An Online Assessment and Feedback Approach in Project Management Learning

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Abstract: This work presents an online system to facilitate the assessment and feedback in project management education. Students are involved in real-world engineering projects in order to promote professional project management learning. Thus, students share an experience in executing and managing projects and are able to put into practice different skills and competences that a project member should possess in the development of a project. The proposed system considers competence assessment through different pieces of evidence that are pertinent to each assessed competence. Information from the three main actors in learning activities (teacher, peer, and learner) is collected by means of specifically developed online forms. All the gathered evidences are considered in a weighted integration to yield a numerical assessment score of each competence that is developed for each student. Furthermore, three different types of feedback are implemented and provided several times in order to promote and improve students' learning. Data analysis from a specific academic course suggest that the presented system has a positive impact on students' academic performance.

1 INTRODUCTION

Assessment can strongly influence the learning process. In fact, it is well-known that what influence students most is not the teaching but the assessment (Snyder, 1971; Miller and Parlett, 1974; Black and Wiliam, 1998; Gibbs and Simpson, 2004; Andersson and Palm, 2017). Each assessment has different goals and occurs in specific contexts, and the design must adapt to changing circumstances, while meeting the challenges of scientific credibility (Tridane et al., 2015). In the academic literature, two major forms of assessment are identified:

- **Summative assessment** or *assessment of learning*, which measures a student's learning at the end of a period of instruction. In general, summative assessment includes scoring for the purposes of awarding a grade or other forms of accreditation (Gikandi et al., 2011). This is the traditional and conventional form of assessment.
- **Formative assessment** or *assessment for learning*, which is concerned with the promotion of learning during a period of instruction. Research shows that formative assessment can be related to *self-regulated learning* (Nicol and Macfarlane-Dick, 2006; Black and Wiliam, 2009; Clark, 2012; Meusen-Beekman et al., 2016), which can be described as "an active, constructive process whereby learners set goals for their learning and attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and contextual features in the environment" (Pintrich, 1999).

Formative assessment is, without a doubt, a powerful tool to positively impact on students' learning and achievements. According to Black and Wiliam (2009), there are five key strategies for implementing formative assessment:

1. Clarifying and sharing learning intentions and criteria for success;
2. Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding;
3. Providing feedback that moves learners forward;
4. Activating students as instructional resources for one another; and
5. Activating students as the owners of their own learning.

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These strategies involve the three main actors in learning activities: teacher, peer, and learner. Furthermore, they are consistent with other studies that examine different mechanisms for providing formative assessment, such as feedback (Shute, 2008; Strudwick and Day, 2015), self-assessment (Panadero et al., 2014; Ross, 2006), and peer-assessment (Gielen et al., 2010; van Zundert et al., 2010).

Aligned with the five strategies put forth by Black and Wiliam (2009), this paper presents an online system for assessment and feedback in Project Management education beyond the stage reached in our previous work (González-Marcos et al., 2015). The question to be addressed is the following:

- *Does the proposed system for assessment and feedback promote students to improve their academic performance?*

The organization of the remainder paper is as follows: Section 2 is dedicated to briefly describe the designed assessment and feedback system. Section 3 presents how the system is implemented. Section 4 provides the results observed in the academic course analyzed. Finally, Section 5 discusses some general conclusions and presents future work.

2 THE ASSESSMENT AND FEEDBACK SYSTEM

Our previous work on assessment of project management competences (González-Marcos et al., 2015) focused on the methodology for gathering and integrating information about the individual performance of students in order to obtain numerical assessment values of each competence. The purpose of this paper is to present an improved version of our assessment and feedback system, as well as to analyze its impact on students' academic performance.

As mentioned in the previous section, the proposed online system is based on the five key strategies identified by Black and Wiliam (2009) because our goal is to carry out formative assessment. How those strategies are implemented is explained below.

