LEARNING FROM HUMAN TEACHING STRATEGIES

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Abstract. Recent works in the area of adaptive education systems point out the importance of aumenting the student model to improve the personalization and adaptation to the learner by means of several aspects such as emotions, user locations or interactions. Until now the study of interactions has been mainly focused on the student-learning system flow, despite the fact that the most successful and used way of teaching are the traditional face-to-face interactions. In this project, we explore the use of interactions among teachers and students, as they occur in traditional education, to enrich the current student models, with the aim of providing them with useful information about new characteristics for improving the learning process. At a first step, in this paper we present the formal process carried out to obtain information about teachers' expertise and necessities regarding the direct interactions with students.

Keywords: Student model; Face to face; Interaction model;

1 Introduction

Recent studies have remarked the important causal relationship between the strength and mechanisms of interactions and the success of learning results. The Interaction Hypothesis [1], states that the most effective form of tutoring is the most interactive one, i.e. the face-to-face human tutoring. This hypothesis predicts also that the effectiveness of tutoring increases monotonically with the degree of interactivity: *the more interactive the tutoring, the more the student learning* [2].

However, the interactions among teachers and learners do not consist just of knowledge transmission, but many others factors enrich the communication flow for the learner to internalize that knowledge. When a teacher gives a class, it is assumed that each present learner withhold the given knowledge. But, this is not always true by many possible reason: the student does not comprehend the material, the way of teach does not fit with the learning style of the student, personal problems do not permit the student concentrate, etc. The learning styles, the individual traits, the social interactions related to the subject or the affective states can influence a lot the interactions among teachers and students, but also the material used, the educational tools, the activities carried out in class, the group work, the types of evaluations, etc.

On the other hand, Chi et al. proved [3] that the one-to-one tutoring is the best way to learn. Nowadays, in the schools, institutes or at university level, this is something

practically impossible to carry out. Nevertheless, we use to have supporting tutorships for the attendance classes, which many times are not as exploited as they could be.

Taking these aspects into account, a clear question arise to us: *How can we exploit to the maximum the interactions among teachers and students to take advantage from them and improve learning?* The answer is not that simple. Therefore, starting from the modeling of traditional interactions to enhance the learning process, our final aim is to create a tool that helps both teachers and learners in the management of their interactions, directly or in a blended environment.

Many studies have been conducted about student modeling focusing on students' competencies and learning achievements [4]. Most of the works present different approaches for modeling the knowledge acquired by the student in an adaptive system, and also the student's interests, goals and tasks [5]. More recent works model the individual traits of students, such as: learning styles [6] or cognitive styles [7]. Other works try to go further and investigate the modeling of the learning context: user platform [8], user location [9], environment and human dimension [10] or affective states of the students [11].

However, all these models leave apart the interactions happened in traditional sessions, which are the most typical in the learning process. They do not model *how* the knowledge has been acquired in traditional learning, whereas it is the process where the learning lacks can be discovered. Because of that, in this paper we expose the first step in the effort of modeling these interactions, what will enrich the actual student models, providing useful information to learning systems.

We have designed a questionnaire for teachers –as main actors of the learning-teaching process and arising interactions– parallel to that carried out in [12] where a survey was presented to investigate the teachers' needs for tracking student-computer systems interactions. This paper describes the whole empirical process we have carried out for seeking teaching experience from face-to-face learning interactions. Its purpose was to promote an introspection process in teachers to allow them to express, articulate or identify that relevant information used as the base of their learning-teaching activities.

The final questionnaire is described in the Section 2. The next phase was to design the process of data treatment and interpretation to be applied on the obtained teachers' data (Section 3). We start from a series of hypothesis: (1) *The more students they have, teachers seek more support in educational*; (2) *teaching planning in optional subjects is generally more flexible than planning compulsory*; (3) *the age plays an important role in the registration mode of the evaluation; younger teachers tend to use more technology support than the older ones in this aspect*; (4) *the more teaching experience teachers have, the more interest they might be recording the interactions happened in tutorships*; (5) *teachers might be interested having more awareness about students academic workload in other subjects*; (6) *the most interesting issues for teachers are the coordination between themshelves and the detection of students with problems in their learning process*. Section 3 shows the promising results of the inferential study applied on this preliminary work. Finally, some conclusions and future work are drawn in Section 4.

2 Searching for communication resources in teacher-student interactions

The main purpose of the designed questionnaire is to know how teachers and students interact with each other. If we discover the actual and desired interaction mechanisms we will be able to provide them with more adapted help, in useful contexts. This questionnaire pursues to foster an introspection process about the teaching activities carried out in classroom to improve the students' learning conditions; so, it may help teachers to specify, articulate and identify that deal of information. This information will make up the ground basis for a model of interactions.

The questionnaire is composed of 31 questions. Firstly it included a big list of questions that were identified as meaningful by the designer team. However, through the iterative design process we obtained a more compact question set categorized in four item blocks, which was more understandable and less tedious for teachers. The four blocks are: Teaching context, Planning of learning sessions, Interactions with students (attendance classes, tutorships and evaluation) and Technological help to cover the teaching learning necessities.

Basically three types of questions have been used: multiple choice, scaled and open-ended questions. With the aim of facilitating the selection of answers and maintaining teachers' motivation, the most of them are multiple-choice items. Scaled questions have been set mainly in the last block, where teachers can show their interest about some proposals. In all cases teachers may give their opinions or suggestions in the final open entry called Others. The survey contains two open-ended questions too where we needed more explanations to analyze teachers' behavior. Next is presented block by block a summary of the questions:

Teaching Context.

