THE IMPROVEMENT OF COLLABORATIVE PROJECT WORK USING ORAL PRESENTATIONS: THE EXPERIENCE OF ROAD ENGINEERING STUDENTS

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Abstract. A successful road engineering project is often a highly collaborative team-based activity, and the engineering education community must therefore prepare graduates to work in this type of environment. A large body of research has demonstrated the considerable benefits and minor organizational problems of collaborative work in engineering education. However, there are only a few case studies reported in the literature that evaluate the positive and negative experiences encountered by students when undertaking group projects. The prevailing scientific view is that the "soft skills" derived from collaborative learning through teamwork are obtained automatically by the students once the project work is finished, but some "soft skills" are not obtained at all. The ability to express orally oneself and defend technically the solution adopted by the team, is a "soft"skill which is not enough trained in most of the cases.

This paper contributes to this limited literature by assessing previously methodologies applied to group projects with students enrolled in the "Roads" course (Civil and Territorial Engineering degree at the Madrid Technical University -UPM). Results obtained through a survey campaign to student have led to analyze the reasons why a panel of oral presentations (focused on the project work technical solutions) at the end of the course of "Roads", could improve the learning and the acquisition of some "soft" skills. Attending the results of this study, oral presentations will be incorporated in the academic year 2018-2019.

1 INTRODUCTION

For engineers to be effective global leaders in the workforce, they need to master a range of interdisciplinary and interpersonal skills such as teamwork, critical thinking, decision making and communication skills. These are what are known as transversal competences and engineering education has been undergoing changes promoted by the Accreditation Board of Engineering and Technology [1] that include these competences. The main problem lies in the fact that these "soft skills" require continuous training throughout the engineer's education process. Technical oral presentation is one of those important skills or requirements that every engineering student needs to go through prior to graduation, as it is necessary not only for

academic performance, but also to secure employment after graduation. nevertheless, most students find the idea of oral presentations frustrating and intimidating. This is because they may feel a slight apprehension about their communication skills, and also about the content of oral presentations. therefore, it is clear that students need to master both the content as well as the skill of oral presentation in order to make an effective one.

This paper focused on an experience of teamwork in a "Roads" course within the Civil Engineering Degree of UPM (Technical University of Madrid). Students were working in groups during four workshops and previous surveys (carried out in 2015) on the student's perception had revealed that a new learning tool was needed to present the projects developed by the groups as a way to go through and share the long list of contributions and group solutions to the workshops. Oral presentations seem to be one of the best tool to help to achieve this target but, due to the high number of students in the course (more than 90), this initiative (if we use traditional "PowerPoint" presentations) would consume one entire day. For that reason, the faculty staff has decided to introduced the short format of "Pecha Kucha" oral presentations. By forcing students to simplify the content, it meant more hours of work and more effort in understanding the subject matter. The following sections shows the preparation phase of this new experience to be implemented in the academic year 2018-2019, together with an assessment tool to evaluate this new initiative.

2   ORAL PRESENTATION IN ENGINEERING EDUCATION

Literature on the specific areas of difficulty that students face while performing an effective oral technical presentation (and the different ways to improve them) have been analyzed by the literature. In a first approach, a qualitative study was conducted at a private university located in Perak Darul Ridzuan, Malaysia [2], which attempted to find answers to specific areas of difficulty that students face. In the context of this study, the selected participants were members of three focal groups (26 students, 13 lecturers and 12 professional engineers). This research aims to discuss the perceptions held by focus groups on the apparent discord between academia (students and teachers) and industry (professional engineers) over communicative competence in technical oral presentations. the study also aims to explore the preparation of graduate's communication skills for the future workplace and its pedagogical implications.

