Self-creation and results of expert systems as a help in the university teaching of future engineers

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Abstract: Despite that "learning by doing" is one of the basic principles inspiring the today´s university educations, it has been proved that the possibilities offered by the processes applied by the students themselves and related to the design, creation and use of expert systems associated with learning contents of studies concerning certain techniques and technologies in the university sector and how they could positively influence the learning has been scarcely studied. Based on the need to broaden the knowledge on this field, the present research has its origin in the framework of our teaching experience in the Higher Technical School of Building Engineering in the University of Seville. For five academic years, it has been experimented with a sample of university students from the technical field of building. The main objective of this study was first to go deeply into the state of the art and make progress in the knowledge by means of the experimentation with the students mentioned above, and then analyse the results and reach to the respective conclusions, especially those related to the improvement in the competencies acquired as well as in the degree of satisfaction when the teaching was finished. The study sample was allocated in two groups: an experimental group (whose members individually built and used expert systems) and a control group (which only took part in the formal teaching, without using or building an expert system). To guarantee the homogeneity, the students were individually evaluated with regard to their initial knowledge on the issue that they started to study as well as on computing/programming. Furthermore, all the students carried out evaluations of knowledge and competencies when the respective teaching was finished. On the whole, results were significantly positive in the learning, so the grades in the evaluations of knowledge and competencies were on average higher than those of the students from the control group, as well as the degree of satisfaction when the teaching was finished, highlighting the increase of motivation. Finally, those conclusions were analysed and discussed, proposing possible further researches and suggestions to teachers and educational authorities.

Keywords: assisted teaching – artificial intelligence – expert systems – auto-learning – university

1 Introduction

The expert systems are usually identified by computer applications which try to reproduce the intellectual process that a human expert develops when giving an opinion of a particular case, solving a problem, working with incomplete data or inaccurate information, explaining results, learning, etc. [1]. Although the first approaches of expert systems were developed at the beginning of the second half of the 20th century, since 1960s its technology has been developed as MYCIN to help doctors to diagnose blood pathologies. As Buchanan indicated [2], "the thousands of expert systems following it (MYCIN) became visible demonstrations of the power of small amounts of knowledge to enable intelligent decision-making programs in numerous areas of importance". Since then, their applications have been very varied [3] and the future promising [4]. Also, there is a huge number of bibliography and references on this matter [5] as well as of expert systems (XCon, Dipmeter Advisor,

CADUCEUS, R1, CLIPS, Jess, Prolog, AIPI, XFuzzy, Fuzzy Control Language, Mathlab, STEAMER, etc.).

On the other hand, several researches and studies related to the use of the expert systems for pedagogical processes of learning in general [6] and as a help tool for a certain and specific scientific and professional training have been detected during the last years [7] [8] [9].

Although not in a usual way, experiences with regard to motivating the students by means of carrying out computer applications by themselves as part of the didactic methodology have also been dated.

Nevertheless, a methodology based on the online auto-creation of specific expert systems by the students themselves and without the need of having computing or mathematical knowledge is a highly new matter as well as quite valuable from the point of view of intellectual training.

2 Problem Formulation

Based on what has been previously exposed, the need to make progress regarding the fact that whether the creation process of the expert systems could be useful for the pedagogical progress is evident [13].

First, the problem was focused on knowing whether the tools to build the expert systems with certain ability of reaction, adaptability, auto-learning and autonomy in a simple and quick way were available [14]. Moreover, these computational systems should be useful for "obtaining active and motivated students, who are involved in the learning process and able of managing themselves in an efficient way" [15].

Once the problems of the tool to be used as well as its characteristics were solved, the second problem and main objective to overcome was being able to assess the effectiveness of the training activity when the students are given the chance of learning by means of using an interface that allows them to create expert systems in a autonomous way. For this purpose, an experimental study has been carried out. Thanks to its results, we have found out whether the design process as well as the creation and use of the expert systems related to learning contents of studies concerning certain techniques and technologies in the university sector could positively influence the respective learning and to what extent.

3 Problem Solution

To solve the problems arisen, the choice of the most convenient tools was initially made by compiling the basic characteristics of the systems detected and the requirements pointed out in the respective bibliography on the good online training areas [16] [17] [18]. Considering the aspects reflected in the scientific literature, an online application adequate to the purposes pursued to be used by the students was developed (see Fig. 1).

Figure 1. *Graphical interface of the computer application.*

Then, for five academic years, students from the Higher Technical School of Building Engineering of the University of Seville took part in the experimentation during their training. They were divided into two groups: one group aiming to create expert systems, and the other group aiming to use and control the expert systems created (see Fig. 1). When the teaching of the respective discipline was finished, tests for checking knowledge and competencies acquired were carried out (see Figs. 2 and 3). The results of the experimentation visibly showed the potential usefulness of the methodology. In this sense, the grade obtained by the students was satisfactory with a percentage of students higher than 94.76% who obtained a grade higher than 5, reaching even the percentage of 70.48% with a grade higher than 7.

