

# Web-Based Peer Assessment

## A Case Study with Civil Engineering Students

<http://dx.doi.org/10.3991/ijep.v3iS1.2411>

Gonçalo Cruz<sup>1</sup>, Caroline Dominguez<sup>1&2</sup>, Ana Maia<sup>1&3</sup>, Daniela Pedrosa<sup>1&3</sup>, and Gordon Grams<sup>1</sup>

<sup>1</sup> UTAD - University of Trás-Montes e Alto Douro, Vila Real, Portugal

<sup>2</sup> C-MADE - Center of Materials and Building Technologies, Covilhã, Portugal

<sup>3</sup>CIDTFF - Research Center for Didactics and Technology in Teacher Education, Aveiro, Portugal

**Abstract**—Peer-assessed online collaborative writing is of growing importance for higher education. Based on the quantitative and qualitative analysis of collected data, this work presents the results of a case study in a graduate civil engineering course at the University of Trás-os-Montes e Alto Douro, Vila Real, Portugal. After an overall presentation of the learning activity, it examines students' attitudes towards web-based peer assessment and identifies which factors are related to students' use and appreciation of feedback. In addition, an analysis of the type of feedback is presented in an attempt to evaluate students' written communication skills. The results of this study provide indications on how to improve the design and implementation of future web-based peer assessment tasks and raise questions on the effectiveness of peer/teacher grading in the use of feedback.

**Index Terms**—Collaborative Writing; Web-based peer assessment; Students perceptions; Peer feedback; Higher Education;

### I. INTRODUCTION

The role of educators is changing in the face of growing opportunities for applying technology in engineering education [1] and students are increasingly aware of the importance of new employability skills related with digital literacy [2]. Analytical, active and self-learning skills, working in groups and effective communication are increasingly sought competencies, among others, although little encouraged by educators [3]. In particular, the development of effective communication skills is considered to be one of the main goals of engineering curricula [4][5][6], and web-based collaborative environments can help to achieve this [7].

Research in a higher education context is beginning to emerge from web-based collaborative writing activities and peer assessment approaches. Some studies evidence students' resistance to peer review [8]. They are not conclusive, however, on which factors lay behind that resistance. Furthermore, there is little understanding of the impact of students' perceptions of peer reviewed work [8]. This paper presents results of a study carried out in a higher education course at the University of Trás-os-Montes e Alto Douro, in which civil engineering students at mid-course level were challenged to reinforce a set of personal and cognitive competencies, using a web-based collaborative writing environment and a peer assessment approach.

The goal was to examine students' attitudes toward peer assessment using the web-based learning environment Google Drive (previously called Google Docs) and the

factors related to students' use and appreciation of feedback. This paper describes the students' feedback and sheds light on the effectiveness of their written communication skills. The results are based on the analysis of quantitative and qualitative data collected from a questionnaire applied to students who participated in the activity, and an analysis of the assignments produced by students in the Google Drive environment.

### II. BACKGROUND

Many authors have recently demonstrated the increasing importance of communication skills in the lifelong learning process for future engineers [1][5]. From this perspective, writing as well as collaborative skills should be promoted [9][6][7].

According to Calvo & Ellis [9], helping engineering students to learn how to write and communicate efficiently is an activity that has many challenges. Giving/receiving/using feedback can be considered an adequate strategy to provide students with a meaningful learning experience. For teachers, however, giving feedback to a large number of students may be too difficult considering the variety of students' characteristics and the limited time available [10]. Peer review may, therefore, be an alternative or complementary method of assessment.

In higher education, the use of collaborative environments to improve students' written production has been studied, particularly in academic peer review activities. The literature reports some important discussions in the field of Computer Supported Collaborative Learning [11][7], including the use of a Google Docs (currently Google Drive) environment [12][13], as well as in the field of educational psychology [14], and in studies on the impact of feedback on writing [15].

For most authors peer review is regarded as an assessment tool which promotes active learning [14], encouraging the development of new ideas and critical thinking [16], because when students assess the work of their colleagues they also observe how they solve problems, and thereby learn to think critically. However, students' perceptions about the usefulness of feedback depend on different factors, one of them being the perception of fairness, which is considered critical to its acceptance [8].

As for the effective use of feedback by students, some authors point out other critical factors. Among them, is the regard that students have toward their own colleagues' competencies in giving feedback. When feedback is given only by peers, it seems to be less enforcing [15] than when the involvement of the teacher is also present. The type of feedback is also critical. For Shute [10], in a learning

context, feedback provides guidelines when it is specific and clear. However, it's important to consider the influence of other variables, like students' individual characteristics (eg. level of cognitive skills, motivation, etc.).

