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The Experience of Community of Practice in Polytechnic School and its Impact on the Chemical Engineering Courses at the University of Genova

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Communities of Practice (CoP), defined as learning groups that have the goal of producing organized and quality knowledge, are recognized nowadays as an effective approach to Faculty Development. At the Polytechnic School of the University of Genova, meetings of the CoP are active since 2017, to favor sharing teaching practices and tools, positive results as well as difficulties and expectations in the experience of teaching. One of the advantages of the CoP model is the cross-communication among the participants from different Courses and Departments. In this framework, the involvement of professors in the CoP led to the share of two experiences, Quiz and Podcast tools and methodology, which were presented during CoP meetings and were then successfully applied in Chemical and Process Engineering Courses. Participants reported that these experiences allowed direct feedback and better involvement of students in class activities and interaction with classmates and with professors. Therefore, in our experience, the CoP model has proven to contribute to the sharing of good practices in teaching Engineering Courses.

1. Introduction

A Community of Practice (CoP) is a group of people who share a specific craft or profession. The group can evolve naturally due to the common interest in a particular field of interest. It can also be created specificall to gain knowledge related to their area. Indeed, the members learn from each other and have an opportunity to develop themselves personally and professionally through the process of sharing information and experiences within the group. Members have an identity defined by a shared domain of interest and they value collective competence and learning from each other. Members of a community of practice are practitioners. They develop a shared repertoire of resources, experiences, stories, tools, and ways of addressing recurring problems. Members engage in joint activities and discussions and share information. They build a relationship that enables them to learn from each other (Wenger, 1998).
Communities of Practice are one of the main approaches to Faculty Development, as stated by Steinert (2010), and it is a kind of informal group of professors who meet to develop their teaching skills.
In these communities, people aim for continuous learning through awareness of their knowledge and that of others. Members of the Communities of practice collaborate, promote, discuss, and confront issues related to their different interests. These are groups of people who interact based on shared expectations starting from the individual knowledge of the individuals who compose them. Each person contributes with his or her skills. Every member has free access and, usually, there is no hierarchy within the community.
The goal of the community is a collective improvement. People aim at a model of shared intelligence, there are no private or individual spaces, as everyone shares everything.
This method aims to build shared collective knowledge, a different way of working.

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Communities of practice are "places" where learning takes place. The way and means to develop it are different from past years also thanks to the development of new technologies. Knowledge becomes a tool to build collectively, following the method of social constructivism. From this point of view, learning emerges as:
• Creating meaning: in a lifelong learning perspective, our experience is meaningful.
• Identity development: learning is a process that allows us to interact, participate, and help define our space/role in a community.
• Belonging to a community: to change, recognize or move away, individuals must know their community, identify themselves or not with it, making their contribution.
• Result of practice in a community: the union between know-how and competence.
This paper will present the CoP model at the Polytechnic School, focusing on two significant results of the cross-communication among the participants from different Courses and Departments brought together in a common discussion path: quizzes using student response systems and the creation of a Podcast. Such activities and tools have fully experimented with in the Courses of Chemical and Process Engineering.