In a second approach, another study conducted at Universiti Teknologi Malaysia, Johor Bahru Campus [3], analyzed student perception on oral presentations. In this case, respondents were students from five different engineering faculties and data was collected through the distribution of a questionnaire to 235 students. This questionnaire consisted of three sections. Section A focused on the collection of demographic information from respondents; section B focused on the area of oral technical presentation difficulties commonly faced by students; and finally, section C looked at respondents' perceptions of how to improve oral technical presentation. Some of the difficulties common faced by students were linked to the inadequate knowledge of presentation skills and low confidence. Finally, the data collected were analyzed by frequency counts using the SPSS Statistical Package.

In the first area of difficulty experienced, when students were surveyed before their presentations, concerns about this issue are among others:
- − Do not know the proper pace of presentation.
- − Not paying attention to intonation.
- − Do not know how to use nonverbal communication in presentation.
- − Reading notes/ slides prepared.
- − Present points that are confusing and long.
- − Do not know how to answer questions.
- − He doesn't give examples.
- − Do not know how to organize the content.

In the second area of difficulty, low confidence correlates with the question of what students feel when asked to make a technical oral presentation, in which their response was summarized as feeling stressed, worried and anxious. In light of the above difficulties, the three best valued solutions for improving technical oral presentation seemed to be: reading books and articles focused on oral expression techniques, followed by self-study multimedia courses and, finally, viewing presentations on the internet.

Oral presentations are not only important for the student's education, as a "soft skill" to acquire but also for the teaching staff, in their expositive classes. Some authors [4], based on faculty conferences, had identified strengths and weaknesses that need to be improved in an oral presentation and these strengths and weaknesses can also help student to improve their own oral presentations. For the three main phases of an oral presentation, the beginning of the presentation should not exceed 10-2-% of the time allotted to the presentation, the body of the presentation only 60-80% of the time and the end takes 10-20% of the time allotted. As regards the **initial part of an oral presentatio**n, the audience appreciates more the ability of the interlocutor to attract attention, then the enthusiasm and less the ability to motivate the audience. In the **central part of an oral presentation**, the following indicators were selected: clear structure; accessible, easy to understand presentation, self-management and trust; accuracy and relevance of oral expression; appropriate posture; modern visual aids used effectively. In this case the audience, from the most important and highly appreciated to the least, considers: speaking accurately and appropriately; self-control and confidence; modern visual aids and finally clear structure. The **end of an oral presentation** was analyzed according to the following indicators: allow students to ask questions; repetition and clarification; bibliography and complementary materials. The results have helped to identify the strengths of an oral presentation itself and those of the speaker himself: indicating a bibliography and allowing the audience to ask questions in the first case, and an appropriate posture and suitable speech in the second case. By contrast, the least appreciated were repetition and clarification, motivation and enthusiasm. The conclusions of this study can definitively help students to prepare their own oral presentations, avoiding the least appreciated behaviors.

In **traditional presentations** too much time is usually spent on telling a lot of information without focusing on the main ideas. Power Point is the common resource for oral

presentations and usually text is overused in the slides, which causes the speaker to turn his back on the audience most of the time, or in the excessive use of notes. The issue of the impact of PowerPoint on student learning, especially in relation to traditional classes, continues uncertain. The effectiveness of PPT as a teaching tool may continue to diminish over time [5]. **Pecha Kucha** has appeared because it was necessary a new kind of learning that helps to internalize ideas, understanding, and remembering the material learned through active learning. The structure consists of a presentation of 20 slides at a rate of 20 seconds per slide, which limits the total presentation time to 6 minutes and 40 seconds. The interlocutor is challenged to use more visual images on the slides and to relate them directly with his verbal presentation, so it is necessary to know the material well enough to present it without the support of notes. At the beginning, Pecha Kucha was planned for an individual presentation through a timed presentation; nevertheless, research has been carried out to modify the main rules of the original style [6]. In this case, these traditional rules are modified to be used in group presentations, being from 3 to 5, the number of speakers and the time allowed per slide varies as long as it does not affect the total duration of the presentation of 6 minutes and 40 seconds. Students can "borrow" time from a slide to focus more on other important points.

