Individual Assessment Procedure and its Tools for PBL Teamwork*

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Project Based Learning (PBL) is a methodology that requires students working in teams. Based on the Agile philosophy, this article presents a procedure (and its tools) to assess individuals in a team based on, not only the final project, but on the process, where each contribution to joint work is better seen. Students are asked to fix SMART objectives, tasks, dates and people in charge for each one and include it in the project status table. Students make weekly follow up meetings (with or without the teacher) to share and review information, results and project process. Portfolio including the meetings minutes, peer and self-assessment of teamwork and project status table provides teachers a rich information to evaluate students and give them feedback. This iterative process of continuous review and short-design time frames helps the team to quickly adapt the projects and the teachers to detect team problems. We propose two rubrics: one to assess individually teamwork using a peer and self-assessment; another to evaluate learning outcomes in each the delivery, both individually and within the team. Teachers' and students' perceptions while using this Agile methodology have been collected from a qualitative approach. Proposed rubrics along the whole process give the required feedback to teachers and students making a 360° assessment and introduces individual assessment of learning outcomes. Overall, the results obtained are quite positive in terms of working atmosphere, quality of the work, learning outcomes achieved and assessment. However, a careful planning and assessment is needed.

Keywords: project-based learning; teamwork; agile methodologies; scrum methodology; assessment; rubrics

1. Introduction

Project Based Learning (PBL) is an active learning methodology widely used in engineering to stimulate learning improving student motivation and engagement [1–4] that also helps to the develop key skills and competences among students [5]. Under the EHEA (European Higher Education Area) approach, the School of Engineering, Architecture and Design of the Universidad Europea de Madrid (UEM) changed its academic model (in the degrees belonging to four fields of study: Information and Communications Technology (ICT), Industrial, Aerospace and Civil Engineering). So, the teaching-learning methodology on which the degrees of the School pivots would be the PBL. Students will carry out one team project per year during the first three years of each degree (last year students develop the final degree project). Teams must give a solution to an open-ended problem formulated as an engineering project. Final deliveries to the teachers are a physical product and its documentation per team. However, teachers are aware that not all the students of a team have worked to the same extent, nor have acquired the same skills and of course they have not reached the same level in their learning outcomes. On the other hand, being a member of an ineffective team affects negatively the students'

attitude about the teamwork and, as a result, they get worst results.

Therefore, teachers have an important concern when setting up the assessment procedures for the PBL, so each individual student feels that its contribution is important. To do so not only assessment procedures are important but also to give each student a different mark depending on their involvement in the project. On the other hand, to promote the students' learning teachers must use a well-designed system of formative assessment. When teachers are effective assessing learning outcomes, students are more motivated, and this has a positive impact in their learning [6].

The aim of this paper is to present the procedure designed to focus the teamwork of the students on the process rather than on the final project. This procedure is based on Agile methodologies, in particular the Scrum methodology [7], with the ultimate goal of:

- helping students better organize their teamwork by holding them accountable for their contribution,
- facilitating teachers to follow-up students individually during the project teamwork,
- allowing teachers to assess the contribution of each student during the project development, providing them with the tools needed not only

for the final project but also for the intermediate deliveries.

2. Framework

Team work is widely used in the teaching context. However, sometimes it is not team work but group work what the students do. So, the first step should be to explain students the difference between a group and a team. Groupwork consists of partial tasks distributed individually that are joined together for a final product. In teamwork responsibilities can also be distributed, but since everyone have the same objective, the final product is made among all team members. In teamwork, they share goals and they are bound by their commitment to reach them. Each individual work has an impact on that of the others, leading to a unique result for the team. So, despite the benefits of team projects in the students' learning, problems raise when thinking in the assessment of the individual development within the teamwork context. If this assessment is not fair, there is a decrease of individual effort in the team [8]. Students with better results and behavioural habits are more satisfied with the assessment when they feel that their individual effort is awarded, but also team assessment helps to promote positive interdependence in those with worst results [9].

In the literature, we can find quite a lot of experiences about teamworking assessment as a competence [10, 11]; but still remains the debate about which is the best way of organizing, handling and assessing students in a team work [12–14]. Besides, in the field of engineering, several experiences can be found using peer-assessment techniques [15, 16]. Since 1974, at Aalborg University, where programs are based on PBL, they have been changing assessment procedures and, today, as peer assessment is not legally allowed, the students make a team oral presentation where each student is asked to answer questions about the project individually.

In our experience within a Project Based School [3], which started in 2013, also problems within the assessment have come up at the beginning. To address them, the assessment procedure presented here was designed, developed and implemented gradually over the last years. The idea that a student has of what they have to learn depends not so much on what the teacher says, but on how they are evaluated. So, to motivate students to have a deeper learning, the assessment procedures must be not only useful to the teachers in their teaching, but rewarding for the students in their learning, being a guidance for both in their actions [15]. These assessment procedures are therefore more important, if possible, in teamwork. Within a team, students must feel that their individual learn-

ing efforts are considered. Thus, assessing individuals based on their contribution to joint work and in terms of their individual learning outcomes is very important. Consequently, there should be a monitoring of the entire process associated with the project. That means not only those outcomes product related but also process or participation related. So, individuals will see their effort rewarded or, the lack of effort punished when assessing the quality of the performance related to the process [17].

3. Procedure for an Effective Teamwork and its Assessment during the Project

Projects within the PBL involve some learning objectives and several learning activities must be done. But, to develop the project within a team means not only focusing on the final result but also in the process and partial results to get it. Therefore, assessment will have to consider two components: the product and the process.