1. Clarifying and sharing learning intentions and criteria for success

The course contains the following materials:

- Assessment procedures and instruments. This document presents the competences to be assessed during the semester, the instruments (forms, audits, etc.) used to collect information, and how all this information is integrated to provide individual scores for the assessed competences. Furthermore, it explains how the feedback is provided.
- Specific procedure manuals that describe the responsibilities of each role, explain how to operate, how to do things, how to communicate mandatory information, etc.
- Quality criteria for management products. This document defines the requirements that the management products created during the project should fulfill.
- Quality criteria for management processes. This document provides the quality criteria for what is considered good practice standards.
- Assessment checklists and rubrics used to assess the project management competences.

The first module of the course is dedicated to explain the methodology that will be used during the semester, as well as to clarify goals and success criteria. Thus, students become familiar with the course objectives and requirements for success from the beginning of the semester, besides basic project management concepts or the use of the web-based learning environment.

2. Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding

In order to be aligned with the real environment in project management and provide an authentic context, students are involved in real-world engineering projects. These projects are oriented to learning about the professional project management methodology PRINCE2 ™(Project IN Controlled Environments) (Office Of Government Commerce, 2009). According to this methodology, a project is split into multiple phases or stages that do not overlap (Figure 1). Between each phase the outcome of the prior phase is evaluated and it is considered if the plans for the upcoming phase might need to be modified.

Students, as in professional projects, assume different roles with different responsibilities in the project team. Thus, they adopt an active role during the learning process and are able to put into practice different skills and competences that a project member (project manager, team manager, etc.) should possess in the development of a project.

In summary, students are *situated* in a *project* development process that is interesting and useful to them and in which their individual differences are considered. Furthermore, *self-directed learning, learning by doing and a sense of responsibility are fos-*

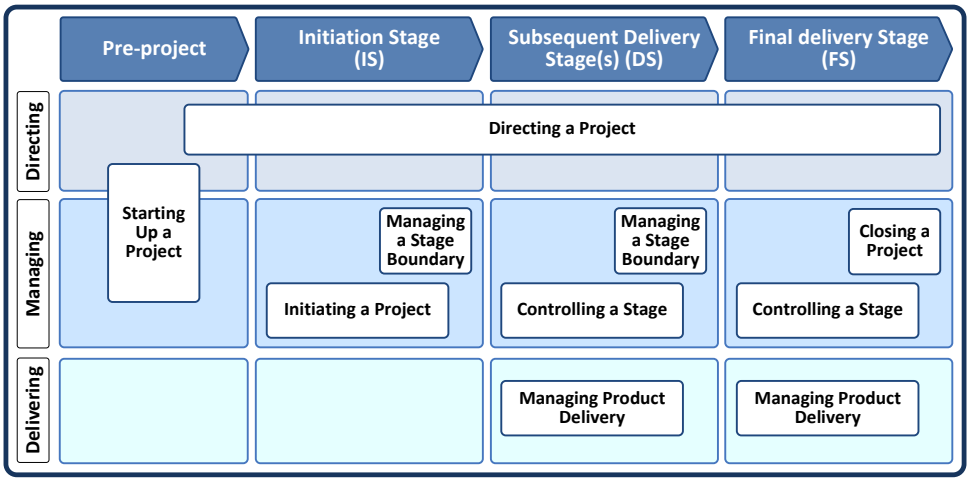

Figure 1: The PRINCE2 Process Model (Source: Office Of Government Commerce, 2009).

tered. A detailed description of the learning environment adopted can be found in (González-Marcos et al., 2016).

3. Providing feedback that moves learners forward

Within the literature there is general agreement that high quality feedback to students on their assessments is important and is of benefit to their future learning (Strudwick and Day, 2015). Feedback is not only regarded as crucial to improve knowledge and skill acquisition, i.e. achievement, but also depicted as a significant factor in motivating learning (Shute, 2008).