Although Pecha Kucha is a very recent tool for oral presentations, literature on his effectiveness is beginning to spread. One first approach for researchers is to use an experimental post-test design to determine the effectiveness of a Pecha Kucha presentation compared to one with the traditional Power Point style. The advantages of this new style of presentation are accompanied by some disadvantages. Pecha Kucha emphasizes the **rapid transfer of information from the speaker to the audience.** It does not allow the use of flexibility of the traditional Power Point where you can pause the presentation for questions or change the content based on the public's understanding of the topic. In fact, the presentation is blocked and cannot be altered along the speech. The speed of a timed presentation of Pecha Kucha makes a nuanced **explanation of many complex concepts impossible**. Therefore, the topics that can be expressed must be carefully chosen. In addition to prepare the slides, Pecha Kucha presentations should be rehearsed as a lecture, so that they are understandable to the student audience and flow uniformly, fluently, and without delay.

This type of presentation was experienced at Texas Tech University in 2012, in a class of 60 students and then again in 2014 in a class of 42 students [7]. It was found that the students spent at least 2-4 times more time and effort preparing and practicing for the Pecha Kucha presentation than they would have required for a standard Power Point presentation. Texas students were rated using a rating rubric that measures content accuracy, presentation clarity, slide quality, presentation quality (with or without notes), creativity and interest generated. By forcing students to simplify the content, it meant more hours of work and more effort in understanding the subject matter. They learn to synthesize the essentials in a few slides. More time is spent on preparing this type of presentation, due to this format takes students out of their comfort zone. On average, students practiced more than two hours, while traditional presentation groups practiced half an hour, an hour or less. In addition, the student audience was more involved and interested in the presentations, asking more questions than in the traditional PPT. Nevertheless, it results in a more professional preparation and content and more self-confident speakers in the public exhibition. Most students enjoyed the presentation

and learned the exam subject much better than if they had just studied it. In terms of exams, grades were not significantly different from other subjects with similar characteristics, where the Pecha Kucha presentation style was not used. Although there was no quantitative support for the Pecha Kucha format to improve understanding and retention of content, it seems to focus on enhancing students' presentation skills.

Another method to reinforce students' oral presentation skills was based on the use of video recorder [8]. Tugrul conducted a research in 2012 with 82 students and examined the impacts of both the video recording process and group project presentations in class and the discussions that result of seeing these recordings on students' perceptions. This study implies that the recording of video presentations of group projects and the use of these videos to evaluate student performance were perceived as an effective, useful, satisfying and good educational technology to promote learning. The added value of Tugrul experience is the items used to measure oral presentation skills and communication skills. Oral presentation skills were studied using five items: ability to manage speech tone, manage body movements, maintain audience attention, maintain adequate eye contact, and answer questions effectively. The communication skills were studied using three items: ability to speak effectively to groups, communicate with an appropriate level of detail, and communicate orally. In career-related skills, applying for employment is studied and those skills that are needed later, related to job performance. The motivation for learning was measured using two items: working hard for the presentation and studying more to learn more about the topic of the presentation.

As conclusion, the literature review has reinforced the importance of the role of oral presentations, as learning tool in Engineering education, but at the same time has revealed that students are not enough prepared and trained to make efficient oral presentations. Students should be provided with documentations and instructions related to how to prepare a successful oral presentation. The items that faculty should use to assess an oral presentation are also an issue that need further research (technical contents should be evaluated separately from communication and oral skills). Some studies have demonstrated that surveys on student perception (before and after their oral presentation) can be a good methodology to assess a pilot experience of oral presentations. Next section describes the case study where our experience will take place.

3   THE CASE STUDY: PROJECT WORKS ON ROADS INSTRUCTION

In recent years the whole civil engineering education community in Spain has been immersed in a vigorous debate in order to establish the competences needed for current and future engineering practice. The new European Higher Educational Area has served as a major stimulus to revise university degrees and identify basic, transverse and professional skills. Once these new programs have been established, the issue is how to implement this new scenario in current subjects. The new Civil and Territorial Engineering degree was launched in September 2010, and is organized in eight semesters (30 ECTS each), and each student must choose one specialization (Civil Constructions, Hydrology and Transport and Urban Services) at the beginning of the sixth semester.

