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Well-being E-Portfolio: a Methodology to Supervise the Final Year Engineering Project*

GEMMA FILELLA
Department of Pedagogy and Psychology, University of Lleida, Spain. E-mail: gfilella@pip.udl.cat

FRANCESC GINE
Department of Computer Science, University of Lleida, Spain

FERRAN BADIA
Department of Environmental and Soil Sciences, University of Lleida, Spain

ANNA SOLDEVILA
Department of Pedagogy and Psychology, University of Lleida, Spain

MARGA MOLTÓ
Department of Business Administration and Economic Management of Natural Resources, University of Lleida, Spain

ISABEL DEL-ARCO
Department of Pedagogy and Psychology, University of Lleida, Spain

This paper presents a new portfolio-based methodology for supervising the Final Year Project (FYP) in Engineering studies at the Escola Politècnica Superior (EPS) at the Universitat de Lleida (UdL). The main aim of the portfolio methodology, or learning-folder, is to maintain the students' motivation throughout the FYP process, keeping their stress level within advisable limits and increasing the student–teacher interaction. Thus, the students' well-being is improved and, as a consequence, the FYP completion rate rises. In order to achieve this goal, the proposed methodology emphasises the following aspects: (1) put in place a continuous outcome-based assessment, (2) plan and schedule periodic face-to-face meetings and (3) motivate the students to think about their own incentives. This methodology was implemented in a web-based tool, over the Sakai virtual campus. In order to compare our methodology with the traditional one, an evaluation was carried out during the 2008–09 and 2009–10 courses with a control group of 40 students and 11 teachers. The experimental results have shown that a high percentage of students who used the portfolio finished their FYPs within the time envisaged in the curricula plan. They also obtained higher marks in the majority of evaluated skills and planned their leisure time better.

Keywords: personal well-being; portfolio; final year project; learning outcomes

1. Introduction

The Engineering curricula include the development and assessment of a Final Year Project (FYP), which represents the culmination of the student learning process. Several studies carried out in Spain show that unfortunately the FYP has a much higher non-completion rate (around 60% on average) than the other subjects on the curriculum [1]. These poor results are due mainly to a lack of motivation in the students, which can be related to the Project's specific characteristics: a lengthy exercise (around 12 ECTS (European Credit Transfer and Accumulation System) on average).

A group of teachers from the Polytechnic School and the Education Science Faculty of the University of Lleida (Spain) focused their efforts on counteracting this lack of motivation among the FYP students. With this aim, a change in the methodology on the FYP guidance is proposed based on the following three aims:

1. Motivate the students to think about their own incentives, both in the short (weekly) and long terms (when they finish the FYP). The short-term incentives are a way of aiming of combining academic studies with a student's particular hobbies, whereas the long-term incentives are focused on creating an extra motivation to finish the FYP.
2. Increase the guidance by means of scheduling periodically meetings (every one or two weeks) between the tutor and the student, according to their timetables. Likewise, specify the protocol to be followed in these meetings: follow-up and reflection on the pending jobs, assigning new jobs scheduled according to the student's daily timetable, reviewing the degree of compliance

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with the proposed timetable (incentives included).
3. Apply a continuous outcome assessment [1–2]. This means defining the learning outcomes and applying three assessment milestones (initial, progress and final) carried out throughout the FYP process.

The above aims are designed to maintain a student's motivation throughout the FYP process, keeping their stress levels within advisable levels and increasing the student–teacher interaction. Thus, the personal well-being of the students can be improved and, as a consequence, their academic efficiency. This is the basis and the real novelty of our work.

In order to put our proposal into practice, we implemented this methodology with the electronic portfolio (e-portfolio) tool [3] of the Sakai campus used by our University [4]. Sakai provides all the tools needed to improve student–teacher interaction, which is the key issue of our proposal. According to the proposed aims, the newly-implemented tool has been called the well-being e-portfolio. As we can see in Fig. 1, the well-being e-portfolio integrates the three different goals into a cohesive structure.

Taking the electronic portfolio into account, we compared two different experimental groups of students (with around 20 in each) belonging to a variety of engineering studies (Computer Science, Building and Industrial) during the 2008–09 and 2009–10 courses. The proposed methodology was applied to one group, while the other group was guided using the traditional methodology. As a result, 90% of students tutored with the new methodology finished their FYP in the time specified in their curricula plan, whereas only 50% of the second group did so.

The remainder of this paper is organised as follows. Section 2 explains the related work. Section 3 describes the main characteristics of the proposed methodology. The electronic portfolio used to implement our methodology is explained in Section 4.

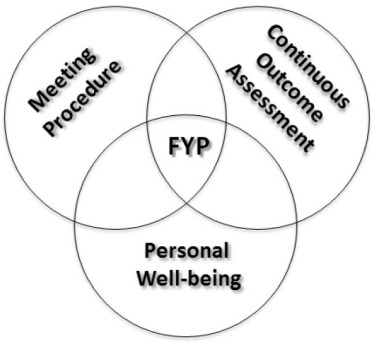

Fig. 1. The structure of the FYP portfolio.

