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An Experiential Engineering Learning Model for Knowledge and State of Flow Creation

*By Riadh Habash**

Education in professional degree programs is charged with serious responsibilities in the classroom and practice spaces. To meet these responsibilities, educators must serve as both teachers and learners in both spaces. This article demonstrates an experiential project-based learning model to enhance the teaching of an undergraduate engineering course on mechatronics. An important aspect of this model is an experiential learning model that complements the well-known international CDIO™ Initiative which is an innovative educational framework for producing the next generation of engineers. This model reflects on challenges of experiential learning for group-based design projects and faculty competition teams where learners including faculty and students collaborate to create their community of design and practice to physically and virtually share knowledge, perspectives, and opinions. The model reveals the impact of collaboration, practice spaces and exhibitions, and open educational resources in the enhancement of engineering education. The experience of adopting the model for several years recommends a number of practical approaches instructors may embrace to enable knowledge creation and enhance the effect of flow experience.

Keywords: *experiential learning, knowledge creation, reflective practice, state of flow, community of design and practice, open educational resource*

Introduction

An understanding of the new realities of globalization, cultural change, and digitization requires three converging mindsets of Age 5.0 (industry, society, and education) that help to "learn-think-research-create-change" as conceptualized in Figure 1. The ultimate "change" defines that future institutions of higher education must adapt along with the populations they serve to remain competitive and ready to account for their decisions to a wide range of stakeholders (Habash 2022). The process requires an active transdisciplinary education to integrate tools, techniques, and approaches as well as a concurrent collaboration by sharing ideas between and across disciplines, and beyond (Habash et al. 2022).

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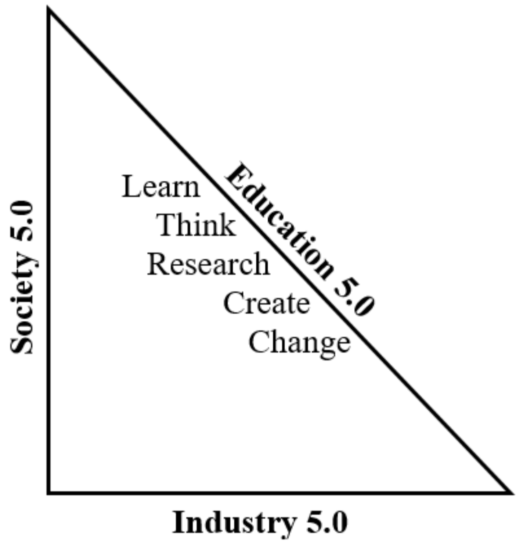
Figure 1. *Converging Mindsets of Age 5.0*



In today's engineering education, students do not learn just by sitting in classes listening to teachers, memorizing information, and preparing answers. They should think about what they are learning, write about it, reflect on their experiences, and apply it to what they feel is important (Daud et al. 2008). These experiences may take place within or outside of the classroom. The students should be active participants in the learning process, not passive witnesses to it. They should make what they learn a part of themselves. To accomplish this, the teaching content being pursued must be essentially relevant to the learner. The objective is to advance students beyond plain memorization of facts to higher-order domains of integration and applications. Such learning may happen in every domain but is perhaps most noticeable with engineering education.

Attempts to improve engineering education and student learning include a diversity of advanced pedagogical approaches. This may include first-year design courses, transdisciplinary teaching, design and practice spaces (physical and virtual), and online learning. These approaches inspire reflection and action in the form of knowledge creation and transferable skills through experiences, academically known as experiential learning. It is more specifically defined as "learning through reflection on doing", which in turn implies a constructive, reflective approach based on the "experience-share-process-generalize-apply" cycle (Younghui 2010, Gadola and Chindamo 2017, Voehl 2018). In this process, the learner takes ownership of learning, tackles risks and failure, reflects and learns from mistakes, and maybe incorporates some sort of creativity and innovation.

Experiential learning is an old concept where the contributions of Socrates, Plato, and Aristotle to its philosophies are well documented (Wurdinger 2005). Socrates' greatest contribution to experiential learning was his elenctic method. Plato calls the Socratic method elenchus, meaning, positively, a way of asking questions that help the interlocutor know what they know and do not know. In this regard, the practiced teacher only facilitates learning, accurately considering where the student is, and stimulating the student's discovery.

According to the Association for Experiential Education, experiential learning can be defined as the "challenge and experience followed by reflection and application leading to learning and growth." This definition is based on Kolb learning circle (Kolb 1984), which is formed on the background of the research from many recognized theorists in cognitive science. According to Kolb, this type of learning is defined as the process whereby knowledge is created through the transformation of experiences.

