On the effect of assessed returnable documents as active methodology in Power Electronics*

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***Abstract*– The methodological change caused by the implementation of the new degrees provides a clear opportunity to improve educational practices. This paper describes a teaching tool, named returnable document, to increase student work outside the classroom, motivate the students while raising their awareness about the importance and impact of their work. By using returnable documents teachers manage to strengthen the results of homework and the learning process in a flexible, motivating and entertaining way. In addition, compared to more traditional learning models, student participation is encouraged.**

***Keywords*-- Continuous evaluation, active methodology, assessment, teaching/learning process, Power Electronics**

I. Introduction

Motivating students' interest is really important to achieve learning objectives satisfactorily by means of the called active methodologies. In the new European Higher Education Area (EHEA) [1] it is necessary to involve more efficiently to the students and encourage their independent study and active participation: thought-provoking activities encourage students, by actively engaging them in their learning process [2].

This adaptation of university studies in Spain means an important change in the teaching/learning process: it is necessary to involve more efficiently to the students. Moreover, university education has undergone a significant change to new models that encourage the active role of students in the teaching/learning process. This process of adaptation has brought not only a reorganization of the materials, subjects and courses, but also changes in how students should be assessed and evaluated. These changes are especially relevant, since they affect which learning aspects should be evaluated. Instead of organizing the evaluation exclusively around the contents of a course or subject, the new assessment also deals with the skills and behaviours that students should achieve. In order to assess these competencies, students must be instructed during their learning process. That is, a student that has not been taught cannot be properly assessed. At least, the student requires sufficient tools to enable self-directed learning.

Moreover, a new challenge arises: it is necessary to integrate learning and evaluation of contents, skills, as well as behaviours, which can be specific to several subjects at different level in the whole Bachelor Degree so that students develop these new educational competences and aptitudes, in the framework of the new teaching/learning process.

With this objective in mind, to achieve this aim there is not a single answer. The problem must been tackled using multiple tools and strategies that, wisely combined, will provide the desired and targeted learning outcomes [3]. In this work a very simple and effective tool is described, named returnable document, in the framework of Power Electronics subject at Universidad de Malaga.

II. Returnable Document Description

A returnable document consists of a set of exercises organized in topics. Despite its simplicity, the main value of the tool comes from its usage, which is organized around peer assessment, by students in this work. There are many studies focus on the benefits and advantages of the use of peer review in class. For example, student participation in peer-review process achieves an important enhancement and improvement in their learning of the basics of the subject and an outstanding achievement of the higher-level learning outcomes [5] and when students evaluate the work of their peers, they increase their self-assessment abilities [5].

Because of these benefits and much more, peer review schemes have been proposed in the literature for more than 30 years, in several disciplines like [6] Industrial Engineering, Mathematics, Education or Computer Architecture.

The main objectives that the returnable pursues are three: first, to motivate students to work with the entire course contents, both theory and practice, from the beginning of the course; second, to assist the teacher to assess students work in a continuous way; third, to help the students to develop cross-curricular and high-level competencies. Achieving these three objectives must be done without overloading the students and the teacher.

The main value of these returnable documents comes from the way they are used, which yields a set of features that are helpful to reach the aforementioned objectives. To enable continuous assessment, there is a returnable document for each topic of the Power Electronics course. A returnable document is composed of:

- A pair of handouts with exercises. Each leaflet includes a different exercise that works with a part of the contents and skills regarding the corresponding topic. Together, both exercises deal with the whole topic objectives. In addition, the exercises are presented similarly to how they will be proposed in other future evaluation tests.

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- Evaluation criteria. The handouts include information to assist peer assessment. Of course, the main objective of this information is to help students to perform peer assessment. However, it also achieves two additional goals. On the one hand, it promotes consistent marks, since all the peers use the same criteria. On the other hand, it provides knowledge about the importance of the different parts and aspects of the exercises, which can be of use in the study to perform future evaluation test.

The use of a returnable document transforms the described simple set of leaflets into a powerful tool, which aids both students and teachers in the teaching/learning process. The different stages of the life of a returnable document are:

- Preparation. Once a given topic of the course has been finished in class, the teacher prepares the documentation.
- Distribution. Each student gets one of the handout models included in the pair. However, it is important to perform a nearly even distribution, since it is critical for the proper application of the returnable. Students must feel that they have some freedom to choose their assigned homework, which is motivational.
- Resolution. Students solve their copies of the exercises as homework. There is no restriction about how to perform this task, that is, a given student can do this alone or with the aid and collaboration of other classmates. The deadline to return the solved exercises is about one week.
- Exchange. Once the mentioned deadline has passed and students return their exercises to the teacher and the teacher redistributes again the returned handouts as soon as possible, taking care that every student gets a handout model different from the model they solved previously.
- Assessment. In this stage, the evaluation criteria commented above is used to help students to evaluate the work performed by their classmates in the redistributed handouts. A key aspect to consider is that the teacher does not provide solutions, so evaluators have to solve the exercises by themselves. To do that, an evaluator can develop a complete solution or base it on the work of another classmate. Different solutions can also be compared and analyzed.
- Review. Students deliver, again, the evaluated handouts to the teacher, who may review a subset of them. The review has multiple goals: to reduce the stress that some peers suffer when evaluating other classmates; to detect important errors when applying the evaluation criteria; and to find common errors incurred by most students, hinting the teacher about the weakest spots that must be reinforced in the learning process.
- Return. Finally, the returnable comes back to the author that solved it in the resolution stage. It returns with the marks and relevant comments produced in the assessment and review stages. Therefore, an initially simple set of exercises becomes a powerful learning and study tool through the multiple stages of its usage.

III. Experiences and Results

Returnable documents have been used during this academic year for the first time, in a single group of the Power Electronics (first semester) subject belonging to the Bachelor Degree in Industrial Electronic Engineering offered by the Escuela Politécnica Superior at Universidad de Málaga and for the Power Electronics and Control Circuit (second semester) subject belonging to the Bachelor Degree in Electronic System Engineering offered by the Escuela Técnica Superior de Ingeniería de Telecomunicación at Universidad de Málaga. The total of students has risen up to 72. Both teacher and students agree on their satisfaction using this tool.

Related to the first semester subject, once the subject finished, the students were asked to fill in a short survey with 15 questions and a free comment regarding to different aspects of the returnable document experience devoted to teaching and learning on specific topics of Power Electronics courses as well as other general competences in education engineering. For each question, students can choose one among five answers: Totally disagree; Disagree; Neutral; Agree; Totally agree. The values assigned to each answer are 0, 2.5, 5, 7.5, and 10, respectively.

To summarize the most important results of the survey in the first semester subject about the overall student satisfaction, their answers are classified in several groups related to the adequacy of the experience ("Complexity and time needed to solve the returnable" and "Complexity and time needed to assess the returnable"), its usefulness ("Usefulness of returnable to study and learn") and the student satisfaction level ("General satisfaction with the returnable"). More than 90 % of students consider adequate time given and effort required to resolve and assess the returnable documents. It can also be observed that the use of the returnable documents has been useful to prepare the exams to almost 80 % of the students, and that more than 90 % is satisfied with the experience.

Finally, it is important, from the point of view of students, to highlight that assessing and evaluating their classmates work represents a challenge for fresh students who have not been prepared for these tasks.

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