The product is what the team will deliver at the end of the process. It can be a report, an oral presentation and/or a product that works. The process is the way by which the team organizes the project making and the different partial deliveries, that means, the meetings, the schedule, the tasks, etc. This is an important part to be assessed individually if we want our students to be aware that they will get an individual mark for their job in the project. Therefore, a procedure focused on the process, such as that of Agile or Scrum methodologies [7, 18, 19], is needed.

3.1 Introduction of Scrum and Agile Methodology for the Students' Project Management

To facilitate the process of the project development, Agile methodologies like Scrum [18, 19] are explained to our students. We explain them that Scrum is defined as "a framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value" [7]. It is based on the fact that the greatest effort should not be invested in the long-term planning of the project but rather in establishing objectives focused on what the customer wants. This requires continuous iterations during the process making the needed changes in the initial plan to get the final solution. Agile philosophy emphasizes that the risk is minimized by focusing on iterations made on short-term defined goals with well-defined deliverables. In that way, teams can quickly adapt to any change in the requirements. Scrum methods are based on the rugby term: restart the game after an interruption. The heart of the Scrum lies in the iteration of the process, so the
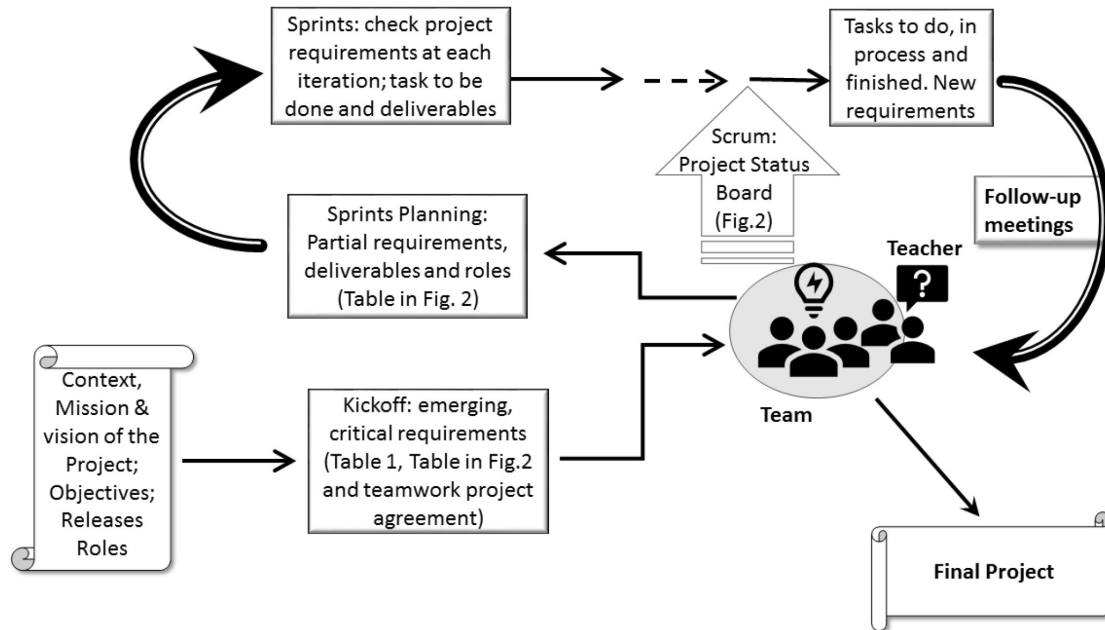
Fig. 1. Scrum process adapted to the PBL academic context.

project, the team and the working environment can be improved. This process is based in five activities:

- kickoff where goals are defined;
- iterations (sprint) planning: where the team defines the project requirements at each stage;
- iteration (sprint): the team decides the next steps to be done and deliverables before next meeting;
- daily Scrum using dynamic charts with 'post-it' notes in order to document the progress of each sprint focusing on the work done, the one on progress, and the problems arisen to get on with the project; and,
- follow-up meeting (sprint review).

The main difference with a traditional project is that sprints are limited to short term defined goals (daily, weekly or monthly).

So, at the beginning of the project, the teacher explains to the students not only the project they will develop but also the Scrum methodology and how it helps to make a good teamwork due to the short cuts (Fig. 1 shows Scrum process adapted to the PBL context). Tuckman model [20] is explained to students as a starting point to succeed in not having problems in their teams. We stray from the Agile philosophy in some ways as this methodology is mainly focused on computers engineering. We introduce it to students as far as it is essential to encourage teams to be self-organized, self-managed and self-motivated for success. Students are told the importance to set objectives and tasks in the short term so that long-term objectives are more easily achievable.

3.2 First Phase: Project Objectives and Team Roles

Once the challenging project to be developed is presented to students, teachers organize teams. When knowing their team members, they feel either excitement about the task or fear and anxiety about the job ahead. To deal with it, we remind them the importance of well-defined objectives. So, instead of giving the students a concrete set of project objectives, we present them the project management and planning form included in Table 1. First task assigned to them is to define the project mission and vision and decide the tasks needed to accomplish it. Once they have the mission, they must turn it into SMART objectives (Specific, Measurable, Attainable, Relevant, and Time-bound) so that success can be monitored. With the objectives in mind they must identify critical targets and milestones to keep the team on track. Also, they must determine acceptable team behaviors and how they will resolve problems within the team (Forming stage). At this stage, they must identify the talents and areas of expertise of the team members. By doing this, different roles, tasks and responsibilities of each one will be clarified. Teachers suggest teams to create a project agreement to be signed by each one of the team members committing to work on it and establishing ground rules, roles and responsibilities.