Although experience may be the basis of learning, it does not necessarily lead to it (Boud et al. 1993). Using an active learning environment can enhance the integration of theory and practice in the classroom by using instructional activities involving learning by doing (LBD) and thinking about the process. Active learning is a student-centered pedagogy in which learning activities are used to motivate and engage the students in the learning process beyond listening and passive note-taking. It promotes skill development through activities that may include system and design thinking in an active learning environment. Its main desire is to place the responsibility of learning in the hands of the learners themselves and allocates the role of leadership and facilitation to the teacher. This active learning environment should stimulate students' interest in the subject and increase their engagement and enjoyment.

Experiential education is broader than experiential learning. It is a teaching philosophy with a transdisciplinary approach toward learning. It first immerses learners in an experience and then encourages reflection about the experience to develop new knowledge and interpersonal skills, new attitudes, or new ways of thinking (Lewis and Williams 1994). Experiential education is also built upon a foundation of transdisciplinary and constructivist learning. The experiential methodology does not treat each subject as being walled off in its room but creates an interdisciplinary learning experience that mimics real-world learning. In experiential learning, there must be a mixture of content and process with a balance between the experiential activities and the underlying content or theory. Students should be able to reflect on their learning, bringing "the theory to life" and gaining insight into themselves and their interactions with the world (Voehl 2018). This holistic endeavor of learning that involves thinking, feeling, developing, and reflecting is the process of knowledge creation, not knowledge acquisition only.

Engineering students are educated into a profession where they use high-level theoretical knowledge in qualified solving of complex engineering problems. Accordingly, experiential learning focuses on the practical usage of knowledge and skills in real-world experiences to further increase learners' knowledge and develop competence in skills and behaviors. It provides opportunities for those students to interact directly with the knowledge by using tools, data collection, models, and laws of science. Such experience meets several goals including mastery of subject matter, developing scientific reasoning, and building practical skills.

Experiential education in an engineering setting is realized when learners are enthusiastically involved in activities or experiences including the design, analysis, and improvement of complex systems. These are participative, either by making or doing, which take diverse forms. Students would learn through doing and reflecting on those activities by applying in-depth knowledge to practical experience to develop skills or new ways of thinking (Habash 2019a). Experiential learning in project-based learning (PBL) goes through the application of science and engineering to open-ended problems rather than through the solution of traditionally closed exercises, to inspire creativity and innovation (Siddique et al. 2010) by integration of education and research.

This article is framed around five subsequent research questions. First, what is the gain of integrating the practical experience into a course mostly organized around the modality of classroom learning? Second, what is the role of group-based student projects, competition teams, a community of design and practice (CODAP), and physical and virtual exhibitions in experiential learning? The third question is what collaboration, exhibition, judgment, and sustainability mean to experiential learning. The fourth question is if various course components impact students' experience of knowledge creation. The fifth question is about how can teachers encourage flow and how can students achieve flow. To realize the above questions, an enhanced experiential learning model that complements the well-known international CDIO™ Initiative is proposed, implemented, and assessed for several years. This active learning strategy is supported by an open educational resource (OER: g9toengineering.com) developed by the instructor (author) to enable knowledge creation and enhance the effect of the flow experience.

The C-CDIO-R-J-E Experiential Model

Experiential learning is not new but an age-old concept. In Greece, knowledge was classified into four categories: know what; know why; know-how; and know who. "Know what" is related to facts, is close to the information, and is related to typical engineering education. "Know why" represents principles and laws. "Know-how" is related to transferable skills and the ability to do or build something. "Know who" refers to information about who knows and who knows what to do. This knowledge is related to engineers knowing who they can consult when they encounter a problem (OECD 2000).

Aristotle wrote in Nicomachean Ethics that "the things we have to learn before we do them, we learn by doing them", as a principle for thousands of years, is often overlooked in the domain of typical education. Adjusting education to a such activity means adopting an open curriculum that provides learning from experiences resulting directly from one's actions, as compared with learning from watching or listening (Habash 2019a).

By moving beyond theory to the realm of LBD design, the learner gets a first-hand experience of practicing what has been taught in terms of fundamental concepts on which a system is based. This plays a crucial role in retaining concepts and ideas. The principle has been promoted widely and in many forms, including trial-and-error learning or discovery versus instruction, practical experience versus book learning, and others (Lester and Kezar 2017). LBD has long been a tradition in the technology disciplines including engineering.

