RESULTS OF THE "PROYECTO AULA" APPLICATION TO ENGINEERING STUDENTS

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Abstract

At Universidad Veracruzana, "Proyecto Aula" (PA) is the name given to the academic project that sets the groundings for innovation in the institution's educational model, the Modelo Educativo Integral y Flexible. In PA, the teaching and learning process focuses in the students' achievement of competencies and their ability to develop complex learning skills. The project has been going on for two years. This work presents the results of the implementation of this project in three different subjects in selected groups of engineering students at the Facultad de Ingeniería / Veracruz. In two subjects, PA methodologies were applied to different groups and the results were compared to those of similar groups of the same subjects, in different scholar periods, taught by the same professor using traditional teaching strategies. In another subject, the comparison was made between one group that worked with the PA methodology and two other groups of the same subject, during the same scholar period, taught by the same professor using traditional teaching strategies. In all cases, explanations of the instructional designs, scaffolding techniques, the incorporation of ICTs by the use of the institution's web based platform Eminus v2.2, the used evaluation criteria and the achieved results are shown. Students that have taken their courses under the PA methodologies have reported their preference for this new approach to knowledge and skills development over traditional methods.

Keywords: competencies, higher education models, teaching and learning process, teaching strategies, instructional design.

1   INTRODUCTION

Academics at Universidad Veracruzana have been working since 1999 on the implementation of the Flexible and Integral Educational Model (Abbreviated as MEIF in Spanish) [1], which provides the student with the opportunity to assume his integral formation, choosing the time spent to attend his subjects (known as Educational Experiences or EE in this model), the locations where he would attend his EE in accordance with his professional interests and his desired graduate profile.

To achieve this new teaching paradigm, an update has been made to the study plans through the curricular redesign of the EE with a strong collegiate activity from the academics of each program.

This seeks to strengthen communication and self-learning skills by students themselves. To reinforce the MEIF, a tutorial system was created that allows a greater interaction between students and academics, seeking to detect, through regular meetings, possible problems in learning, desertion, in addition to proposing the academic load of students, invitations to participate in projects, exchange programs, scholarship programs, etc.

The results of applying the model are still being evaluated. In the very same context, in 2009 was started a program called *Proyecto Aula* (Spanish for *Classroom Project*) [2], which seeks to change the traditional methodology of teaching and learning based on three main objectives: To enhance the link between teaching and research, assign complex tasks that get the students involved in solving real life problems and the intensive use of Information and Communication Technologies (ICTs). To measure the acceptance of the *Proyecto Aula* by the students, a survey was designed and the results are presented in this paper for two different Educational Experiences. The survey results show that most students feel comfortable working on projects, researching and using ICTs; they approve that other EEs be designed using this teaching and learning methodology and they assure they have obtained a better knowledge in solving real life problems.

2   BACKGROUND

Concern on achieving closer ties between education and the great scientific and technological changes, has driven organizations such as the UNESCO to analyze deeply the matter and to propose strategies which lead to an utopia in the educative ambit based on the acquisition, actualization and use of knowledge, as mentioned in the Delors report [3]. Many countries which, finding themselves immersed in a globalized world, instead of worrying about it, they have focused on reforming their educational system, mainly, at the higher education level. Recent studies such as García-García et al. [4] show the opinion of the academics regarding educational reforms that have been applied in their respective teaching areas in Spain and Italy. Kartal and Bakaç [5] suggest that the Problem Based Learning Method (PBLM) is more effective that the traditional teaching methods, because students learn to solve real life problems which imply an approach to research in order to find appropriate solutions to these problems.

De los Ríos et al. [6] show the results obtained in the Agronomic Engineer Technical School of the Technical University of Madrid trough 20 years of applying the Project Based Learning (PBL) educational methodology, which develops or increases the professional competencies in students, who learn to have an active participation in projects of the different areas. PBLM was also applied by Hsieh and Knigh [7], librarians who trough the course named "Introduction to Engineering" prepare students to understand the role of engineers and their activities in society. They conclude from the literature review and their two-year comparative study that PBLM can be an effective pedagogical approach for information literacy instruction to engineering students.