During this first session teacher moves around the classroom to follow-up how they are focusing the project. Teacher's questions around the project are related to the previous knowledge and skills. To

Table 1. Project management and planning form given to students

Adapt the following elements to your team's situation:	
Context:	What problem is being addressed? What result, or delivery, is expected? Why is this important? Identify the "product Owner" as the "voice of the client" and responsible for developing, maintaining and prioritizing the tasks of the project
Mission and Vision, Tasks &Responsibilities	Turn it into SMART objectives Decide critical targets and milestones List each team member and define the roles and responsibilities of each one. Who will be the team leader?
Plan weekly meetings to check how the work is being done in order to be able to change whatever is needed. These meetings must answer to:	1. What did you do last week? 2. What do you have planned to do this week? 3. What obstacles did you find on the way?
Have a table representing the status of the project with 3 columns:	To DO In process Finished
Set up new tasks if needed	

answer these questions, students discover that they will have to do some research to help them to clarify the problem. They will discover that, sometimes, the problem is more complex that initially thought. To simplify it, they must separate the general objectives of the project into specific ones. Then, each objective should be broken up into the different tasks that should be done to achieve it. For each task, they will have to designate one or more responsible and the final date when it should be finished. To make all this process possible, starting from Table 1, they are asked to fill in the project planning and status using the table found in Fig. 2. Filling it, students interiorize their responsibilities. They know that probably, as the project evolve, changes will be made on this first table, as completing a project with deadlines is not simple. In order to be able to follow up the process properly, the milestones of completion of each task must be weekly.

Fig. 2. Project planning and project status table and filled example of a board of one of the students' team (post-it notes outline tasks and people in charge).

This first document establishing specific objectives and tasks is the first part of their assessment.

3.3 Following-up Process

Students have at least weekly meetings during the classroom sessions. Maybe they will also have more meetings (face to face or virtual). To follow them up, each week, they will upload to the virtual campus the meeting minutes. In the meetings, they will share information, progress and results. They know that, not only they are allowed, but recommended, to make changes from the initial planning: they make deliveries iteratively maximizing opportunities for feedback. In the meeting minute, they must incorporate a table with tasks and dates and three more columns indicating the progress of the project (to do, in process and finished) adapting the Scrum methodology to their project management [7, 18, 19]. How this methodology is adapted to the academic context can be seen in Fig. 1 (Scrum process) and in Fig. 2 (project planning and status).

Thus, each team creates a high-level work line for their project associated with a lower level one which will be modified each time that is needed in the follow-up meetings. Using this iterative process of continuous review and short-design time frames the team can quickly adapt the projects to have a good solution, and teachers can detect team problems (and intervene if needed).

In these following-up steps, the teacher acts as a tutor and facilitator, as feedback is essential to better focus the project. Hence, teacher observes the team, the individuals and the project development, listening discussions and helping them to correct deviations from their objectives. Some of the items that the teacher will observe in the following-up steps are the observable attributes proposed by Besterfield-Sacre et al. [21]. Each time, they are asked to show the status of the project, following the

Scrum methodology and to answer some questions. As this table must be dynamic, new tasks or objectives, as well as changes to the existing ones, can appear. We recommend students to have a board, like the one shown in Fig. 2, with these three columns and use post-it notes or similar that will move of column depending on their status (is it still to be done? are you working on it? Have you finished it?). Post-it notes will help students to outline how the team will operate on near day-to-day basis. This can be as detailed or as minimal as the situation warrants. It may be comprehensive and detailed for a long-duration team or limited to a few bullet points. For example, in Fig. 2, we can see how students have added some new lines showing resources needed, work to be done in the labs or studios, and tutoring needs.

At this point the column showing the responsible is the most important to avoid tensions. Students must be aware that communication is a crucial factor to ensure team success in accomplishing its goals. Roles and boundaries properly defined will

Table 2. Rubric for Individual Self and Peer Assessment of team work

INDICATORS	Very Competent (4)	Competent (3)	Not too bad (2)	Bad (1)
Planning and organization	The student has participated in planning team objectives setting goals effectively. He/she participates in planning, schedule, tasks and people in charge of each one.	The student has participated in planning his objectives setting goals. He/she assumes the team planning, schedule, tasks and people in charge of each one.	The student has planned his goals, but some of his goals is not realistic. He/she accepts the team planning proposed by others (schedule, tasks and people in charge of each one).	The student does not plan objectives, nor goals. His attitude in the group is very individualistic. He does not collaborate in the organization and distribution of the tasks
Fulfilment of the task	The quality of the task carried out makes a remarkable contribution to the team. Focuses on the task and what needs to be done anticipating the deliveries to encourage the discussion between the members of the group.	Focuses on the task and does it satisfactorily. Other group members must sometimes nag, prod, and remind to keep this person on-task.	The task performed has rectifiable deficiencies. Other members of the team must remind this person to keep on-task	The task performed does not correspond to the proposed objective or he lets others do the work.
Compliance with deadlines	Routinely uses time well throughout the project to ensure things get done on time, giving new and good ideas to the team work. Anticipates deadlines to encourage discussion.	Usually uses time well but may have procrastinated on one or two things. Student respects deadlines and delivers on time the tasks.	Student tends to procrastinate. It is delayed without damaging the progress of the team's work.	Student is delayed, harming the progress of the team's work.
Participation and Involvement	The student is active and participatory in meetings. His/her contributions are fundamental to improve the quality of the team's results. Integrates everyone in the team to have a full participation, having a positive attitude of collaboration and support to all the team members.	The student is active and participatory in meetings. Usually has a positive attitude of collaboration and support between the members of the team.	Intervenes little in meetings, rather at the request of others. Rarely listens and supports the efforts of others.	The student doesn't make the tasks. Refuses to participate. Frequently absent or his/her presence is irrelevant
Work Climate	The student actively listens to each other, being never publicly critical of the project or the work of others. Maintains a good atmosphere climate of collaboration and support among team members by constructively accepting and integrating everyone points of views.	The team member listens to each other without disqualifications and impositions. The student tries to create a good atmosphere.	Sometimes doesn't listen to other members or disqualifies his/her colleagues. The student wants to impose his opinions.	The student does not listen to the interventions of his colleagues, systematically disqualifies them, wants to impose his opinions. The student creates a bad team work climate.