"Roads", the UPM scenario in which this empirical research took place, is a compulsory course (subject or module) in the seventh semester of the Civil and Territorial Engineering degree, with a workload of 4.5 ECTS (European Credit Transfer System) credits. There are other previous modules related to "Roads" but this is the first to be specifically based on road design. In one semester, students are supposed to learn how to design roads using four aspects (approaches): traffic, layout, geotechnics and drainage (hydraulics and hydrology). Teamwork is combined with conventional classes and, using the content of these lessons, the project work is organized in four sessions (four cases of study): planning and traffic, layout (road alignment), geotechnics and drainage. The project work, which represents 20% of the total workload in our course (Roads) syllabus, taking into account the project workshops and preparatory practical classes. This project is based on the design of a real road. The group for each project, comprise four members (formed with the student selection criteria) and work on the same map (the same location), although the project solution may differ from one team to another. Each workshop is conducted by the student groups inside the classroom during the assigned timetable (each workshop has a maximum duration of 2 hours and 30 min); all the teaching staff are present in the classroom during the workshop in order to track student progress and answer queries. At the end of the workshop each team hands in a written report with the results of the workshop to the teaching staff, with no option for the team to complete the report at home.

Surveys on student perception, carried out in 2015 [9], revealed that the project work itself was very appreciated for students but the least-liked element of the Madrid project work for the students (66.7%) was the problem of **time management**. Firstly, it was very important to research the theory before attending the workshops, which some students probably failed to do (48.96% of the students confirmed they would improve this aspect if they repeated the teamwork). Secondly, as far as the authors know, Madrid students had very little background in class teamwork under time limitations in the degree so far. By forcing students to prepare an oral presentation on the project work, once the project is finished, and simplify the content, it meant more hours of work and more effort in understanding the subject matter, before the final exam. Pecha Kucha format could also help to select only the most important results of each workshop, coming back to the usual mistakes and also to the most brilliant contribution of each group.

Next academic year (2018-2019), with a workload of 10% of the total, there will be an oral presentation and a defense of the four workshops proposed during the course, using the Pecha Kucha methodology. Each oral presentation will be conducted by one of the members of the group, who will be selected by the teacher immediately before the exhibition. Prior to the delivery of each practical case, the student must compile the information which considers necessary for the preparation of the presentation. A maximum of 2 hours and 30 minutes (150 minutes) will be available for the whole process. Each group, composed by a maximum of 4 students, has about 6 minutes to show their work, following the Pecha Kucha method. Therefore, they will be able to present around 25 groups, which means 100 students, during this time. Apart from that, individual/autonomous resolution of exercises and problems associated with one of the four practical cases, which represents also 10% of the total workload, are carried out by the student during the course. To sum up, the project work

assessment, in which all four workshops are considered equally, accounts for 40% of the final mark, with the other 60% based on an individual exam.

Students will be provided with useful guidelines for preparing successful oral presentations, such as the subject, the objective, the target audience and how the interlocutor should act (adaptation to the time available and the message to be transmitted). For the exhibition, recommendations will be defined (arrive on time and check the outfit you will use for the presentation, suitably dress for the occasion) and psychological preparation (sleep well the night before, anticipate questions and possible answers). And finally, the evaluation phase, where it is analyzed how the interlocutor feels and which things can be improved for the next time. These guidelines will also include recommendations to use the Pecha Kucha and the items susceptible to being evaluated by the teaching staff during the presentations and not related to the technical contents of the project work.

4   ASSESSMENT OF EXPERIENCE

The assessment of the experience has been structured in three parts. First part focuses on the student feelings before the oral presentation and their expectations prior to the oral presentation. The second part assesses the oral presentation itself, attending communication and oral skills separately from the technical content. Finally, the third part focused on the student perception of the experience.