In order to help students have better performance in terms of writing, educators should analyze and record the types of feedback which have more impact. Feedback should begin with a summary of the evaluated colleague's performance, as happens among professional reviewers of articles in scientific journals [17][18][15]. When a problem is detected and outlined, the location of the problem should be indicated by the fellow reviewer, as well as a solution to the problem [15].

In this sense, Nelson & Schunn [15] proposed a set of characteristics of "good" feedback in two domains: the cognitive and the affective. In the cognitive domain, there are four essential characteristics which affect understanding: 1- Summarization: the summaries are intended to make an overall assessment of the work and indicate the parts that need special attention by the feedback receiver; 2- Specificity of comments, involving three components: the identification of the problem, which allows an increased probability of implementing the feedback; the provision of a solution, with a comment that suggests how to deal with the problem; and the location of the problem/solution (with the location of the problem/solution the author gets a second chance, after identification, to detect a problem that might have been forgotten).

Comments can be global or specific, although specific ones are considered to be more useful; 3- Provision of clear and concise explanations: the explanations convey or clarify the reasons for the purpose of feedback; and 4- Scope: deals with the spectrum of the feedback (narrow or large). The only characteristic in the affective group (which affects the agreement of the author) is the use of affective language, which includes the use of praise (and not of "inflammatory language", which is considered as non-constructive criticism), or the use of comments which mitigate or soften the criticisms.

According to some authors [6] [7], online collaborative environments can help the development and acquisition of communication skills presented in the engineering curricula. Peer review activities can therefore be developed in an *online* environment, but the learning process reveals a greater degree of complexity when compared with that performed in the classroom [14]. It also involves greater motivation and effort by the teacher. Regarding the use of the Google Docs (currently Google Drive) environment for this type of activity, many studies report its benefits [19][20][13][12].

In addition, Blau & Caspi [13] believe that the quality of a document is greater if it is written collaboratively, compared to an individually written document. Nevertheless, Brodahl *et al.* [12] show that students' computer skills and positive attitudes towards the use of digital tools play a crucial role in the perceived quality of the final document. However, the problems encountered are not exclusively of a technological nature. They also depend on other factors such as the course content, the pedagogical approach used, the time set for the activity, familiarization with the tool, prior knowledge and institutional and administrative restrictions [12].

### III. CHARACTERIZATION OF THE ACTIVITY

The activity under analysis was carried out at the mid-course level (3rd semester of a 6-semester program) of a Bachelor of Civil Engineering course, focusing only on one component of the syllabus of Management of Construction Enterprises Curricular Unit. This unit allows students to get acquainted with the business world and to learn about the main management function of a company. In particular, one of the cognitive objectives of the component of the syllabus at stake was to familiarize students in the exercise of the SWOT (Strengths, Weaknesses, Opportunities, and Threats) economic strategic analysis approach. In this case, students had to identify and characterize the opportunities and threats that construction companies (and other agents) face according to its economic, technological, legal, political and social-cultural environment.

The activity consisted of the following tasks which were performed, individually, by the students during one week: 1- Select an economic article from one available source (eg. an economy newspaper, magazine, etc.), dealing with recent news (1 or two weeks) of an economic phenomenon (eg. the closure of a company, the internationalization of an economic sector, etc.); 2- Upload the article in a MS Word file to Google Drive (drive.google.com); 3- Perform a summary of the article; 4- Analyze the article identifying and classifying the type of variables (technological, economic, socio-cultural, environmental, legal and political) used in the text and evaluate them in terms of Opportunities and Threats; and 5- Give his/her own opinion on the reported news.

Once these tasks were finalized, the document was shared through the online environment with the colleague-reviewer and with the teacher. The reviewer had one week to read the document, give written feedback with suggestions for improvement to the author through the comment function of Google Drive (similar to the Microsoft Word tool) and evaluate the colleague's work on a 0 to 1 grading scale (0 being the lowest grade and 1 the highest). Once the revision was done, the teacher made a revision of the work done by the author and the reviewer colleague, evaluating both of them with the same grading scale. Then, the student-author had one week to make voluntary improvements to his/her original document, and the teacher had another week to give a final grade.

This cycle of tasks was done twice during the semester, with two different selected articles and with different reviewer students. Through this activity, besides the cognitive competencies related to the curricular unit, students were also meant to reinforce/develop the following competencies: writing, synthesis, analysis, critical thinking, written inter-personal communication, use of information and communication technologies and group work.

As stated above, the evaluation of this activity was done in two steps: an intermediate evaluation of the author's work by the student-reviewer and the teacher, and a final evaluation from the teacher after the student-author improvements (if applicable). The final grade for this activity consisted of the average from the teacher's final grades given to both assignments. In turn, this final grade contributed to one third of the total grade of the curricular unit (on a grading scale from 0 to 20).