help them to manage how to achieve the mission without problems. Also, they must think about the resources and support needed to finish the project satisfactorily. So, after each meeting they will upload, apart from the meeting minute, a portfolio. Even if the project status table contain all the information, we ask students to include in the portfolio not only this table but also the self and peer assessment rubric filled (Table 2) and the answer to the following questions:

- Did the team discuss tasks to do/set goals for the next meeting? Who suggested next steps to be done?
- Did the "to Do" or "In process" move to the next column? Which tasks were finished and by whom?
- Did any team member present new ideas or solutions meaningful for the advance of the project? Who?
- Did everyone participate actively during the meeting? Were all the others' opinion respected?
- What obstacles did you find on the way?

As specific responsibilities for the various tasks appear, the individuals within the team take full responsibility for planning and executing activities to make a good project.

3.4 Project Deliveries

Every week, students deliver the portfolio derived from the follow-up meetings. But it is also important to set several milestones for the intermediate project reports. These deliveries will include the consecution of some specific objectives related with their learning outcomes. Each time one specific objective is achieved it is important to give an individual mark to each student for this milestone and a constructive feedback on the work done, as this motivate them to continue with the project (Fig. 3). At these moments, students will be asked to make peer assessments of their team mates and to evaluate themselves as a learning strategy [22, 23].

Finally, when the project is finished, they write a report and make an oral exposition of the project. Even though both are made in team, different teachers' questions after the presentation will be addressed to each one of the student's members (and not necessarily about the part they have presented).

So, each one will have an individual mark depending on their oral defense, the responses to the questions posed and the portfolio containing the minutes of the meetings and the assessments done in each milestone. The portfolio will include a peer-assessment of their perception about their team mates work in the project. On the other hand, they will have a team mark for the written report, the final presentation and the demo of the project [8].

To summarize the deliveries students must submit are:

- Goals setting with tasks, dates and responsibilities (project planning table in Fig. 2).
- Meeting minutes: at the end of a meeting, with or without the teacher, students write a minute showing the project development, discussions and decisions. Meetings where the teacher is

Fig. 3. Teamwork procedure for an individual assessment.
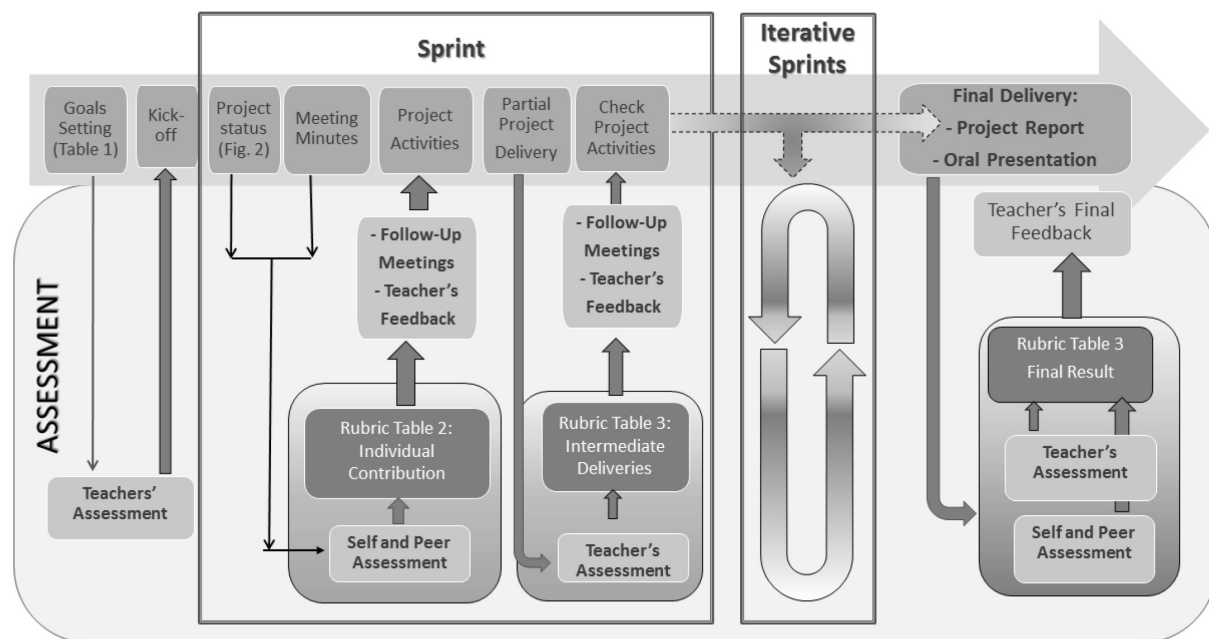
present are useful for the follow-up of the project and the assessment of individuals.