At Facultad de Ingeniería de la Universidad Veracruzana the educational reform began with the introduction of the MEIF in 2004, without achieving transcendental changes. With the introduction of the *Proyecto Aula* in 2009, the changes in the teaching process have been a subject of intense debate, beginning with the natural inertia to any change, followed by the problem represented by the pedagogical terminology, which is confusing for engineering teachers.

At the moment, the third generation (G3) of teachers is being trained. The *Proyecto Aula* method is based in teachers designing complex tasks based in the solution of real life problems which involve the student in complex thinking, research and the intensive use of ICTs. In this work, the method was applied in the courses *Mechanical Installations* and *Computer Programming*.

3   METHODOLOGY

Implementation of *Proyecto Aula* began with the instructional design of the course, through which complex tasks are designed, with levels that range from doing a bibliographic search regarding a specific subject, to the design of a computational system or a project related to the engineering area. The instructions needed to accomplish the complex tasks are available on the *Eminus* web page, where the students can consult them, download varied information, examples and submit their homework.

The *Eminus* web page is also used to have students take part in discussions about certain subjects through the *forum* tool. *Eminus* is therefore, a great tool for teachers and students in this collaborative environment.

An evaluation rubric is also designed in order to grade the student's projects. It is clearly explained to students at the beginning of the courses. For the subject of *Mechanical Installations,* the projects based learning method is used. This course is appropriate to use this particular method because the student can combine traditional learning with an active participation in project completion.

In the case of the *Computer Programming* course, the student applies his growing knowledge of the structured programming paradigm and of the elements of the language to modify the programs made in previous homework with intermediate levels of complexity and obtains different results; subsequently, the student designs and develops programs according to the specifications demanded. It's in this part where the student designs and implements his final project (high level complex task), applying the knowledge learned throughout the course. The teacher has the opportunity to evaluate the student's performance in front of the computer, working in a real programming scenario, interacting with the Integrated Development Environment (IDE) software.

In order to know the acceptance of the *Proyecto Aula*, a survey was designed which is given to the students at the end of the course. The results are shown in the following graphics.

4   RESULTS

In the subject *Mechanical Installations*, the projects assigned to students were related to: fire protection systems, industrial and residential L.P. gas and air conditioning installations. Two complexity levels were evaluated in the projects. The quality of most of the projects presented by the students was excellent; they fulfilled the items established in the evaluation rubric. At the end of the course the survey was given to the students to evaluate the application and acceptance of the method and the results are shown in the Figures 1-5. The first question was: *how do you consider this new way to teach with research projects, use of ICTs and technical visits to factories and industries.* 71 per cent answered that it was an excellent teaching-learning method, because with the development of the projects they understood better, the theoretical concepts that they are taught in class. This method also allows them to discover that there are situations that are not taught in the classroom and they must solve using their own criterion. They also commented that this activity was a good way to work in teams.
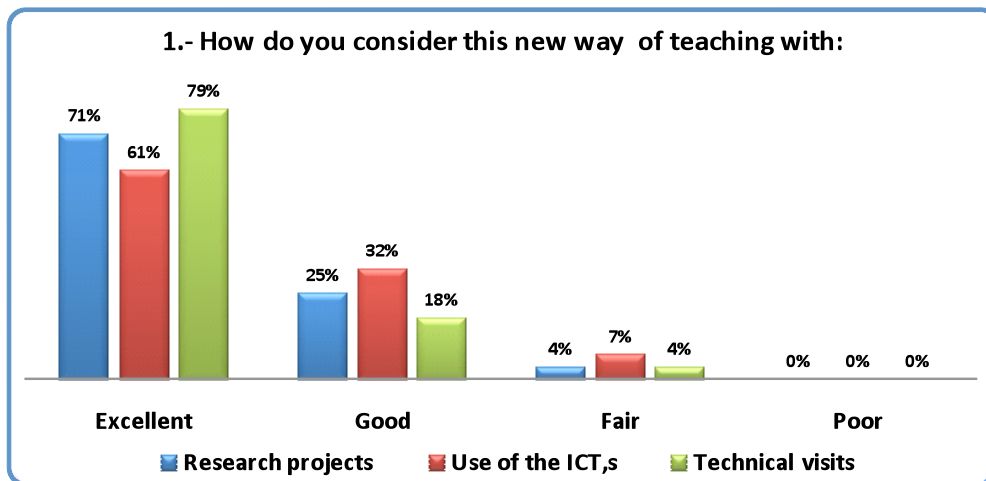