Section 5 evaluates the performance of the proposed methodology over that of the control group. Finally, Section 6 outlines the main conclusions and future work.

2. The well-being e-portfolio background

The portfolio is nowadays widely used within the framework of degree and postgraduate studies in the field of education both as a learning methodology (Portfolio Process), and as an instrument of evaluation (Portfolio Assessment) [5–6]. Beyond the field of education, portfolios are widely used in the field of languages [7], medicine [8–9] and technology [10], as well as in engineering, where it is becoming ever more widely used [11–13]. In general, all the areas mentioned emphasise the success of this tool to help students to develop not only their professional skills, but also those related to procedures and attitudes, creativity, etc. [10, 14–15].

The use of the portfolio, given its structure, is related to students' self learning, as the different activities that make up the portfolio can be performed at different rates and in a totally creative way. In this mode of learning, the student takes on more responsibility for organising his or her work, and acquiring knowledge, and is encouraged to reflect on his or her own learning process [7–8].

Although it is true that the tool began in printed form, an electronic version, also called an e-portfolio, is becoming increasingly usual; the users state that it also strengthens their skills in the use of the new technologies [9–10].

Concentrating on the field of engineering, the use of the e-portfolio has recently spread to a wide range of processes, including institutional accreditation [16], evaluation and self-evaluation [17] and reflections on the academic and professional development of the students [11–12, 18]. Many works in this latter line of research show the portfolio to be a crucial tool for increasing reflection among the students about their own learning process, which has led to the creation of important working groups, such as the Folio Thinking project carried out by three universities: the Royal Institute of Technology (KTH), Uppsala University and Stanford University.

The study in this article is in this latter line of research. In contrast with earlier works, this study proposes a new methodology based on the portfolio to influence the reflection process in the students, looking at both their academic performance and their personal well-being. The works by Poyatos [15, 19–20] emphasise the importance of taking the whole person into account to improve the learning process. This means that students learn better when the learning process includes both the cognitive and

the affective aspects. There is research that relates stress and anxiety with low levels of academic performance [21]. Long-term work, like the FYP, with incorrect tutoring can increase the stress in the students to above the advisable levels, which may lead to a lack of motivation for the FYP and it may finally lead the student to abandon the FYP. The main idea is that if the students enjoy a feeling of well-being, their stress levels will be reduced and, as a consequence, they will be able to face the increasing problems of the FYP with a higher likelihood of success.

In line with the above, the aim of this study is to design, implement and evaluate an electronic portfolio, called the well-being e-portfolio, with the aim of tutoring and evaluating the Final Year Projects of engineering students, effecting the evaluation by abilities, and in the tutoring process, while incorporating aspects of the students' well-being as an innovative element.

3. FYP guidance methodology

Some external events, such as the pressure of the labour environment or the absence of a procedure to give students correct guidance, can lead them to lose the motivation to finish their FYP in the time established in the curricula plan.

The proposed FYP guidance methodology is based on the use of a portfolio. It aims to improve the motivation of the students by emphasising the following aspects: (a) maintaining the personal well-being of the student, (b) increasing the level of guidance by means of scheduling periodical meetings between the tutor and the student and specifying the protocol followed in these meetings; (c) applying a continuous outcome-based assessment throughout the FYP process.

The proposed portfolio allows systematic interaction between the supervisor and the student, allowing an interchange of tasks and subsequent evaluation. The quality of this interaction is a key issue for improving satisfaction, especially if there are academic, intellectual and technical aspects combined with personal and social ones. To achieve this, the activities and tasks that promote the emotional well-being of the student are an innovative component of the proposed portfolio.

These three aspects are discussed in the following sections.

3.1 Personal well-being

The works of Poyatos *et al.* [19–20] reveal the importance of taking the whole person into account to support the learning process. This means that students learn better when the learning process includes both cognitive and affective aspects. For this reason, we believe it is worth paying attention to the personal well-being of the students during the FYP.

There is no doubt that the FYP generates stress among the students, and for this reason it is still considered necessary to check that student stress levels do not hamper their work. Although a suitable level of anxiety is needed for learning, exceeding a specific stress threshold in the learning environment can contribute to exhaustion and provoke social isolation and lead to a student abandoning his or her studies. Thus, our portfolio seeks to help maintain the well-being of the students while they carry out their cognitive tasks.

For this reason, the portfolio tool incorporates a section where the student must schedule those activities that help him or her in the long-term (an incentive to finish the FYP) as well as in the short-term (including regular activities such as physical exercise, social activities, etc.). At every meeting, the tutor will supervise both the development of the cognitive tasks and the fulfilment of the planned leisure activities. Thus, the tutor can be aware of the level of stress that the student is undergoing and reschedule the FYP activities accordingly. Thus, the students will be able to face the growing challenge of the FYP with a high likelihood of success. In addition, this methodology will help the students to develop skills for facing stress that should also surely be useful for their professional future development.

3.2 Meeting procedure

Correct scheduling and the following-up of the different tasks to be carried out throughout the FYP process is a key issue in completing the FYP by the deadline. Accordingly, using the portfolio enables the organisation of the meetings between the tutor of the FYP and the student by scheduling the periodicity of the meetings and the procedure to be followed during these meetings.