- Portfolio with the project status table (Fig. 2).
- Intermediate deliveries of the project in some specific weeks: in these partial project reports, it is necessary to make very clear which are the specific learning outcomes and objectives that must be achieved.
- Self and peer assessment rubrics: done during the process and a final one.
- Final project report.
- Oral presentation of the final project.

This procedure engages all the team members as the scrum philosophy requires that each team member assumes a significant task each week. All the deliverables will be stored in folders in the virtual campus, so all the members can see them.

4. Teamwork Students' Assessment Process

As we have seen several deliveries are evaluated. The process by which it is done is summarized in Fig. 3. Following the Scrum methodology, each sprint is iteratively repeated and allows the individual assessment of each student during the process and the teamwork assessment of each delivery. Students know from the beginning the specific criteria of their evaluation, as it is very important to improve their learning [24].

4.1 Individual Assessment of the Teamwork along the Process

Follow-up meetings are an important aspect for the individual assessment. In the meetings (Fig. 1), they check the project requirements at each iteration, discuss any issue that has come up previously about the project development and make important decisions to continue with it. They reflect it on the project status board (Fig. 2) and answer the questions posed in the planning form given (Table 1). During the meetings, they are expected to discuss and answer the teacher questions. These questions require that the teams must deeply explore their resource materials to get a good project.

Once the first activities are made, they can assess themselves work and their team mates' participation on it [15]. To do so, they use the rubric presented in Table 2 where they mainly evaluate the performance of the team and the involvement of its different members, that is, the teamwork as a skill. This rubric helps the teacher to assess the individual participation observed in each student during the development of the project. This assessment tool [25] helps students to review the fundamental components of an efficient teamwork. These

peer and self-assessments are used as, by themselves, improve student learning, promote self-reflection and, hence, help them to adopt a responsible attitude towards the team [26, 27]. Therefore, it provides them feedback about how the team is working. In the rubric, students find the individual participation in the teamwork divided into several indicators with a description of the levels of performance. The rubric presented in Table 2 is a four-level rubric adapted from Terrón et al. [10] to avoid that students choose the middle level of performance. For each indicator of the team work, a statement describing the expected performance at each level is shown. The indicators are: planning and organization, fulfillment of the task, compliance with deadlines, participation and involvement and work climate. These filled rubrics are reviewed by the teacher, helping to detect difficulties in the functioning of the group and gathering evidence of the contributions of each student during the process. Also, if a constructive and quick feedback is given, it allows to intervene solving problems with individuals who do not participate properly in the team. This cycle can be repeated several times throughout the project depending on its duration and on the fixed milestones to deliver partial reports, as seen in Fig. 3. Besides, the completed rubrics become part of the individual mark given at the end of the project to each student (Fig. 4).

Additionally, during the follow-up meetings the teacher poses questions related to the learning outcomes, evaluating, hence, students' knowledge and skills individually. These tracking meetings will also serve to re-focus objectives, tasks, responsibilities and schedule. So, after each meeting, project status will change (Fig. 2) and a new one will be uploaded to the virtual campus together with the meeting minute (portfolio).

4.2 Learning Outcomes Assessment along the Process (Team and Individual)

Every two weeks, students hand in an intermediate project report to be assessed. In them, learning outcomes must be achieved according to the objectives predefined by the teacher. It is very important
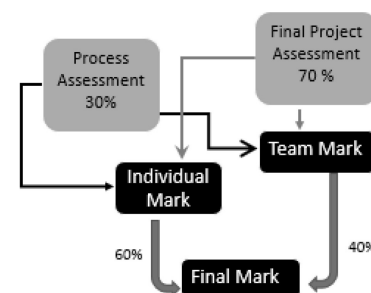

Fig. 4. Final Mark of the project developed by students in teams.

Table 3. Rubric for the Deliveries of the Project (Intermediate and Final)

