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SUPPORTING A COMMUNITY OF PRACTICE WITH A COLLABORATIVE PLATFORM OF ACTIVE LEARNING STRATEGIES

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Abstract – *Communities of practice are supporting growth, development and collaboration in various environments. A new Chair in teaching and learning at Polytechnique Montreal, focusing their activities on active learning strategies, perceived useful and relevant to build a community of practice around this widespread academic topic. To achieve this goal, they built a repertoire of active learning strategies to stimulate meetings and encourage exchanges between engineering educators.*

The ultimate objective is to promote the use of active learning strategies, which are more effective than the traditional ones, to enable in-depth and lasting learning. Many success factors and integration challenges concerning this type of approach have been studied and are considered and addressed with this new instrument.

Francophone teachers from all around the world, will be able to share their experiences with active learning in an engineering context as well as learn from and teach to others in the community. The platform's effectiveness as a collaborative tool will be studied and measured with an action research protocol, analyzing quantitative and qualitative data.

Keywords: Community of practice, active learning strategies, collaborative digital platform, engineering community.

1. INTRODUCTION

Active learning has been documented and used by educators in many fields for the last 50 years. Numerous researchers and pedagogues have developed hundreds of strategies or techniques to increase students' participation during their own learning processes. To deepen the study and applications of this specific aspect of engineering education, a new research Chair was created at Polytechnique Montreal in 2017: IMPACT^G (*Innovation in active learning educational strategies for engineering*¹). For their founders, active pedagogy causes a profound change in the way students learn as well as

how teachers teach. They wish the Chair acts as a catalyst for implementing new practices at this institution but hopefully in many other engineering school around the world [1]. Furthermore, they believe this platform could be useful to other educators, at different levels of education.

As reported by Borrego [2], awareness of active learning strategies and its theoretical basis does not seem to be the issue but rather the adoption rate. Word to mouth and presentations on campus, are the most common tactics used to share knowledge even though conference papers, workshops and journal articles are also relevant. However, numerous barriers are often mentioned as to why active learning strategies are not more in application.

Looking to fill a practical gap, the Chair decided to build, as one of their first project, a community of practice supported by a digital collaborative platform, gathering dozens of active learning strategies listed and classified with the same criteria. This tool has the potential to help and guide educators in their objective to enrich their courses with more participative strategies.

The platform will provide a common space for engineer educators to share, exchange and collaborate on active learning pedagogical issues. This first attempt to build such a platform will allow the francophone engineering educators' community all around the world to create and share common knowledge and experiences.

1.1. Context

Engineers should have an adaptive expertise that allows them to be innovative and efficient in their work. As teachers, this means students need to be prepared to enter that kind of environment. Therefore it is important to reflect on the skill development needed to facilitate their integration in those particular conditions [3]. Are auditoriums filled with passive students listening to knowledge distributors the right path to fulfill that goal?

The concepts of "active pedagogy" or "active learning" are not new since the first writings date from the sixties. However, the emergence and rise in popularity of many active learning strategies is increasing the pressure on teachers to rethink how they work in the classroom. Even if the change process is requiring a significant

¹ Free translation

amount of resources, the integration of such practices is usually up to the teachers themselves [2, 4]. Also, at the graduate level, numerous students have already experienced active learning strategies in their academic background and expect their graduate courses to follow those footsteps.

2. LITERATURE REVIEW

2.1. Definitions

Communities of practice have been discussed in the literature for more than two decades. Wenger, a pioneer in the field, defines the concept as “groups of people informally bound together by shared expertise and passion for a joint enterprise” [5]. He states they add value in organizations in many different ways: help drive strategy, start new lines of business, solve problem quickly, transfer best practices, develop professional skills and help recruit and retain talents [5]. Even though, it is presented with a business perspective, parallels can easily be made with the education domain.