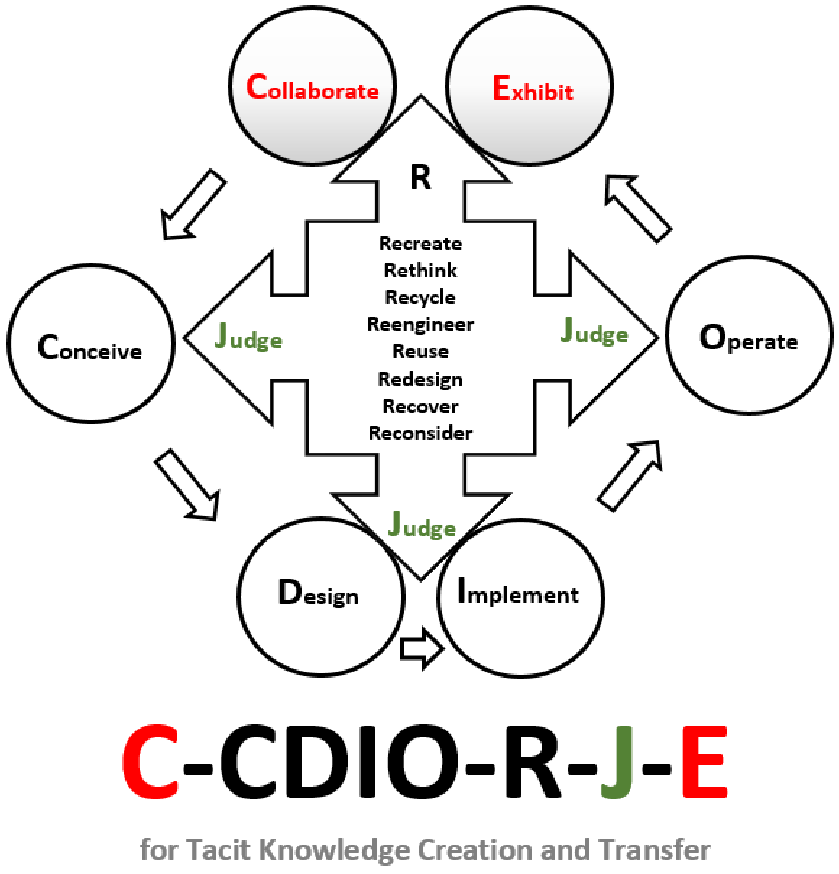
However, there is no doubt that it is the "hands-on" work that reinforces theory into practice through the sharing of knowledge between individuals as typically occurs through joint activities in combination with physical proximity. Such experiential activity should include exploration, sharing, processing, and application. This requires the student to perform an activity or task, share the results and observe, discuss, and then reflect on the process, connecting it with real-world examples and applying it to another situation.

Engineering as the art of shaping and navigating the design promotes the "invisible" learning that aligns with knowledge creation. An essential building block of this methodology is experiential learning which goes beyond LBD by stressing the need to educate students to understand how to conceive- design-implement- operate (CDIO) complex value-added engineering systems in a modern, team-based environment. The CDIO teaching approach changes the way students learn and how teachers teach (Wang et al. 2021). CDIO collaborators have adopted this approach as the framework of their curricular planning and outcome-based assessment through ways that may together be depicted as active learning.

Adding to the CDIO framework is the role of collaboration "C", judgment "J", exhibition "E", and R's of sustainability "R". This is reflected in developing the experiential C-CDIO-R-J-E model shown in Figure 2. The model complements the well-known international CDIO™ Initiative which is an innovative educational framework for producing the next generation of engineers. Collaboration and connection establishment (including online) provide a platform for knowledge transfer through a process of "socially constructed learning". This is based on the idea that the social nature of collaborative student groups offers the opportunity to learn through shared conversations among participants and exposure to new ideas. The realization of ethics and judgment consists of taking the most appropriate decision in the face of a dilemma in which one must choose the one that is most in line with professional accountability. On the other hand, an exhibition by seeing design and hands-on work is a strategy that calls for making students' work visible to transfer the knowledge embedded in how work is done. The model is inspired by sustainability (Rs: recreate, rethink, recycle, etc.) to direct student thoughts about the environment in which we work and live (Habash 2017).

The proposed C-CDIO-R-J-E experiential model presents the "how" of the knowledge transfer, the practice that translates a learning institution's vision into an innovative exercise. This approach makes the students sense that their teacher is enthusiastic about teaching and confident in their learning where classes are open to diverse experiences and the teacher continues as a creative mediator by facilitating critique, encouraging partnership in learning, and fostering reflective practice. This model would suit any course in which practice is pertinent.

Figure 2. *The Proposed Experiential C-CDIO-R-J-E Model*



Setting of the Course

In engineering, mechatronics is a discipline that reflects transdisciplinary real-life applications effectively. It is the synergic design of computer-controlled systems that integrates mechanical, electrical, and computer tools with information systems for the manufacture of products and processes. Such integration offers a wider spectrum of assignment potential and thereby also opportunities for student freedom in being creative (Habash and Suurtamm 2010). In promoting an active and collecting environment for student participation in the learning process, the instructor sets a learning atmosphere for everybody, including the teacher (Habash et al. 2011).

