

Editorial

Rebuilding Education—Contributions to STEM Education Practices and Research during the Post-COVID-19 Era

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COVID-19 resulted in an unprecedented transformation in the context of learning and teaching, wherein a significant shift in the different realms of educational attainment was observed [1]. This Special Issue in *Sustainability*, titled “Rebuilding Education—Contributions to STEM education practices and Research during the post-COVID-19 Era”, comprises 12 contributions. These contributions demonstrate the diverse approaches adopted in different developing and developed countries to remediate the analogous challenges, which prompt us to explore the variant underlying factors. Delving into the uncertainties posed by integrated teaching practices, specifically across STEM education, it was observed that the teaching community faced diverse challenges in both learning areas and improving learners’ cognitive behavior [2]. Gaining clarity to nullify inherent uncertainties is quintessential when dissecting the teaching and learning processes.

As cases of COVID-19 were initially reported in China, educators in China pioneered methods of overcoming most classroom drawbacks by initiating flexible learning with enhanced accessibility and implementing open educational practices and resources. However, significant concerns were raised by STEM educational researchers from diverse communities in implementing multidisciplinary education, which was, at that time, acquiring augmented responses from diverse audiences. To sustain and nurture multidisciplinary learning, researchers developed an innovative STEAM education model supported by collaborative teaching employing project-based learning and collaborative learning, successfully promoting a multidisciplinary approach (contribution 4). Meanwhile, in Korea, convergence education was introduced into STEAM education to enhance multidisciplinary education. STEAM-integrated convergence education solves the problem of the lack of knowledge associated with segmented academic paradigms resulting from rapidly disproportionate digital transformation (contribution 6). It is also interesting to observe the findings from a study associated with a Qatar-based university course that adopted a multi-course project-based learning (MPL) approach in which educators observed effective achievement of student outcomes, promoting multidisciplinary research (contribution 11). Studies from Spain introduced a STEM-driven multidisciplinary approach by blending pedagogic and architectural backgrounds with substantial experience in instruction, organizational management, and ICT applied to education. The key highlights were, however, limited to the relationship between the setting/learning space (bedroom and facilities) as a moderator and students’ effective learning outcomes (contribution 9).

Researchers also explored more direct challenges that were faced in formal settings, such as in school or university classrooms. For example, researchers studied the challenges faced during the online regime by most computer education professionals in understanding students’ programming processes (contribution 8). They employed visual representations to clarify the evolution of source-code contents, thereby serving as a reference for future real-time implementation in class. Meanwhile, two student-centered instructional strategies (problem-based learning (PBL) and just-in-time teaching (JiTT)) were adopted across multiple disciplines to encourage a non-conductive online learning climate, with technical problems being the main implementation challenges (contribution 7). Researchers also



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delved into exploring the impact of different teaching styles adopted during online lessons, specifically, experimental classes, by approaching the experiments with activities that could be conducted at home by employing daily-use materials (contribution 12). Meanwhile, it was reported that online ICT implementation using flipped classrooms in Physics and Chemistry teaching to university students gained popularity with the initiation of lockdown (contribution 10).

On the behavioral front, it was also observed that university students' responses during a vulnerable situation, as in the case of a pandemic, adversely affected their emotions, as researchers explored the impact on students' cognitive responses to adaptability and the resultant emotional development (contribution 5). The researchers also reported that this emotional behavior influenced the degree of engagement and investment in school-related activities. Meanwhile, a study based in the United States and Mexico explored the effects of taking online classes on students' sense of belonging in engineering, whereby students had uncertainties about successful learning in the domain, including deficits in peer collaboration and faculty support (contribution 1). While re-conceptualizing education to incorporate STEM education practices with utmost efficiency in the post-COVID era, the key highlights were limited to innovative research that demonstrated students' knowledge or capabilities in multi-disciplinary settings.

However, further studies need to be performed to expand the scope of these research findings beyond the COVID pandemic with concise and conclusive directions for educators in engaging students for sustainable impact. The evolution of teaching practices from the pre-COVID era to the post-COVID era with sustainable takeaways needs to be elaborately explored so as to create models that can be replicated or built upon to attain meaningful and productive student learning gains. It would also be interesting for STEM educators to explore the possibilities of effective implementation of digital tools in the post-COVID era with the escalated digital presence in students' lives.

List of Contributions

1. Effect of the COVID-19 Pandemic on the Sense of Belonging in Higher Education for STEM Students in the United States and Mexico
2. Exploring Teachers' Perceptions of the Barriers to Teaching STEM in High Schools in Qatar
3. Searching for Pedagogical Answers to Support STEM Learning: Gender Perspective
4. Promoting STEAM Education in Primary School through Cooperative Teaching: A Design-Based Research Study
5. Students' Emotions and Engagement in the Emerging Hybrid Learning Environment during the COVID-19 Pandemic
6. Developing Students' Attitudes toward Convergence and Creative Problem Solving through Multidisciplinary Education in Korea
7. Impacts on Student Learning and Skills and Implementation Challenges of Two Student-Centered Learning Methods Applied in Online Education
8. Visualizing Source-Code Evolution for Understanding Class-Wide Programming Processes
9. Students' E-Learning Domestic Space in Higher Education in the New Normal
10. Impact of the COVID-19 Confinement on the Physics and Chemistry Didactic in High Schools
11. Case Study of Multi-Course Project-Based Learning and Online Assessment in Electrical Engineering Courses during COVID-19 Pandemic
12. Compilation of Chemistry Experiments for an Online Laboratory Course: Student's Perception and Learning Outcomes in the Context of COVID-19

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1. Wang, X.; Zou, Y.J.S. Psychological Research of College Students Based on Online Education under COVID-19. *Sustainability* **2023**, *15*, 1040. [[CrossRef](#)]
2. Al-Thani, N.J.; Santhosh, M.E.; Bhadra, J.; Ahmad, Z.J.S. The Prominent Roles of Undergraduate Mentors in an Online Near-Peer Mentoring Model. *Sustainability* **2023**, *15*, 3020. [[CrossRef](#)]

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