

Early Awareness of Global Issues and Development of Soft Skills in Engineering Education: An Interdisciplinary Approach to Communication

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Abstract—To tackle the challenges of the 21st century, the future scientists and engineers have to understand the interplay between societal challenges and technical solutions as early as possible in their education. They also have to develop the communication and the teamwork skills required to be effective professionals. This paper presents the Communication module of a new course in Social and Human Sciences (SHS) introduced for all first year students at the Swiss Federal Institute of Technology in Lausanne (EPFL). This course aims at tackling Global Issues with an interdisciplinary perspective and at developing soft skills. The Communication module puts emphasis on the challenges associated with the instantaneous and ubiquitous access to information and knowledge. The introduction of a mobile app supporting anonymous interaction during the lectures is also discussed.

I. INTRODUCTION

Over the last two decades, communication technologies have become pervasive and ubiquitous. Far from solely being technical props, the advances in communication have had major implications on the way we go about our daily lives. They are affecting everything from education and health-care to transportation and safety. They have affected businesses as well as politics creating a vast amount of new opportunities, accompanied with equally impressive challenges. As these opportunities and challenges transcend the disciplinary boundaries and have potentially important societal implications, it is crucial that the next generation of scientists and engineers becomes aware of them in order to build tomorrow's technology [1]. For this reason so-called *soft* skill courses are gaining traction in engineering curricula [2]. The Swiss Federal Institute of Technology in Lausanne (EPFL) has integrated such courses in its curricula for several years and has recently introduced an innovative course, co-designed by one of the authors (Isabelle Vonèche Cardia¹), centered on Global Issues to motivate further engineering study and develop interdisciplinarity.

A. Global issues at EPFL

The Global Issues course for first year science and engineering students covers topics derived from reports produced by the United Nations and the Word Bank [3]. These topics are health, food, mobility, energy, climate, and communication.

¹Isabelle Vonèche Cardia has also co-created and taught the *Food A* module of the Global Issues course.

Students can select any of the topics indifferently from their study programme on a first registered first served basis. For each of these six topics two modules were created to accommodate 1800 students in twelve classes of 150. As the emphasis is put on presenting each of these topics from both a technical and a societal perspective, each module is taught by a team of at least one lecturer with a background in engineering and at least one lecturer with a background in social sciences or humanities. Each one of these courses includes class activities, online activities and group activities. During the class activities, the interdisciplinary content is presented by the lecturers. During the online activities, students receive guidelines on bibliographical research, reference management, teamwork and conflict resolution through short video sequences. Then, during their group activities students have to work on a poster for the rest of the semester. In this poster they have to present both the technical and the societal challenges and opportunities of one particular instance of the issues that were studied in class. Finally, they have to defend their work in an oral presentation.

B. Global issues in communication

In this paper, we focus on one of the twelve modules of the Global Issues course, namely *Communication A* created and taught by three of the authors (Adrian Holzer, Samuel Bendahan and Denis Gillet). We present the syllabus and the methodologies of the module. Issues covered ranged from critical information assessment to social media, and from leadership to personal learning environments. An unorthodox teaching approaches has been introduced to highlight communication challenges. To start the course with a memorable experience for students and to introduce our lecture on critical information assessment, we started by presenting pseudoscience and urban legends as fact during a full hour. In order to change the rhythm and keep students interested, we used the opportunity of being three lecturers to frequently alternate between speakers and perspectives.

C. Using Temporary Social Media as Support

In order to increase the interactivity during the lectures in a auditorium with 150 students, we used SpeakUp, a temporary social media application available for smartphones. With SpeakUp [4], [5], a chat room was created at the beginning of each lecture where students could anonymously

post questions and comments. The chat room then disappeared the next day. The students appreciated the usage of SpeakUp and used it extensively to ask questions and as backchannel for social interaction. While one lecturer was teaching, the others interacted with students on SpeakUp and addressed the most relevant questions orally.

D. Roadmap

This paper is structured as follows: Section II details the class activities of the *Communication A* module while Section III presents the group activities. Then, Section IV discusses the usage of the SpeakUp app during the class and Section V presents evaluation results of the class and group activities before Section VI wraps up with a conclusion.

II. CLASS ACTIVITIES

As mentioned above, *Communication A* was one of the twelve Global Issues modules taught in the Spring semester of 2014 at EPFL to all first year students. The idea of the course was not only to show interdisciplinary content but also to have it presented by an interdisciplinary teaching staff. In our case, we were three lecturers covering expertise in behavioral economics, leadership, electrical engineering, knowledge management, human computer interaction, social media, information systems, mobile and ad hoc computing.