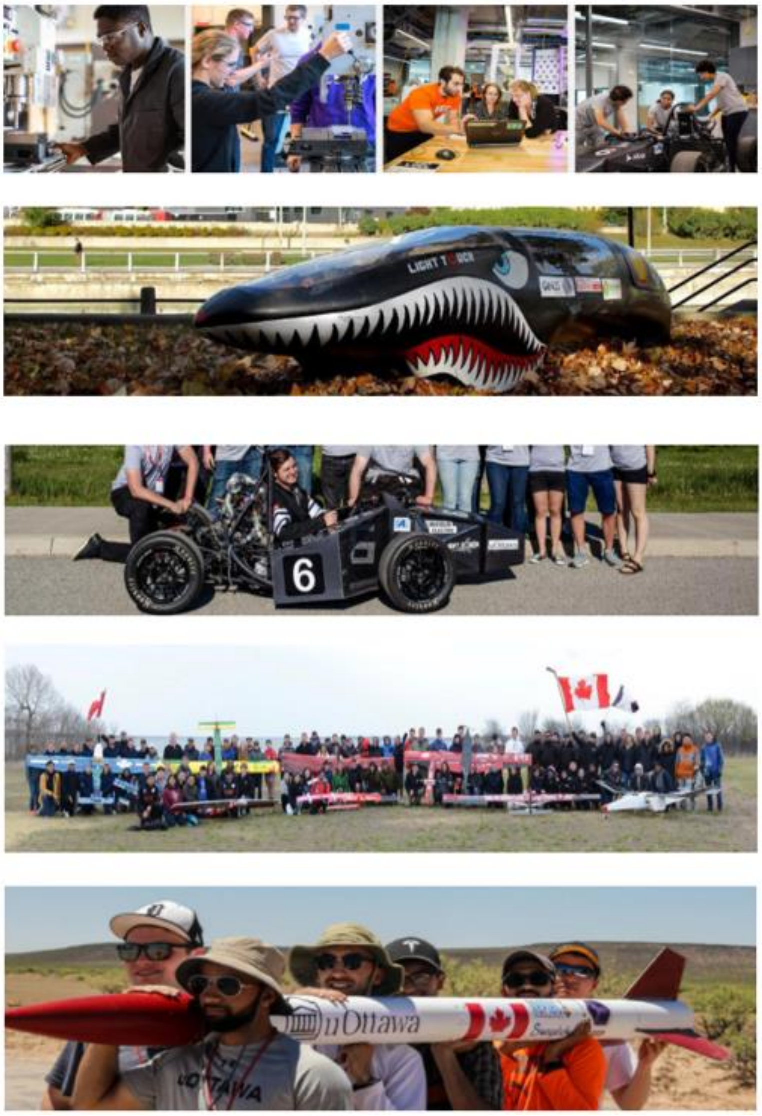
Initially, the teaching experience under consideration has specifically evolved from PBL to the proposed C-CDIO-R-J-E experiential model. It is shown that projects are used as an integral and essential part of the learning activities provided in teaching mechatronics especially when they are made part of a larger engaging learning task like faculty competition initiatives. Group-based design projects with sustainability in mind have been implemented in teaching a course on mechatronics to third-year mechanical engineering students. The average class size is 150 students. Teaching this course is based on both teachercentered and learner-centered environments. The knowledge structure approach is a steady move from direct instruction in the form of lectures and tutorials, to hands-on lab tasks, to self-controlled experiences of 10-weak design projects. The projects are introduced at the beginning of the semester through formal request-for-proposal announcements. Each group of two-three students is expected to select one project idea to proceed with throughout the semester. A proposal must be prepared by each group in the fifth week, which concludes the conceptual design phase. Upon approval, the group proceeds toward detailed design and prototyping. These projects aim to embed learning in real-world contexts, which give students a sense of responsibility and ownership.

The projects are rewarding, as they often afford the students their first opportunity as design beginners. These projects require knowledge of electronics, mechanics, and simulation as well as the acquisition of components such as breadboards, sensors, motors, gears, controllers, and other accessories. Such a PBL experience needs careful design and continuous monitoring by the instructor. Many of the group-based projects share a systematic reverse engineering approach for analyzing the design of existing devices in system prototypes used for major student competition teams. Such projects are scientifically sound and relatively open-ended where the students apply a typical iterative design process, run tests, and diagnostic troubleshoot on all performance parameters. They require in-depth knowledge and information about economics and project management, standards and codes with appropriate attention to health and safety risks. However, they involve occasionally encountered issues.

The course concludes with an exhibition of project prototypes where students share the experience as well as with students from other classes and sometimes visitors from local high schools. This represents a collaborative exercise that involves reflection on the subject matter from the viewpoints of different people and disciplines. The goal of this exhibition is to increase awareness about engineering design in general and the faculty competition teams in particular. Another key deliverable is an educational video, which should stand as a design communication for the project. Several videos are selected to be shared at the course OER.