Before beginning the activity, a 40 minute-orientation on how to perform the activity was presented in class, by the teacher and 2 pedagogical consultants from an institutional e-learning team. The Google Drive environment and the objectives and tasks to be performed were presented and questions clarified. Several online supporting documents were also provided and shared in Google Drive, with the objective of helping students to cooperate in the different work phases. Among them an Excel table (see Figure 1.) with the names of “author students” and their corresponding classmate reviewers with their respective e-mails, allowing the sharing of the documents and the performance of the different tasks between students.

The second table (see Figure 2.) presented a list of all the participants, as well as the performance state (done or not) of all the tasks proposed within the activity in the form of a checklist. This resource aimed to facilitate the coordination of the work between all participants (student-authors, student-reviewers and teacher) and allowed the students and teacher to manage the time to do all the activities and monitor the workflow. Along the activity, student-authors, student-reviewers and the teacher had the responsibility of coloring the respective section of the task in green to indicate completion. If the section remained yellow it indicated that the task had not been concluded.

The “orientation document” conveyed a description of the objectives of the activity and the different tasks to be performed. It included indicators regarding the evaluation (grading) methodology for students as reviewers and for the teacher, either for the intermediate or the final evaluation (only for the teacher). The evaluation had to take into account evidence of the following skills from the author-student: summarizing (if he/she demonstrated good ability to summarize his/her work already had half of the grade), identification of all the variables of the economic environment present in the news article and drawing conclusions in terms of opportunity and threats, and finally the elaboration of a well-grounded final individual commentary on the news. Orientation for feedback was not transmitted in a written document, but presented orally in a general way.

Paper	
STUDENT AUTHOR's Name - Delivering the article until November, 8	STUDENT REVIEWER's name, with delivery on 15th November
Student A	Student G
Student B	Student F
Student C	Student E
Student D	Student D
Student E	Student C
Student F	Student B
Student G	Student A

Figure 1. Student-authors and corresponding Student-reviewers

PAPER	TASKS						EMAIL
	A1	A2	A3	A4	A5	A6	
Student 1	Green	Green	Green	Green	Green	Green	xxx10@gmail.com
Student 2	Green	Green	Green	Green	Green	Green	xxx6@gmail.com
Student 3	Green	Green	Green	Green	Green	Green	xxx@gmail.com
Student 4	Green	Green	Green	Green	Green	Green	xxx@gmail.com
Student 5	Green	Green	Green	Green	Green	Green	xxx@gmail.com
Student 6	Green	Green	Green	Green	Green	Green	xxx@gmail.com
Student 7	Green	Green	Green	Green	Green	Green	xxx11@gmail.com
Student 8	Green	Green	Green	Green	Green	Green	xxx22@gmail.com
Student 9	Green	Green	Green	Green	Green	Green	xxx33@gmail.com
Student 10	Green	Green	Green	Green	Green	Green	xxxtr@gmail.com
Student 11	Green	Green	Green	Green	Green	Green	xxx8@gmail.com
Student 12	Green	Green	Green	Green	Green	Green	xxxaf10@gmail.com
Student 13	Green	Green	Green	Green	Green	Green	xxx65@gmail.com
Student 14	Green	Green	Green	Green	Green	Green	xxx@gmail.com
Student 15	Green	Green	Green	Green	Green	Green	xxx1234@gmail.com

Figure 2. Management of the activity

#### IV. RESEARCH METHODOLOGY

The methodology of the study was supported by two different elements: a questionnaire and the use of students assignments. In order to assess the students’ satisfaction and perception of the proposed activity a questionnaire was elaborated and made available online through the Google Drive environment. It included quantitative and qualitative questions.

In a total of 46 quantitative questions 12 were related to the characterization of students’ profile (sex, age, previous digital skills), 17 with the pedagogical approach adopted (execution of the tasks, facility of use the online environment, time availability, and support material), 6 dealt with the students’ perception about the quality of the feedback (its value and impact to the writing improvement), and 10 on the acquired skills and the general satisfaction with the activity.

In addition, 4 qualitative open questions allowed students to state why they found (or not) the suggestions made by the peer-reviewers and by the teacher important, and why they used (or not) these suggestions to improve their own work. The enquiry response from 47 students was 23 who completed the activity, representing a response rate of 49% of the total population.

After data collection via the questionnaire a simple descriptive statistical analysis was made for the quantitative questions, limited to counting frequencies of the response modalities for each question [21]. For the qualitative questions, the nature of each response was verified through a structured content analysis grid (see Table 3).