The periodicity and the timetable of the meetings are established at the beginning of the process using a weekly calendar. This leads the students to think about their real availability for work on their FYP.

During each of the meetings tutor and student have to fill in the so-called Monitoring of Tasks form. This form has two main objectives. One is to track the fulfilment of the tasks agreed at the previous meeting. These tasks take into account both the cognitive and personal tasks. The second is to record the tasks to be completed by both the tutor and the student before the following meeting. A new form is generated and completed by the tutor and student at each meeting.

3.3 Continuous outcome-based assessment

In Spain, in most schools FYP students are traditionally assessed on the basis of a final written report of their work plus a public presentation before an examining board, composed of several experienced professors. Unfortunately, this approach has serious drawbacks:

- Assessment via a unique final milestone clashes directly with the formative purpose of assessment.
- Assessment is highly dependent on the subjective criteria of the academic jury.

In contrast to this, we propose a new assessment process based on outcomes, which highlights the training aspect of the assessment. In addition, we propose a global evaluation throughout the process, improving the traceability and objectivity of the assessment process.

In line with these aims, we implemented the assessment guidelines described in [22]. This proposes a process based on the six stages shown in the Fig. 2.

For each stage, we proceeded as follows:

(a) *Definitions of skills and descriptors*: This consists of establishing what skills the students must show on completing their FYP. We selected the same six transversal skills (generic), from the Tuning project [23], for all the studies in the School. On the other hand, three different specific (technical) skills were chosen for each specific study. For each generic or specific skill, we defined a set of objective descriptors that make it possible to evaluate the level of acquisition of the skill by the student.

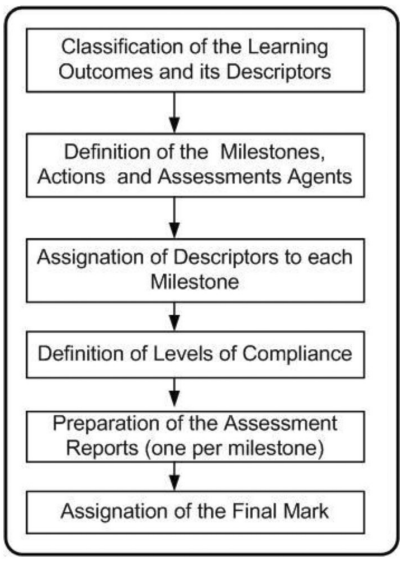

Fig. 2. Procedure proposed for the definition of the FYP assessment process.

(b) *Milestones, actions and assessments agents*: We proposed the establishment of three moments or 'milestones' for the assessment: (i) at the beginning of the project, when the student has developed a clear approach to the work, the state-of-the-art and its viability; (ii) in the middle of the process, when problems in the initial approach can be detected, but when there is still time to make the necessary corrections and (iii) a final assessment milestone when the work is completed. At each milestone, one or several assessment actions are proposed. The first milestone includes two assessment actions: the development of an initial report and a presentation of this report to the student's colleagues and assessment agents. The second milestone includes the presentation of a project progress report. The final milestone continues the traditional method of presenting a final report on the work and its public presentation. Finally, the agents who should evaluate each of the actions are proposed. We consider that the supervisor/tutor should be involved in the assessment of all the actions. In addition, there is peer evaluation at the first milestone. The third milestone is evaluated by means of an examining board in the presence of external experts.

(c) *Assignation of descriptors to the assessment actions*: The descriptors defined for each skill are distributed between the assessment actions so that the evaluator knows the specific points that need to be assessed at each moment. We evaluate between 10 or 15 descriptors in every action.

(d) *Level of compliance with the descriptors*: Four levels of compliance are proposed for the descriptors: Level 0 considers that the student does not fulfil the descriptor. Level 1 corresponds to the minimum that the student must be able to demonstrate. Level 2 is that which is considered adequate for the FYP. Level 3 represents an excellent level.

(e) *Assessment reports*: For each assessment action, a report is developed. This contains the set of descriptors to be assessed, a column for the mark (from 0 to 3) and the levels of demand for each descriptor. These reports are given to the students. The results of these three assessment reports are used to automatically complement the Overall Assessment Report. The latter groups the set of assessments made throughout the FYP, but now organised by skills, in such a way that it is easy to visualise the student's progress over time.

(f) *Qualification*: Taking the *Overall Assessment Report* into account, the final mark is obtained by means of a two-stage process. First, for each

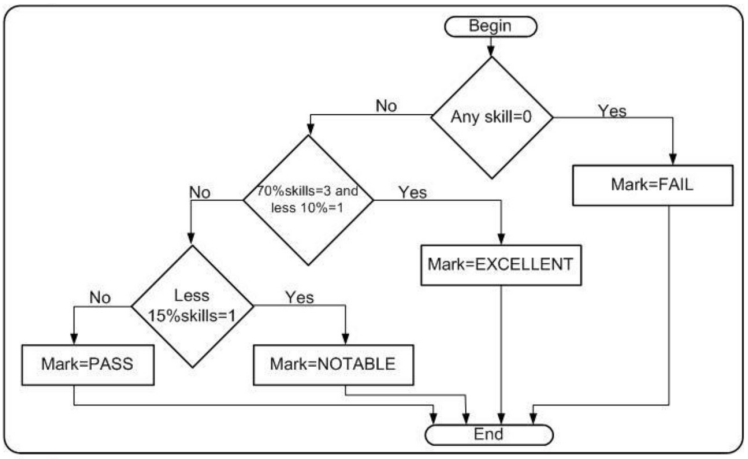

Fig. 3. Qualification process.