A. Week 1 – Introduction

In the introductory week, the structure and the objectives of the course were presented. As shown in Figure 1, the entire course lasted 14 weeks and was divided in two parts and three activities. The first part covered class and online activities, whereas the second part covered group activities. The objectives of the class activities were to explain the Global Issues linked to communication technologies in general, show the links between technological issues and societal issues, guide future scientists and engineers to become responsible citizens, and develop their critical thinking around global issues. The online activities were aimed at filling cross cutting objectives, such as enabling students to perform a literature review and cite sources, work in a group, manage a project, prepare a poster and present and defend solutions. The group activities in the second part of the course were aimed at providing students with a space for actively putting in practice the knowledge that they acquired in the first part and developing their soft skills. During this part students working in groups of five prepared and presented a poster.

B. Week 2 – Information issues

Before talking about how technology can influence communication, we spent some time on the qualitative aspect of information and questions about truth, trustworthiness and reliability. To start the course with a memorable experience for students and to introduce our lecture, we started by presenting pseudoscience and urban legends as fact during a full hour. Then for two hours we presented ways to evaluate information critically, using among others, tools from Carl Sagan’s baloney detection kit [6]. We also illustrated how some cognitive biases lead to false conclusions and sloppy thinking based on seminal work in behavioral economics (e.g. Daniel Kahneman [7]).

	Part 1	
Week	Class activities	Online activities
1	Introduction	How to form a group
2	Information issues	How to find information
3	Social media issues	How to plan a project
4	Privacy issues	How to manage references
5	Leadership issues	How to cite
6	Knowledge management issues	How to solve conflicts
7	Future issues	How to style a poster
8	Conference	
Part 2 - Group activities		
9	Poster preparation	
10		
11		
12		
13	Poster presentations	
14		

Fig. 1. The *Communication A* module outline.

Finally, we discussed how technology could enable reviews and vetting of Internet content by showing the use case of *rbutr*² a browser plug in that allows to view, rate and post rebuttals for web sites.

C. Week 3 – Social media issues

To put social media in a historical perspective, we presented a history of Social Media based on Tom Standage’s recent book *Writing on the Wall* [8]. This historical approach allowed to tackle issues such as freedom of speech, censorship, information dissemination and information technology architecture (centralized vs decentralized control). We also discussed the role of social media in spreading information, disinformation or dangerous ideas. Finally, we also conducted a class discussion around existing social media used by the students, and how they see them evolve over time.

D. Week 4 – Privacy issues

We presented challenges and opportunities with today’s data collection capabilities. From improving epidemics detection with tools such as Google’s Flu Trends³ to privacy intrusion by advertisers, employers or governments [9]. We introduced the difference between data and metadata and highlighted how little information is needed to identify someone [10]. Then, we discussed different privacy policies and user interfaces by companies such as SnapChat or Facebook, which are currently heavily used by students.

E. Week 5 – Leadership issues

We presented how communication has a strong impact on the way organizations, corporations and countries are led. We explained how leader distance can influence the nature of motivation and collective action [11], and how technology can mediate the relationship between leaders and followers. Leadership is strongly based on charisma, values, and vision [12]. We also presented the way motivation works, by

²www.rbutr.com

³www.google.org/flu trends/

making the difference between intrinsic and extrinsic motivation, and showing how intrinsic motivation can take an even stronger influence when discussing online activities. We also presented some issues related to collective communication and decision making, showing how formal voting processes can be facilitated by technology, although there is also a fair share of risks and challenges, like security and privacy.

F. Week 6 – knowledge management issues

We showed how education around the world is affected by communication technologies. Especially, we discussed the process of creating, adopting, exploiting and sharing knowledge with communication technologies. We also discussed and illustrated the concept of wisdom of the crowd. Then, the possible benefits of the rich digital ecosystem exploited daily by the students for their own study were highlighted through the concept of personal learning environments (PLE) [13]. Finally, the challenges and opportunities associated with a global access to knowledge through Massive Open Online Courses (MOOCs) were tackled.

G. Week 7 – Future issues

We presented potential future paths in communication technology. From haptic devices to the Internet of Things through virtual realities. Then we presented several technical communication challenges linked to ad hoc networking [14] and social challenges of advances in technology. In particular the advances of skill biased technology that can lead to greater inequality (Stiglitz - Price of inequality [15]). We presented alternative innovations in GreenIS or JustIS [16], information system innovations that aim at reducing ecological and social footprints. Finally we showed that as communication technology designers we are potential architects of choices that we can nudge (Nudge - Sunstein and Thaler [17]).

