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Assessing EHEA methods in the HCI1 subject at the College of Computer Science at the University of Castilla-La Mancha (Spain): an experience in the Promotion to Degree Course

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***Abstract*—This paper describes the experience developed in the subject *Human-Computer Interaction 1* (HCI1) in the Promotion to Degree Course that has been introduced during the 2011/2012 academic year in the College of Computer Science, Ciudad Real. This experience has provided us an opportunity to measure and evaluate various aspects of the course from the point of view of the students. Those aspects are related to the applicability of this subject's contents, the effort to assimilate them, the suitability of the proposed activities, the methodologies, criteria and evaluation methods, and so on. The study conducted and presented in this paper has allowed us to contrast the opinions and experiences of different groups of students with the approaches of the *European Higher Education Area* (EHEA). In this study we analyse the results by applying classical statistic methods and probabilistic graphical models (Bayesian Networks). This last representation has a richer semantics and, at first glance, provides a snapshot of the relevant relationships among the variables under consideration.**

***Index Terms*—Human-Computer Interaction, European Higher Education (EHEA), learning evaluation, skills.**

I. Introduction

THE Spanish university system is currently undergoing a period of development, not yet completed, with major changes being implemented in order to adjust the structure of university studies to the model of the *European Higher Education Area* (EHEA) [1]. The new scenario of teaching/learning involves the application of different methodologies and activities (tutorials, seminars, research work, problem-based learning, cooperative work, etc.), which will allow the acquisition of certain skills to be promoted and guaranteed.

The College of Computer Science (CCS) at the University of Castilla–La Mancha began teaching the Promotion to Degree Course during the 2011/2012 academic year. The aim of this course is to allow previous graduates (three years curricula) to obtain the Bachelor Degree in Computer Science Engineering (four years curricula) from UCLM, covering gaps in those new skills which have to be acquired within the framework of the new European Bachelor Degree. Among these skills are those related to the contents of *Human-Computer Interaction* (HCI) developed in two subjects: Human-Computer Interaction 1 (HCI1) and Human-Computer Interaction 2 (HCI2) which are included in the curricula of the new Degree and which are, therefore, included in the Promotion to Degree Course. These contents were already partially included in the *Computer Science Degree* (five years curricula), so we have significant experience in teaching these subjects [2].

The students enrolled in the Promotion to Degree Course are characterised by its heterogeneity. Different students profiles are clearly identified: those who completed their studies some years ago (they are not familiar with the teaching/learning approach of the EHEA) versus those who have recently obtained a degree and are familiar with the new teaching practices; those who share studies and professional work (they have professional experience) versus those who are studying only (they have never worked in this area of the industry); etc.

In this article, our objective is to reflect and draw some conclusions on the implementation of new teaching methods and their application to subjects with heterogeneity in the student profile such as we have previously pointed out. Thus, the following section introduces an overview of the teaching of HCI in UCLM and in CCS. Subsequently, some characteristics of the HCI1 subject of the Promotion to Degree Course are described. Then, the details of the study conducted with students enrolled in that subject are presented. Finally, some of the lessons learned are highlighted and some concluding remarks imparted.

II. The HCI Subject at the University of Castilla –La Mancha

The main objective of the discipline of Human-Computer Interaction (or HCI) is to develop and improve the usefulness, effectiveness, efficiency and usability of systems that include computers [3]. HCI is not limited to addressing methods of developing the user interface but there are also many disciplines that deal with the development of usable interactive systems, including research on new styles and paradigms of interaction. Clearly, the educative community should be aware of the need for teaching and for research in the field of HCI. Therefore, more and more universities include this discipline in the curricula of their degree programmes [4].

The Association for Computer Machinery (ACM) in conjunction with the Institute of Electrical and Electronics Engineers (IEEE) have a special working group on issues of HCI. This interest group is called SIGCHI (Special Interest Group in Computer Human Interaction). SIGCHI make certain recommendations about the contents of HCI that should be covered. These recommendations are included in the SigCHI Computing Curricula [5]. Another international curriculum that includes recommendations for the provision of such content is the Computing Curricula of ACM and IEEE [6], or the more recent report of 2005 [7]. These reports, together with the Software Engineering 2004 (SE2004) [8] and the Information Technology 2005 (IT2005) [9] curricula, defend the existence of HCI contents in the curricula, with particular emphasis on issues related to User Interface Design and Usability Engineering [10].