The second element used in the collection and data analysis was a sample of the final assignments. The type of feedback made by student-reviewers and by the teacher was analyzed in each document, using the feedback model of Nelson & Schunn [15]. For this purpose, an analysis grid corresponding to a checklist of analyzed criteria was elaborated (see Table 4). A total of 39 assignments (41%) of 81 were selected and analyzed at random. They all had feedback given, both by peers and by the teacher. These assignments did not necessarily correspond to the students who responded to the inquiry, since this last one was anonymous. Finally, the average of the intermediate grades given by reviewers and teachers was calculated and added to Table 4 for additional information.

Our research methodology followed three main steps: sample characterization; quantitative and qualitative analysis of student perceptions; description of the type of feedback found in the final documents with a comparison the grades given by student-reviewers and the teacher.

#### V. EVALUATION OF THE ACTIVITY

##### A. Characterization of the sample

55% of the students of the sample were male and 45% female. In terms of the use of digital tools, while most of the students used social networks and e-mail on a daily base (73% and 77%, respectively), a great number did not use Radio/TV or online games (approximately 59% and 73% of the sample, respectively). Only one student already knew about or had previously used Google Drive or a similar online environment. Thus, for almost all the participants this was a new experience. Regarding the adopted approach and strategy, the results were clearly

positive: 95% of the students performed all the proposed mandatory tasks (see III. Characterization of the activity).

### B. Use of the Google Drive environment

Regarding the use and the ease of use of the Google Drive, time and available support documents:

All of the students (100%) considered Google Drive to be a useful and efficient platform for the proposed tasks and 85% agreed that Google Drive made communication between colleagues and the teacher easier; 77% of the students evaluated the support documents for the activity (tables and orientation document) positively, allowing better organization, coordination and management of the activity; 91% of the students evaluated the initial session of explanation and clarification of the activity positively; 55% considered the time available to perform the activity to be long enough; and only 55% considered the support given by the teacher during the activity process as sufficient [21].

### C. Overall student perception based on quantitative data collection

The analysis of the quantitative data collected showed a very positive general appreciation of the activity by the students. Despite being the first experience with the use of an online collaborative writing environment and specifically with Google Drive for most of them, the digital factor did not influence attitudes towards peer assessment, such as students' motivation to carry on with similar activities in the future. Factors such as the provision of support materials and training sessions seem to have been critical to the students' fulfillment of tasks and may be further improved.

The results of quantitative analysis were not conclusive (22). Although 100% of the students liked to assess and be assessed by the peers and the teacher and most of the students were enthusiastic about the activity and recognized the value of classmate and teacher assessments (82% and 92% respectively), more than a half did not use the feedback to improve their final written document and only 22% were interested in knowing if their colleague made (or not) changes in the reviewed and assessed documents.

Therefore, a complementary and further analysis of the qualitative questions was undertaken, with the goal of identifying and analyzing the factors/reasons for student perceptions in regard to appreciation and usefulness of peer and teacher feedback.

### D. Students' perceptions based on qualitative data collection

The complementary qualitative analysis consisted in the analysis of four open questions which had the aim of identifying the factors underlying the students' appreciation and usefulness of feedback received, either by the peer reviewers or by the teacher. To perform the analysis two main categories were created (Figure 3.): (1) Peer feedback and (2) Teacher feedback. The first category, 'Peer feedback', was divided into two subcategories: (1.1) 'Appreciation' (Factors/reasons for positive or negative appreciation of the feedback); and (1.2) 'Usefulness' (Factors/reasons for using (or not) the feedback).

By looking at the first subcategory, which corresponds to the question "Why do you find the feedback received by your colleague important or not important?" the main

Categories of analysis	Subcategories	Units of analysis (factors/reasons)	Total	Frequency
1. Peer feedback	1.1 Appreciation	Time, regulation and motivation	2	=0,08 = 8%
		Type of feedback	10	=0,44 = 44%
		Lack of feedback	3	=0,13 = 13%
		General perceptions	8	=0,35 = 35%
	1.2 Usefulness	Type of feedback	4	=0,18 = 18%
		Time, regulation and motivation	2	=0,08 = 8%
		Teacher's status	1	=0,04 = 4%
		Evaluation grades	4	=0,18 = 18%
		Lack of feedback	3	=0,13 = 13%
		General perceptions	9	=0,39 = 39%
2. Teacher feedback	2.1 Appreciation	Type of feedback	11	=0,48 = 48%
		Teacher's status	7	=0,31 = 31%
		Lack of feedback	1	=0,04 = 4%
		General perceptions	3	=0,13 = 13%
		Without answer	1	=0,04 = 4%
	2.2 Usefulness	Type of feedback	3	=0,13 = 13%
		Time, regulation and motivation	2	=0,08 = 8%
		Teacher's status	2	=0,08 = 8%
		Evaluation grades	7	=0,31 = 31%
		Lack of feedback	1	=0,04 = 4%
		General perceptions	6	=0,28 = 28%
		Without answer	2	=0,08 = 8%