skill, a qualification between 0 and 3 is obtained. This mark is an average from the descriptors related to such a skill. From the qualification of each skill, the FYP mark is calculated according to the procedure shown in Fig. 3. It is worth pointing out that the percentages shown in Fig. 3 should be defined by each School according to its own needs.

4. The well-being e-portfolio

In order to make the supervision task for tutors and FYP development for students easier, we designed and implemented a web-based tool to support the proposed methodology. As mentioned above, we have used the portfolio tools provided by the Sakai platform [4] to develop the e-portfolio tool. It will enable and facilitate the teacher–student interaction. In addition, it allows students' progress to be monitored when they are taking the course by distance learning and also for the final data analysis. At the same time, it facilitates the interchange of information between the student and the tutor (this is very important in technical studies as students usually start work before finishing their studies, and the FYP is the most seriously affected).

Figures 4, 5 and 6 reveal several parts of the current state of the e-portfolio tool (available on this link http://portafolieps.udl.cat/portal).

The left frame of Fig. 4 shows the main menu of the tool, which is shared by the supervisor and the student. This offers access to the assessment activities and monitoring forms, the assessment reports, general project data and questionnaires, and some

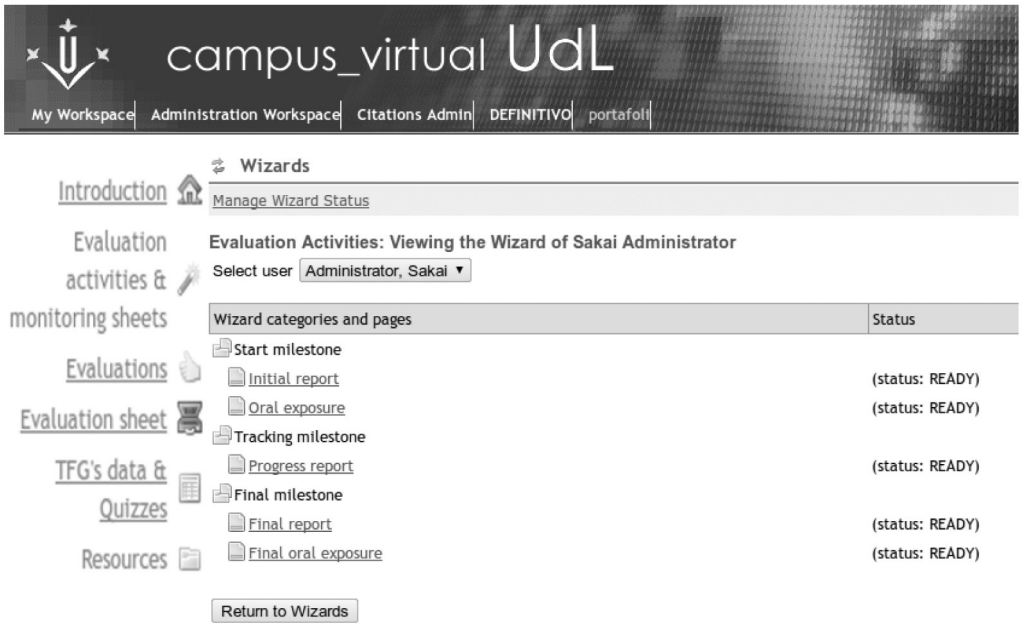

Fig. 4. Evaluation activities screen.

The TFG can be qualified with:

APPROVED

Skill B3: That students have the capacity to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflection on relevant issues of social, scientific and ethical

Descriptor	Start Milestone	Tracking Milestone	Final Mileston
B3-a: Identifies the basic parts of the project.	2	2	N/A
B3-b: Presents a block diagram level where their relationships are shown and described.	3	2	N/A
B3-c: Understands the basic knowledge required to carry out the project.	1	3	N/A
B3-d: Applies their own knowledge of this discipline and/or another to carry out the project correctly.	2	2	2
B3-e: Analyzes every part of the project with the scientific arguments of the discipline.	N/A	1	3
B3-f:Assesses the importance of the interrelation and interdependence of each part of the project and knowledge involved.	N/A	2	2
B3-g: Synthesizes the information obtained and their own knowledge of each part of the project and the knowledge involved.	N/A	N/A	3
B3-h: Evaluates the results of the project by comparing them with similar results from external sources.	N/A	N/A	2

Skill B4: Students can communicate information, ideas, problems and solutions to public so as not specializes specializes

Descriptor	Start Milestone	Tracking Milestone	Final Mileston
B4-a:Explains concepts and ideas in an understandable way.	1	N/A	2
B4-b:Makes use of precise technical vocabulary.	2	N/A	2
B4-c:Uses appropriate vocabulary in each circumstance.	3	N/A	3
B4-d: Relates the concepts correctly.	2	N/A	2
B4-e:Uses a consistent structure to transmit the information.	1	N/A	1

Fig. 5. An example of the overall assessment report.

shared resources. For instance, the screenshot shown in Fig. 4 is obtained from the second option of the menu 'Evaluation Activities and Monitoring Sheets'. This option allows access to the three abovementioned 'assessment milestones': initial, progress and final.