Thus, new curricula in Computer Science often include compulsory subjects related to the profile of HCI [2]. This is the case with respect to *Computer Science Engineering* at the University of Castilla–La Mancha. The goal is to turn out graduates specialising in the use and integration of technologies that facilitate and promote interaction and communication between people and information technology.

III. The HCI1 subject in the Promotion to Degree Course

The HCI1 subject is intended to help students achieve the acquisition of specific expertise and skills related to the "*ability to design and evaluate computer-user interfaces that ensure accessibility and usability of the systems, services and software applications*". A total of 6 ECTS are allocated to the subject: 4.5 ECTS are awarded for theoretical activities and 1.5 ECTS for practical activities. By means of these activities, the basic principles of design and development of user interfaces will be acquired. This course addresses issues such as human factors of interaction, interaction styles and paradigms (direct manipulation, ubiquitous computing, virtual and augmented reality), methods for user interface design, prototyping, usability, use of standards and guidelines, etc. The methodology used in this course is based on lectures, problem solving, practical case studies, creation of reports, and exposition of results.

Regarding the practical aspect of the subject, the principles of prototyping as a primary tool in the process of development of usable interactive systems are presented [11]. In laboratories, students make use of software tools for creating, sketching and rapid prototyping, and perform guided exercises that show the entire process of creating graphical user interfaces with Swing (Java is the language used in most subjects of the degree programme). Evaluation is carried out through the implementation of a practical project, which may be developed in groups.

IV. The HCI1 experience in the Promotion Course

Teachers who have taught the HCI1 subject have analysed and evaluated the process followed during the course in order to improve the quality of teaching in this subject for the coming years. To this end, besides observation and follow-up tutorials, we have used some questionnaires. In this article we describe the information provided by the questionnaire that we used to obtain the viewpoints and perceptions of students, subsequent to the assessment of the subject. In the following subsections we present some details of the questionnaire as well as the results obtained and the analysis performed.

4.1 Questionnaire

The first part of the questionnaire comprised a set of questions related to the background and profile of students, such as the year of completion of the *Technical Engineering in Computer Science*, employment status and, if in employment, whether they work in the field of software development, their experience in developing graphical user interfaces and their motivation for enrolling in the Promotion Course. The second part of the questionnaire consisted of 89 items for which the students had to select their level of agreement or disagreement on a scale from 0 (*Completely disagree or Nothing*) to 5 (*Completely agree or All*). In order to facilitate the reading and analysis of data, questions were grouped in the following categories:

- *Theoretical Content*. These items are related to the material used in theoretical classes, the amount of hours dedicated to lectures and to solving practical exercises or case studies, the complexity of contents covered, etc.
- *Attendance, participation and involvement*. The items included in this category are related to students' involvement in their own learning, attendance and its usefulness, and/or need to pass the course, etc.
- *Methodology, planning and workload*. This part refers to the methodology as well as the main types of activities performed, the delivery times, the need for planning, the feedback received from teachers at an appropriate time, workload and effort.
- *Skill Acquisition.* This section deals with students' perceptions about their improvement in different specific and transversal skills such as analytics, critics, planning and public speaking skills.
- *Group work*. This part contains several items related to the main difficulties that arise when working in group, basically, those concerning planning, division of responsibilities and coordination needs.

TABLE I.
EXTRACT OF QUESTIONS INCLUDED IN THE EVALUATION QUESTIONNAIRE. MEAN SCORES AND STANDARD DEVIATIONS FOR THE QUESTIONS.