Student competition initiatives seem to play on a different level, at least in engineering education. They are renowned international, long-term events rather than classroom activities, and they offer all the elements that are the key to successful experiential learning. They are open-ended tasks where reflection is facilitated through subjective experience, objective results, advice, and judgment from industry experts. In this regard, several groups of students from the class pick up design projects related to major competition initiatives funded by the faculty's Brunsfield Centre for Engineering Student Projects and Entrepreneurship. This participation in inter-university competitive teams such as Supermileage, SAE Formula Electric, Baja, SAE Aerospace, Rocketry, Roboboat, and Rover (Figure 3) is critical for the advancement and success of the teams in diverse national and international thoroughly judged competitions. Teams work on multiple aspects of their projects, from mechanical, electrical, and software. They usually develop and test various mechatronic systems including engines, avionics, ignition mechanisms, and different controls. The Faculty's John McEntyre Team Space provides a collaborative space for the pre-competitive teams as well as the infrastructure required to push technological boundaries, promote the development of skills and expertise, and strive for success. In general, the course represents a recruitment hub for the faculty competition teams.

Figure 3. *Examples from Student Competition Teams*



State of Flow Experience

According to positive psychologist Csikszentmihalyi (1982), flow is a state of mind in which a person becomes fully immersed in an activity. It is a learning journey from routine and unfeeling to enlightenment, empowerment, emancipation, and an entrepreneurial mindset. Matching challenge and skill could be an important consideration in this state. It is often associated with rewarding creative arts, however, it may also occur while engaging in a sport, dance (Cherry 2022), or technology. The state of flow can be attained by balancing the skills students possess with the challenges.

Students learn in many ways, so the challenge for teachers is to discover which approaches help students to learn most effectively. Both flow and experiential learning underline the importance of the learning environment and the choice of task. The advantages of flow experience are obvious, as it improves students' ability and their attitude to learning (Kiili 2005). Experiential learning provides an intentional way of shaping hands-on learning and may have consequences for learner engagement (Younghui 2010).

The above state may be summarized as LBD and emphasizes that the material and approach used during the learning process are critical for deep engagement in the task (Gauntlett 2007), hence for entering the state of flow. As a way to realize this state, the CDIO methodology has been adopted by the author in teaching several undergraduate courses including the course under consideration.

Often, groups of students try to build a particular system for a competition team with a tendency of getting fascinated with details. They spend extra hours added to their class experimenting in a mind-absent flow and are driven by the needlessly ambitious plan for a fully sophisticated system but fail to implement their plan with the available resources or time. During the consultation with the instructor, the students explore their inclination to over-engineer the system and change their minds toward a much simpler solution to complete the work.

Experiencing flow during the learning process is supposed to be linked to improved learning outcomes (Shernoff et al. 2003). By combining all course learning components, it is observed that active experiential learning is a supportive form to enter the state of flow but it is not enough requirement. To deepen flow and maximize student concentration, the top course projects and winning competition teams are usually awarded bonus marks in addition to the full graded marks. In general, the final course grades are largely a reflection of the effectiveness of the C-CDIO-R-J-E experiential teaching model.

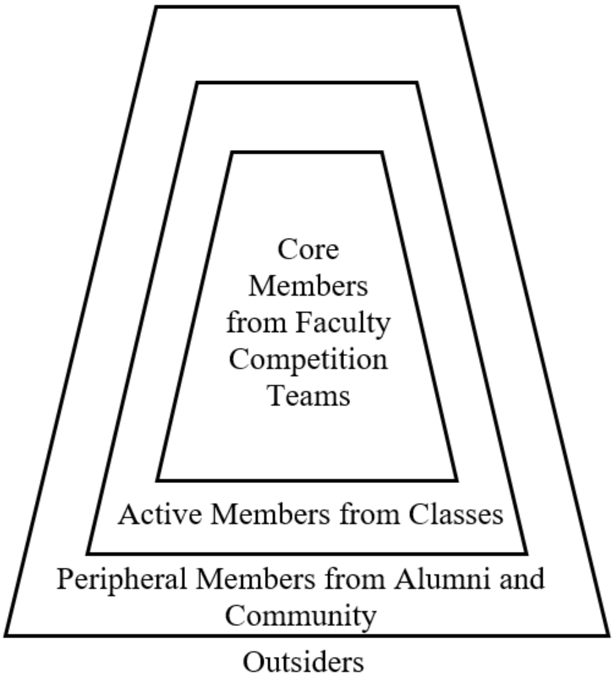
Community of Design and Practice (CODAP)

The engagement of students in course projects and faculty team competitions tends to naturally conform to the criteria laid out in Kolb and Kolb (2005); in particular, their suggestion that experiential activities draw students into a community of practice. The practice means students employ what they learn in the classroom. Therefore, this course plays a significant role in creating new competition teams and feeding the existing teams with members, ideas, and solutions for continuation and progress. This means expanding their knowledge beyond the classroom and getting a practical hands-on experience that all employers want.