Multiple perspectives can be used to describe active learning. A pedagogical dictionary defines active learning as “an approach to teaching-learning where student's motor and intellectual activity is the main catalyst for developing the structuring of his knowledge, his skills and his attitudes” (free translation) [6].

As part of this research project, it was chosen to establish a definition of active pedagogy in collaboration with the university's Educational Support Office: “any strategy, approach or method used in the classroom to promote student engagement and participation. This can range from very simple strategies (questioning, using televoters, etc.) to more elaborate methods or approaches (flipped classroom, PBL, case studies, etc.)”.

Active learning strategies have different characteristics (duration, process, material, teacher involvement, etc.) but all of them contribute, to a certain extent and at different levels, to deep learning and students' engagement in their learning process [7, 8]. Many authors in multiple fields have suggested and described hundreds of methods, techniques or activities based on active learning principles, some of which are well known: problem-based learning (PBL)[9], case studies, peer learning, discussion, serious games [10], or role playing [11-13] just to name a few.

2.2. Active learning theoretical foundations

To enhance their own networks of concepts, learners must integrate the new acquired information. This ascertainment shows the importance of the student's active role in learning; supporting the case for active learning pedagogical strategies. Adhering to this perspective would mean that teachers do not deliver knowledge but transmit information that students

transform into knowledge, skills, and attitudes. For some, there is a significant paradigm shift from “teaching” to “learning” [14, 15]. The teacher should be a guide, a mentor responsible for directing students through their learning process to acquire knowledge and develop skills [15]. In this sense, teaching strategies based on active learning become essential tools for any teacher wishing to optimize students' learnings.

Cognitivism, refers to how individuals acquire and use knowledge. Cognitive psychologists suggest a three-phase learning process: 1) learners activate previous knowledge when they encounter new information; 2) learners get destabilized or confused; and 3) they develop or construct new knowledge [16-18]. Cognitivism also distinguishes three types of knowledge: declarative (what?); procedural (how?); and conditional (when? and why?). Learners choose various learning strategies depending on the phase of learning and type of knowledge implicated.

Furthermore, meta-cognition, a process where learners may become aware of their own learning processes is of great potential when teachers want to optimize learnings [19]. Active learning strategies are an ideal opportunity to raise awareness about these concepts and therefore optimize students' learnings about the subject itself but also how they learn it.

2.3. Rise in popularity

The literature about active learning is abundant and the theoretical principles underlying this teaching philosophy seem to convince many teachers and pedagogues of its relevance. [20-22]. As early as 1991, Bonwell & Eison summarized the literature on active learning to conclude that it enhances students' attitudes as well as thinking and writing skills [23]. More recently, McKeachie [24] has found evidence that discussion, a form of active learning, surpasses the traditional lesson for knowledge retention, motivating students to continue learning and develop reflexive skills.

In practice, many professors, departments, faculties (eg., nursing and medicine department at Université de Montréal) and institutions (eg., Université de Sherbrooke, McMaster University, University of Buffalo), have already made concrete actions to modify their programs to adhere to active learning's philosophy. The traditional classroom model where the teacher is responsible for sharing his knowledge with passive students has been questioned for many years. In 2014, Freeman [25], compared the results of 225 studies on students' performance in courses with at least some active learning activities versus traditional lecturing. He found that on average, students' performance in active learning environments increased by around half a standard deviation and that students in traditional lecture environment were 1.5 times more likely to fail the course.

According to Prince [8], active learning stimulates student's engagement and promotes cooperative and

collaborative learning. Although the results vary in intensity, his study demonstrated support for the active learning formats examined. A very compelling affirmation Prince makes is that active learning should be considered an approach or a philosophy rather than a method in itself [8]. To achieve this goal, it is important to consider validated success factors as well as manage integration challenges.

2.4. Active learning strategies census

Even with a rather limited literature review (around 20 documents) it was possible to find nearly 200 strategies [11, 12, 26-28]. There are so many possibilities, the team evaluated that it would be an unnecessary and even impossible task to make an exhaustive census of all existing strategies. Each strategy is presented, explained and described in very different ways making it difficult to compare them from the same perspective.