#	Question	Does Not Work vs. Works				EHEA vs. Classic			
		Does Not Work		Works		EHEA		Classic	
		Mean	Dev	Mean	Dev	Mean	Dev	Mean	Dev.
P6	I had problems with the *texts in English.*	**3.38**	1.85	2.07	1.62	2.82	1.60	2.25	1.96
P9	I think the number of *deliveries* is *excessive.*	2.63	1.41	**3.00**	1.41	2.45	1.51	**3.25**	1.22
P13	I have attended the *follow-up sessions.*	2.13	2.17	2.27	2.15	1.64	2.01	**2.75**	2.14
P15	The *work rate* was *as expected.*	3.38	0.74	3.40	1.06	**3.64**	1.03	3.17	0.83
P20	I *took notes* in class.	1.75	1.67	**3.07**	1.94	2.36	1.80	2.83	2.08
P21	I find it *useful to attend* classes *to pass* the course.	2.38	1.77	**4.07**	1.39	3.18	1.94	**3.75**	1.48
P22	I find it *necessary to attend* classes *to pass* the course.	1.13	1.13	**2.53**	1.60	1.64	1.69	**2.42**	1.44
P23	I *participated actively* in class.	2.63	1.41	2.67	1.76	2.36	1.50	2.92	1.73
P25	The *methodology* has led me to *plan my time better.*	**3.50**	0.93	2.80	1.26	**3.55**	0.93	2.58	1.24
P26	I felt *overwhelmed* with the *delivery of activities.*	2.00	1.60	**3.60**	1.06	2.45	1.69	**3.58**	1.00
P29	I find it *useful* to receive *feedback* on my work during the course.	**4.25**	0.71	3.47	0.92	**4.00**	0.89	3.50	0.90
P31	On most occasions I *left work for the end.*	1.50	1.60	**2.40**	1.55	**2.36**	1.91	1.83	1.27
P38	I think that the *EHEA methods* have made me *more involved* in my learning.	2.63	1.41	**3.40**	1.45	3.00	1.55	3.25	1.42
P41	I think that *EHEA methods facilitate passing* the subject.	3.88	1.36	**4.13**	0.92	**4.27**	1.27	3.83	0.83
P44	I think that I have *improved* my *planning and organisational skills.*	2.88	1.13	**3.47**	1.25	**3.64**	0.67	2.92	1.51
P45	I think I have *improved my public speaking skills*.	**4.00**	1.07	3.00	1.30	**4.27**	0.79	2.50	1.62
P46	I find it *useful* to make *oral presentations* in class.	**3.88**	1.81	3.40	1.30	**4.45**	0.93	2.75	1.42
P49	I prefer the *classic methods.*	1.88	1.73	1.60	1.54	1.91	1.70	1.50	1.50
P50	I prefer the *EHEA methods*.	3.50	1.69	3.33	1.50	3.18	1.72	3.58	1.30
P53	I had *problems coordinating* with my fellow students when working in group.	1.38	1.69	**2.13**	1.88	0.91	1.58	**2.75**	1.60
P74	I think that *theoretical* and *practical* contents are *well interconnected*.	**3.25**	1.04	2.87	1.19	**3.36**	1.12	2.67	1.07
P75	I think that *theoretical contents are useful for my work.*	1.50	2.00	**3.47**	1.51	1.91	1.80	**3.58**	1.56
P76	I find *practical contents* learned are *useful for my work.*	1.50	2.10	**3.07**	1.44	1.82	1.72	**3.17**	1.59
P82	*Overall satisfaction* with the course.	4.38	0.52	4.40	0.63	4.36	0.50	4.42	0.67
P83	*The effort has paid off.*	4.25	0.71	4.40	0.63	4.18	0.75	4.50	0.52

- *Practical contents*. Similar to theoretical contents, some aspects dealing with practical contents have been analysed: complexity, motivation, usefulness of guided exercises and effort, among others.
- *Content relationship of theory and practice*. Analysis of such connections.
- *Usefulness*. This set of items referred to the usefulness, as perceived by students, of theoretical and practical contents received and of the different skills to enhance their future or present employment: public speaking, group work, etc.

Finally, some open-ended questions were included with the aim that students could highlight the strengths and weaknesses of the subject, as well as make suggestions and proposals for improvement.

Table I shows an extract of the questionnaire.

