

**Teaching Culturally and Linguistically Diverse International Students in Open and/or
Online Learning Environments: A Research Symposium**

**Toward an Agile Pedagogical Strategy for the COVID-19 Era:
A Case Study of Teaching Sustainability Topics**

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Abstract

Students' engagements and creating an effective learning experience in the classroom are essential in active educational strategies. Flexibility and adoption of new learning technologies play a critical role during the pandemic. Different active pedagogical strategies enhance students' learning experiences on the online platforms. The lecturers should be dynamic and flexible, in terms of using hybrid strategies, to optimize this experience. Teaching sustainability courses require innovative teaching styles for encouraging students for active engagement, as well as collaboration, and participation of different stakeholders. This study presents the different teaching approaches for a graduate course in an engineering school during the pandemic. It shows how the combination of case studies, simulation, class guests, and Q&A on a virtual whiteboard could improve students' engagement in a sustainable production course. Kolb's learning model is used to show the advantages of the proposed approach. As the teaching approaches are evolving, as the result of digital transformation, the future perspectives in the post-pandemic period are also discussed.

Keywords: flexibility in teaching, agile pedagogical strategy, COVID-19, teaching sustainability topics, hybrid strategies

Introduction

The emergence of new industrial technologies requires new skills and competence for engineers in the future. The teaching styles for stimulating imagination, creativity, learning by doing, and innovative solutions are essential for the industry 4.0 era. Flexibility in learning and teaching is the leverage of creating an active learning space. The pandemic, as an urgent need of switching to online courses, provided opportunities for educators around the world to test and experiment with different teaching approaches to achieve the educational objectives and students' satisfaction. Teaching sustainability courses, considering the complexity of topics and multidisciplinary nature, require more flexibility, particularly during the pandemic. The Kolb learning model frequently is used in literature for addressing flexibility in teaching and learning personalization. This work, in progress research, aims to address the effectiveness of flexibility in teaching based on the Kolb learning inventory 4.0 model for designing and personalization of teaching sustainable production in engineering schools. The rest of this extended abstract is organized as follows: first, a brief literature review on flexibility in teaching and learning and personalization is provided; then a conceptual framework is proposed; finally, the plan for completing this research and the conclusion is provided.

Literature Review

In this section, a brief review of the Kolb model, the flexibility in teaching, and personalization in learning are provided.

The Kolb experimental learning model includes four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. The starting point in a learning experience could be any of these four stages. The Kolb learning style inventory 4.0 includes nine styles: initiating, experiencing, imagining, reflecting, analyzing, thinking, deciding, acting, and balancing (Kolb, 2007). The combination of different learning styles, based on the Kolb model, could be formed using the divergent, assimilator, convergent, and accommodator styles. Among these styles, the divergent style, with the sense of observation and facilitating the imagination, can stimulate creativity and innovative activities. The accommodator style allows adapting to new experiences, learning by doing, and risk-taking.

Brintha et al. (2021) studied the role of flexibility in teaching and evaluation in engineering schools. They discussed that considering the diversified background of students and the required skills and competency in their future careers, flexibility could provide a creative learning environment. Verna (2020) studied the flexibility in teaching and learning styles in teaching an accounting course. The author proposed a framework based on the Deming PDCA (Plan, Check, Do, Act) cycle and Kolb's experimental learning model for discussing the flexibility. The results showed the positive impacts of flexibility on learners' and educators' experiences.

Lamya et al. (2020) discussed the personalization of learning activities. Personalization allows learners to have choices in the content, teaching method, and pace of learning. The authors explained that this customization provides flexibility in educational scenarios. Sanjabi and Montazer (2020) focused on personalization in the e-learning context. They also used the Kolb model to show the advantages of personalization in an effective learning process, and via a case of an online course, with 19 students showing the positive impacts on students' performance and their satisfaction. Walkington and Bernacki (2020) performed a state-of-the-art design in the

personalized learning context. They concluded that design-based research and class observations should be considered as the future of research direction.

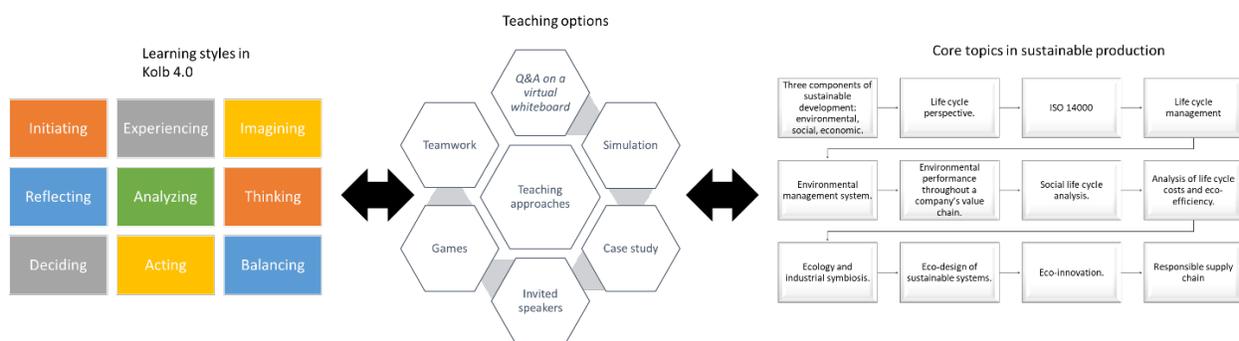
The following points could be highlighted from the literature review:

- The new Kolb learning model 4.0, with nine learning styles, is an interesting framework for discussing the flexibility in learning and teaching for engineering courses
- The new context of the pandemic requires more flexibility in teaching style, and there is a need for a comparative study on learning styles, based on the class observations.

Methods

Figure 1 shows a preliminary conceptual framework for linking the nine learning styles in the Kolb model to the core concepts in teaching sustainable production. The idea is to adapt the learning and teaching style, based on the learning objectives of each topic in the course.

Figure 1
A Preliminary Conceptual Framework



Initiating style refers to the ability to initiate the action to deal with an experiment. According to Kolb (2007), this learning style is appropriate for active learning and accommodation style. Hence, learning by doing, try and error style, could be matched with this style. One effective teaching method for responsible supply chain and comparing the trade-off between changes in product design, monitoring suppliers' environmental performance, the collaboration with suppliers, and vertical integration is simulation and games, via teamwork activities. This interactive learning style aids students to experiment with the impacts of each decision-making component on the supply chain, via an interactive learning dashboard. The imagining style is preferable in addressing different alternatives and perspectives of an experience (Kolb, 2007). This learning style is preferable for eco-design, eco-innovation and ecology, and industrial symbiosis concepts. Team projects and brainstorming could aid students in creating innovative solutions in design and stimulate creativity in the classroom. Analyzing is a preferable approach in reflective conceptual learning and it is appropriate for teaching life cycle analysis, life cycle cost, and social life cycle assessment. Q&A on a virtual whiteboard, assigning problems to teams for analyzing and discussion, and learning the key elements of the life cycle approach is an effective teaching approach for these concepts. In deciding style or converging, the objective is selecting the best option for action. Selecting the appropriate

standards and designing the action plan for implementing the environmental management systems and performance evaluation frameworks could be taught, via this approach. Inviting the speakers from the industry could aid students to know the real challenges in integrating sustainability into the organization's processes and have better insights for decision making.

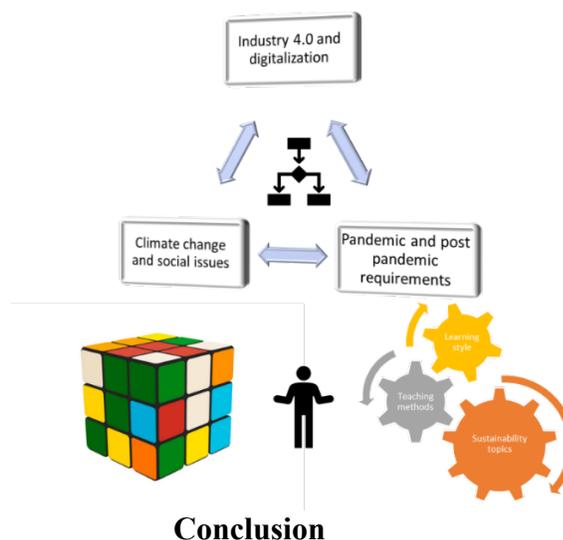
Discussion and Research Agenda

Industry 4.0 and the digitalization era led to novel teaching and learning methods. Besides, the pandemic imposes fundamental changes in the future of educational systems. Climate change and social issues are also playing an important role in the current and future of the production courses. The interaction among these factors influences the learning and teaching approaches. Hence, a Rubik's Cube of teaching and learning styles with maximum flexibility is needed to customize the pedagogical strategy based on the nature of each topic, the requirements of the engineering job market, and the uncertainty of the disruption and crisis that would be happening.

This new paradigm creates a new learning space (Figure 2) and calls for research to assess the different aspects of the problem. The conceptual frameworks and class observations are required in this context. The following tasks are the research agenda of the author for completing this working paper:

- assessing the interaction among industry 4.0 enabled education, pandemic and post-pandemic impacts on teaching, and the evolving climate change issues
- addressing the detailed features of each learning style in the Kolb model and addressing the alternative teaching methods for the sustainable production course
- creating a course supermarket of different teaching approaches to give the students the opportunity for personalization
- testing the proposed approach in a pilot workshop for the sustainable production

Figure 2
The New Learning Space



In this study, a hybrid teaching approach is proposed for teaching sustainability topics during the pandemic. The dynamics and flexibility of pedagogical strategies are discussed via Kolb's learning model. Discussing the perspectives of the innovative educational methods in the context of sustainability is essential, and could be addressed as future research.

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