The team looked at strategies used in engineering education but not exclusively. Active learning strategies are eventually developed for specific purposes; however, it could be beneficial to learn and be inspired by other disciplines to improve our own.

2.5. Success factors

Many authors have studied success and resistance factors when engaging in a change process [29, 30]. Sunal studied these factors specifically for pedagogical innovations in science in higher education environments [4]. He formulated necessary conditions for successful implementations. First, interaction between faculties, not only different universities but also different domains, should be present and encouraged. Secondly, motivation to explore new territories and make changes part of the plan (own it), should be understood by the participants. Next, building a community with motivated and convinced stakeholders is crucial. The development of trustworthy and respectful professional relationship where there is a desire to learn and share with others, is sought-after. Then, planning for incremental changes should be privileged (rather than disruptive ones). Action research should be used to help teachers measure and understand the impact of the changes made. Also, it is suggested that building a reliable community with the same interest and motivation, who meets and discusses regularly, has an important influence on the outcomes. Finally, administrative support is, in any context, an essential factor to foster success.

2.6. Integration challenges

Despite all the advantages and theoretical reasons for integrating strategies based on active learning, it remains challenging and complex for teachers to change their

practices as well as for students to adapt to a new learning perspective [2, 13].

According to Furco, there are resistance factors from the faculty when trying to integrate pedagogical innovations [31]. First, innovations' goals are not always completely understood by the faculty members making hard for them to see the overall purpose. Secondly, changes will undermine the academic freedom and lead to a less comfortable environment which is important and desirable for teachers. Also, academic development will take time away from research projects. Because pedagogical efforts will not be valued and recognized at their true value by colleagues and administrators, it does not seem like a worth it compromise. Even though these elements are based on 20-year-old literature, they are unfortunately still relevant.

2.6.1. Teachers' perspective. What seems to be difficult is the transition from a perspective of "teaching" to a perspective of "learning" in a context where the content (number of concepts) is critical. Some teachers tend to be reluctant about removing content considered central to the discipline [32], while others think it's necessary to say or explain everything themselves instead of supporting student's in their own discoveries. Many professors tend to react quickly to new developments in their field by adding new content to their courses and changing their teaching methods to allow more time to cover that content. However, this philosophy although justifiable, does not allow students to make deep learning [33]. The combination of the pressure to incorporate new content and the necessity to make time and space for more active teaching strategies is a real challenge.

Also, active learning pedagogy is always "optional", *ie* up to the educators to modify their classes, usually on their own time and with very limited resources (time, support, collaboration) [2]. Teachers need peer support and department/institutional structure and policies, to engage in the transformation process required to integrate active learning strategies [2]. In many institutions, research (projects, funds, publications, etc.) seems to be more valued than pedagogy [2]. This situation does not motivate teachers to invest time and efforts in changing their practices.

From another angle, teachers have concerns towards their students' behaviors when implementing new learning strategies. They fear the loss of control in large groups, they anticipate students' resistance and they foresee that students will rely on others [2]. These apprehensions are certainly valid and demand attention to be resolved.

2.6.2. Students' perspective. Since the millennials came into the school system, teachers have been invited by the education science research community to change their teaching strategies. The goal was to adapt to the rise of technology and changing attitudes towards cooperation

and social connectivity [14]. Indeed, changes in this direction have been observed on the ground, but important challenges have also emerged. Given the slow pace of changes in the education system, students are still accustomed, to some extent, to traditional education, where they are more passive and expect to receive the information. A period of adaptation is inevitable for them when introducing new ways of doing things in class.

Active pedagogy strategies require students to be more active, more engaged, and therefore possibly demanding more efforts, which can confuse and destabilize them [13]. According to some anecdotal observations, one of the potential consequences is the decrease in the results of course evaluations. This is an aspect to be taken into consideration by professors but also by academic managers. However, given time, when courses are well structured, well presented and learning objectives are clear, students should become familiar and benefit from such methods.