INDICATORS	Very Competent (4)	Competent (3)	Not too bad (2)	Bad (1)
SECTION 1: Team Contribution				
Structure of the Report: format, writing, organization of information	The report is well structured. The documentation provided is relevant and well assigned. High capacity for synthesis and organization of information. It includes suitable bibliography well referenced.	Meets all points of the content of a report correctly. Good classification of the information, although the organization and / or synthesis of it could be improved.	Meets all points of the content of a report but lacks rigor. Low synthesis capacity and / or the information is not written clearly, and / or the information is not related correctly. It does not contain references.	Poor structure Missing relevant chapters (index, bibliographical references, etc.). The information is not organized in a coherent manner and / or insufficient synthesis capacity.
Quality and Depth	All the required aspects are complete, reaching goals. Good explanations providing examples and illustrative graphics that clarify the ideas.	The report is complete, and the explanations and ideas required are presented, but clarity is missing in some specific aspects.	Although everything appears in some way, there are some aspects which are treated in a very ambiguous way and confused ideas remain.	The requested points are exposed too briefly and many of them are even missing. Not all the goals are achieved.
Contents	All contents and results are correct and adequately explained, based on the necessary equations and graphics.	The contents are adequate to understand the scope of the topic, the results are correct in general and understood. Some complex aspects are confused or absent.	There are gaps in the contents that should be exposed. Some results are not correct. The explanation and support for contents are not enough.	There are many inadequate contributions or that do not fit within the contents. Most of the results are incorrect or missed.
Theory application to justify the results. Analysis of the information and results	An analysis of all the required information is carried out. It includes and adequately explains the results. Supports all the results obtained with the appropriate theoretical fundamentals referenced in bibliography. The results are analyzed in detail.	There is sufficient analysis of information related to the topic and endorse the results. It does include, but explains only superficially, the results. Correct Bibliography. The results are analyzed briefly.	Unsupported or insufficient analysis. It includes, but does not adequately explain, the results. Insufficient bibliography. Does not analyze the results.	There is no analysis of the information or it is incorrect (It does not support the results obtained). There are not explanations neither analysis of the results.
Support used in the presentation	Well-designed, original support that increases the clarity of the explanation.	Correct material but originality is missing. No adequate support means are used.	Improvable support material. It does not facilitate the understanding of the presentation.	Deficient support material. Inadequate design and does not support exposure.
SECTION 2: Individual Contribution				
Individual Technical Contribution	The technical part associated with the contribution of this student in the distribution of tasks has been excellent in the final document.	The technical part developed mainly by this student is correct but has some lack in the exhibition within the final document.	The technical part developed by this student has been very incomplete or presents important errors.	The technical part whose main responsibility was this student has been left undone or has been made by another student.
Oral presentation of the work done	Clear, original and enthusiastic presentation that captures the listener from beginning to end, using the appropriate means.	Good presentation (easy to follow, in time) sometimes lack enthusiasm and / or captivate the listener. No adequate support means are used.	Understanding the presentation, or to follow it at certain times, is difficult. The presentation time exceeds the planned one. The choice of words is not adequate (to the topic, to the public or to the objectives of the work).	The information is not clearly stated, the content is read, it is very difficult to follow the oral presentation, and / or the presentation time exceeds the planned. The choice of words is not adequate (to the topic, to the audience or to the objectives of the work).
Answer to the questions posed	The student answers correctly, clearly and well justified to all the posed questions, convincing the audience.	The student answers correctly, clearly and well justified to most of the posed questions, convincing the audience.	The student just answers correctly to some of the posed questions, or he doesn't do it clearly and well explained.	The student doesn't correctly answer to none of the posed questions.

to give students a useful feedback about how they are developing their project as soon as possible. This partial report will have a team mark and an individual mark. This mark will be given using the items related to written report of the rubric shown in Table 3. That is: the structure of the report (associated to the delivery); quality and depth; contents; application of the necessary theory to justify the results; analysis of the information and results; and, individual technical contribution.

In the following meeting, the teacher will orally give them the needed feedback. This feedback will not only be for the team but, also individual, as thanks to their portfolio, the process is known by the teacher. Teacher detects poorly developed technical aspects or poorly acquired technical knowledge and fix them in a process of continuous improvement in the students' learning. Having the filled rubric (Table 3) on their hands and the positive feedback of the teacher, students will improve their project before finishing it (Fig. 3).

4.3 Assessment of the Final Product (Individual and Team)

Final portfolio will contain intermediate deliveries, meeting minutes, partial project status and the different rubrics used during the project process. Apart from this portfolio, the final report and the final presentation of the project will be evaluated using the rubric presented in Table 3. This rubric has got two sections. The first section allows to evaluate the team (final result and oral presentation) and, the second section, to evaluate each student individually.

The first section aims to measure the quality of the final project (report and/or product), although in the latter case some items of the rubric could be adapted. Items such as the application of theory to practice, scope and depth, correction of results are evaluated for the team as a whole. In the second section individuals are evaluated. Technical knowledge acquired by each student is evaluated with the help of the meeting minutes (where the person in charge of each task is written), as well as with the intermediate monitoring done during the whole process. On the other hand, the clarity in the oral presentation and the answers to the question posed are also evaluated individually. This oral presentation is done in front of all the teachers related to the project. Students don't know who is going to present and what. Questions, at the end of the oral presentation, are asked to any of them (not necessary to the one who has presented the related part). This allow to mark students individually on their oral presentation skills and on their technical knowledge.

4.4 Final Mark

The way of obtaining the final mark is shown in Fig. 4. Section 1 of the rubric shown in table 3 will allow to give a mark for the team. The team grade will have a weight of a 70% for the final project and a 30% for the intermediate ones. For the individual mark an arithmetic mean is made between section 2 of the rubric of Table 3 and the marks teachers have given throughout the intermediate process. The weight of each contribution (individual vs. team) is decided by the teachers, but it is recommended that it never exceed 60% in either of the two contributions.

5. Findings and Discussion

Implementation of the procedure was done in the 2017–18 and 2018–19 academic years. In a process of continuous improvement, we collected the opinions of teachers and students about the procedure. We followed a deductive research approach in which the hypothesis was that process focused procedure designed facilitates the individualized follow-up of students during teamwork, allows teachers to assess the contribution of each student during the project development and, therefore students feel that their individual effort is awarded. To test this hypothesis, qualitative data were gathered from semi-structured interviews [28] using guide-questions related to: using individual assessment; tools used in the process and main difficulties found in the implementation.

Participation in the interviews was voluntary. To participate in them, an email was sent to 70 teachers and 653 students participating in projects. This email contained the description and purpose of the interviews. From those who expressed interest in participating, people that would be interviewed was defined: 31 teachers from the different degrees and departments and, 57 students selected so that we had diversity in terms of gender, degrees, courses and marks (students with good academic results, with bad ones and with results in the average).