4.2 Results

The questionnaire was completed by 23 students, of whom 14 were men and 9 were women. In addition, 15 were in employment, of whom 12 were employed in software development activities. Regarding the motivation for enrolling in the Promotion Course, the responses were related to promotion at work, improving the curriculum or academic qualification, and personal growth, among others. Approximately half of responses (48%) were familiar with the EHEA methods, while the rest completed their technical engineering studies using traditional methods. We appreciate, as we had guessed, that there is a correlation between students' age and familiarity with EHEA methods. Thus, the age of those who have studied using these methods is between 22 and 27, and of those using traditional methods, the age is between 30 and 40.

Nevertheless, we performed a statistical analysis in order to facilitate interpretation of the large amount of data collected [12]. To do this, we began conducting a hypothesis testing based on the χ^2 statistic test, thanks to which we confirmed the next *null hypothesis*

$H_{1,0}$: "*The data for the responses to the items P1 to P83 follow a normal distribution*".

TABLE II.
CORRELATIONS BETWEEN SOME ITEMS OF THE QUESTIONNAIRE.

#	Aspect 1	Aspect 2	Corr.
POSITIVE CORRELATIONS			
C1	P8: I find it *useful* to devote class time to activities.	P3: I consider the *number of lectures* to be *enough*.	0.79
C2	P33: I worked *harder than expected.*	P26: I felt *overwhelmed* with the delivery of activities.	0.83
C3	P38: I think that the *EHEA methods* have made me *more involved* in my learning.	P36: I think that the *EHEA methods* are *more motivating*.	0.75
C4	P21: I find it *useful* to *attend* classes *to pass* the course.	P20: I *took notes* in class.	0.77
C5	P57: The resolution of the *final practice* has been *motivating*.	P56: The *final practice* has helped me to *reinforce* what has been learned in *theory*.	0.73
C6	P74: I think that *theoretical* and *practical* contents are *well interconnected*	P56: The *final practice* has helped me to *reinforce* what has been learned in *theory.*	0.72
C7	P73: In short, I am *satisfied* with the *practices*.	P17: In short, I am *satisfied* with the *theoretical part* of the course.	0.73
C8	P76: I find *the practical contents* learned to be *useful for my work*.	P75: I think that *theoretical contents are useful for my work.*	0.90
C9	P83: The *effort has paid off*.	P82: *Overall* satisfaction with the course.	0.83
NEGATIVE CORRELATIONS			
C10	P50: I *prefer* the *EHEA methods*	P49: I *prefer* the *classic methods*	-0.81
C11	P55: I would *work in groups again*	P54: I would have *preferred* to perform the various jobs *individually*.	-0.71
C12	P68: The *presentations of practices* made me see other *points of view*.	P53: I had *problems coordinating* with my fellow students when working in groups.	-0.72

Given that in normal distributions the maximum likelihood estimators are the mean and standard deviation, we proceeded to calculate these indicators for the responses to all items from P1 to P83. Table I shows the mean scores and standard deviation for some answers to the questionnaire. The items on which there has been a difference between the mean scores which can be considered significant are highlighted.

We then performed two ANOVA analyses, with a significance level below 0.05, to check whether there were significant differences between the responses given according to sex and employment status, respectively. Then, we defined the following *null hypotheses*:

$H_{2,0}$: "*There are no significant differences by gender"*.
$H_{3,0}$: "*Employment status does not influence the type of responses to the questionnaire items"*.

The first analysis allowed us to confirm $H_{2,0}$ and the second helped us to reject $H_{3,0}$ and then confirm the alternative hypothesis:

$H_{3,1}$: $\neg H_{3,0}$.

A third ANOVA analysis on the responses of all the items P1 to P83 allowed us to reject the *null hypothesis*:

$H_{4,0}$: "*The answers to all items can be considered equal"*;

and confirm the alternative hypothesis:
$H_{4,1}$: $\neg H_{4,0}$.

Therefore, in light of the result of the last analysis, we studied the correlations between students' answers to different questionnaire items. Some of the questions were related to each other (or had opposing aspects referring to one another), so analysis of positive or negative correlation was used to study the consistency between the answers given by students. Table II shows some pairs of items among which correlation was detected (both of a positive and negative nature).