H. Week 8 – Grand witness conference

In the last lecture, a *grand witness*, Pascal Lamy, the former head of the World Trade Organisation, gave a talk on his experience with global issues in general to all 1800 students. He emphasized that for many issues it is hard for big international organizations to act and it is more effective to create ad hoc initiative combining civil society, policy makers and companies.

III. GROUP ACTIVITIES

At the end of Part 1 students had to form groups of five students for Part 2 in which they had to prepare a poster, as illustrated in Figure 2, and a presentation.

A. Posters

First, each group had to choose an issue to analyze in their poster, which was validated by the lecturers. To qualify, an issue had to (1) affect a large amount of people internationally, (2) require a coordinated action from several stakeholders, (3) be related to the global issues studied in the class activities, and (4) include a technological and a societal dimension. Then, they worked together during four weeks to create a poster and prepare a presentation. Each week they had to hand in

a brief group report as a self-reflexion exercise (soft skill) and to inform the lecturers and the teaching assistants about their progresses. In the example in Figure 2, students chose to discuss how a greater access to network infrastructures could improve education and potentially lead to more inclusive political and economical structures in places that are currently not covered. Finally, the posters were evaluated based on (1) their interdisciplinary, showing at least one social aspect and one technical aspect of the chosen topic, (2) the relevance and coherence of their content, (3) the quality of their references, and (4) their visual aspect. An online form was used by the lecturers to ease the evaluation.

B. Presentations

To end the group activities, students had to give a five-minute presentation of their posters followed by five minutes of questions by the lecturers. During the presentation, the groups were requested to sketch potential solutions to the issue that they chose and identify some consequences. In order for every group member to be involved, two group members were in charge of the presentation, while the remaining three members were in charge of answering the questions. The presentations were evaluated on (1) the clarity with which the issues were presented, (2) the originality of the solutions and on how well their consequences were identified, (3) the relevance of the answers and (4) the timing and involvement of all group members.

IV. SPEAKUP

To make the class activities more interactive, we used SpeakUp. SpeakUp is a mobile app that allows to create temporary chat rooms that students can join anonymously and where they can post messages and vote on them. Figure 3 shows screenshots of SpeakUp. When the students open the app, they see the nearby chat rooms (screen 1 in Figure 3). Students can enter the room, post and vote on messages without the need to login or identify themselves. Inside the room (screen 2), the message list is displayed, sorted either by time or by score. Each message can be rated up or down, which adds or removes a point to the score. If a student does not see the room in the nearby list, or if she chooses to disable her GPS, she can press the + button from the home screen to join the room with the room number (screen 3). The room number is randomly assigned to each room and can be found below the room name inside the room (screen 2), in this case the number is 44382. Screen 4 shows how the teacher created the room in the first place. Note that SpeakUp does not restrict room creation, so anyone can create a new room as long as the location service is enabled.

A. Using SpeakUp

Figure 4 presents the usage data of SpeakUp for each week. We did not use SpeakUp during the first hour of Week 2 when we present pseudoscience as fact. We wanted to see whether some students would dare to call out our false claims orally in front of the other 150 students. In fact no one interrupted the lesson. Shortly before the end of this hour, we finally introduced SpeakUp right before showing ten minutes of a pseudo-scientific documentary on the construction of the