4.1   Survey of students' expectations prior to the oral presentation

In order to know the strengths and weaknesses of the students in an oral presentation, a survey of around 10-15 questions will be distributed. It will be answered in a scale from 1 to 5, where 1 equals strongly disagree and 5 equals strongly agree. Among them, the aim is to find out if students, when it becomes the interlocutor of the presentation regard to the project work, feel frustrated, nervous or with sufficient capacity to face it. Similarly, it is questioned which audience feels more comfortable with the speaker, or which they would prefer to use as support in order to guide their presentation. On the other hand, it is useful to know, if they believe that the university/school itself collaborates in improving the students' abilities in oral exhibitions, for example through lectures and conferences on their own experiences and the advice of professionals, more practical classes in which students discuss their personal opinions, courses specialized in this field, a higher percentage of workload in group work, or providing prior documentation for students to serve as a brief guide to use.

- I think I have enough self-confidence to do a professional presentation.
- I prefer that the responsibility lies on another colleague in the group.
- I am usually intimidated, nervous, weak, and insecure before a presentation.
- I use lots of notes or I read the slides to give continuity to the presentation.
- I try to show more graphics and images, because I think the message to be transmitted is much more direct and dynamic.
- I prefer a close audience to feel more comfortable.
- I usually prepare the presentation by repetition the content rather than understanding the ideas to be conveyed.

- The university collaborates in specialized courses that promote these skills (discussion forums, competitions, etc.).
- The percentage of workload in project work and oral presentations, is very low for the work and dedication they require.
- I would improve my self-confidence if classes were encouraged where personal opinions are discussed and expressed more openly.

4.2 Evaluation of the oral presentation

For the evaluation of students, teachers choose to use a rating rubric in which certain evaluation criteria are set out, with scores from 1 to 5, being 1 defined as "Poor" and 5 as "Excellent". The points to be evaluated are the following:

- Speech and vocabulary: speak slowly and clearly, with appropriate vocabulary.
- Voice tone: a volume loud enough to be heard by everybody.
- Body posture and eye contact: look at all audience naturally.
- Self-confidence and reliability in the approaches described.
- Time use: perfectly the interlocutor adjusts to the time limit by presentation and group.
- Use of visual and/or technological resources: appropriate use to enrich the presentation.
- Quality of the presentation: it keeps the attention on the viewers and avoids just reading what is written in slides or notes.
- Dynamic presentation.
- Content control.
- Organization and sequence: a logical and orderly sequence is adopted between the different cases of study presented.
- Clarity and precision in the presentation: Non ambiguities.

4.3 Survey of students' perception after the oral presentation (final evaluation of the experience)

After the presentation of the project work, the students will carry out a post-presentation survey to know their experiences regarding the new methodology adopted. In this way it is possible to identify the differences with respect to the beginning of the course and whether they have found it really effective to adopt other methods to enhance their confidence in oral presentations.

- The oral presentation helped me to better understand the workshops.
- The oral presentation helped me to understand the subject better.
- I will spend less time on the final exam preparation because oral presentations have help me to understand the content of the exam.
- The oral presentation has developed my communication skills.
- I am now more prepared to present any project orally.
- I will use Pecha Kucha in the oral presentations of other courses.
- I will use Pecha Kucha in my professional career.
- Pecha Kucha requires more preparation than traditional Power Point.

5   CONCLUSIONS

Literature has shown the need and benefits of including learning tools to train "soft skills" in Engineering Education. Oral presentations are one these tools, although engineering students are not used to work with oral presentations in the majority of the courses of the degrees. This paper describes a methodology to assess a pilot experience of implementing students 'oral presentations in a course of "Roads" at UPM (Technical University of Madrid). Although this pilot experience will be carried out during the next academic year (2018-2019), the paper describes the content of the questionnaires that will be distributed to students before and after the oral presentation as well as the items that the faculty staff will use to evaluate the oral and communication skills of the students during the presentation itself.

6   ACKNOWLEDGEMENTS

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