Likewise, from the third option of the main menu 'Evaluations', the screenshot shown in Fig. 5 is obtained. This figure shows the Overall Assessment Report described in the previous section. We can see the marks obtained for a given student for all the descriptors related to two specific skills (Skill B3 and B4 in the Fig. 5) and for each milestone. Note that the acronym N/A means that this descriptor is not assessed at that assessment milestone. In addition, the final mark obtained by the student according to the procedure described in Fig. 3 is shown (i.e. :NOTABLE).

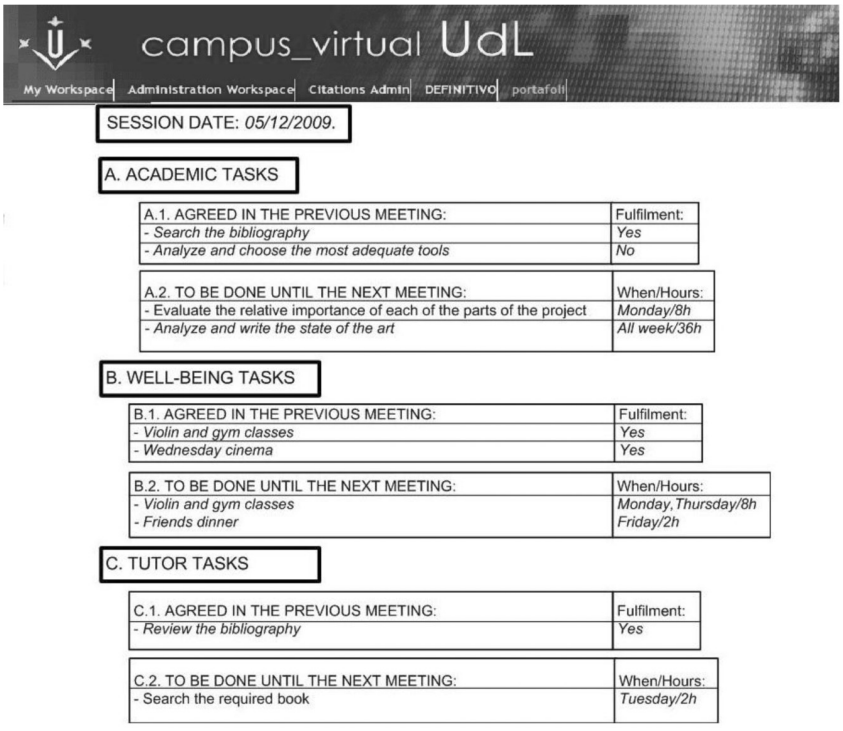

Fig. 6. Monitoring of tasks form.

Finally, Fig. 6 shows an example of the Monitoring of tasks form, which is filled in at each meeting between tutor and student. As explained in Section 3.2, this is made up of three different parts: (a) academic tasks and (b) non-academic tasks to be performed by the student before the following meeting and (c) academic tasks to be performed by the tutor. Note that the tutor and student must review and reflect on the level of fulfilment of each task agreed at the previous meeting, and each task to be completed before the next meeting. The tutor and student must schedule how many hours they will spend and when they will do this, both for the cognitive and personal tasks.

5. E-portfolio evaluation

The next step was the evaluation of the portfolio methodology through an experimental group of 40 students per course, who were supervised by a set of 11 teachers. Students and teachers were from different engineering degrees (Computer Science, Industrial and Building Engineering). Each teacher was responsible for supervising several students under both the traditional and the portfolio methodology.

This evaluation was carried out during the courses 2008–09 and 2009–10. In each course, 20 students were supervised under the portfolio methodology (experimental group) with 20 more being supervised using the traditional method (control group). We must emphasise that the portfolio evaluation was performed by means of three main assessment milestones (initial, progress and final) and it was based on the assessment of the different skills that the student had acquired. On the other hand, under the traditional methodology, the evaluation was made only at the end of the process and was based on a project-report presented to an examining board that was made up of three teachers. In addition, the traditional methodology does not provide any rule for scheduling and following the meetings between tutor and students.

The following sections describe the results obtained in the evaluation process developed, both at the quantitative and qualitative levels.

5.1 Quantitative evaluation

This section describes the results from both groups and courses, for the time taken to finish the project and the marks obtained.

Figure 7 shows that there were similar trends in both courses (2008–09 and 2010–11). In general, more than 70% of the students supervised using the portfolio finished their FYP on time, while only 50% of the group supervised with the traditional methodology met the deadline in the best course, 2008–09. Therefore, the portfolio methodology, used by the experimental group, improves the academic performance rate by 60% compared with the traditional one. Moreover, it is also notable that the most important difference between the two methodologies was the number of students who dropped out, which was three times higher in the group using the traditional method. This high drop-out rate corroborates the need for a guidance process that is closer to the student.