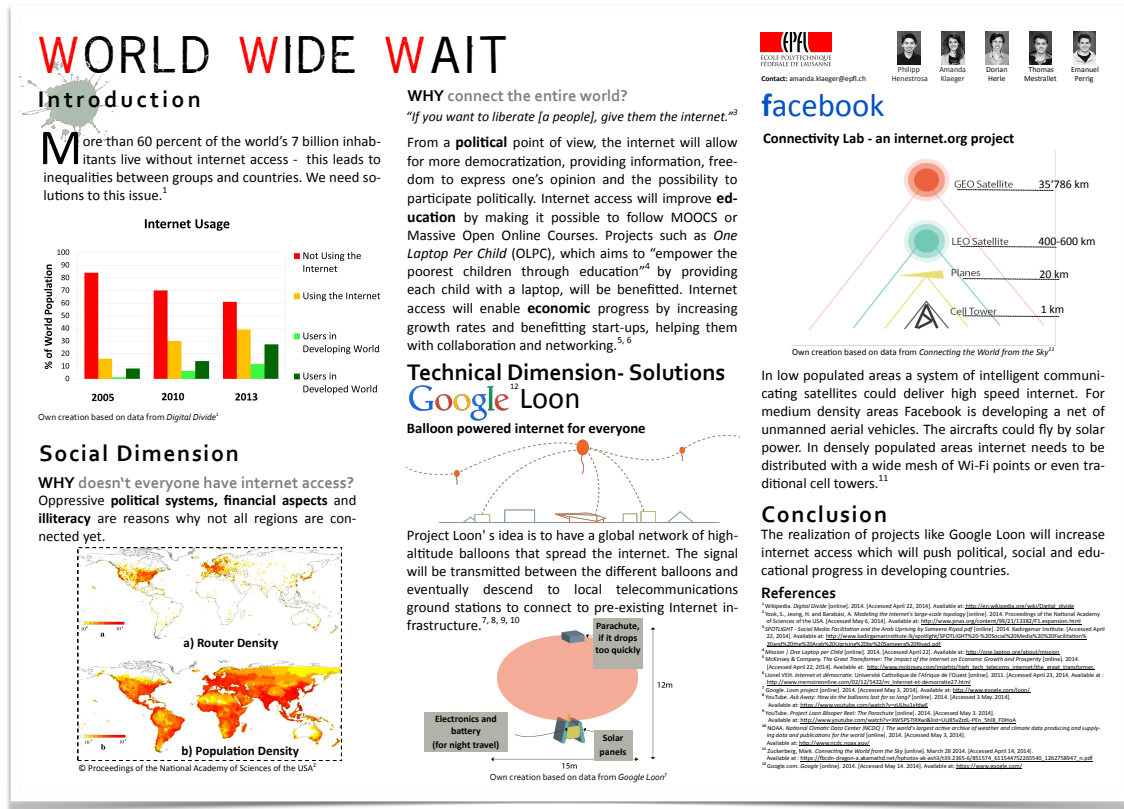


Fig. 2. An example of a poster created by students during the group activities.

Great Pyramid⁴. Within seconds, students started to voice their doubts on the accuracy of the content of the lecture. During this video not less than 25 messages (128 votes) posted by 17 different students raised doubts on the documentary. Examples of messages include: *CONSPIRACY !, FAKE !!!, One finds correlations when one looks for them !!!, Personally I don't believe this video, etc.*

Then starting from the second hour of Week 2 until the end of Week 7, we used SpeakUp in the following way: while one lecturer was presenting course material, the other two would look at the activity on SpeakUp and possibly answer relevant questions directly by posting a new message, or they would address questions orally after the lecturer finished. Since there was a high number of messages, we asked students to tag messages using the @prof keyword to make it easier to find questions among the general comments. Figure 3, screen 2 shows actual messages from students using this tag.

Over the course of the six weeks we used SpeakUp there were a total of 1159 messages and 9436 votes. In Weeks 2 and 3 there were over 250 messages per hour and around 2500 votes per hour. During these weeks almost all students were connected. Among these messages, many were playful messages unrelated to the course that showed that students adopted SpeakUp as a communication tool. At the beginning

of Week 4, we presented the *SpeakUp etiquette* to students. We reminded the students that we wanted to keep messages anonymous, but we wanted them to make sure that their messages were useful to the class before they posted them. This resulted in a drop in the number of playful messages that would then be more or less similar in the remaining weeks around 100 messages and 600 votes, with the exception of Week 5, where a server crash occurred, explaining the low numbers.

B. SpeakUp survey

We conducted a survey with the students on the usage of SpeakUp. We received 93 responses (63%). Figure 5 presents the results of the evaluation. An overwhelming majority of respondents posted (76%) or rated a message (95%). Among the four who did not rate a message, three reported that they were not able to install the app on their phones in the comment section of the survey and one failed to come to any lecture. Almost two thirds of the students were positive about the usage of SpeakUp in class and would like to see SpeakUp used in another class, compared to only around 15% who were negative or somewhat negative about that prospect. Students found messages addressed to the lecturers generally useful (76% agreed or strongly agreed), unlike messages addressed to the audience (28% agreed or strongly agreed). However, over 60% of students were against or strongly against limiting messages only to the ones addressing teachers. It seems that