Figure 3. Categories of analysis for the open questions

reason (unit of analysis) for a positive or negative perception of the colleague's feedback is the 'Type of feedback', corresponding to 44% of all responses. On the one hand, the lack of specification of the problems and their location and the lack of providing solutions had a negative impact on the appreciation of the feedback, as the following student comments from the questionnaire show: "some suggestions were not specific, like: "I believe that some variables are missing. I do not consider this feedback explanatory because it does not point out which variables are missing." On the other hand, specific comments had a positive effect ("Because it always helps to see what and where one is wrong and can improve", student 3). Thus, the 'Type of feedback' may result in both positive and negative perceptions. In addition, other units of analysis were created, such as 'time, regulation and motivation,' 'Lack of feedback,' and 'General perceptions.' The last one (General perceptions) lists indefinite reasons, some positive ("Because," 7 students; "because they allow me to improve," 19 students) and other negative ("because not", 22 students; "because it did not allow me to improve" 15 students) but does not allow any conclusions to be drawn. This situation is repeated in the other subcategories under analysis.

In relation to the second subcategory, which corresponds to the question "Why did you use/or not the feedback received by your colleague?" the main reasons stated were the "Type of feedback" and the "evaluation grades", corresponding to a total of 36% of all responses. As shown previously for the "Type of feedback," the "Evaluation grades" have also a double effect (positive or negative) in the use of the feedback: students use the peer feedback as an opportunity to get a better grade on the final work ("to raise the grade", Student 6) or on the contrary ("I could not make improvements in my document and since I had a satisfactory grade I tried to focus on other disciplines," student 8).

The second category (2) 'Teacher feedback', was also divided into the same two subcategories, namely: (2.1) 'Appreciation' (Factors/reasons for positive or negative appreciation of that feedback); and (2.2) 'Usefulness' (Factors/reasons for using (or not) that feedback). In the first subcategory, corresponding to the question "Why did you find the feedback received from your teacher important (or not)?" the 'Type of feedback' is again shown to be a major reason, but only related with positive appreciation, corresponding to a total of 48% of the students. A new reason appears to have an important role (mentioned by 31% of students): the 'Teacher's status.' The teacher's knowledge and experience is not questioned and posi-

tively influences the students' perceptions of the teacher's feedback ("The assessment of the teacher is always more relevant because she has more experience and knowledge," student 21). Therefore teachers are considered to have a higher status than colleagues ("a teacher knows where I was wrong, and her suggestions help more than those of my colleagues, although they also are relevant," student 12).

Subsequently, in the second subcategory, which corresponds to the question "Why did you use / or not the feedback received from your teacher?" the reason 'Evaluation grades' is stated by 31% of the students. As for subcategory 1.2, students use teacher's feedback as an opportunity for improving their grades ("because the suggestions given by the teacher would improve the work, thus I could get better grade", student 13). On the other hand, teacher grades may also be a barrier for the use of the feedback ("I could not make the improvements in my document and, since I had a satisfactory grade, I tried to focus on other disciplines", student 8). Once again, the 'Evaluation grades' proves to be one of the main factors/reasons which influence the use / non-use of the feedback. Other reasons such as time availability, motivation and self-regulation under student appreciation and use of feedback had no weight (very few responses).

As this analysis shows, the importance given to the feedback and its use depends to a large part on the type of feedback. Therefore, the type of feedback has been analyzed. The next section describes the type of feedback given by students using the following categories of the model proposed by Nelson and Schunn (2009) [15].

#### E. Type of feedback given by students

The 39 analyzed documents have intermediate feedback, both from peers and the teacher. In addition to the categories from the Nelson and Schunn model [15], three more aspects were considered in the analysis (see Table I.): the counter-argument by the student-author to the reviewers' feedback, the implementation of that feedback by him/her, and the average grades (both from peers and the teacher).

TABLE I.  
DESCRIPTION OF FEEDBACK ANALYSIS BASED ON THE NELSON AND SCHUNN MODEL [15]

		Peer Reviewer	Teacher
Problems	Summarizations	16	3
	Global	4	6
	Local	85	45
Solutions	Global	3	1
	Local	62	14
	Explanations	25	1
	Praises	62	25
	Mitigations	29	10
	Counter-Argumentation	2	0
	Feedback Implementation	2	1
	Average grades	0,8	0,86

In general, it is possible to observe that peer reviewers used all the presented categories more than the teacher. On one hand, this could be justified by the large number of documents that the teacher had to review and, on the other hand, his/her feedback was given after the peers' evaluation (with no need to be so complete).