It is also recognized that effective feedback is not only based on monitoring progress toward the specific learning goals but also focuses students on specific strategies for improvement (Brookhart et al., 2010; Gikandi et al., 2011). Consequently, effective feedback should deliver high quality information to students about their learning, as well as provide opportunities to close the gap between current and desired performance, among others (Nicol and Macfarlane-Dick, 2006).

In our case, there are three different types of feedback provided to students about their performance:

- Feedback on student activities within the developed web-based environment. An auditing tool was developed to automatically check the integrity of performed actions and procedures, such as work planning and proper effort allocation, document consistency, correct use of the collaborative tools, etc. Students are able to order an online self-audit based on these automatic checks at any time. Therefore, they can identify their mistakes and improve their performance.
- Feedback on the contribution of each product or procedure to the effort claimed by each student. Students can gather detailed –tabular and graphical– information about what product(s) and competence(s) affected their current scores. This information is provided at least three times during project execution (one per project life cycle phase).
- Lessons learned. Also conducted at the end of each project phase, a lessons learned review is provided to each project through the web-based environment. This report, which is based on actual project performing, identifies good and poor practices over the course of each project phase. Furthermore, each lessons learned report is analyzed in specific sessions to collectively discuss what is working and what is not working well. It is not possible to rebuild the already delivered and approved items, but this feedback provides advice on how to proceed and how to improve in the future.

4. Activating students as instructional resources for one another

Peer-assessment can be defined as an arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status (Topping, 1998). Although peers are not domain experts, the use of peer-assessment and feedback can be beneficial for learning, not only for the receiver but also for the peer assessor (van den Berg et al., 2006; Gielen et al., 2010; Tenório et al., 2016; Topping, 1998). Furthermore, peer-assessment can be regarded as a form of collaborative learning (Falchikov, 2001; van Gennip et al., 2010).

In our case, each student is assessed by all the other students of the project interacting with the student in question for a given competence. The peer-assessment is carried out by means of different forms, by means of at least one piece of evidence clearly having those criteria determining the maximum degree of performance specified therein. Thus, the proposed system collects evidence-based opinions about the products being produced and how the team is managing the project.

5. Activating students as the owners of their own learning

Findings from research conducted on self-assessment (Andrade and Du, 2007; Boud, 1995; Panadero et al., 2014; Ross, 2006) show that self-assessment contributes to higher student achievement and improved behavior. Since self-assessment requires students to reflect on their own work and judge the degree to which they have performed in relation to explicitly stated goals and criteria, they have the opportunity to identify strengths and weaknesses in their work (Andrade and Du, 2007) and, thus, what constitutes a good or poor piece of work.

Taking into account that self-assessment can have positive benefits for the students' learning process, the proposed assessment and feedback system also considers the opinions from those students who produce a product or are responsible for its process implementation.

In summary, our proposal gathers information from the three main actors in learning activities (teacher, peer, and learner) to assess each student's performance. Therefore, the proposed assessment and feedback system uses some kind of 360-degree overview of different activities inside the project. All the collected evidences are considered in a weighted integration to yield a numerical assessment score of each competence that is developed for each student.

3 IMPLEMENTATION OF THE PROPOSED ONLINE SYSTEM

The online assessment and feedback system was created by integrating information gathered from the following open source tools:

- A project and portfolio management software (http://www.project.net) that provides the necessary project management tools, as well as some collaborative tools such as blogs, document repository, etc. The lessons learned reports mentioned in Section 2 are provided through the project's blog of this web-based software.
- A survey collector (https://www.limesurvey.org) that contains the designed forms to conduct the proposed assessments. Teachers, learners and peers use the same assessing forms.