Fig. 1. Opinion with regard to PA method.

The second question was: *do you think this method should be applied to teaching other subjects*? 89 per cent of students gave an affirmative answer, because they understand better the subjects when they apply their knowledge to real life problems; however, most teachers have not been enabled to apply this method. Other students thought that this method facilitates the process of learning.
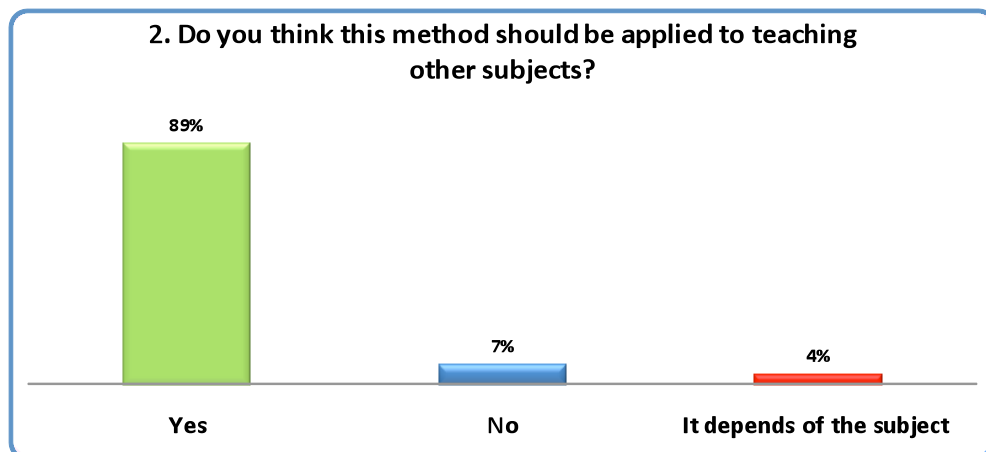

Fig. 2. Opinion with regard to applying the PA method to other subjects.

With regard to question three, the most significant answer was the need to get more training in the use of the *Eminus* platform at the beginning of each course. Students commented they had several problems to submit homework and projects using *Eminus*. Some other comments can be observed in the Fig.3.

3 .- What changes would you propose to the method? Explain

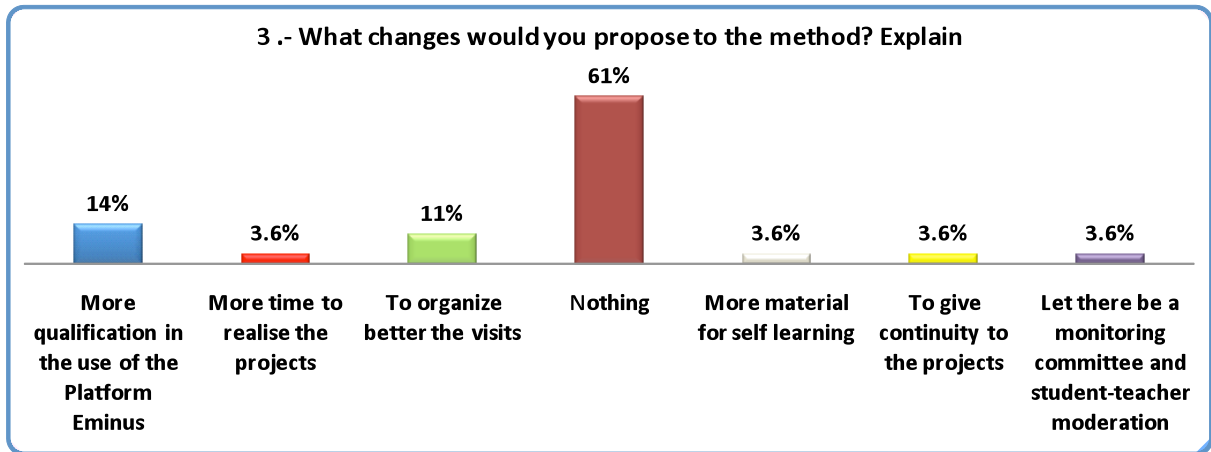| More qualification in the use of the Platform Eminus	More time to realise the projects	To organize better the visits	Nothing	More material for self learning	To give continuity to the projects	Let there be a monitoring committee and student-teacher moderation
14%	3.6%	11%	61%	3.6%	3.6%	3.6%