Communities of practice were common as far back as ancient times. In Greece, for instance, corporations of metalworkers, potters, masons, and other craftsmen had both a social purpose and a business function (members trained apprentices and spread innovations). In the Middle Ages, guilds played similar roles for artisans throughout Europe. Today's such communities are different in one important respect: instead of being composed primarily of people working on their own, they often exist within large organizations (Al-ghamdia and Al-ghamdib 2015, Habash 2020).

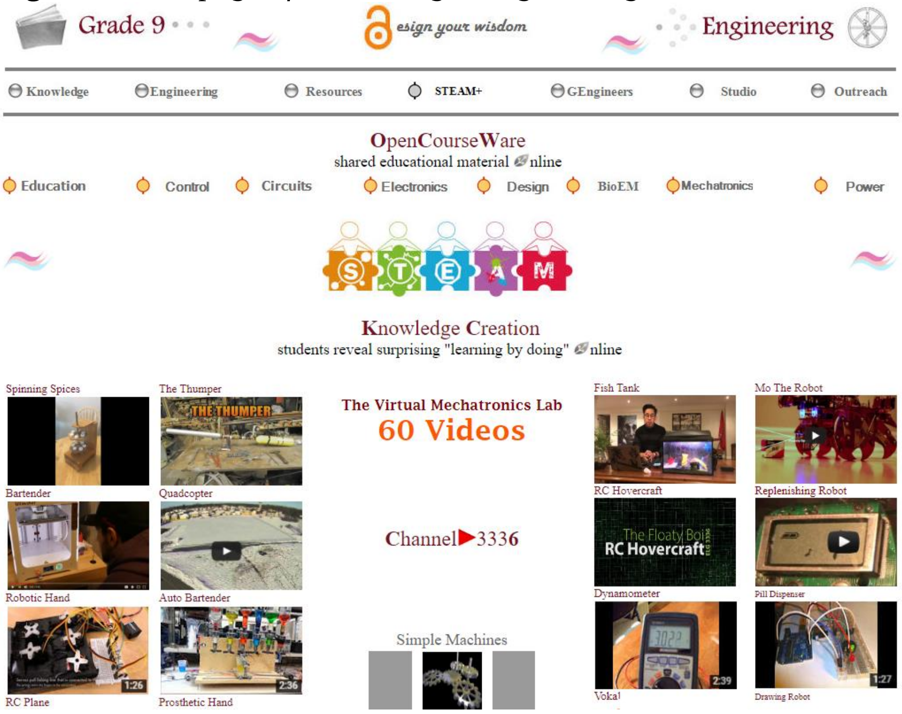
A CODAP may be regarded as a layered structure of participants, frameworks, ideas, physical and virtual spaces as shown in Figure 4. It is a mechanism to facilitate social interactions, knowledge creation, and sharing within a culture of collective learning. Over years, graduates from the faculty joined graduate programs, the industry, and other institutions. Several others established their firms and continued collaborating with the faculty. Today, those graduates represent an outer community that supports and benefits from the CODAP. It has been the author's experience that the CODAP can benefit students and the community through positive social interaction networking that enhances belonging and experiential engineering learning.

Figure 4. *A Framework for a Community of Design and Practice*



With the emergence of Web 2.0, many techniques that allowed the considerable potential for developing CODAP roles in learning processes have become available, which has, in turn, led to the emergence of the virtual CODAP (VCODAP) (Vinson 2013, Habash et al. 2022). The Internet is currently one of the first digital places where people go for information and knowledge, and it can be of great assistance to both educators and students. To realize this fact, an OER, namely "g9toengineering.com (Figure 5)" as a VCODAP was developed by the author in 2007 to support teaching and to provide open space for knowledge in various disciplines and topics (Habash 2019b). This OER provides in addition to multiple resources, a list of student projects in the form of educational videos as well as the activities of various faculty competition teams.