2. Methods: The Community of Practice of Polytechnic School

The project of creating a Community of Practice (CoP) at the University of Genova started a few years ago, in 2017, within the activities of the G.L.I.A., working group on Faculty Development (Gruppo di Lavoro sulle tecniche di Insegnamento e Apprendimento). The project was founded based on the Communities described by E. Wenger (1998), which is a group of persons whose sharing of knowledge will enhance cooperative learning and a sense of community.
In 2017, six communities of practice started: one for each School of the University of Genova (Scuola di Scienze Umanistiche, Scuola di Scienze Matematiche, Fisiche e Naturali, Scuola di Scienze Sociali, Scuola Politecnica) and two for the Scuola di Medicina (Area Clinica, Area Preclinica e Farmacia). Each community was led by two facilitators, professors at the School deeply involved in the activity of faculty development, usually belonging to GLIA and following the first practical guidelines proposed by the G.L.I.A. group (Lotti et al. 2020). The aim was indeed to share positive results with all the participants as well as difficulties in the experience of teaching (Lotti 2021, de Carvalho-Filho et al. 2020). This experience is still ongoing at the Polytechnic School and overcame the COVID quarantine period by shifting to online activities on a dedicated TEAMS platform. Between December 2017 and November 2022, the CoP met 32 times in different locations. The scheduled meetings, usually one every one/two months, are now a moment for professors to discuss together and to present innovative activities or technologies in higher education.
Facilitators are in charge of the practical organization of the meetings: they decide and fix the scheduling in a time range of three-four months and propose the location of meetings within the several buildings of the School (Opera Pia, Villa Cambiaso, Stradone S.Agostino, in Genova), informing the participants by email through the Aulaweb of the Community. Facilitators also organize an informal buffet lunch, considering that meetings are usually fixed at lunchtime.
They are informal moments, in which everyone can feel part of a community and, by having lunch together, a more welcoming atmosphere is created to listen and report one's experiences. It is not easy to have moments of confrontation and growth in the busy schedule of activities of every professor.
The strategy of the organization of meetings can be diversified: several events were dedicated to specific topics, inviting speakers and experts either from other Schools or from other University structures, such as E-learning services. Moreover, professors who participated in the workshop organized by the University were invited to share their experiences and their impressions, as well as professors applying specific methodologies were invited to present results and problems arising from their practical applications, thus giving rise to a fruitful network of interactions (Figure 1). The “title” of the meeting was specified on the Aulaweb program.
Other meetings did not propose specific topics but were available for an open discussion on topics suggested spontaneously by the participants, to share resources, tools, and recurring problems and mistakes. This approach was chosen from the experience of several meetings. Moreover, a very recent report on the Community of Practice model exactly pointed out the importance of changing methods and topics in the organization of community events. Also, the meeting calendarization, to be proposed in advance over a few months appeared to be useful to improve participation (Serbati et al. 2023).
In the last years, a significant number of participants in the CoP belong to the Department of Civil, Chemical and Environmental Engineering, namely to the Chemistry and Chemical Engineering area, with an evident impact on Courses of Chemical Engineering degrees.
In this frame, one of the main advantages of CoP has proven to be the sharing of good practices, as exemplified in the following paragraphs for two specific methodologies.

3. Results

More than 50 persons are nowadays enrolled on the Aulaweb platform of the Community of Practice, however, the active participation in the meetings is usually limited to a few teachers. The reasons for such small numbers, sometimes common also to other CoPs, have been recently analyzed in a survey on CoPs at Genoa University and appear to be ascribed mainly to the lack of time of participants (88% of collected responses), being professors and researchers deeply involved in teaching, research, and institutional roles.

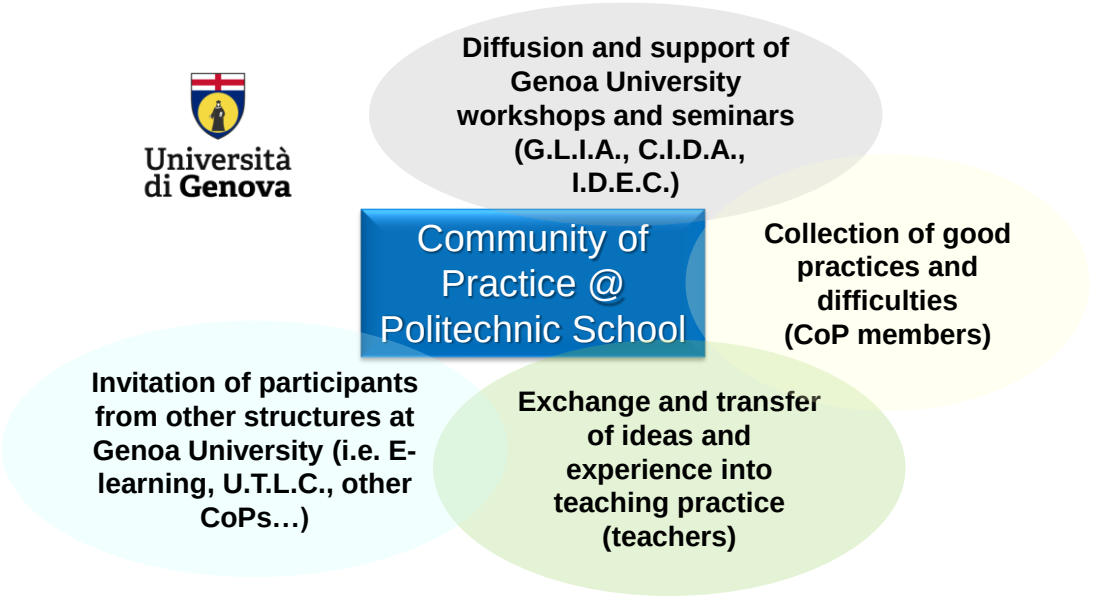


Figure 1: Network of interactions involving the CoP at the Polytechnic School. (C.I.D.A.: Comitato per l'innovazione didattica di Ateneo, I.D.E.C.: Settore innovazione didattica, sviluppo e certificazione delle competenze, U.T.L.C. Unige Teaching and Learning Centre).