The least used aspect of the feedback was summarization. Although students showed capacity to locate general and local problems, they did not show equal competence in presenting solutions for these problems. Students used affective language, praising and justifying their peers' work, resulting in a decrease of any negative feeling from identifying weaknesses and limitations of the work. The counter-argumentation was almost non-existent (2), performed only with peer reviewers.

Only 3 students used the feedback to improve their work. In the particular case of the use of teacher feedback, instead of the peer response, the peer reviewer provided more complete feedback (4 local problem identifications and respective solutions, 1 explanation, 3 praises and 1 mitigation) than the teacher (2 local problem identifications). This could be explained by the perception of the relative importance of the teacher's status versus the peer (see D. Students' perceptions based on qualitative data collection).

In general, this analysis shows that students have fairly good communication skills in the delivery of feedback, since they use all of the categories presented in Nelson and Schunn's model, either from the affective or cognitive domain, although an effort of clarification and specification should be made in the provision of solutions and in the summarization.

In addition, the grades assigned by the teacher and the peers were not significantly different. Applying the test for equal variances, it appears that there is practically no difference between the scores assigned by reviewers and teacher ( $P(T \leq t) = 0.00\%$ ). The marks awarded by teachers vary on the same order of magnitude as the reviewers. That means that, on average, teachers and reviewers-students attributed the same grades, thus showing high homogeneity in the quantitative values assigned.

#### VI. DISCUSSIONS AND LIMITATIONS

From the overall analysis of the activity, it is possible to draw a set of conclusions and some guidelines for future interventions of this type of approach. In the first place, the use of an online environment did not present any difficulty for students, contrary to the thought of Knight & Steinbach [14]. The use of Google Drive allowed all of the planned tasks to be performed and proved satisfactory, as other studies have demonstrated [19][20][13][12]. Students' previous acquaintance with digital instruments was certainly a favorable condition [12]. The support material prepared by the pedagogical team proved to be very important for the realization of the activity, although more time for teacher support the activity was needed.

As for student appreciation and use of feedback, the type of feedback received from reviewers appears to be a critical factor. As the analysis and characterization of the feedback showed, students have a satisfactory level of written communication skills. However, some negative perceptions of feedback remain due to the lack of clarity in some cases, non-specification of problems and of their location as well as no provision of solutions. Thus, from a

pedagogical point of view, and according to Shute [10] and Knight & Steinbach [15], it seems necessary to perform one or more training sessions with students on “what are the characteristics of a good feedback.” These sessions can use a demonstration of good practices, models, key aspects, etc.

Another factor which appears to influence the use (or non use) of peer or teacher feedback is the evaluation grades. The small number of students who used the feedback to improve their work in the analyzed documents (= 3) and the high average (0.86 in a scale from 0 to 1) of the intermediate and final grades assigned by the teacher to each document leads us to consider the importance of testing the following question in future research: how does the intermediate grade evaluation by the teacher influence the use of peer feedback by the student author for improving his/her work?

The final important factor in our analysis appears to be teacher status, specifically the overvaluation of teacher feedback compared with the reviewers, as other studies already have demonstrated [15]. However, when we look at the grades assigned by the teacher and the peers, there was not a significant difference. These results lead us to question the necessity to perform graded assessment of work at the intermediate level by both the teacher and peers (although this would require awareness and credibility of their own grading ability from the students, contrary to their current beliefs).

As a final remark, the large number of responses listed in the sub-category of “general perceptions” did not allow a good comprehension of the students' reasons for appreciating or using feedback. This results from a limitation of the research methodology, which was based exclusively in the use of a single instrument of data collection (in this case, the questionnaire). To overcome this problem, and in an attempt to better understand the perceptions of students regarding the appreciation and the usefulness of the feedback, we suggest the use of other instruments and / or data collection methods such as personal or focus group interviews. We can also consider other instrument of data collection: the documents analyzed. However, another limitation of our study is the fact that the questionnaire was anonymous and we can't do any data correlation between the two instruments.

## VII. CONCLUSIONS AND FUTURE WORK

The results presented here contribute to the body of recent research on web-based peer assessment and offer some new insight. Firstly, digital competencies do not present any difficulty for the realization of the activity. However, good preparation and support guidelines are essential for its success.

Secondly, relevant factors underlying the students' appreciation and usefulness of received feedback, in particular by the peer reviewers, were identified: type of feedback, influence of the teacher status (versus peers), and grades. The written communication skills seem to be quite developed and applied, although they can be improved at the level of summarization and provision of solutions. Thus, it is important to spend more time in developing skills on how to deliver good feedback, improving effective communication, for example by demonstrating successful models and case studies on feedback as well as the benefits of this type of activity.

