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Editorial: Applying lean six sigma and industry 4.0 concepts to enhance higher education

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Editorial on the Research Topic

[Applying lean six sigma and industry 4.0 concepts to enhance higher education](#)

As higher education institutions face mounting pressure to prepare graduates for rapidly evolving workplaces, the strategic adoption of industry-proven methods has become increasingly important. This Research Topic focused on the application of tools and methodologies, originally developed and proven effective in industry or other fields, within the educational sector. The topic explored the integration of emerging technologies (e.g., simulation, virtual reality, artificial intelligence) in educational processes in order to enhance the quality of teaching and learning, achieve higher order thinking skills and increase student engagement. It also illustrated the use of Lean Six Sigma tools and techniques to enhance students' skills and knowledge that are in great demand in the Industry 4.0 era, and to optimize academic and administration processes.

One contribution to the topic addressed the limitations of traditional quality management models in education, which do not sufficiently consider the integration of advanced digital technologies. [Abnoulgid et al.](#) addressed it in their study "Quality 4.0 in Higher education: Integrating Industry 4.0 Technologies in Higher Education Quality Management Practices". The authors proposed an integrated conceptual model (the HEQ4.0 model) based on the findings from a systematic review of 32 articles. The HEQ4.0 model is built around six interdependent and complementary components: data, ethical envelope, technological tools, operational practices, strategic outcomes and outputs, which enables a systematic and coherent approach to the integration of digital tools in higher education.

[Chowdhury et al.](#) focused on stakeholder engagement in preparing a workforce equipped for the demands of the twenty-first-century market in Bangladesh. In their article titled "Integrating an educational supply chain model in the higher education sector: meeting the twenty-first century workforce demands in Bangladesh" the authors proposed an analysis of the higher education system as Educational Supply Chain Management. Using focus groups and semi-structured interviews, the aim was to identify ways to improve university's capabilities, infrastructure and culture for the development of the twenty-first century workforce. The study highlighted the shifts in university

culture, the enhancement of facilities, and the importance of understanding job market trends, all of which are essential for developing a skilled workforce ready for the 4th Industrial Revolution.

The article “Role of artificial intelligence in enhancing competency assessment and transforming curriculum in higher vocational education” investigated the combined influence of AI-driven training, engagement, and demographic factors on competency assessment scores in vocational education. Yan et al. carried out a set of statistical analyses of the 1,200 valid entry data points collected following FAIR (Findability, Accessibility, Interoperability, and Reusability) principles. The findings of the study revealed a strong positive correlation between AI-driven training and competency scores, which showed the benefits of personalized learning experiences and immediate feedback. The study also identified a positive impact of the student engagement with the AI-enhanced learning platforms on the competency scores and further showed that female students obtained better median competencies.

Another contribution to the topic was brought by Khadka et al. in their article titled “Higher-order thinking skills in e-learning contexts in higher education: a phenomenological study”. The study focused on understanding participants’ experiences in acquiring higher order thinking skills (HOTS) through online courses in the higher education context of Nepal. In-depth interviews were conducted with four participants (teachers) who had been taking online classes at the Nepal Open University. The findings uncovered the participants’ significant improvement in their skills, including better teaching practices, increased cultural awareness, and greater confidence in applying HOTS in both professional and personal contexts. That was the result of using a blended synchronous-asynchronous approach, and specific strategies and pedagogies.

Continuing the focus on blended learning, Zhang et al. examined “Mixed teaching quality evaluation of organizational behavior course based on CIPP model”. They proposed the CIPP-AHP integrated framework as a practical diagnostic solution for blended learning quality in organizational behavior courses. The CIPP (Context, Input, Process, Product) model offers a comprehensive evaluation framework which incorporates all aspects of blended teaching. The process evaluation, which was found the most significant factor in blended teaching quality evaluation, was enhanced to include student learning, teacher instruction, process assessment, and formative evaluation. The AHP (Analytic Hierarchy Process) was employed to conduct the empirical analysis which involved a questionnaire distributed to 326 randomly selected students. Although the authors acknowledged the limitations of the study in terms of generalizability, there is scope for adapting the CIPP-AHP evaluation framework to other disciplines.

Avilés-Noles et al. contributed to the assessment of Lean adoption in higher education in their article “Optimizing efficiency and sustainability in higher education: development and validation of a lean thinking adoption instrument”. A measurement instrument was designed to include 8 dimensions: leadership, long-term thinking, continuous improvement, student value, teaching, research, linkage with society, and waste elimination. To validate

the tool, 315 Industrial Engineering students were selected for investigating perceptions of Lean implementation in Ecuadorian Higher Education Institutions. Findings of the study proved the tool a reliable means to assess Lean adoption in higher education and suggested that Lean implementation enhances institutional efficiency and student experience, though sustained impact requires long-term strategies.

In their article “Comparison of simulation software and contrastive training on ECG interpretation competence in newly graduated nurses” Kabiri et al. addressed the need to improve the ability of nurses to interpret ECG and diagnose pathological disorders. An experimental study was conducted in Shahrekord (Iran) to compare the effect of contrastive training and simulation software on the level of critical thinking and clinical competence in newly graduated nurses. The findings of the study showed that both contrastive training and simulation software promote critical thinking and clinical competence in interpreting electrocardiograms, but the effects of training are fading over time. Therefore, the study highlighted the need for periodic refresher courses or booster interventions.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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