Their opinions were transcribed verbatim. Code and analysis were done with the help of the NVivo13 software. From the answers obtained, common themes emerge among which we highlighted the following perceptions of teachers and students. Some quotes are chosen to illustrate the data. Perceptions were divided in three main categories: about the tools and the process, about the individual evaluation and, positive and negative perceptions.

5.1 Teachers' Perceptions about the Tools and the Procedure

Regarding the procedure, it is difficult to develop

new learning or evaluation methodologies without the commitment of the teachers involved. Teachers must understand and appreciate the need of change to include new methods in their teaching. Therefore, faculty receives training at least once a year for the improvement of their teaching practice. In this experience, training was focused in the use of Agile and Scrum methodologies, team and conflicts management, and the use of rubrics for evaluation.

Related to this training, in the interviews, teachers, especially the youngest ones, highlighted how important it is, since this evaluation process is not intuitive. 74% of the teachers coded references were positive and 26% neutral. Let's keep in mind that some of these teachers (mainly computer engineering ones) already knew the Agile methodology.

Related to the tools, all the teachers perceive them as very useful since they allow them to organize the evaluation in a more objective way, providing students a constructive feedback on their learning: "*I know that give feedback is a good strategic to improve learning, so it is important to know how to give it to be encourage and constructive [...] but when I give individual feedback to one student in front of the group, it can be read as a public attack on them and their ability. Rubrics and training help me to improve in that way and not to be misinterpreted*". All the teachers interviewed pointed out that the rubrics helped them a lot because, as they are very descriptive and specific, they allow them to know where to focus the feedback.

However, asked about the feedback given to students, everyone agreed on that students feel more comfortable with the qualitative feedback given in the follow-up meetings rather than with the quantitative given by their teammates.

5.2 Teachers' perceptions about the assessment

As one of the objectives was to facilitate teachers the individual assessment of students within a team project, they were asked about this issue. They commented, on a 64.3% of the coded references, that it is difficult to give a fair distribution of individual marks in a teamwork when it takes place mainly outside the classroom. That's why 90% of the teachers said that the follow-up meetings helped them but indicate that these meetings should include a continuous feedback and assessment in order to achieve the objectives.

Asked about the use of student's peer-assessment, 40% of the coded references show that it helped teachers to identify those students not working in a team. Even though they say that it is relevant to give formative assessment to others, 25% indicates that this tool is not always reliable since, sometimes, students are not totally honest in the answers, and

that is why they consider the follow-up meetings important.

Although 77% of the teachers affirm that they have not found significant differences regarding the average grades of their students, in their opinion, the fact of granting individual evaluations, makes the students see their individual contributions to the team valued. This is especially relevant in those students with higher grades who, sometimes, feel that their mates slow their work. Thanks to the individual evaluation it is possible to reward some relevant or outstanding contributions, as well as to identify early those students who are not working properly in the team, avoiding their responsibilities and tasks. A teacher relates "*I used the individual grades to encourage some behaviors in the team specially those related to responsibility or finding solutions. In the follow-up meeting I can identify those students that are avoiding their responsibility in the team. [...] I have saw, also, some student that are only interested in getting a high grade but not really commitment with their team. In these cases, is important to remember him that his group assessment is as important as the individual*"

All the teachers highlight the importance of explaining this process to the students. They must know how teachers are going to stablish de marks and how their individual work will be assessed. They also say that it is important that students know the rubrics they are assessed by and understand how to fill them "*to prevent any confusion and subsequent surprises*".

5.3 Positive and Negative Teachers' Perceptions

Teachers were asked about the advantages and disadvantages of this procedure and the tools. They related as the most positive aspect of the process, in a 93% of their coded references, that projects get to a better end since they have asked their students to follow agile methodologies. One teacher said that "*results of the projects have improved, and I think that, may be, the better atmosphere I saw in the teams helped*". They pointed out as one of its advantages that it gives the chance to modify the project from their learning. For instance, they say that some teams who performed poorly their project at the beginning, after the positive feedback, improved their project in the remaining stages achieving the required learning outcomes.

Related to the negative points or difficult bounds, 77% of teachers declare that they perceive a greater workload when having to perform this double (individual and group) evaluation ("*it requires a high work load in the follow-up sessions if you want to do it well*") and because "*you need to invest extra-time in your class sessions to adequately explain this methodology to the students*". These feelings change

when the students are in higher courses because "*the level of support needed by the students in the first year is not the same as in the last year, nor the same type of feedback*". At this point they say that "*to give a good guide to follow to students is very important*".

Additionally, even if most of them agreed on the importance of a quick feedback, on occasion, it generates certain stress and pressure in the teachers. For instance, a teacher complains: "*Students expect answers and feedback on their partial reports within what they consider a reasonable time, and this include weekends!!*".

Other topics frequently appeared in interviews, which are not an advantage or disadvantage, but that are indicated as something to consider achieving better results. All the teachers (100%) agreed that one of the keys to the success of the procedure is to explain this methodology very well to students, and to make a careful design of the projects and their assessment before they start. Everyone said that even if this takes a long time, when well-designed, it will revert to spending less time on the process.

5.4 Students' Perceptions

Students were asked to give their opinion about the process. Their perceptions, which emerged from the qualitative analysis, are grouped according to the categories corresponding to the overall objectives of the process implementation and the use of the assessment tools.

When students were asked about the procedure and the use of Agile methodologies to facilitate the development of the project, 80% of the students' coded references were positive, 12% were negatives and 8% neutral.