Figure 8 shows the average marks obtained by the two experimental groups. First, it is clear that students supervised using the traditional method

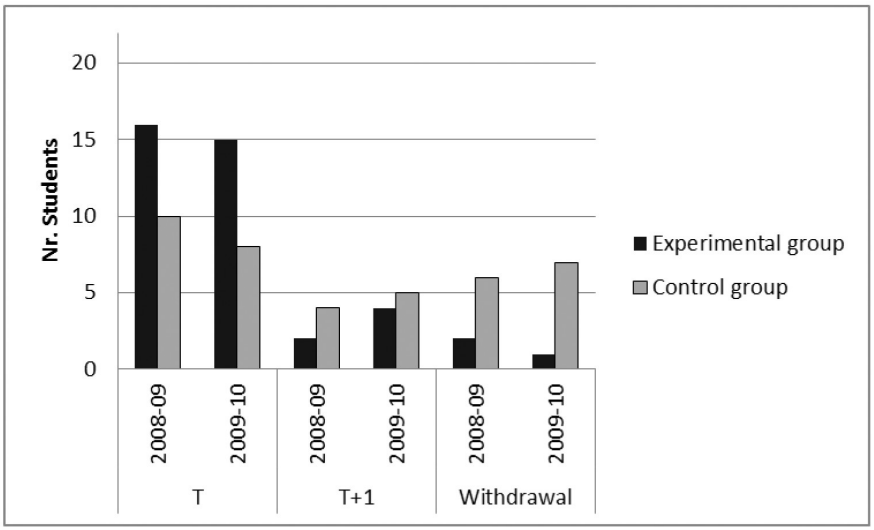

Fig. 7. Number of students who finished their FYP on time (T), required an additional semester (T+1) or dropped out.

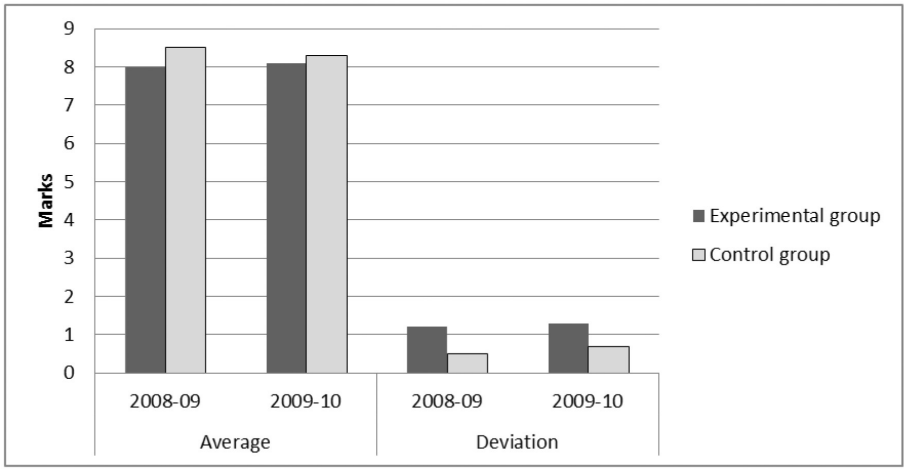

Fig. 8. Average and deviation marks.

obtained slightly higher marks with a lower deviation. These results confirm that using an assessment milestone (traditional method) alone is too subjective as it does not take into account the students' progress throughout the project. Also, the traditional method is unable to represent the students' diversity relative to the varied degrees of achievement.

5.2 Qualitative evaluation

The qualitative evaluation was made through a survey of the students from both the experimental and the control groups, as well as the teaching staff who supervised the work of each group. This survey was carried out before the oral defence of the FYP, associated with the end of the FYP evaluation process.

Figure 9 shows the results obtained from the survey conducted among the students, from both the experimental (Fig. 9 (left)), and control groups (Fig. 9 (right)). The average results obtained are shown by the vertical line. In general, the analysis of this mean shows that the overall level of satisfaction among the students in the experimental group was