4.3 Discussion

We begin discussing the differences between two distinct groups of students: students who currently work and those that do not. From the analysis of the data in Table II and considering the graphic representation of Figure 1. (a), which shows the aspects in which differences are more significant, we were able to draw the following conclusions:

- In general, we can see how students who have greater difficulties in attending class (those who work) are the ones that have most valued and benefited from class attendance. Thus, we can see that on average, they considered attendance as more useful (4.07) and more essential with respect to passing the subject. Similarly, these students often take notes in class, whereas students attending classes regularly do not take notes often.
- Due to the difficulties experienced by working students in combining work and study, these students tend to perform the activities to the end of the course and they have felt overwhelmed (3.60). They have also considered as high the number of deliveries to be made (3.00). Regarding methodological issues, the working students considered that the EHEA methods have facilitated them in passing

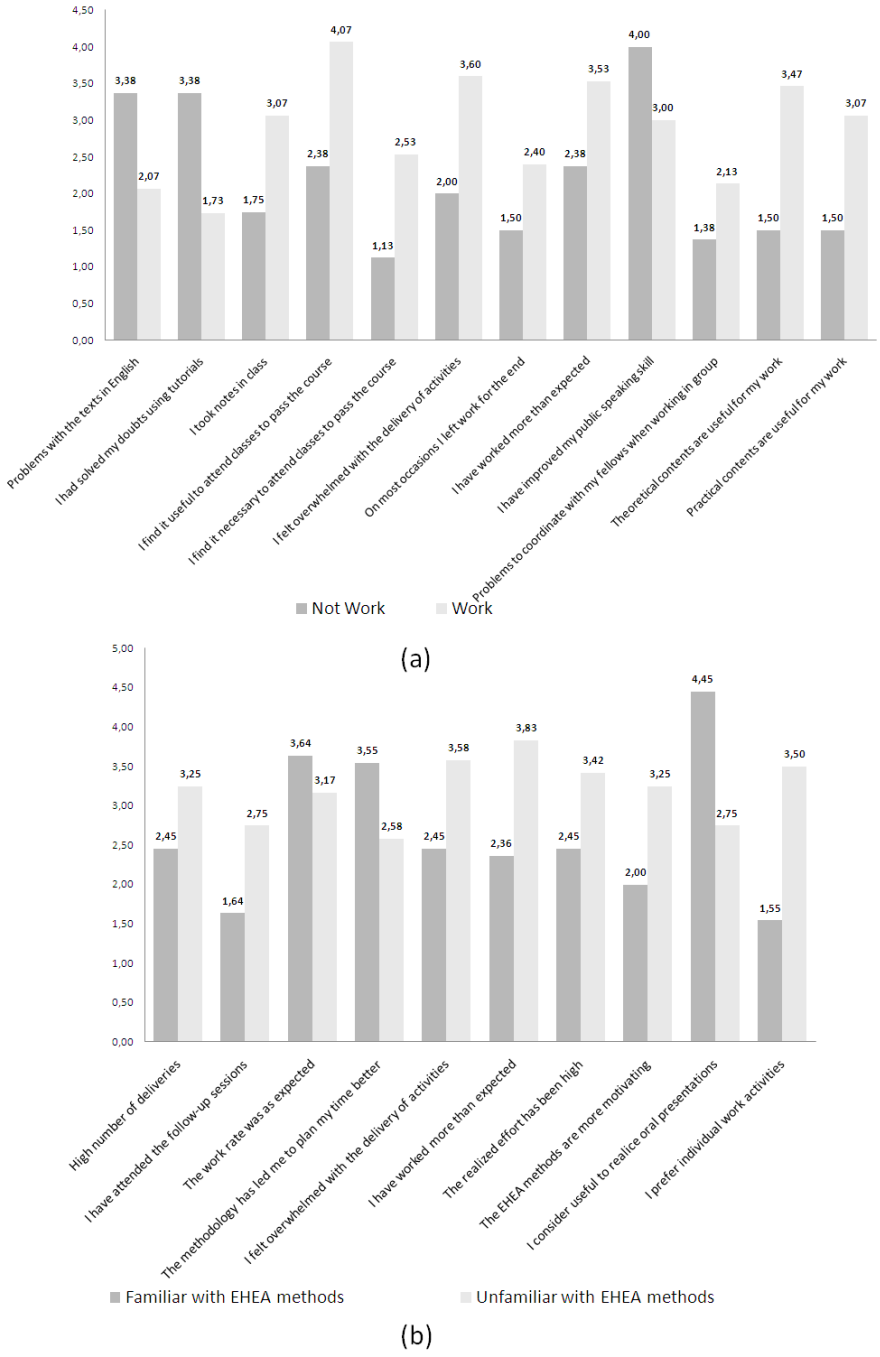

Fig. 1. (a) Significant differences in mean scores of students who "work vs. not work". (b) Significant differences in mean scores of students "familiar with *EHEA methods* vs. unfamiliar with *EHEA methods*".

the subject (4.13), leading them to plan their efforts in a better way (3.47). Meanwhile, students who do not work, on average, have considered the feedback received during the course as more useful (4.25) and believe they have improved their ability to speak in public (4.00), valuing this type of activity especially. Improvement in this capacity is not as appreciated by students who work, as most of them have already acquired this skill in the course of their work.

- In general, students who work have fewer problems with documents in English, possibly because they often use information in this language as part of their work. For their part, working students have more difficulties in group activities, partly because they have difficulties in coordinating with other team members (2.13). Regarding this point, teachers have detected that the working groups formed (both for theoretical and practical activities) were composed of students of the same profile, so that the coordination difficulties increased in the groups in which all members were working.

- Students who work, on average, have valued the utility of theoretical (3.47) and practical (3.07) contents more positively in an occupational context, the difference being very significant with respect to the group formed by those who do not work (1.50 in both aspects).
- Finally, regarding students' overall satisfaction with the course, both groups responded positively (with an average score of around 4.40).

Regarding the differences in scores related to prior experience in EHEA and not-EHEA (classic) methods (Table II and Figure 1.b), we have extracted the following conclusions:

- In general, students who had no experience of EHEA methods have made better use of the tutoring and follow-up sessions made available.
- Students who were unfamiliar with the EHEA method considered the number of deliverables as very high (3.25) and they had difficulties in working in groups. Most of them preferred individual work activities (3.50). Regarding the expectations of both groups regarding the effort realised and the amount of work carried out, the students unfamiliar with EHEA methods considered that they have worked more than expected (3.83), and considered the effort made during the course as very high (3.42). However, they positively evaluated the new methods, considering them to be more motivating than traditional methods.

Regarding the analysis of correlations, we detected 32 significant correlations (with a correlation coefficient above 0.7 or below -0.7), 27 of them positive and 5 negative. Table II shows some of these correlations. Most of the values obtained have allowed us to confirm the consistency of the answers given by students (C2, C6, C10, C11). Some of them (for example, C12) may be the result of chance. It is worth reflecting, however, on some of the correlations. Firstly, regarding the C1 correlation which indicates students' preferences for activities other than the classical classroom lectures, students positively value the opportunity to devote class time to solving exercises or case studies, to take part in tutorials, and to perform other monitoring activities. On the other hand, the C3 correlation shows, as expected, the need to motivate students and to encourage their participation and involvement in their own learning. Students consider that the EHEA methods encourage these aspects. The C4 correlation indicates that those students who value attending classes make better use of them, for example, by taking notes. The C5 correlation relates the motivation to perform the final practical activity with the perception that its realisation serves to reinforce what is learned in theory. We believe, therefore, that we must make an effort to properly connect theoretical and practical aspects with the aim of making them more motivating for students. The C7 and C8 correlations show that students are satisfied with both the theoretical and practical aspects of the course, considering them as useful for their work. Finally, the C9 correlation indicates that there is dependence between the degree of overall satisfaction with the subject and the effort devoted to it.

No significant correlations were detected between familiarity with, and preference for the EHEA methods. Neither is there a correlation between students' employment status and a preference for either the EHEA methods or traditional methods. In general, most of students (independently of their profile) prefer the new methods compared to traditional teaching (mean score of 3.40 against 1.70). Positive correlation has been noted between students who work (particularly in the area of software development) with the usefulness of the theoretical (0.85) and practical (0.74) contents in the context of their work.