3. PEDAGOGICAL PROJECT

Having displayed all these considerations, it will now be discussed how the pedagogical project, a community of practice supported by a repertoire of active learning strategies, addresses many of those concerns and corresponds to multiple success factors. The platform will most importantly allow collaboration and cooperation between all interested educators. Also, if the platform is treated and considered as an action research methodology, it has the potential to reconcile pedagogy with administrative priorities (such as research). Being built as a research project and a work-in-progress tool, it brings closer pedagogy and scientific research, giving credibility to the process.

The platform will support the community when sharing experiences and help them grow as much or as little as they choose. This community can act as a catalyst to attract other teachers and be an example of how change can be achieved. With the same idea, the pedagogical tool allows for incremental changes where teachers choose activities they are comfortable with.

The platform, being a practical tool, will accompany educators in their change process and help them transform their mindsets with real-world actions. It will give the implicated community, ways to share the word about active learning and educate other faculty members towards knowledge acquisition and competency development. It becomes a complementary resource to the Educational Support Office. The platform could also contribute to peer support, helping teachers feel less isolated with their challenges as well as with their victories.

Sustained attention from educators in such a community of practice, validates the great possibilities engendered by engineering education and active learning

such as international cooperation, interdisciplinary projects and why not engineering education as a promising research field.

From the get go, many francophone faculties showed enthusiasm for the platform. Conscious of the keen interest, it was decided that the tool would be available to all the concerned communities. The research team thought it would be a great opportunity to build an international community around the use of active learning strategies in an engineering education context: a space where educators from various countries and backgrounds could collaborate and share practical experiences in developing and conducting active learning strategies with their students.

3.1. The platform

The synthesis tool is a digital, collaborative, cooperative platform which will reunite an international francophone engineering education community. To achieve this goal, the new Chair worked in collaboration with the university's educational support office. The team defined each strategy with 14 common elements: a title, a "teaser", an overview, five generic indicators (length in class, structure, facility, participants and animation capacity), keywords, a detailed procedure, tips, variants, references and an example of application from the faculty. The platform initially comprised of 65 pedagogical strategies, described according to those elements. The platform is not only a translation exercise because it also includes the representation of each strategy from the same perspective *ie* with the same criteria. An important work of standardization was done to reconcile the existing disparate literature.

3.1.1. Search criteria. The five indicators are defined with fixed criteria so they can be used to search the platform. The length in class has three categories: short (less than 30 minutes), developed (between 30 and 60 minutes) and elaborated (more than one hour). The structure indicates if the activity is sporadic, extended over more than one class, in class or outside class time. The participants' category informs the educator if the technique is good for large groups (> 100 students) or small groups (< 100 students) and if it is for individuals or teams. These indicators are not mutually exclusive criteria. Facility refers to the classroom's layout needed (fixed or moving furniture) and finally the animation capacity states if the teacher needs to be comfortable with a low, medium or high level of animation during the activity.

3.1.2. Pedagogical material. A technical datasheet (on screen, printable version) will be produce for each strategy. It will have: a title, a "teaser", an overview, keywords, a detailed procedure, tips, variants, references and an example of application from a faculty member.

Jointly with the university's Educational Support Office, the research team built two surveys on active learning strategies, one for the faculty and one for the students. The research team will visit department meetings and numerous classes to manage and supervise the surveys and hence increase participation rates. The survey prepared for the faculty will ask if they use active learning activities in their practice, which ones, how often, but also what they thought of their effectiveness on students' learning. From the students' viewpoint, they will be asked if they feel they are experiencing active learning activities in their classes at Polytechnique Montreal, what types of strategies they have experienced, do they like it, do they feel it helps their learning process.

These results will be used to enrich the platform with usable, effective and appreciated active learning strategies in Polytechnique's engineering environment.