Figure 5. *Frontpage of the OER: g9toengineering.com*



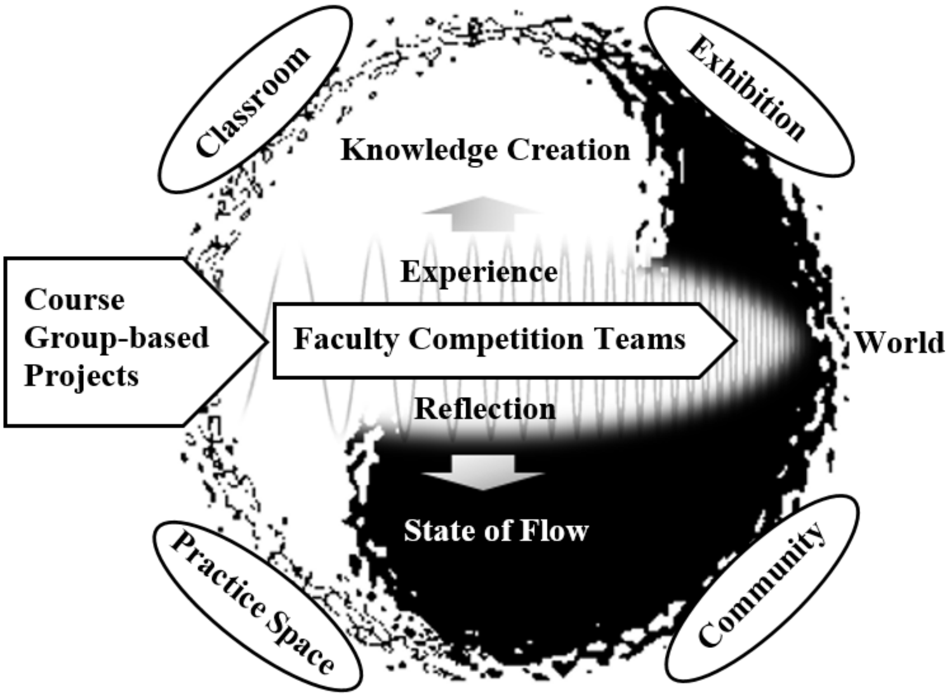
Reflective Practice and Knowledge Creation

Reflective learning facilitates learners to activate prior knowledge and develop new knowledge. In reflective practice, students engage in an endless cycle of self-observation and self-evaluation to realize their actions and the reactions they induce in themselves and other learners. The CODAP concept applies very well to the structure of teaching the course under consideration in terms of classroom, design and practice spaces, exhibition, community outreach, group-based projects, and faculty competition initiatives. The reflective practice of the group-based projects feeding the competition teams takes a constructivist approach to knowledge creation and sharing as shown in Figure 6.

To effectively realize reflective practice, certain adjustments in the education system should take place where classes will be more open spaces for diverse learning experiences and teachers will continue as mentors, guides, facilitators, designers, and organizers of learning tools. However, this break with traditional sequences is not without debate. Students may be unenthusiastic to depart their comfort zone if they do not see the value of learning strategies that require more effort. To this end, there is no specific answer to that dilemma, no recommendation for how the components of a learning environment should be gathered for the highest benefit of learning.

Reorienting learning away from knowledge acquisition toward knowledge creation and translation involves careful consideration of the students as learners. Knowledge is created due to two distinct learning processes: grasping and transforming of experience (Kolb 1984). Grasping may be hypothesized as a scale between concrete experience and abstract conceptualization. Transforming spans from active experimentation to reflective observation (Jentsch et al. 2012). Because the final verdict on the effectiveness of an approach lies in learning outcomes. The focus should center on the student experience and reflection supported by facilitating interaction in practice and exhibition spaces as well as OERs.

Figure 6. *Reflective Practice within the Framework of CODAP*



Assessment and Feedback

To improve the quality of teaching methods and practices, there are several strong approaches to the assessment of pedagogical innovations and student performance in engineering education. These include in addition to institutional self-evaluation, student online anonymous surveys and feedback comments as well as instructor observation, critique, and judgment.

When brainstorming for the online anonymous survey, the instructor thought of four specific questions about the effectiveness of the course learning components including lectures, design modules, lab tasks, and projects. Students' satisfaction concerning the course learning components and results are measured by analyzing the data collected from Questions 1 to 5 (Table 1). In general terms, the data from Question 1 of the survey shows that the majority of students support learner-centered learning (case studies and projects) over teacher-based learning (lectures). In particular, only 27% of the students showed interest in competition teams since only about 30% of the students participate in these teams. Students' feedback from Questions 2 and 3, shows the impact of the C-CDIO-R-J-E experiential model on the learning process. Data from Question 4 indicates that about 71% of students "agreed" with the CODAP and OER creation. Data from Question 5 shows that a good number of students engaged and enjoyed the course activities and entered the state of flow.

Despite the satisfaction, this process might sometimes involve student discomfort by taking responsibility for their learning. Results from Table 1 show that majority of students agree with the learning approach and usually recommend activities that reflect real-life applications. The data from group interviews show that students want and expect more LBD via PBL from other courses across the semester. Based on student comments, it is believed that educators have an opportunity to proactively drive the motivation of their students to enhance their learning and develop the graduate attributes.