Other correlations were detected (related to the *background* of students and their response to the questionnaire) which, although less significant, we want to comment upon. For example, students currently working in software development have considered the material provided in class as more useful (0.61). Students that have used email in addressing any doubts are the most knowledgeable in object-oriented programming (0.62) and Java (0.55). Possibly, the issues raised by these students were more specific and they could use this medium to solve them. Similarly, those who have more experience with Java language have lower classroom attendance (-0.61), have felt less overwhelmed with the deliveries (-0.55) and considered the practical activities as less complicated (-0.56). As for the difference by gender, we can comment that women considered themselves more involved in their own learning (0.51) and have availed of the opportunity to attend tutorials to resolve their doubts (0.66).

As for this empirical experiment, it is necessary to point out some limitations and suggestions for improvement. The methodology used (based on questionnaires) can be affected by the desire of students to give the answers expected of them or to avoid any perceived harm in answering the questions truthfully. However, conducting the questionnaire after the evaluation period allows this inconvenience to be limited. Another problem may be the size of the questionnaire. However, students did not appreciate this aspect negatively. On the other hand, the large number of items (some of which were related) and subsequent correlation analysis has allowed the consistency in the answers given by participants in the study to be validated. In future, we plan to use telematic media to complete the questionnaire (preserving confidentiality), which will facilitate its further treatment.

4.4 Understanding correlations through a Bayesian network: A first approach

As well as the numerical information provided by the analysis of correlations performed previously, we are also interested in discovering the qualitative dimension, if there is any, underlying these numerical data. Given that there was an important burden of *uncertainty* associated with the collected data, we decided to utilise Artificial Intelligence tools to manage all this information jointly. In this context, Bayesian networks (BN) [13] constitute a powerful choice because they can represent both quantitative and qualitative features simultaneously, using probability as a measure of uncertainty. The main advantage of Bayesian networks is

that they have a rich semantics and they can be easily interpreted without the need of extensive knowledge of Statistics. From an operational point of view, Bayesian networks provide a natural framework for relevance analysis and they can also be used for prediction tasks. Thus, in [14] we find an example of the application of this technique in the relevance analysis of performance indicators in higher education.

A Bayesian network is an acyclic directed graph whose nodes represent random variables and whose links represent probabilistic dependencies and independencies between them, together with a probability distribution over its variables. A link A → B is considered causal when there is a mechanism by which the value taken on by A influences the value of B. There are basically two ways of building a BN: the manual process (with the help of human experts) and the automatic process (also known as *learning*, in which we take a database and apply one of the many algorithms that yield both the structure and the conditional probabilities). In this case, we decided to learn the network from the collected data in order to be detected by the model of the underlying dependencies.

First of all, we defined a discrete variable for every item in Table II. However, we decided not to use all the items because some of them were complementary, as was the case with items P49 and P50. In this case, both items were represented by only one variable, named *Prefer EHEA methods*. The same happened with items P54 and P55, both represented by the variable *Prefer Work in Groups*. Other items that have not been considered are P68 and P74 because they were not useful for our purpose. Once all variables were defined, we used the K2 algorithm [15] implemented in the Elvira program [16] and we obtained the Bayesian network shown in Figure 2. We have used such software because of its explanation capabilities [17] which will be used in subsequent phases of our research to better analyse and improve this model.

As it can be seen, most of the correlations of Table II are represented as causal links, as is the case with correlation C1, represented in the network as a causal link from *Enough Lectures* to *Useful* Activities; the correlation C2, represented by a causal link from *Feel Overwhelmed* to *Work Harder,* etc. However, there are two correlations which are represented in a different way, so these are worth analysing in more detail. The first is the correlation C3, which correlated items P36 and P38, represented in the network by variables *EHEA methods motivates* and *EHEA methods involves,* respectively. However, the Bayesian network shows that those variables are dependent through the *Took Notes in Class* variable, which implies that if we know whether a student takes notes in class, the motivation and the involvement of the student through EHEA methods are independent. This also occurs in correlation C5 between items P56 and P57, represented in the network by *Practices Reinforce Theory* and *Practices Motivate* respectively. These variables in the network are correlated through the variables *Took notes in class* and *Satisfied with Theory*. This means that items P56 and P57 are independent once we known if the student takes notes in class or if he/she is satisfied with theory contents. Finally, it is worthwhile to note that the variable *Effort Paid Off* is independent of the rest of variables once we know the value of *General Satisfaction,* meaning that the assessment the student gives to his/her effort depends only on the overall satisfaction with the course.