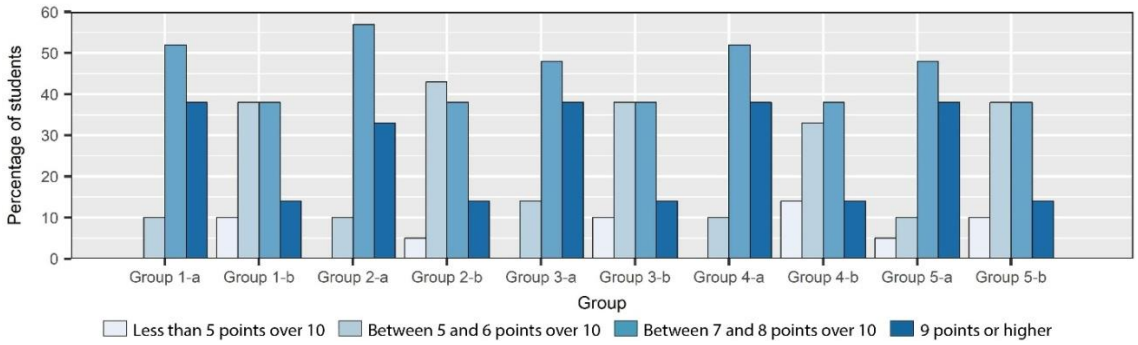

Figure 2. *In experimental groups of creating (a) and controlling (b) the expert systems. Those students were classified depending on the grade obtained in the final evaluation of knowledge and competencies*.

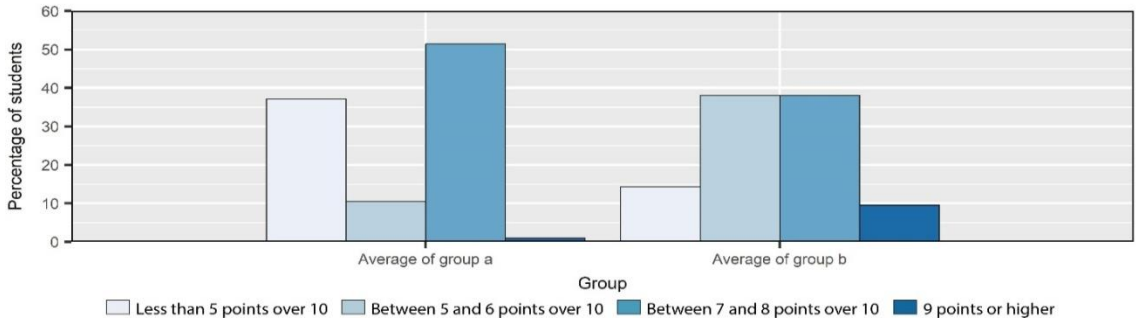

Figure 3. *Grades obtained in the final evaluations.*

Furthermore, the students were asked for making a satisfaction questionnaire with the teaching given, where they could assess different concepts at a scale from 0 to 4. As it can be appreciated in Fig. 4, all the considered concepts obtained a mark of 2 or higher, reflecting on the part of the students the usefulness of these tools. Likewise, it could be appreciated how the assessment on the part of the students from the group of creating the expert systems (group a) was quite more positive than the one from the control group (group b), so it was shown that the students from group b did not carry out the tasks assigned not as interested as the students from group a. Thus, both groups will be mixed in the future, so the student makes the expert system and assesses its usefulness.

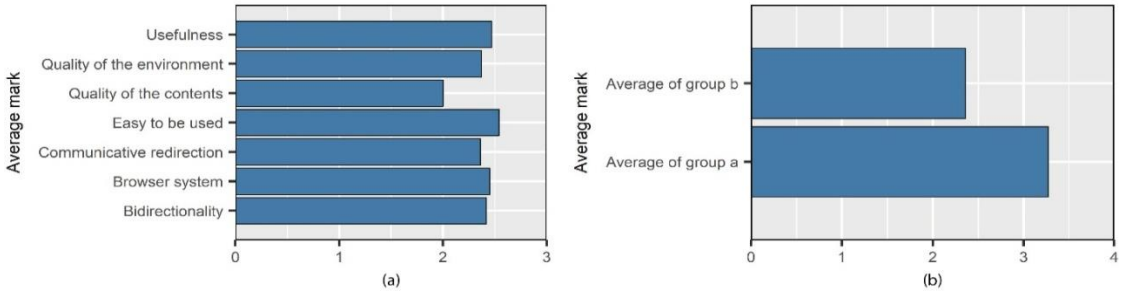

Figure 4. *Results of the satisfaction questionnaire: (a) average assessment of the different concepts on the part of the students, and (b) average of the assessment of the students by each group.*

4 Conclusion

Based on the experiment carried out, it is confirmed that the usefulness of expert systems is very positive for the learning by including the creative factor in the learning with the result of cultivating the loyalty of the students and motivating them to continue their autonomous learning. As a result, new up-to-date data could be constantly provided which, at the same time, allow to develop the system for the benefit of all the participants and of the learning quality, warning of the effect of their decisions in real time.

Therefore, the teaching and political actions which make the application of these tools easier contribute in the advance in the didactics of the professional and scientific training, which suitable fit the inspiring principles of EHEA (European Higher Education Area) by focusing on learning by creating, doing and practicing "Learning by Doing" [19], making the requirement of attending more flexible and making progress in the autonomous learning as well as in the didactic innovation for the improvement of the performance and motivation of both teachers and students.

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