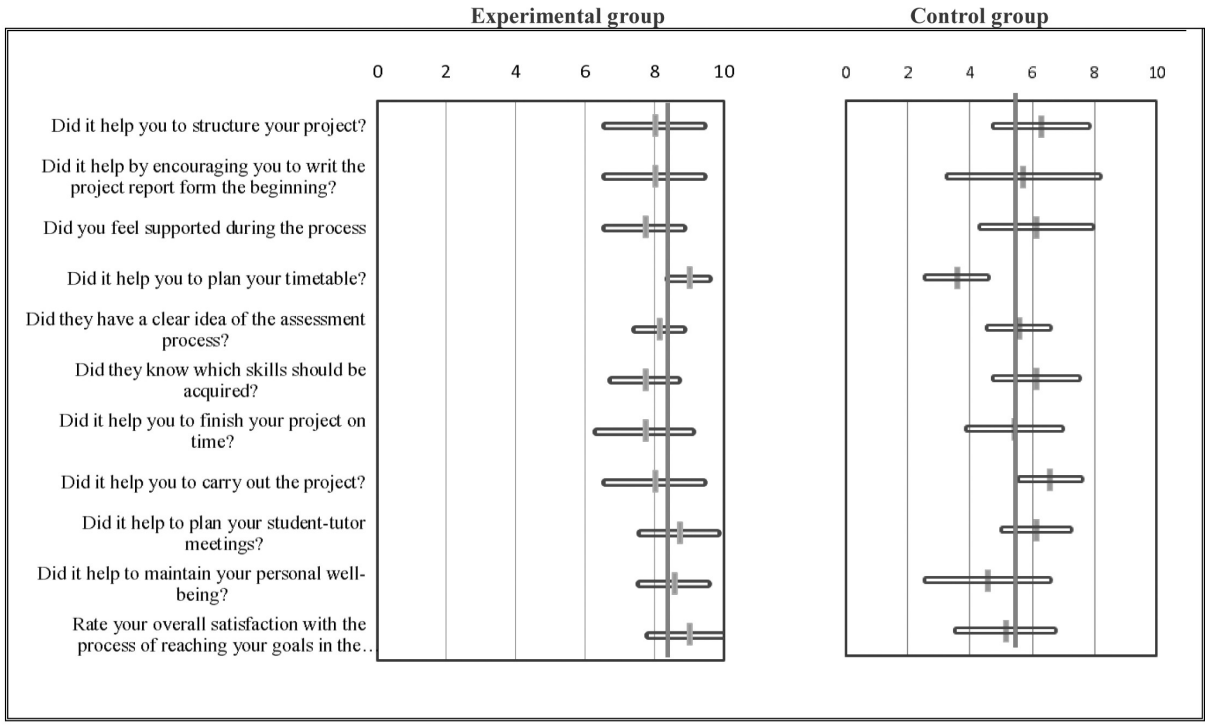

Fig. 9. Students' opinion poll about the portfolio methodology.

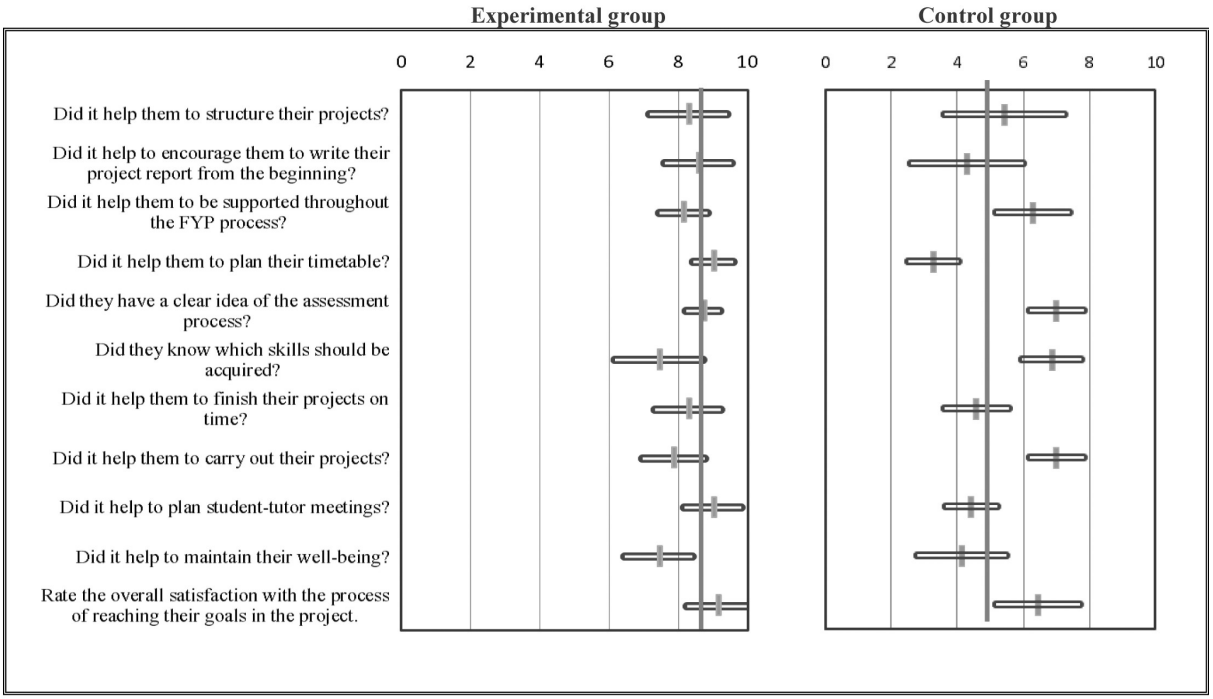

Fig. 10. Supervisor's opinion poll about the portfolio methodology.

much higher than that of the control group, specifically about three points higher. Another outstanding point is the difference in the deviation of the results, this being much lower in the experimental group. When we focus on the results obtained for each of the questions asked, a large difference can be seen in the answers to those questions associated with both the well-being of the student and the tutorial process, results that back the achievement of the initial targets proposed. However, the question related to scheduling the timetable led to one with the greatest differences between the two groups, which shows the difficulty that the students have in scheduling their timetables.