3.1.3. Future additions. The platform is a work-in-progress project. Many possibilities to improve the functionalities and their effectiveness can be considered. Interested teachers will be able to share their innovative pedagogical strategies by suggesting new strategies or by adding examples of their own personal experiences for strategies already on the platform. All the additions will be supervised and approved by the team at Polytechnique so that a certain standardization can be kept and monitored.

Also, it will be possible to add videos of educators' experiences, in class, using active learning strategies. Often, it is hard to imagine how some strategies are lived in a "real world" context. This resource will help teachers get inspired by others' specific actions.

The platform will be initially for the francophone community, where it is felt there is a lack of resources. However, if enthusiasm was being shown for an English version, it could be a possibility.

4. RESEARCH PROJECT

As discussed above, making a significant sustainable change in the pedagogical environment of a higher education establishment represents a massive challenge. In addition to the platform designed to address some of those challenges, it was found appropriate and relevant to study and analyze the community of practice through the platform's performance and effectiveness as part of an action research project [34]. Evidence suggests that action research is a valuable methodology for the academic field. It provides teachers with a methodical, collaborative, and participatory analysis process actively helping with areas of concern. Moreover, action research gives teachers specific technical skills and knowledge essential to implement positive change within classrooms, schools, and communities [34].

4.1. Qualitative data

The literature reporting studies about pedagogical changes has many examples where questionnaires and interviews are used to collect qualitative data [4, 35, 36]. Pursuing along those lines, the team will develop qualitative instruments to measure and evaluate the platform's use and desirability from the users' point of view.

First, a questionnaire will be offered to all subscribers (active or not) to gather as much information as possible on their habits towards the platform (why they consult it, when, how many times, etc.). However, the response rate being usually low with this strategy, the study will be extended with personal interviews to specific users. The results will be used for the platform's continuous improvement. It is planned to keep monitoring users' experiences throughout the first year of activity to maximize the enhancements and reinforce the involvements.

4.2. Quantitative data

Being a digital tool, numerous quantitative data can be gathered to study and understand how the platform is being used by the educators. Many indicators will be created and followed to measure traffic. For example, it will be possible to follow the new strategies added, the number of registrations, the number of printings, the number of comments made by users, the "liking" frequency (stars). All these statistics will allow the team to keep in touch with the activities on the platform and plan modifications if needed. Relevant and interesting analysis will be possible to investigate educators' behaviors when engaging in a pedagogical innovation process.

Combining both data strategies will provide the research team with various, valuable information on the platform's success. It will help the team adapt the tool to the users' needs and perhaps avoid creating a disposable, forgettable instrument.

5. CONCLUSION

The pedagogical project reported in this article consisted in the establishment of a community of practice supported by a digital collaborative platform regrouping active learning strategies. Literature reviews about community of practice, active learning and action research methodology made possible the construction of a digital platform allowing engineering educators to communicate and share information efficiently. The goal is to support faculty members in their desire to modify their practice.

The platform answers important concerns when trying to make pedagogical improvements, for example: display

practical strategies, provide guidelines for implementation, share useful experiences, stimulate collaboration, suggest stratagem to adapt and diminish resistance [2].

It is well understood that the project is in its early stage and that several variables are still in development. However, the team sees this platform as the start of an ongoing project that will grow and shape itself with its users, therefore the action research approach. To present the work in this initial state was rather bold but also an opportunity to collect comments and advices from a larger, concerned engineering community. The development could then be continued with a deeper understanding of the needs and challenges experienced on the field. This tool is meant to be implemented by its users not only serve as a theoretical database. Moreover, the measurement instruments developed to assess the platform's performance will ensure the tool corresponds to the community's needs and therefore does not fall short of the adoption threshold.

The research team is composed of dedicated educators that believe this tool is the beginning of a big, relevant and effective collaboration between motivated educators who want to make engineering education more participative with active learning strategies.

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