Positive comments were related to the way in which Agile methodologies helped them to plan better, although they confessed, they spent too much time in learning how to use them. One student said that "*once we started using post-it notes and a board to follow-up the project, things came up easily. I loved using this scrum methodology! Until now, I always have tried to keep on the things we fixed at the beginning, but doing it knowing that changes were welcomed, help us to achieve better results and before time!, I mean, the deadline*". From the positive coded references, 64% show that using this dynamic way of managing the project, helped them to identify who could be the best in making each task needed to complete the project. As a result, we found 76% of the students interviewed acknowledged having changed those responsible for each task during the process. They say that they felt these changes translated into better development within the team.

Related to teamwork and conflict management, especially in cases where a member of the team has not fulfilled their tasks or responsibilities, one student said that "*problems arose when xxx wasn't working for the project. However, I think that thanks to the continuous being there of my teacher, xxx perceived that he'd better work . . . and, at the end the project was well developed*". The complain of another student about someone in their team that was not working, in the end it was not such: "*I think that to have team problems is something that always happen. However, as the teacher was with us in some meetings, as far as she saw that xxx wasn't working on the assigned tasks, nor coming to the meetings, well, at the beginning, she tried to help us to solve it but as things were worst and worst, she just removed xxx from our team. This is something that before never happened as the teacher didn't know how our team was working*".

It is important to note that 30% noted that, although they had work previously in teams, they found that they didn't know how to successfully work in teams. These students affirm that now, they have improved the required skills to success in team-work as this methodology facilitated them a path.

Negative comments were mainly focused on the time spent to follow this methodology. A student complained about overwork but notes that in the end he saw his effort rewarded: "*to write meeting minutes each time was annoying, because it took too much time. However, xxx was ill for 2 weeks, and suddenly they turn on into something really useful. She was able, reading the minutes to catch the rhythm of the project!*".

Students, especially freshmen, gave their opinion about peer and self-evaluation indicating that they think they are important but difficult. Some commented that they were benefited by peer assessment because their work improved due to the received feedback. Others said that this process interfered in the relations with their team mates: some as something positive ("*as I knew that my way of working liked my peers, I increase my confidence and my personal relations in the team improved*") and others as something negative ("*I felt like if I was in a competition*").

Regarding the follow-up done by the teachers, they believe that it helped them to find aspects of improvement in the project, although they expressed that they sometimes would have needed a faster support from the teachers. Others claimed for a more detailed analysis of their work. However, students report that probably because this continuous feedback and follow-up, they made "*exceptionally good projects*".

Regarding the evaluation system, 68% of the coded references shown that students feel happy because they see their individual effort reflected on the final mark. They emphasize that it forces all the

members to work making the same effort, without being able to delay in the project.

6. Conclusions

We present in this paper the procedure followed to facilitate students' teamwork when using PBL and to help teachers to assess them individually. Results are presented in terms of the procedure used, the tools provided and students' and teachers' perceptions about it from interviews.

The procedure presented is based in the Agile and Scrum philosophy as they are based on the process and not in the project. Procedure includes training, follow-up meetings and project and assessment tools. Overall, objectives have been achieved as findings in the qualitative analysis on the perceptions of teachers and students about this methodology are positive:

- Students and teachers affirm that this iterative procedure facilitates the dialogue between teachers and students to guide teamwork.
- It has helped students to plan the project identifying different roles and tasks during the process which led to fulfill the project.
- Students have learned to better understand teamworking dynamics reinforcing the importance of the skills needed for an effective teamwork such as planning and conflict management.
- Follow-up meetings with their associated portfolio (minutes, peer and self-assessment rubrics, project status reports and partial reports) provide teachers with a rich information to evaluate students (both individually and in teams) and students appreciate the feedback given in them.
- Coaching and feedback of teachers in the meetings encourage students to participate actively in them.
- Both consider that as the focus is on the process, the projects came to a good end forcing the involvement of all team member as students see their individual contribution valued.
- With some refinements, the procedure designed to develop the projects of the students following a PBL methodology, seems effective in assessing individual student performance.

Results remark the need of a specific training on the procedure for both, teachers and students as the way of performing the evaluation is not intuitive. Further training in these procedures will make the implementation easier. This will also help to reduce the stress perceived.

Teachers and students recognize as negative that more time is needed. Teachers, because a very careful planning of the projects and their assessment must be done, and students because all the deliveries that must be done and since it is hard to fill in the rubrics assessing the team mates and, to elaborate the portfolio along the process. Teachers and students feel that these rubrics are just a tool that helps in the assessment, but they put the focus not in this quantitative feedback but on the qualitative done in the meetings.

As not only the project, but also the process is assessed, students spend their time not only preparing the final report and the oral presentation, but also in showing that they have been working during the entire process. This way of working with students will make our future engineers competent not only in the required technical skills for their professional future but also competent on the soft skills developed in teamwork, as the proposed system force each student working in a team to make the necessary effort to have positive results.

Our experience has shown that the procedures and tools described here result on greater level of teachers and students' satisfaction with teamwork as it forces them to make the necessary effort to have positive results.

This paper only reports on preliminary results. Limitations concerning the impact of this experience can be found as we only have retrieved students' and teachers' perceptions from qualitative data. Further ones could be taken from quantitative analysis such as making questionnaires and analysis the students' marks compared to previous years. But it seems that the agile methodology, with its short-design focused on the project process, helps a formative assessment of each student individually and make teams work more effectively.

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