Fig. 3. Opinion with regard to changes proposed to the PA method.

It is important to know how to improve the delivery of the courses. Fig. 4 shows some opinions from students to this matter. To have a better calendarization of technical visits was the most significant request by the students, because the schedules of the students were full of activities along the day and that fact complicated attending the visits. Other opinions show the importance to have activities out of the classroom to apply the knowledge learned in class

4.- What would you propose to improve the subject?

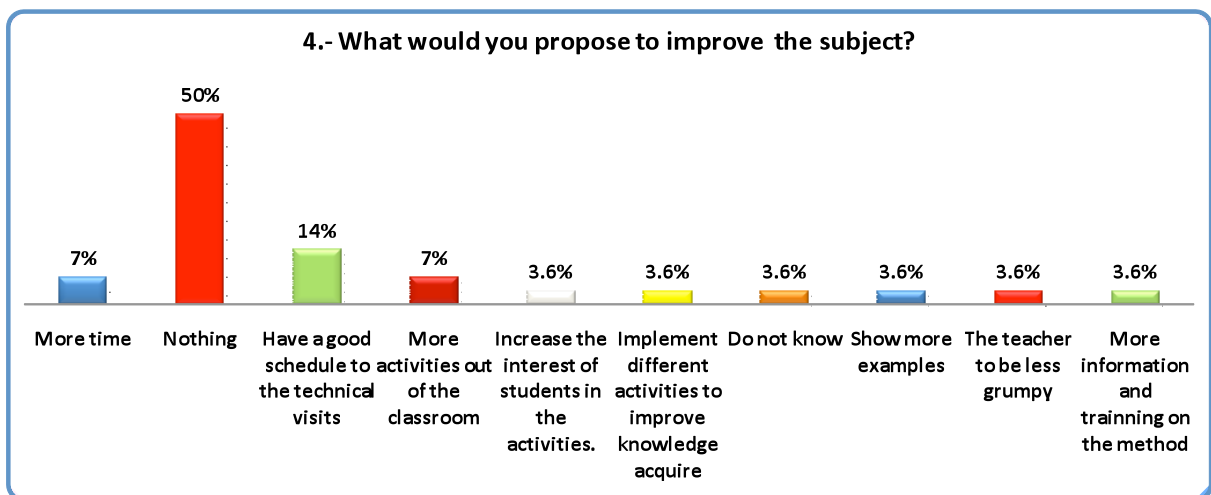| More time	Nothing	Have a good schedule to the technical visits	More activities out of the classroom	Increase the interest of students in the activities.	Implement different activities to improve knowledge acquire	Do not know	Show more examples	The teacher to be less grumpy	More information and trainning on the method
7%	50%	14%	7%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%

Fig. 4. Opinions with regard to ideas to improve the courses.

From the application of this methodology to the *Computer Programming* course, the following can be said:

Homework and projects allow students to get in touch with the reality of designing, creating and debugging computer programs.

