LAB ISSUES IN A VIRTUAL ERA: UNVEILING CHALLENGES FACED BY STEM STUDENTS IN MATERIAL UTILIZATION

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Abstract

The laboratory has been assigned a central and distinct position in science education, and science educators have indicated that conducting laboratory activities provides rich benefits in learning. Since the start of the school year 2020-2021, online learning has been one of the modes of learning delivery allowed by both the Department of Education [DepEd] and the Commission on Higher Education (Tria, 2020). Due to this, STEM students face many issues in the fast-evolving world of virtual learning, particularly regarding material utilization in laboratory settings. The digital world has transformed education, allowing students to engage with knowledge and communicate remotely in unprecedented ways. However, the lack of physical laboratories has given rise to many new concerns that necessitate attention and creative solutions. Hence this study shed light on the challenges that STEM students confront in material utilization within the virtual domain, its impact on students' performance in active learning, and coping mechanisms of the dilemma which gave ramifications in their educational journey.

Keywords: Challenges, Laboratory materials utilization, online learning, STEM students

1. Introduction

The COVID-19 pandemic tremendously impacted educational institutions globally, particularly in STEM fields (Science, Technology, Engineering, and Mathematics). It has not been exempted from the rapid growth of technology's revolution in education. Virtual learning environments are being integrated more often, giving students additional chances to interact with course materials and ideas (Costa et al., 2018). Nevertheless, there have been some difficulties, particularly regarding lab-based teachings. Laboratory experiments have historically been a critical component of STEM education because they allow students to obtain practical experience, hone practical abilities, and apply theoretical knowledge to real-world situations (Hofstein & Lunetta, 2004). However, the transition to virtual learning environments has made it necessary to transform traditional laboratory experiences into online experiments, digital simulations, and remote activities (Kebritchi et al., 2017). Although virtual labs provide several benefits, such as accessibility and cost-effectiveness, they also present difficulties that could make learning more difficult for students. With this, experimental activities in the classroom for scientific learning have led to many misconceptions among students, resulting in poor hands-on science learning outcomes (Asio & Mondejar, 2022).

2. Challenges in the utilization of laboratory materials

2.1 Limited access to physical resources in school. STEM students have struggled to obtain the physical resources required for conducting experiments and hands-on learning activities due to the closure of educational institutions and limits on laboratory access (Chen & Moore, 2020).

2.2 Lack of hands-on experience. According to Gallagher et al. (2020), the capacity of students to acquire practical skills and interact directly with materials has been restricted by remote learning and virtual environments.

2.3 Decreased peer and team collaboration. Regarding material consumption, remote learning has made it difficult for STEM students to collaborate successfully with peers and work in teams (Adami & Dineen, 2021).

3. Impact on students' performance active learning

Chen and Moore (2020) also discussed in their study the problems STEM students face in gaining access to laboratory experiences during the pandemic and instances of remote laboratory solutions. It looks into how the absence of laboratory materials affects students' performance and engagement in active learning. The challenges mentioned above faced by STEM students strongly affected their performance in active learning in all laboratory worksheets/activities. The following are the identified impacts on students' performance in active learning observed during the pandemic era;

3.1 Adaptation of Assessment Methods. Due to a lack of laboratory resources, teachers have had to modify their assessment methods to measure student understanding and competencies. More theoretical tests or alternative assignments that assess conceptual knowledge and data analysis skills may be used.

3.2 Challenges in Experimental Design. The pandemic has posed challenges in conducting complex or large-scale investigations that may necessitate specialized equipment or controlled conditions. This can limit students' abilities to independently design and execute experiments, affecting their comprehension of scientific processes and techniques

3.3 Impaired Conceptual Understanding. Access to laboratory supplies is needed to improve STEM students' capacity to build solid conceptual knowledge. Hands-on experience facilitates the link between theoretical concepts and practical applications, allowing students to grasp complicated ideas successfully.

3.4 Reduced Engagement and Motivation. Student involvement and motivation are frequently the driving forces behind active learning in STEM education. The lack of access to laboratory supplies has lessened the interactive and immersive features of active learning, resulting in lower STEM student motivation. Without hands-on experiences, students may get disengaged and lose interest in the subject.

4. Coping mechanisms of STEM student dilemma

STEM students can navigate the challenges faced in material utilization within the virtual era. These strategies empower students to make the most of the resources available, ensuring that they receive a well-rounded education despite the limitations of virtual laboratories. Some students stress that effective online learning requires careful instructional design and planning.

4.1 Virtual Simulations and interactive tools utilization. The lack of virtual laboratories, simulations, and interactive technologies has become a critical resource. STEM students can use virtual tools that mimic real-world experimentation to cope with limited material access. Students can obtain practical experience, observe outcomes, and comprehend concepts from a hands-on viewpoint by immersing themselves in these simulations (Mustafa, 2020). By appropriately utilizing these resources, students may bridge the difference between face-to-face and online learning modalities.

4.2 Making Use of Collaborative Online Platforms. Collaboration has been changed by the virtual era, transferring it from physical interactions to online platforms. STEM students can overcome material utilization issues by actively participating in virtual group projects, forums, and discussion boards (ACKAY et al., 2021). These platforms allow students to exchange ideas, collaborate on issue-solving, and benefit from the experiences of their classmates. Collaborative online environments can foster community and enable knowledge exchange, making up for the lack of in-person interactions provided by physical laboratories.