Table 1. *Course Anonymous Survey Outcomes*

Survey Questions	**Student Response**			
Q1: I learned for future practice from the course content overall, however, I gained more knowledge and experience from	Lectures/ Tutorials 51%	Design Modules 57%	Project 83%	Competition Teams 27%
Q2: While working on the project, I learned more about	Design 76%	Hands-on 82%	Testing 79%	Planning 71%
Q3: These three activities were practiced in the course, However, I benefited the most from	Collaborati on 78%	Judgment 56%	Exhibition 89%	Sustainability 73%
Q4: I think CODAPs including OERs improve understanding of the subject content	Strongly Agree 61%	Agree 20%	Disagree 9%	No idea 10%
Q5: I was totally involved in what I am doing in the course. I have experienced it. With what and how often?	Mostly with Project 34%	Mostly with Design Modules 19%	Sometimes 24%	No idea 23%

Feedback comments on students' performances are critical because they assist in knowing the strengths and limitations of the course in general. Students' feedback indicates notable enthusiasm towards the course on mechatronics, despite its demanding workload. The collected student feedback and data clearly show that unleashing engaging activities into web-enhanced/hybrid/blended paradigms where students receive traditional and technology-mediated learning may significantly improve student analytical thinking, reflective judgment, and self-efficacy (Habash 2018). Feedback can pinpoint the limitations associated with students' intangible understanding related to each of the instructional goals. A significant element of assessment and reflection is student satisfaction, which is related to but different from success as evidenced by student feedback comments and perceptions about the experience in which the learning outcomes meet most of their needs. The most notable quotations during the online survey are the following.

> "The project is interesting, it involves grasping knowledge learned in the classroom and applying it on a large scale in real-life application."
> "Interesting to learn about real-life situations."
> "Real-life implementations. Teamwork is the key. Punctuality is important. I believe this will add to my experience in the future. Improvements are always possible but can't think of any right now."
> "It is certainly useful and is unique. Many things in this world are educated guesses."
> "I believe the development of student projects has a large impact on the learning objectives of students. While working on this project, I learned much more about my topic and was able to condense it in a way my peers could understand. It informally improved my design thinking and hands-on skills. The OER allowed me to connect with the audience in a relaxed manner."
> "Personally, building the project was the best aspect of the course as it allowed me to showcase my creative skills and combine them in a way to educate others on a topic I am very interested in."

Based on the student comment, it is believed that teachers have an opportunity to proactively drive the motivation of their students to impact their perspective on learning. Students appreciated the project and competition task experiences and thought they were efficient in promoting collaboration, systems thinking, and design thinking.

Discussion and Conclusion

Engineers educated today will become industry leaders, educators, and researchers of the future. They should be well equipped to tackle and conquer the rising challenges. To be effective in preparing for these progressively difficult roles, the education system must be far more creative and aspiring intellectually. Teaching content should not be used as an end in itself, but as a means of helping students learn how to learn. Teaching should shift from covering all required content to guiding principles of the learning process. Grading should not be based on reciting back lecture notes. Sometimes, grading is very degrading for students.

Returning to the research questions after collecting data from observation, survey, feedback comments, and interviews. The first question asked about the gain of integrating practical experience into the course. The data confirms a significant advantage in this regard. The second question was about the impact of group-based student projects, faculty competition initiatives, CODAP, and physical and virtual exhibitions in experiential learning. The effect is evident on student engagement and learning. The third question asked about the meaning of collaboration, exhibition, judgment, and sustainability in experiential learning. Data shows that these activities complement the CDIO Initiative and have a great influence on experiential learning. The fourth question is if various course components impact students' ability to create knowledge. It is evident from students' performance by connecting new knowledge with knowledge and concepts that they already gained in the course, thereby constructing new meanings. The fifth question was about students' involvement in the course activities. A good number of students engaged and enjoyed the course activities and entered the state of flow.

Implementing the proposed C-CDIO-R-J-E experiential model including the CODAP requires a change that might be time-consuming and a little bit expensive, but collaboration amongst students, faculty, university and industry facilitates the ground for lessening the task. Not only does this model serve the students in learning competencies but in creating and sharing resources such as equipment and software applications. As observed from several years experience of teaching the course, the integration of group-based experiential learning with CODAP enhances the interprofessional skills of students more than just solving pre-determined theoretical exercises. Students' feedback indicates notable enthusiasm towards the course, despite its heavy workload. Based on students' feedback, the course can address major graduate attributes that are expected from any engineering institution.

The results of this research have identified several critical issues when teachers and students try to take advantage of the proposed C-CDIO-R-J-E experiential model and CODAP as a space of collaboration and source of information for knowledge creation and innovation. Such a combination is an effective indicator of informal learning. It evolves to address normally shared interests and problems. It might postulate a viable alternative to the learning programs being offered by recognized academic institutions. This will place a burden on universities to offer more accommodating practices for the recognition of informal learning and to hold on to their existing domination of educational credential recognition.

This teaching model is helpful, not only in fostering students' practice capability, innovation realization, and team collaboration spirit but also in stimulating the learning curiosity and enthusiasm for research investigation. Therefore, it is recommended that teachers should construct the curriculum with a student-centered approach. It is crucial to make the course easy to study for all students, regardless of their learning background. The author believes that in addition to industry collaboration and research publication, the model is enriched by the ability to engage learners physically, cognitively, and socially in various projects and faculty competition initiatives. It consequently prepares future talents and enhances graduate employability.

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