AUTOMATICALLY GATHERED DATA

Number of Project Members (PM and TM)
8

Current Stage (stage number)
IS: Initiation Stage (0)

Current Process
IP: Initiating a Project

Process Start Date (creation date of the process)
2016-10-14 (2016-10-14 13:07:11)

Number of DS stages defined

ACTUAL STAGE DATA

Current phase correctly defined (name and progress reporting method)
YES

Number of summary tasks defined in current phase
3

Number of tasks defined in current phase (Number of delayed tasks)
18 (7)

Number of tasks defined in current phase that will NOT PRODUCE any deliverable (it should be 0)
4 (22.22%)

Number of tasks defined in current phase with no personal assignments (it should be 0)
5 (27.78%)

Number of milestones defined in current phase (Number of delayed milestones)
1 (0)

Number of deliverables defined in current phase
13

Number of management (mandatory minimum) / specialist deliverables correctly defined in current phase
13 (13) / 0

Figure 2: Partial view of an audit report with data automatically gathered from a project.

The developed assessment and feedback tool (P2ML) – which was build by means of CakePHP (http://cakephp.org) – was designed to communicate with the aforementioned open source tools and to provide feedback as described in Section 2. The first type of feedback is based on student activities within the developed web-based environment. Figure 2 shows a partial view of the audit report about the integrity of performed actions and procedures that each student can order at any time. Text is displayed in red when the system identifies mistakes, inconsistencies or inappropriate behaviors.

The second type of feedback is concerned with the contribution of each product or procedure to the effort claimed by each student. Detailed information about students' performance is updated at least at the end of each project phase. Thus, besides tabular information, different graphical views are provided to illustrate the performance evolution of each student:

- First, each student is able to identify what project management competences were developed during the project execution, as well as to compare his or her performance to the average of the students with the same role. In the case of the proposed system, the reference framework used as a reference for competences was the IPMA Competence Baseline (ICB) (Caupin et al., 2006). The IPMA Competence Baseline is the common framework document that all IPMA Member Associations and Certification Bodies abide by to ensure that consistent and harmonized standards are applied.

  Figure 3 illustrates the individual scores evolution for each assessed competence for two different students that adopted the same role (Project Manager, PM). It is possible to observe, for example, that the first student was involved in activities that required the development of a wide variety of competences, whereas the second student focused on specific activities and developed a smaller number of competences. In this case, detailed information was provided for each PRINCE2 process (see Figure 1).
- In addition to competence assessment details, the online system also provides a unique, numerical, global score for each student. For example, Figure 4 shows the global score obtained by a student (red circle) against the effort claimed by he or she. The size of the circle is related to the efficiency of the student, i.e., it indicates how well a student was able to finish their assignments within the adequate time. This plot also allows students to anonymously compare their performance to that of the other students.
- Finally, the system provides the learning curve through project execution for each student. Figure 5 illustrates the learning curve for the same student shown in Figure 4. In this case, detailed information was also provided for each PRINCE2 process. This plot represents the increase (or decrease) of learning (global score) with experience (claimed effort).

Table 1: Descriptive statistics of efficiency for each project stage

Stage	Mean	SD
IS00	52.88	14.41
DS01	61.43	9.83
FS02	67.43	8.06

4 RESULTS AND DISCUSSION

In this section we examine *whether the proposed system for assessment and feedback promote students to improve their performance*. Since the system provides information at least three times during the execution of a project, one per project life cycle phase (or stage), the analysis of differences in students' academic performance is performed at the end of each executed stage (IS00, DS01 and FS02).

The participants in this study were 42 engineering students from the University of La Rioja (UR). These engineering students were either undergraduates in their fourth year (26 students) or first-year masters degree students (16 students) who were enrolled in project management courses scheduled for the fall semester.

Table 1 shows the descriptive information of efficiency scores for each project stage. In this work, the efficiency is defined as the ability to accomplish high quality tasks (project products, management activities, etc.) within the adequate time and effort. These results indicated an improvement in students performance with every stage, i.e., after each assessment and feedback.