Finally, the low rate of voluntary feedback leads us to question the influence of intermediate grading in the process, which could be better investigated in future research. Also the high number of indefinite open answers in the analysis of the student perceptions showed methodological limitations in the collection of the data, thus making it necessary to reflect on the use of complementary data collection instruments.

We are deepening the analysis on peer feedback, designing and moving the research to other dimensions such as the effect of online peer assessment on critical thinking, based on Ennis Critical Thinking Taxonomy [22] and Ennis FRISCO Approach [23]. We are actually working with three different groups of students (a. Grades and comment-based assessment; b. Only grades-based assessment; c. Only comment-based assessment) which will allow to compare the students' learning outcomes during the academic semester. We are also collecting data with Cornell Critical Thinking Test [24], as a pre- and post-test, to measure the impact of peer review in the students' critical thinking skills.

## ACKNOWLEDGMENT

Thanks to all the students involved in this case study and to the Pro-Chancellery for Innovation & Information Management of the University of Trás-os-Montes e Alto Douro, Vila Real, Portugal.

## REFERENCES

- [1] L.C. Benson, K. Becker, M.M. Cooper, O.H. Griffin and K.A. Smith. (2010). Engineering education: Departments, degrees and directions. *International Journal of Engineering Education*, vol. 26, no.5, pp.1042-1048
- [2] Andreja Istenic Staicic and Ziga Turk. (2010). Powerful Learning Environment in Engineering Education. In P.Dondon and O.Martin, *Latest Trends On Engineering Education: 7<sup>th</sup> WSEAS International Conference on Engineering Education 2010*, pp 409-416.
- [3] Ray, K. A. (2011). Pedagogic Issues and Technology Assisted Engineering Education. *IEEE International Conference on Technology for Education*, pp. 18-24.
- [4] Allenby, B. (2011). Rethinking engineering education. *Sustainable Systems and Technology (ISSST)*, IEEE International Symposium, pp.1-5.
- [5] Sunthonkanokpong, W. (2011). Future Global Visions of Engineering Education, *Procedia Engineering*, vol. 8, pp. 160-164. <http://dx.doi.org/10.1016/j.proeng.2011.03.029>
- [6] Requena-Carrión, J., Alonso-Atienza, F., Guerrero-Curienes, A., & Rodriguez-González, A. (2010). A student-centered collaborative learning environment for developing communication skills in engineering education. *IEEE EDUCON Education Engineering 2010: The Future of Global Learning Engineering Education*, pp 783-786.
- [7] Calvo, R. A.; O'Rourke, S. T.; Jones, J.; Yacef, K. and Reimann, P. (2011). Collaborative Writing Support Tools on the Cloud. *IEEE Transactions on Learning Technology*, vol. 4(1). pp. 88-97 <http://dx.doi.org/10.1109/TLT.2010.43>
- [8] Kaufman, J. H. & Schunn, C. D. (2011). Students' perceptions about peer assessment for writing: Their origin and impact on revision work. *Instructional Science*, vol. 39, pp. 387- 406 <http://dx.doi.org/10.1007/s11251-010-9133-6>
- [9] Calvo, R. A., & Ellis, R. A. (2010). Students' conceptions of tutor and automated feedback in professional writing. *Journal of Engineering Education*, 99(4), 427-438 <http://dx.doi.org/10.1002/j.2168-9830.2010.tb01072.x>
- [10] Shute, V. (2008). Focus on formative feedback. *Review of Educational Research*, March 2008, 78 (1), pp. 153-189 <http://dx.doi.org/10.3102/0034654307313795>