By far, lower percentages are associated with other reasons, such as the lack of incentives and the limited knowledge of the CoP activities. On the other side, in the same survey, among the main reasons proposed to participate in the Community of Practice are the interest in the topics covered, the desire to share and grow, and the welcoming atmosphere that favors the interactions among professors (Bracco et al. 2020). Examples of the involvement of teachers in two innovative learning practices which have been presented in the Community of Practice are discussed in the following.

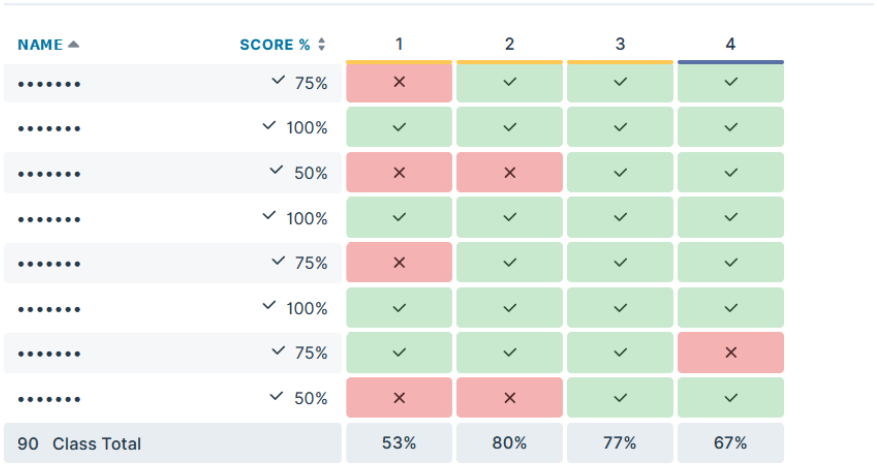
3.1. Experiences of Quiz in Biomedical Engineering and Chemical and Process Engineering Courses

In one of the first community events, the authors discussed the application of student response systems (Clickers, Socrative) as examples of active learning (Shea, 2016). The use of the Socrative system, available free of charge, and the use of Wooclap within the Teams platform, have been since then proposed in several Engineering courses, both in large classes and in small classes.

Socrative system was used by some of the authors in Chemistry lectures delivered to the 1st year Biomedical Engineering bachelor students. In large classes it can be used as an icebreaking system, to introduce students to the class and the professors by choosing questions inquiring the student high school type, any background knowledge of chemistry fundamentals, and so on. This step is also important to get the students familiar with the use of the system, whose questions can be delivered to a PC or smartphone. Moreover, a few simple questions on specific chemistry topics, submitted at the beginning of the course and repeated at the end of the course will highlight the work done during the semester.

After this first approach to the system, a test of 3-4 questions selected by the instructor can be given sequentially or all at once at the end of a single lesson or as a closing of a specific topic, in form of multiple-choice problems or true/false questions. In this experience, answers are to be completed and presented during classes, thus the instant student feedback would be used to assess the degree of understanding. Students can answer individually or can work in groups. In the authors' experience, the analysis of such responses must indeed be presented together and immediately after the closing of the test, to provoke discussion and to clarify some foggy points. For instance, as exemplified in the results reported in Figure 2, a question where the percentage of

wrong answers approaches 50% indicates indeed that some further deepening of the topic is needed (in this case the topic was the correct naming of an inorganic salt).
Pre-prepared quizzes have been directly delivered by the system, answers are anonymous and are not considered part of the final overall grade. No difficulty accessing the system has been reported.
Another option that can be proposed to introduce a new topic and to create curiosity is a word cloud, for instance using the Wooclap platform. A one-word answer is required, and the most frequent answers appear in the biggest letters, allowing an immediate focus on the keywords that students relate to the topic or, possibly, on some student misconceptions (Shea 2016).



NAME	SCORE %	1	2	3	4
•••••••	75%	×	✓	✓	✓
•••••••	100%	✓	✓	✓	✓
•••••••	50%	×	×	✓	✓
•••••••	100%	✓	✓	✓	✓
•••••••	75%	×	✓	✓	✓
•••••••	100%	✓	✓	✓	✓
•••••••	75%	✓	✓	✓	×
•••••••	50%	×	×	✓	✓
90 Class Total		53%	80%	77%	67%

Figure 2: Chemistry questions and student answers: percentages of correct responses as appearing from Socrative Report pages. (About 120 students' class, 90 students participating, 1st-year Biomedical Engineering, multiple choice and true/false quizzes).