The distribution of the efficiency scores of students through the project execution is presented in figure 6. Data analysis was carried out by means of boxplots because they are a way of summarizing a distribution. A boxplot (also known as a box and whisker plot) is interpreted as follows:

- The box itself contains the middle 50% of the data. The upper edge (hinge) of the box indicates the 75th percentile of the data set, and the lower hinge indicates the 25th percentile.
- The line in the box indicates the median value of the data.
- The ends of the horizontal lines or *whiskers* indicate the minimum and maximum data values.
- The points outside the ends of the whiskers are outliers or suspected outliers.

Comparing the boxplots across groups, a simple summary is to say that the box area for one group is

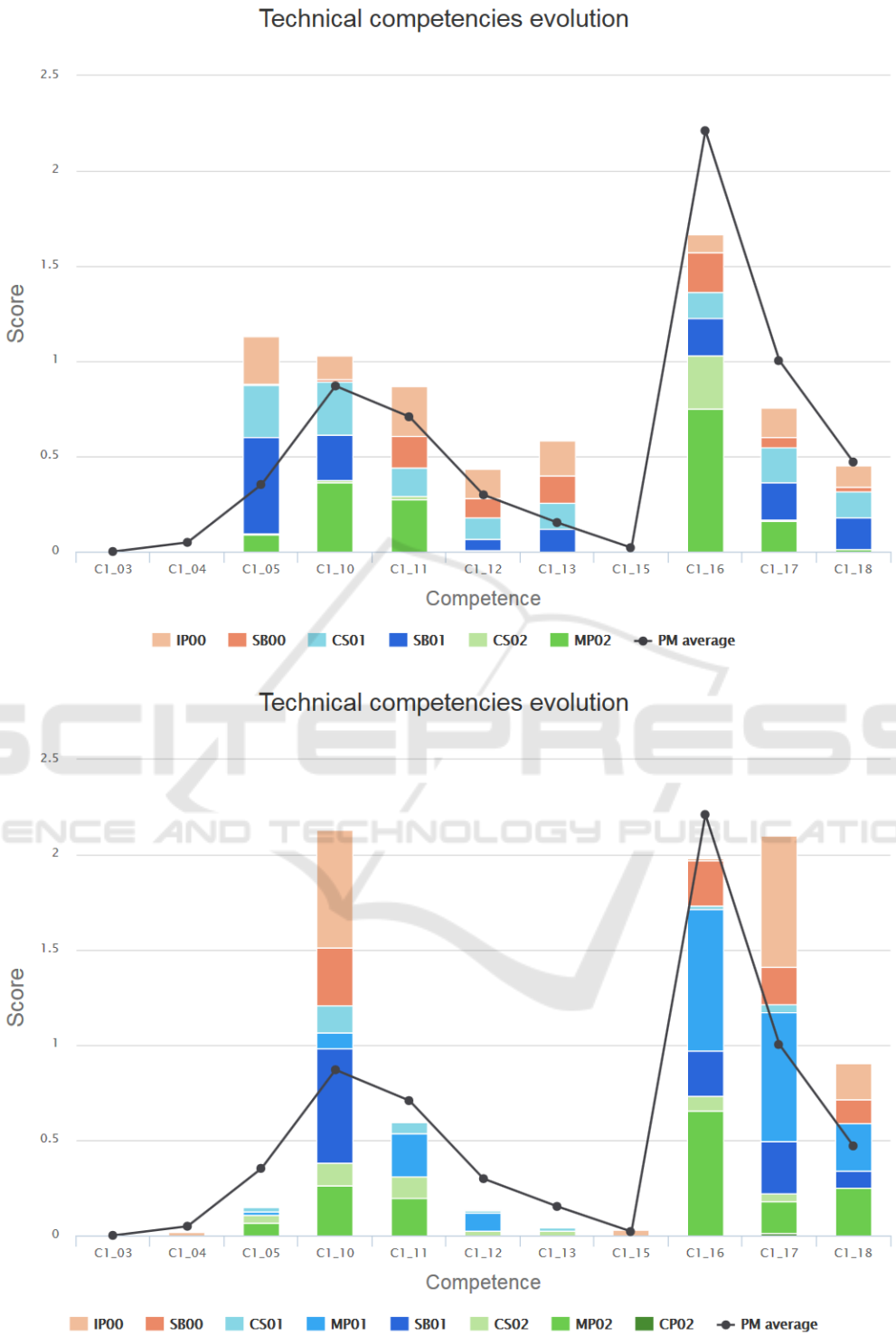

Figure 3: Examples of the *technical competences evolution* plot for two students with the same role (Project Manager, PM).

higher or lower than that for another group. To the extent that the boxes do not overlap, the groups are quite different from one another. Figure 6 illustrates the continuous and global improvement in students performance with every stage. Since the feedback was provided at the end of each project stage, these results

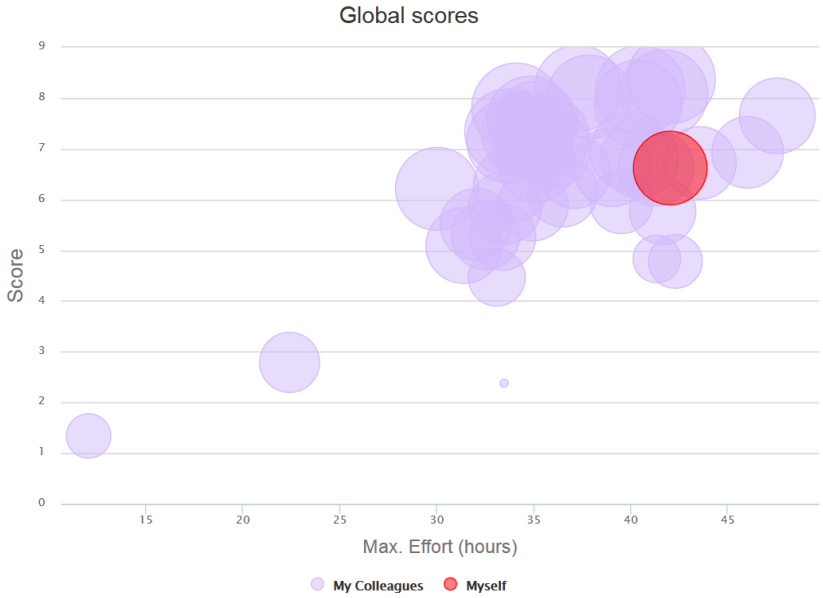

Figure 4: Example of the *global scores* screen for a student.

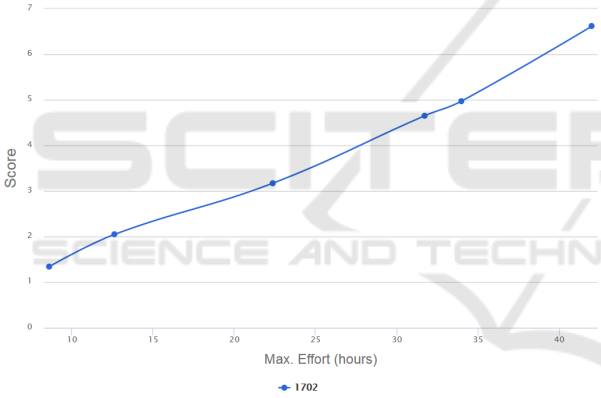

Figure 5: Example of the *learning curve* for a student.