Students prefer the inclusion of projects, research and practical work in the process of evaluating their progress, in contrast to be evaluated only trough written exams.

16 students were actively involved in carrying out their final project.

Most projects were carried out in the form of collaborative work (team).

5 students were able to make their software work well, according to specifications.

5 students were able to make their software work fairly well, with some minor bugs.

6 students were not able make their programs work.

Conducting research activities and collaborative work was well accepted by most students.

The method applied helped keep the interest in the final project.

However, at the time of obtaining the overall results for this group, the percentage of passing grades was too low, far from desirable.

Fig.5 shows a comparison of the results in terms of passing grades, for students from three groups (IME201, IME203 and IME206) of the same *Computer Programming* course, during the february 2010 - august 2010 scholar period, taking classes with the same professor. In the graph, it shows that the group that worked with the PA method had the lowest percentage of passing grades. In a survey applied to the students who took their course with the PA methodology, it was concluded that, although this methodology motivated them to work on their projects, they did not achieve the desired results, they found the goals difficult to achieve.
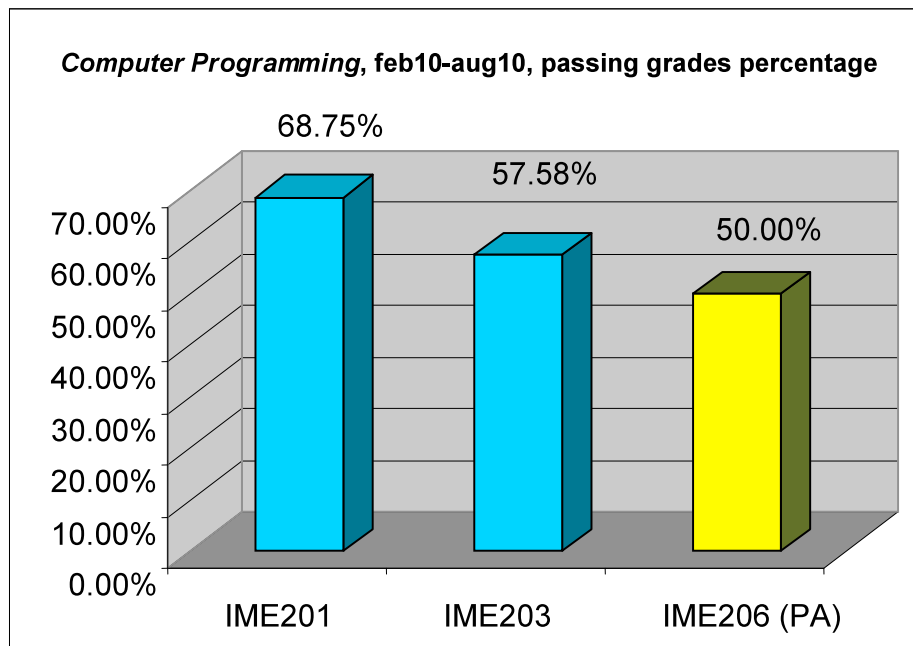
Computer Programming, feb10-aug10, passing grades percentage

Fig 5. Percentage of passing grades in three groups of the same course

5 CONCLUSIONS

Based on surveys and in the knowledge that students say they have acquired, we can conclude that this teaching and learning methodology is gradually being beneficial and accepted by engineering students. *Mechanical Installations* and *Computer Programming* are both appropriate subjects for students to apply the method to solve real life problems; however, there are other subjects, as stated by some students, in which the PA methodology would be very difficult to be implemented.

Teachers are reluctant to change in some extent, it's a natural thing, but this lack of interest in implementing the PA is very likely due to difficulties in communication between staff that provides training for teachers of PA and the teachers who receive such training, since the vision of the former is mostly pedagogical, and do not get an adequate link with the academic training of engineers, ie, do not provide examples of how to apply the method in their subjects. However, it is expected that the authors of this article can contribute, with our experience, in the training of our partners of the so-called Group 3 (G3), to achieve the success expectations of Proyecto Aula.

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