In small classes such as the module of Chemical Thermodynamics in Ideal Systems for the second year of the Bachelor's degree in Chemical and Process Engineering and the module of Chemical Thermodynamics in Non-Ideal Systems for the first year of the Master degree in Chemical and Process Engineering, the use of Wooclap has been successfully tested starting from the academic year 19/20 and this experience has been monitored by the analysis of the "Teaching evaluation questionnaires" (Questionario di Valutazione della didattica).
Wooclaps, originally proposed in online lessons during the Covid quarantine to liven up distance lessons, have been very popular with students. In fact, through the comments section of the questionnaire they fill out for each teaching module, they suggested keeping them once they returned to face-to-face lessons. And also, in the following years, the written comments of the students express wide appreciation and the usefulness of the Wooclap tool.
This form of the periodic survey has been recognized as very functional for reviewing the block of topics developed in the previous lessons and therefore for verifying one's learning. The professor also draws useful information from the class regarding the appreciation of the lessons being carried out in real-time and the need to clarify doubts on topics that were unclear to the students.
In fact, in addition to more technical questions or didactic content (in the form of multiple-choice questions, open questions, surveys, or combinations), Wooclap always includes questions that allow an open dialogue with the student on the progress of the module or future prospects. Some examples of the latter are shown here:

- What do you think is the use of studying ideal/non-ideal chemical thermodynamics?
- Which topic would you like to be taken up among those presented in the previous lessons of the module?
- What did you like or was most useful about the module?
- What would you change about teaching?
- What are your biggest difficulties in studying the subject?

Thus, an advantage of this experience is to provide direct feedback to the professor and better involvement of students in class activities and interaction with classmates, a critical point in the "distance learning" of the last three years.

3.2. Experience of PODCAST in a Chemical and Process Engineering Course

The activity 'Podcast in Chemical and Process Engineering' was created after an exchange of teaching ideas between participants of the Community of Practice (CoP) of the Polytechnic School at UNIGE (Delponte 2021, Moliner et al. 2021). The activity was originally applied in an Architecture Sciences course (3rd year, UNIGE) to bring students closer to the covered topics in a more applied way. The new podcasting activity was introduced in the academic year 2020/2021 in the teaching Multiscale Analysis and Computer Simulation of Chemical Processes in the master's degree in Chemical and Process Engineering (2nd year) to encourage the engagement and creativity of the students while discussing topics related to chemical and process engineering. The activity was carried out in collaboration with industry representatives in the field of chemical engineering (i.e., ABB and STAM s.r.l.) to put the students closer to discussions with professionals in the chemical engineering sector and to promote their participation in providing an applied and closer vision of their future careers.The activity was optional and was presented on the first day of class to allow students to organize well their time. The presentation described podcasts and their role in education (Maag 2006, Ormond 2008) and defined the main objectives of the activity and the proposed schedule, defining the days dedicated to the activity during the teaching.
The proposed topics included (i) the discussion of the teaching contents and their application in the professional context through an efficient and adequate communication strategy and (ii) the student's views on their contribution as chemical engineers to social and professional development. On the second day, the reference teacher (from Architecture Science) held a one-hour lesson on the essential elements of podcasting to provide the technical skills necessary for the creation of high-quality final products. All teams used Audacity software to edit their podcast, which had a maximum duration of 10 minutes (Figure 3).

Figure 3. Topics and tools for the podcast activity.

The final discussion on the created podcast was held online (due to the COVID restrictions) and involved 15 students (out of a total of 20), 3 professors and 2 company representatives (ABB and STAM srl). The podcasts covered the technical contents of the teaching (computer simulations of chemical engineering processes) in an informative approach, and the students' views on the role of a chemical engineer, the traditional and new skills required by companies and the current job market. The participation of the industrial representatives led to a fruitful and multiview debate and a unique training opportunity. In total, five podcasts were created, differing in the organization, introduction or ending, with a high-quality content and presentation format. The activity provided an innovative communication format for engaging students in educational topics and debates while increasing their skills in podcasting technology and science communication.
A survey on the degree of satisfaction with the activity was done after the podcast discussion. The students indicated that they found the task interesting, using a technology they considered useful but unknown up to that moment. They particularly appreciated the possibility of meeting representatives of companies who provided a more applied view to their studied subjects and also closer to their professional perspective career.

4. Conclusions

From the discussion reported in this work, it is evident that the participation of teachers in the CoP of the School can impact the teaching practices of several courses by sharing examples of best practices. In our experience, significant applications of response systems for quizzes and innovative learning through Podcasts have been first discussed in the community meeting and then proposed to students, mainly in Chemical and Process Engineering classes. In this framework, a periodic survey by quizzes has been recognized as a valuable activity for reviewing topics developed in previous lessons and self-evaluating students learning. Moreover, the instructors obtain useful information regarding the appreciation of the lessons and the need to clarify doubts.
Students provided positive feedback also for the podcast learning tool, whose application was perceived as a new skill learned during classes and applied to Chemical Engineering subjects.

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