⁴<http://revelationdespyramides.com>

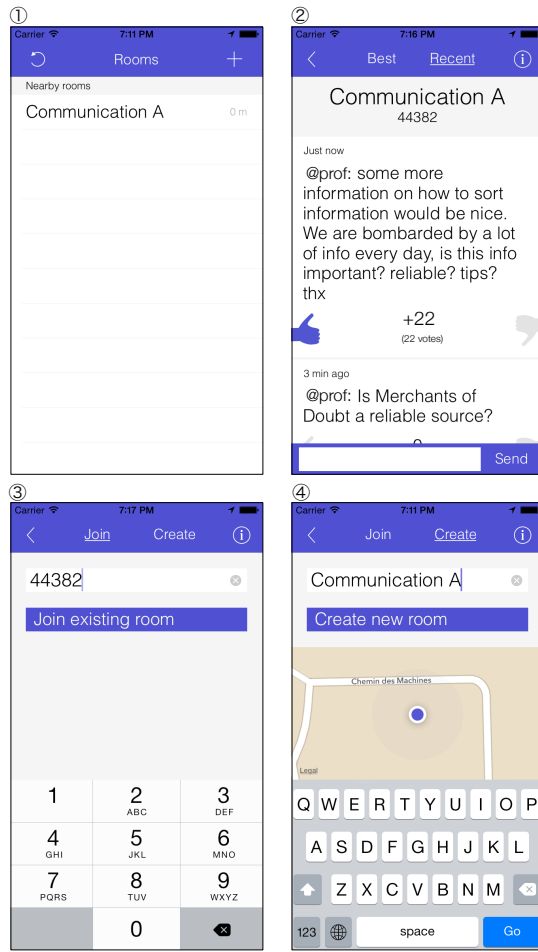


Fig. 3. Screenshots of the SpeakUp mobile app.

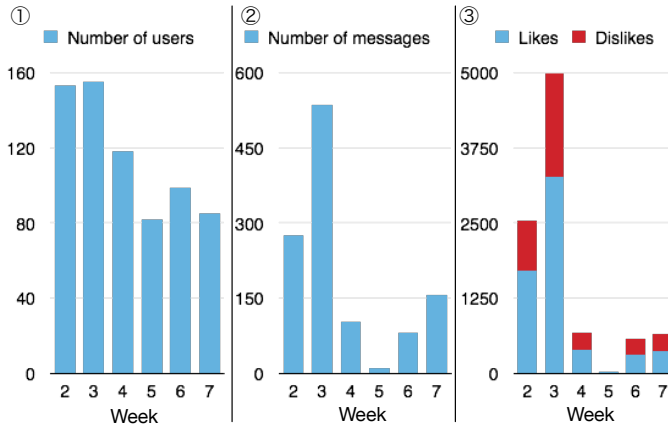


Fig. 4. SpeakUp usage data for each week.

most students (78%) have at least enjoyed one funny message posted on SpeakUp.

V. COURSE EVALUATION

A survey was performed to get feedback from the students on the course. There were 141 respondents out of 150 (93%). The survey evaluated class activities and group activities. Figures 6 and 7 present the results.

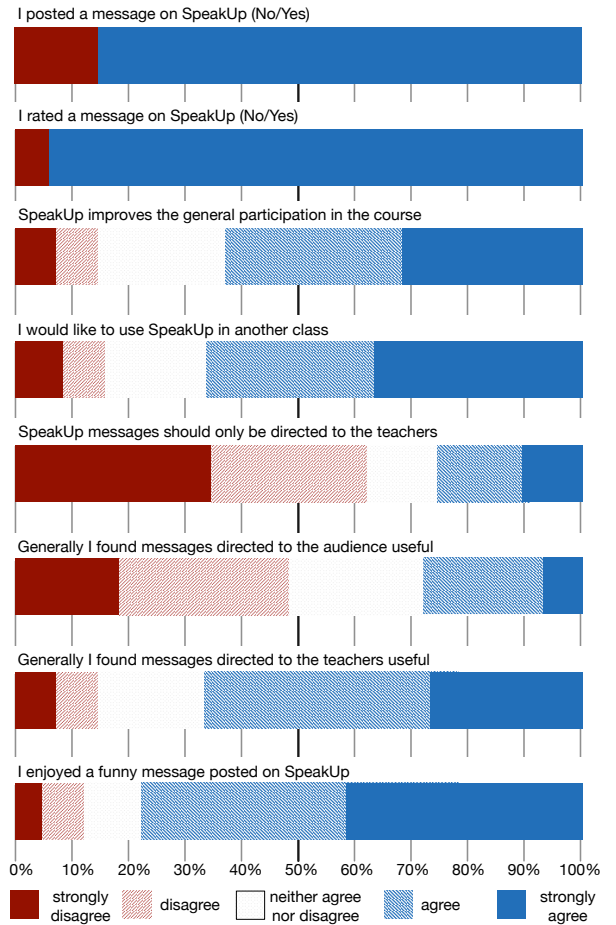


Fig. 5. SpeakUp survey results.