4.3 Adaptive Learning Strategies. STEM students must adapt their learning processes to efficiently use resources in virtual settings. Students can meet the hurdles by varying their learning approaches, such as incorporating visual aids, participating in self-paced learning modules, and exploring supplemental materials (Wu et al., 2021). Students might compensate for the limited practical exposure afforded by virtual laboratories by using adaptive tactics to improve their knowledge and memory of theoretical concepts.

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4. Conclusion and Recommendation

The lack of laboratory materials during the pandemic substantially impacted STEM students' active learning performance. The primary effects reported are worse conceptual understanding, decreased engagement, and motivation, limited skill development, degraded collaborative learning, and increased simulation dependency. Recognizing these consequences is critical for educators and institutions to establish effective techniques and alternatives to lessen the impact on STEM students' learning experiences and outcomes. To overcome these issues, educators and institutions have worked to adapt laboratory experiences for remote or virtual delivery. According to Khan et al. (2021), collaborative platforms and communication tools can promote teamwork and peer-to-peer learning by emulating dynamic interactions in a real lab context. Timely feedback mechanisms and personalized mentoring systems (Chen et al., 2020) can rekindle motivation and give students the assistance they require to prosper. This involves using online simulations, virtual experiments, and interactive platforms to give students hands-on experience. While these alternatives may reduce the damage, they may only partially mimic the benefits of physical laboratory work. Thus, educators and institutions must continue researching novel techniques to provide relevant laboratory experiences to students, even in distant learning contexts. Despite the problems created by the epidemic, this can assist in preserving student engagement, motivation, and skill development in STEM subjects.

References

Adami, R., & Dineen, K. (2021). Discourses of Childism: How covid-19 Has Unveiled Prejudice, Discrimination and Social Injustice against Children in the Everyday, The International Journal of Children's Rights, 29(2), 353-370. https://doi.org/10.1163/15718182-29020001

AKÇAY, A. O., GÜVEN, U., & Karahan, E. (2021). The views of pre-service elementary teachers about online and traditional peer assessment. International Journal of Assessment Tools in Education, 8(2), 409-422. https://doi.org/10.21449/ijate.762104

Asio, J. M., & Mondejar, H. C., (2022). Students' Level of Science Process Skills Acquisition And Academic Achievement. Central Mindanao University Journal of Science, https://doi.org/10.52751/ZFHG2128

Chen, J., & Moore, T. J. (2020). Remote Laboratory Experiences in K–12 STEM Education during COVID-19 and Beyond. Journal of Research in Science Teaching, 57(8), 1094-1100. doi:10.1002/tea.21619 https://doi.org/10.1002/tea.21619

Costa, M. C., Patricio, J. M., Carrança, J. A., & Farropo, B. (2018, June). Augmented reality technologies to promote STEM learning. In 2018 13th Iberian conference on information systems and technologies (CISTI) (pp. 1-4). IEEE.

Gallagher, M. W., Zvolensky, M. J., Long, L. J., Rogers, A. H., & Garey, L. (2020). The impact of Covid-19 experiences and associated stress on anxiety, depression, and functional impairment in American adults. Cognitive Therapy and Research, 44, 1043-1051. https://doi.org/10.1007/s10608-020-10143-y

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the national academy of sciences, 111(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

Hofstein, A., & Lunetta, V. N. (2004). The laboratory in science education: Foundations for the twenty-first century. Science Education, 88(1), 28-54. https://doi.org/10.1002/sce.10106

Kebritchi, M., Lipschuetz, A., & Santiague, L. (2017). Issues and challenges for teaching successful online STEM courses in higher education: A literature review. Journal of Educational Technology Systems, 46(1), 4-29. https://doi.org/10.1177/0047239516661713

Khan, M. N., Ashraf, M. A., Seinen, D., Khan, K. U., & Laar, R. A. (2021). Social media for knowledge acquisition and dissemination: The impact of the COVID-19 pandemic on collaborative learning driven social media adoption. Frontiers in Psychology, 12, 648253. https://doi.org/10.3389/fpsyg.2021.648253

Mustafa, N. (2020). Impact of the 2019–20 coronavirus pandemic on education. International Journal of Health Preferences Research, 4(1), 25-30. Retrieved from https://ln.run/FME9u

Ramlo, S. The Coronavirus and Higher Education: Faculty Viewpoints about Universities Moving Online during a Worldwide Pandemic. Innov High Educ 46, 241–259 (2021). https://doi.org/10.1007/s10755-020-09532-8

Tria, J. Z. (2020). The COVID-19 Pandemic through the Lens of Education in the Philippines: The New Normal. International Journal of Pedagogical Development and Lifelong Learning, 1(1), ep2001. https://doi.org/10.30935/ijpdll/8311

Wu, W. L., Hsu, Y., Yang, Q. F., & Chen, J. J. (2021). A spherical video-based immersive virtual reality learning system to support landscape architecture students' learning performance during the COVID-19 era. Land, 10(6), 561. https://doi.org/10.3390/land10060561