This BN is only a first approach for analysing the relationship between EHEA methods and students' subjective perceptions (captured with the designed questionnaire). Due to space limitations, we have presented only a brief example of the analysis we plan to perform in the next phase of work. In new versions of this BN, the profile of students and their marks will be included.

V. CONCLUSIONS

In this paper we have presented a teaching experience on the HCI1 subject at the CCS in Ciudad Real, in the Promotion Course introduced during the 2011/2012 academic year.

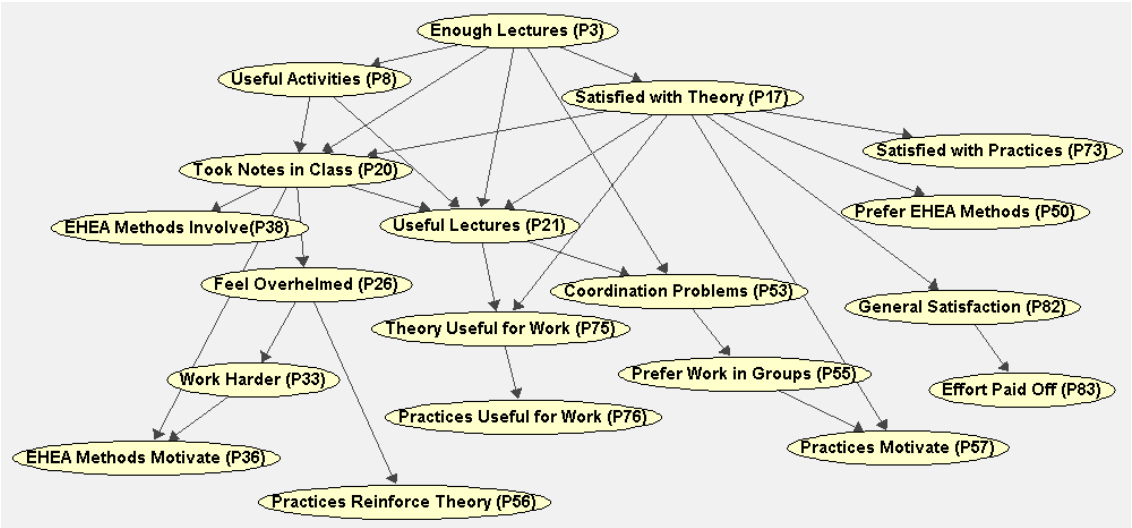

Fig. 2. The Bayesian network learned from the collected data applying K2 algorithm in the Elvira program.

The contents of this subject were covered in previous years in subjects with similar content and delivered as part of the old curricula of Computer Science in accordance with the guidelines of the EHEA and, therefore, have not undergone major methodological changes. However, what it is new compared to other years is that this subject was taught in the context of Promotion to Degree Course in which students presented clearly differentiated profiles, so we could compare the views and experience of the different groups with respect to this methodology. This study has allowed us identify the following improvements for the future teaching of this subject:

- Reduce the number of deliverables.
- Devote more classroom hours to engage the students in group work and monitoring of activities.
- Interconnect theoretical and practical content of the subject so that students can better perceive the relationship between these contents and to increase student motivation.
- Create assessment schedules tailored to students' work situations. In this study it was found that there is an incompatibility between the objectives of the EHEA to facilitate combining work and academic life and methods (preferably in person and in groups) that are often used to apply new teaching methods.

In future work, we plan to improve the Bayesian network model presented in section 4.4 in order to use it as prediction technique for certain aspects such as *student satisfaction, final mark in the subject*, etc. and their relationship with the application of the *EHEA methods* or the *student profiles*. To accomplish this, it is necessary to replicate this experiment in the coming academic years and to obtain a more significant sample.

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