial intelligence functions continues to evolve and increase at a rapid pace. Artificial intelligence is an emerging technology capable of positively impacting every aspect of a higher education ecosystem. The purpose of this article is to explore how artificial intelligence systems may potentiate change in higher education environments with a particular focus on science, technology, engineering, and math (STEM) college students. Understanding the short-term and long-term impacts of artificial intelligence on students, faculty, and administrators is essential to the evolution of artificial intelligence technologies in enhancing STEM undergraduate and department outcomes at colleges and universities.

Keywords: Artificial Intelligence; Expert Systems; Machine Learning; Robotics; College

Introduction

Few technological advancements in human history have generated as much attention and unlimited potential as artificial intelligence. Over the last few years, artificial intelligence technologies have flooded the business and educational sectors [1-3]. These emerging artificial intelligence platforms have the potential to transform educational operations and significantly modify how students learn and progress from matriculants to graduates. Additionally, artificial intelligence technology can boost efficiency from the department's perspective and deliver student services rapidly. Academic success and retention are two essential student development factors regardless of institutional type. Higher education administrators and faculty spend significant resources to ensure that all students achieve, persist, and graduate with the necessary skills to thrive in their next phase of life. Academic attainment and retention are challenging issues for most undergraduates; however, data show that issues like academic persistence may be more difficult for STEM majors, thus a significant focus has been attributed to studying the factors and barriers that affect STEM student success [4]. Artificial intelligence technologies help overcome academic impediments and provide personalized learning support, such as tutorial assistance in complex STEM disciplines or specific core subjects known to obstruct student comprehension, which may prove advantageous in promoting STEM major success.

The purpose of this review article is to explore key literature and discuss how artificial intelligence can improve the academic and professional success of STEM educational environments. A small number of literature reviews exist that explore AI integration in science colleges and universities [5]. Future articles will emphasize the function of specific artificial intelligence platforms, discussing how each platform can help STEM departments improve logistics management and help students acquire knowledge and vital information to conquer educational and professional challenges. Subsequent articles will also explore how faculty can mitigate potential plagiarism, fabrication, and integrity problems caused by artificial intelligence systems by incorporating authentic assessments into STEM courses [6,7]. In a recent study, researchers administered an online questionnaire to ascertain undergraduate students' and college faculty's perceptions and application of AI in educational environments. Surprisingly, they found that both students and faculty responded similarly in terms of how they use artificial intelligence platforms and agreed on the potential benefits of AI technology to accomplish specific goals [8].

Another research team recently explored an issue that requires urgent attention to expand the use of artificial intelligence in higher education. The investigatory team discussed whether artificial intelligence assistance tools help or hinder skills acquisition and knowledge development. The team also presented research topics and questions that academic institutions should study to ensure that artificial intelligence technology is leading to productive outcomes for impacted populations. Vigorous research analysis may help produce information that informs whether specific artificial intelligence platforms promote skill deterioration or block the development of skills necessary for long-term information retention [9]. AI machinery is poised to provide institutional stakeholders with myriad tools to help students persist in STEM programs at a high level and obtain all the necessary skills to secure exciting employment opportunities after graduation.

AI Technology and Stem Environments

Artificial intelligence technologies fall into five major categories, including machine learning, natural language processing, expert systems, autonomous robotic systems, and computer vision platforms [10-12]. Machine learning refers to artificial intelligence systems in which computers learn to perform specific functions by analyzing data patterns in datasets to make predictions and decisions. Natural language processing refers to artificial intelligence systems in which computers comprehend, assimilate, analyze, and summarize language, and provide appropriate written and oral feedback consistent with standard human language dialogue. Expert systems refer to decision-making artificial intelligence systems programmed with reasoning and inference algorithms, as well as large amounts of information on one subject or many subjects, with the ability to solve highly complex problems equal to or greater than humans using logic. Autonomous robotic systems refer to computer-controlled machines that are programmed to perform simple and highly complex physical tasks and make decisions customarily performed by humans, and often include machine learning and sensors as essential robot features that enable these systems to operate in periods without human intervention. Artificial intelligence computer vision systems employ computational techniques to allow computers to process physical images, data visualizations, and videos in a manner similar to humans. Vision algorithms permit computer systems to detect, identify, and classify images, and analyze images. Most of the artificial intelligence technology used in educational environments is a combination of multiple categories described in this section.

The potential use of artificial intelligence technology in STEM higher education environments to improve students' academic and professional success and enhance operational efficiency is virtually incalculable [13]. Machine learning, natural language processing, and expert systems are currently employed to help students learn course material and improve performance on tests and course projects. The development of institution-specific natural language processing and expert systems providing helpful information to students to encourage success and retention could be potentially meaningful. Features of institution-specific AI applications could include supplementing advising and career services objectives, as well as delivering faculty and student affairs insights, and enabling education research data collection. One of the most effective ways artificial intelligence solutions currently help students is by serving as a virtual tutor for STEM courses with high failure rates. Artificial intelligence tutors in many ways exceed human tutors because of their convenience and flexibility. Traditional virtual laboratories and virtual reality applications will also benefit from the infusion of artificial intelligence algorithms and facilitate emerging virtual research technologies in which students can conduct rigorous research from external environments in STEM fields using methods that are currently unavailable and cost-prohibitive. Conflation of machine learning and robotics is a superb way to improve STEM research infrastructure and simulate manufacturing and lab-based industries.

Computer vision systems can enhance biology and chemistry research and teaching labs in exciting ways. These types of AI systems can be programmed to analyze gel electrophoresis micrographs, real-time polymerase chain reaction (RT-PCR) micrographs, and other types of images. Computer vision systems could also be programmed to summarize and interpret data produced from chemistry, biochemistry, and physics experiments and thus used as a training platform for STEM undergraduates initially learning how to analyze experimentally-derived laboratory results. Additionally, exposure to intelligent robots capable of performing routine and advanced scientific procedures will strengthen the career training campus environment, as many STEM research and development job sites require a skilled workforce with the ability to operate computer-controlled automated devices. An understudied area of STEM education research is the effect of college students' interaction with computerized robots to facilitate science and engineering research projects on career readiness outcomes. STEM departments should also consider incorporating artificial intelligence platforms to streamline administrative actions such as department evaluation, longitudinal analytics, professional development, and strategic planning. Principal investigators of STEM grants should contemplate utilizing expert system platforms to develop, manage, and share data management plans with the grant project team, university administrators, and the funding organization.

Conclusion

Artificial intelligence technologies are proliferating at an alarming rate in society. STEM faculty and university administrators must develop an understanding and competence in novel artificial intelligence technologies that provide students with a competitive edge. However, artificial intelligence may be progressing faster than consumption. Educational institutions must become proactive in terms of artificial intelligence identification, usage, ethics, and management policy. Consider hiring a Higher Education Artificial Intelligence Strat-

egist or providing professional development funding to train existing staff and faculty. AI specialists, with the assistance of STEM faculty, can create plans to economically deploy and manage artificial intelligence technology and focus on which operational divisions, students, and employees will benefit from guidance from new technologies. Appropriate utilization of artificial intelligence technology on campus may result in greater return on investment and avoid technology-based boondoggles. To gain insight into the effectiveness of each specific artificial intelligence technology, conduct efficacy analysis on each platform. Enhancing the artificial intelligence literacy of STEM students via certificates and new courses is a beneficial resume augmentation strategy designed to help students in their future occupational endeavors.

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