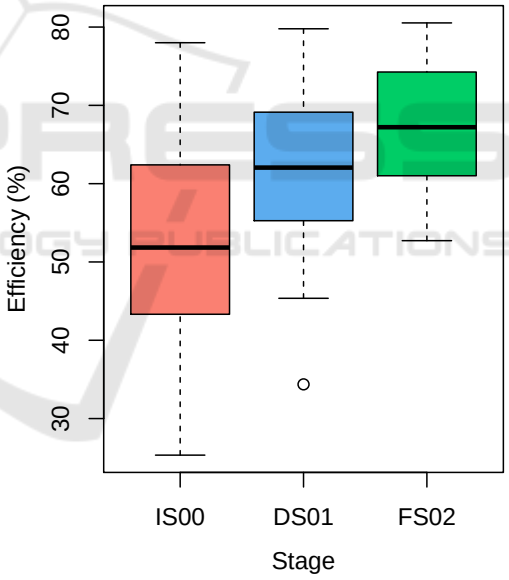

Figure 6: Evolution of students' performance during the course.

suggest that the proposed combination of different types of feedback has a positive impact on students' performance.

In order to determine the statistical difference of the efficiency observed after each project stage, i.e., after each assessment and feedback, the non-parametric Wilcoxon signed-rank test was employed because a normal distribution cannot be assumed. The level of significance (alpha) was determined to be 0.05. As shown in table 1 and figure 6, the results obtained for the students at the end of the second stage (DS01) were superior to the ones obtained by them at the end of the first stage (IS00). In the same way, the results obtained by the students at the end of the third stage (FS02) were also higher than the ones obtained at the end of the second stage (DS01). All the differences observed where significant in the corresponding Wilcoxon signed-rank test (DS01-IS00, $Z = 7.37$, $p < 0.001$; FS02-DS01, $Z = 8.15$, $p < 0.001$). This fact, seems to corroborate the hypothesis that the proposed assessment and feedback systems is useful for the students to improve their performance in project management.

In summary, tracking students performance by means of the provided numerical and graphical information enables each student to identify strengths and weaknesses in his or her work. On the other hand, the

lessons learned reports, which identify what is considered as good and poor practices, provide advice on how to proceed in the future. Thus, students have the opportunity to close the gap between current and desired performance on a stage per stage basis, at least.

Although caution must be taken and further research should be conducted, it is worth mentioning that informal conversations with students revealed that comparison of each students' performance with that of their peers, which is possible by means of the provided plots, seems to play an important role in students' motivation.

5 CONCLUSIONS

This paper has presented an online system for assessment and feedback in learning project management. The proposed system considers competence assessment through a set of performance indicators that are pertinent to each assessed competence. Information, which is collected by means of specifically developed online forms, is not only sought from those who produce a product or are responsible for its implementation (the learner), but also from the other main actors in learning activities, i.e., the teachers and the peers. Thus, all of the numerical data that have been gathered are considered in a weighted integration to yield a numerical assessment score of each competence that is developed for each student. On the other hand, three different types of feedback are implemented and provided several times in order to promote and improve students' learning.

Data analysis from a specific academic course suggest the proposed system has a positive impact on students' performance. Another interesting result is the effect on students' motivation that seems to have the proposed feedback system.

Authors planned to conduct further research with a greater number of students. Also, we consider it necessary to carry out a deep quantitative analysis of the collected data to better identify factors influencing improvements in students' performance.

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REFERENCES

Andersson, C. and Palm, T. (2017). The impact of formative assessment on student achievement: A study of the effects of changes to classroom practice after a comprehensive professional development programme. *Learning and Instruction*, 49:92–102.

Andrade, H. and Du, Y. (2007). Student responses to criteria-referenced self-assessment. *Assessment and Evaluation in Higher Education*, 32(2):159–181.

Black, P. and Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice*, 5(1)(1):7–74.

Black, P. and Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*, 21(1):5–13.

Boud, D. (1995). *Enhancing learning through self-assessment*. Kogan Page, London.

Brookhart, S. M., Moss, C. M., and Long, B. A. (2010). Teacher inquiry into formative assessment practices in remedial reading classrooms. *Assessment in Education: Principles, Policy & Practice*, 17(1):41–58.