A. Class activity evaluation

Figure 6 shows the results of the class activity evaluations. The results show that the class activities were positively evaluated. The structure of the course was evaluated positively by over 85% of the students and 90% found that the class material contained enough illustrations during the course (examples, use cases, etc) and over 85% found that the explanations of the lecturers were clear. The fact that over 90% of the students attended the class regularly confirms that the class activities were able to spark interest.

B. Group activity evaluation

Figure 7 shows the results of the group activity evaluations. In general the group activities can be considered successful with around 80% of the students finding the activity enriching and reporting that they were able to work on a topic for which they had a lot of interest. However more than half of the students found the directives of the project insufficient.

VI. DISCUSSION & CONCLUSIONS

One particular aspect that was very well received by the students and teachers alike was this ability to switch between different bodies of knowledge in a very short amount of time during class, thus showing how disciplines related to engineering, economics and management are in fact intertwined.

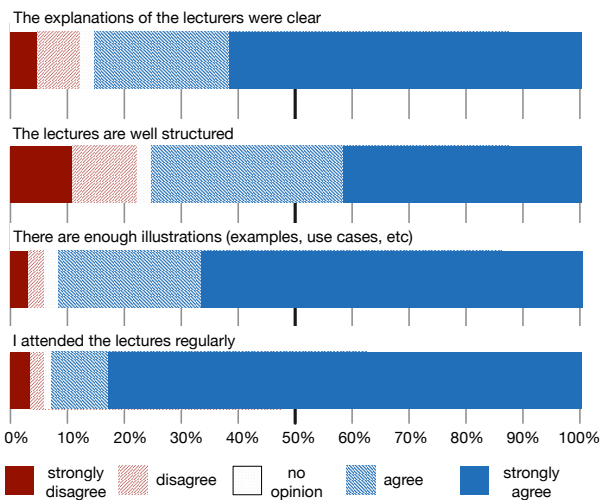


Fig. 6. Evaluation results of the class activities.

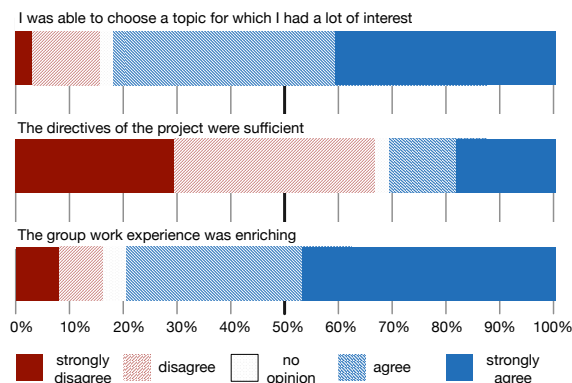


Fig. 7. Evaluation results of the group activities.

This allowed the participants to get perspective not only on the technical aspects of their future studies but also their societal impact. Furthermore, it had the virtue to show how technology is transforming the way economics and management work, and how it can also facilitate communication and decision-making in a globalized environment.

In addition to the positive evaluation of SpeakUp as a live communication channel in a class with many students, the integration of a tool that illustrates the benefits and challenges of instantaneous communication while at the same time supports the study of these same benefits and challenges was highly beneficial. As such, SpeakUp was a mean and an end for the *Communication A* module.

For the next editions of the course, we will try to better integrate the class activities and the online activities as they deal with related topics. Developing effective teamwork skills is indeed strongly related to leadership and knowledge management. Rather than learning how to do teamwork and then doing teamwork, we will establish a scheme in which the two dimensions are tackled concurrently.

Entrepreneurship is an important soft skill which will be developed in an additional lecture; not to wait until the end of the master studies to sensitize students about the opportunities

and the ways for them to contribute to the development of a future sustainable economy.

Due to the logistical constraints associated with a module dedicated to 150 students, lecturers and students did not have enough opportunities to discuss posters. To address this issue we plan to provide more feedback on the work in progress during the group activities by both face-to-face comments by lecturers and online reviews by peers.

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⁵<http://cdh.epfl.ch/page-104435-en.html>