The behaviour extracted from the survey also reflects that the students who used the portfolio attained higher marks in the following skills:

- being self-sufficient, dynamic and organised;
- having self-esteem and patience;
- having skills for resolving problems, with creativity, initiative and decision-making ability;
- demonstrating a good attitude and willingness to put in the necessary effort to achieve the planned goals;
- managing their time.

Taking these results into account, and according to our initial assumption, the students who used the portfolio planned their leisure time better and noticed the positive effects of maintaining a balance between work and personal activities. Finally, it is worth pointing out that, at the beginning of the process, the students showed a relative reluctance to fill in the portfolio section relating to emotional well-being. However, as they became more involved in the process, they became less reticent, which also allowed a more fluid dialogue with the tutor.

Figure 10 shows the results obtained in the survey taken by the teachers. In general, a high level of satisfaction is seen with regard to the portfolio process. Note that although supervision time increased slightly, the perception of an improvement in the evaluation process and a higher student involvement in the FYPs contributed to an improvement in the willingness of the teaching staff to supervise FYP. Likewise, it is worth pointing out that at the beginning of the process, teachers were more reluctant to ask the students about their welfare, but this feeling disappeared during the process due to the involvement of the students. Compared with the results from the students, there is a generally similar tendency, although with less scatter of the results, for both the experimental and control groups. It is also curious to observe that the teachers in the control group were much more critical of the traditional methodology than were the students.

6. Conclusions

This paper presents a new and efficient FYP guidance methodology based on the use of an electronic portfolio. This integrates three different aspects

into a cohesive methodology: (1) to maintain the personal well-being of the students, (2) to specify the procedure followed by the students–tutors in their regular meetings and (3) to apply a continuous outcome-based assessment throughout the process. Our proposal was implemented by means of a web-based tool and tested on a control group made up of 40 students and 11 teaching staff during the 2008–09 and 2009–10 courses.

In general, we can say that the motivation and satisfaction of both the teaching staff and the student improved. In addition, according to our goals, we observed that the portfolio methodology improved the academic performance rate by 60% compared with the traditional method. Likewise, this methodology was seen to be suitable for evaluating the progress of the students in acquiring certain skills.

In the future, the aim is to incorporate optional activities, for students' moments of personal crises, such as workshops on relaxation, group dynamics, control of stress and anxiety, etc. Also, in collaboration with the rectorate team, we are planning to introduce our proposal in other studies in our university.

Finally, it must be mentioned that this work has been awarded the Jaume Vicens Vives Award for Excellence in University Teaching by the Catalan Government [24].

Acknowledgments—One of the problems with working in teams is to acknowledge the valuable input made by of all the members without the list seeming never-ending. We have included six authors in the report, but there were many more: David Barroso, Ramon Bejar, Sergi Buitrago, Fernando Cores, Fernando Guirado, Toni Granollers, Gabriel Perez and Magda Valls. Thank you to all of them. This work was supported by the 2009MQD-0070 project of DIEU of Generalitat of Catalunya.

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Gemma Filella gained her degree in Philosophy and Education Sciences from the Autonomous University of Barcelona (UAB), in 1989. She received her doctorate in Education Sciences at the University of Barcelona (UB) (Spain) in 1996. She is currently a lecturer in the Department of Pedagogy and Psychology at the University of Lleida. Her main line of research is personal orientation and, specifically, emotional education.

Francesc Gine is the Vice-Dean of the Polytechnic School of the University of Lleida. He received his BSc in telecommunication engineering from the Polytechnic University of Catalonia (UPC), Spain, in 1993 and Ph.D. degree in computer science from the Autonomous University of Barcelona (UAB), Spain, in 2004. He is currently an Associate Professor of Computer Architecture at University of Lleida (UdL), Spain.

Ferran Badia is the Dean of the Polytechnic School of the University of Lleida. He received his BSc in physics from the University of Barcelona (UB), Spain, in 1988, and his Ph.D. degree in physical sciences from the University of Barcelona (UB), Spain, in 1991. He is currently Associate Professor in Applied Physics at the University of Lleida (UdL), Spain.

Anna Soldevila received her degree and doctorate in Psycho-pedagogy from the University of Lleida (UdL), (Spain), in 1996 and 2007, respectively. She is currently a lecturer in the Department of Pedagogy and Psychology at the University of Lleida (UdL). Her main line of research is personal orientation and, specifically, emotional education.

Margarita Moltó is the Vice-Dean of the Polytechnic School of the University of Lleida. She received her B.S. in economics from the University of Saragossa, Spain, in 1991. She is currently an Assistant Professor of Business Administration at the University of Lleida (UdL), Spain.

Isabel Del-Arco is the Vice-Dean for Teaching at the University of Lleida. She holds degrees in Philosophy and Education Sciences from the UNED (Spain). She earned her doctorate in Psycho-pedagogy from the University of Lleida (UdL) in 1999. She is currently a lecturer Department of Pedagogy and Psychology.