- [11] Lowry, P.B., Curtis, A., & Lowry, M.R. (2004). Building a Taxonomy and Nomenclature of Collaborative Writing to Improve Interdisciplinary Research and Practice. *Journal of Business Communication*, 41, 66-99. <http://dx.doi.org/10.1177/0021943603259363>
- [12] Brodahl, C., Hadjerrouit, S., & Hansen, N.K. (2011). Collaborative Writing with Web 2.0 Technologies: Education Students' Perceptions. *Journal of Information Technology Education: Innovations in Practice*, 10, 73-103.
- [13] Blau, I. & Caspi, A. (2009). Sharing and Collaborating with Google Docs: The influence of Psychological Ownership, Responsibility, and Student's Attitudes on Outcome Quality. Em T. Bastiaens (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, 3329-3335. Chesapeake, VA: AACE.
- [14] Knight, L. & Steinbach, T. (2011). Adapting Peer Review to an Online Course: An Exploratory Case Study. *Journal of Information Technology Education*, V. 10, 81-100.
- [15] Nelson, M. M., & Schunn, C. D. (2009). The nature of feedback: How different types of peer feedback affect writing performance. *Instructional Science*, 27(4), 375-401. <http://dx.doi.org/10.1007/s11251-008-9053-x>
- [16] Sithiworachart, J., and Joy, M. (2003). Web-based Peer Assessment in Learning Computer Programming. *Advanced Learning Technologies*, the 3rd IEEE International Conference on Advanced Learning Technologies: ICALT03, Athens, Greece, 9-11 July 2003.
- [17] Sternberg, R. J. (2002). On civility in reviewing. *APS Observer*, 15(1). Roediger, H. L. (2007). Twelve Tips for Reviewers. *APS Observer*, 20(4), 41-43.
- [18] Rienzo, T., & Han, B. (2009). Microsoft or Google Web 2.0 tools for course management. *Journal of Information Systems Education*, 20(2), 123-128
- [19] Chu, S., Kennedy, D., & Mak, M. (2009). MediaWiki and Google Docs as online collaborative tools for group project co-construction. *Proceedings of the 2009 International Conference on Knowledge Management [CDROM]*. Hong Kong
- [20] Cruz, G.; Dominguez, C.; Pedrosa, D.; Maia, A. (2012). A avaliação entre pares com recurso ao Google Docs: um estudo de caso exploratório num curso de Licenciatura em Engenharia Civil, in *Livro de Atas - Conferência Ibérica em Inovação na Educação com TIC - Bragança*.
- [21] Google. "Create Documents, Spreadsheets and Presentations Online", Google Drive, Google. 2012. <http://drive.google.com/> (retrieved 2012-09-11)
- [22] Ennis, R. H. (1987). A taxonomy of critical thinking dispositions and abilities. In J. Baron & R. Sternberg (Eds.). *Teaching thinking skills: Theory and practice* (pp. 9-26). New York: W. H. Freeman.
- [23] Ennis, R. H. (1996). *Critical thinking*. Upper Saddle River, NJ: Prentice Hall.
- [24] Ennis, R. H. & Millman, J. (1985). *Cornell Critical Thinking Test, Level X*. Pacific Grove, CA: Midwest Publications.

## AUTHORS

**Gonçalo Cruz** is a research fellow at University of Trás-os-Montes e Alto Douro (UTAD), in Vila Real, Portugal, where he works as e-learning consultant. In 2011, Gonçalo concluded his Masters in Educational Sciences by the University of Coimbra. His main research interests are Distance Learning, Technology Enhanced Learning, Virtual Worlds and e-learning institutional adoption. Currently, Gonçalo is a PhD student in Didactics of Science and Technology at UTAD (e-mail: goncaloc@utad.pt).

**Caroline Dominguez** is a researcher at C-MADE and has been a lecturer at the University of Trás-Montes e Alto Douro (UTAD) since 1995, in Vila Real, Portugal, where she teaches business management. Her main research interests are related to educational issues, project and quality management, and human resources. Before pursuing an academic career, she was the head manager of organizations dealing with development issues in Peru and Portugal, where she developed and implemented various international funded projects. (e-mail: carold@utad.pt).

**Ana Maia** is a research fellow at CIDTFF and University of Trás-os-Montes e Alto Douro (UTAD), in Vila Real, Portugal, where she works as e-learning consultant. In 2011, Ana Maia concluded her Masters in Educational Sciences by the University of Coimbra. Her main research interests are Distance Learning, Technology Enhanced Learning, Virtual Worlds and Learning Design. Currently, Ana is a PhD student in Didactics of Science and Technology at UTAD (e-mail: margaridam@utad.pt).

**Daniela Pedrosa** is a research fellow at CIDTFF and University of Trás-os-Montes e Alto Douro (UTAD), in Vila Real, Portugal, where she works as e-learning consultant. In 2012, Daniela Pedrosa concluded her Masters in Educational Sciences by the University of Coimbra. Her main research interests are Distance Learning, Technology Enhanced Learning, Virtual Worlds and Learning evaluation. Currently, Daniela is a PhD student in Didactics of Science and Technology at UTAD (e-mail: dpedrosa@utad.pt).

**Gordon Grams** has been a lecturer at University of Trás-os-Montes e Alto Douro (UTAD) since 2006, in Vila Real, Portugal, where he teaches English for professional purposes. His main interests are in cognitive awareness and educational methodology. Before pursuing an academic career he worked in personal and professional development and industrial safety and health. (e-mail: gordon@utad.pt).

This article is an extended and modified version of a paper presented at the IGIP2012 conference, held 26 - 28 September 2012, in Villach, Austria. Received 01 December 2012. Published as resubmitted by the authors 28 January 2013.