Caupin, G., Knoepfel, H., Koch, G., Pannenbcker, K., Perez-Polo, F., and Seabury, C. (2006). *IPMA Competence Baseline, version 3*. International Project Management Association.

Clark, I. (2012). Formative assessment: Assessment is for self-regulated learning. *Educational Psychology Review*, 24(2):205–249.

Falchikov, N. (2001). *Learning Together*. RoutledgeFalmer, London.

Gibbs, G. and Simpson, C. (2004). Conditions under which assessment supports students learning. *Learning and Teaching in Higher Education*, 1:3 – 31.

Gielen, S., Peeters, E., Dochy, F., Onghena, P., and Struyven, K. (2010). Improving the effectiveness of peer feedback for learning. *Learning and Instruction*, 20(4):304–315.

Gikandi, J. W., Morrow, D., and Davis, N. E. (2011). Online formative assessment in higher education: A review of the literature. *Computers and Education*, 57(4):2333–2351.

González-Marcos, A., Alba-Elías, F., Navaridas-Nalda, F., and Ordieres-Meré, J. (2016). Student evaluation of a virtual experience for project management learning: An empirical study for learning improvement. *Computers & Education*, 102:172–187.

González-Marcos, A., Alba-Elías, F., and Ordieres-Meré, J. (2015). An analytical method for measuring competence in project management. *British Journal of Educational Technology*, 47(6)(6):1324–1329.

Meusen-Beekman, K. D., Joosten-ten Brinke, D., and Boshuizen, H. P. A. (2016). Effects of formative assessments to develop self-regulation among sixth grade students: Results from a randomized controlled intervention. *Studies in Educational Evaluation*, 51:126–136.

Miller, C. M. L. and Parlett, M. R. (1974). *Up to the Mark: A Study of the Examination Game*. Society for Research into Higher Education.

Nicol, D. J. and Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2):199–218.

Office Of Government Commerce (2009). *Managing Successful Projects with PRINCE2(TM)*. Office Of Government Commerce.

Panadero, E., Alonso-Tapia, J., and Huertas, J. A. (2014). Rubrics vs. self-assessment scripts: effects on first year university students' self-regulation and performance. *Infancia y Aprendizaje*, 37(1):149–183.

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research*, 31(6):459 – 470.

Ross, J. (2006). The reliability, validity, and utility of self-assessment. *Practical Assessment, Research & Evaluation*, 11(10):1–13.

Shute, V. J. (2008). Focus on Formative Feedback. *Source: Review of Educational Research*, 78228173(1):153–189.

Snyder, B. R. (1971). *The Hidden Curriculum*. MIT Press, MA.

Strudwick, R. and Day, J. (2015). Developing effective assignment feedback for an interprofessional learning module-An action research project. *Nurse Education Today*, 35(9):974–980.

Tenório, T., Bittencourt, I. I., Isotani, S., and Silva, A. P. (2016). Does peer assessment in on-line learning environments work? a systematic review of the literature. *Computers in Human Behavior*, 64:94–107.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research*, 68(3):249–276.

Tridane, M., Belaaouad, S., Benmokhtar, S., Gourja, B., and Radid, M. (2015). The Impact of Formative Assessment on the Learning Process and the Unreliability of the Mark for the Summative Evaluation. *Procedia - Social and Behavioral Sciences*, 197(February):680–685.

van den Berg, I., Admiraal, W., and Pilot, A. (2006). Design principles and outcomes of peer assessment in higher education. *Studies in Higher Education*, 31(3):341–356.

van Gennip, N. A., Segers, M. S., and Tillema, H. H. (2010). Peer assessment as a collaborative learning activity: The role of interpersonal variables and conceptions. *Learning and Instruction*, 20(4):280–290. Unravelling Peer Assessment.

van Zundert, M., Sluijsmans, D., and van Merrinboer, J. (2010). Effective peer assessment processes: Research findings and future directions. *Learning and Instruction*, 20(4):270–279. Unravelling Peer Assessment.