The purpose of this block is to establish the teachers' background with the aim of later discovering how the teachers' idiosyncrasy affects their teaching styles and use of educational tools. The last ones will be reflected in the remaining questions of the survey. In this part we have included questions about teachers' aspects (age and teaching experience), about the subject they teach (degree, course, credits, number of students) and about the different material, tools and functionalities they commonly use.

For example, question 6th deals with the functionalities teachers usually use or seek in educational tools (see Fig 1). This is a multiple choice question where teachers can choose different opinions: Repository, task definition, file uploading, examinations, exercise evaluation, access visualization, individual notifications, global notifications, calendar, blog, forums and chats. A final entry allows teachers to explain whether they miss any functionality in the educational tools that they usually use.

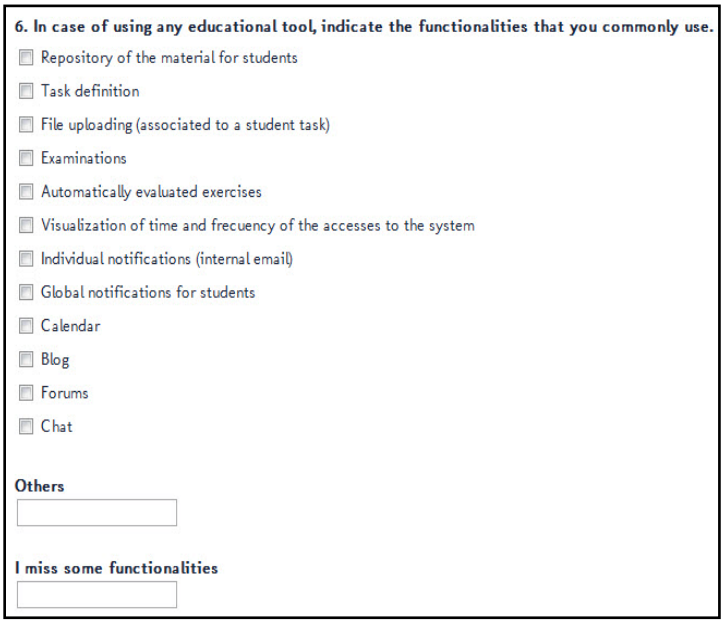

Fig. 1. Sixth question of the questionnaire about the use of the functionalities in educational tools

Planning of Learning Sessions.

This block tries to find teachers' habits when they plan learning sessions. The designed questions concern: the use of planning tools, whom the planning is meant for (the entire class, different groups of students, an individual student, etc.), information included in the plans, what is shown to students, and the typical modifications during the course and their causes. All this information will help us to find work patterns about the content preparation and teaching management.

Interactions with Students.

Here we try to identify how teachers interact with students as the basis for a model of the interactions among teachers and students. Three different learning moments have been focused: classroom attendance, tutorships and evaluation. Next, a summary of the questions divided in the mentioned groups follows:

For the aspects of the classroom attendance we have focused in the activities fulfilled, the information registered about these activities, the formation of groups of students and the reasons to change the planning of the day. These questions will help us to know the most used interactions to guide learning sessions.

Tutorships become a main way for communicating and exchanging knowledge that cannot be forgotten when teachers-students interactions are modeled. The designed questions refer to: the communication media outside the class (email, face-to-face, chats, etc.), the type and frequency of tutorships, the types of problems that students need to solve, and the influence that tutorships has in teachers' decisions. By means

of these questions we try to find out the actual use that students make of tutorships and the way to fully exploit them for a better learning.

In the evaluation part we try to deduce how the evaluation processes are carried out and whether a tool for managing evaluations would help teachers. Because of that, we revise different types of evaluations, the ways to record students' results, the issues in which teachers pay attention to evaluate the student behavior and, finally, the teachers' conclusions from those evaluations.

Technological Necessities/Help.

Finally, the last block studies the interest of teachers in recording the different aspects mentioned in the previous blocks. Questions about the student characteristics and the information storage in classroom attendance, tutorships, and evaluations are here included. Besides, the willingness of the teachers to work coordinated with the rest of the teachers in the same course is explored. After all the introspection process, the final question of the survey allows teachers to valuate some proposals of functionalities in a helping tool.

3 A preliminary study

This section contains the procedure, results and conclusions obtained in this preliminary empirical study. The study was carried out in order to examine teacher and student tutoring communication and the resources involved in it.

3.1 Methodology

Sample. Nine teachers from the Computer Science Faculty of the University of Basque Country formed the sample of the study. Several selection criteria were established to study whether the teachers' background influences their interactions with students. The considered criteria were: age, teaching experience, sex, department, course and use of educational tools. (1) Regarding the sex, we selected a balanced group of 5 women and 4 men; (2) with respect to the age, three groups were considered (less than 30 years, between 30 and 45 years, more than 45 years); (3) two groups of 3 and 6 person respectively were established for the teaching experience criteria (less than 25 years, more than 25 years). (4) Three people of each department (LSI, CCIA and ATC) were chosen as the foreseen differences among subject matters could influence their teaching styles. (5) We also tried to cover different courses; so 6 teachers give a compulsory subject and 3 an optional one. And finally, (6) we took into account just teachers that generally use education tools.

Procedure. The participant teachers received an invitation by e-mail. A special care was taken to explain the survey general purpose in order to involve them and motivate their participation in the project. The response was very positive. One week later they received the questionnaire with a brief description of the purpose and the questions of each block (similar to the Section II of this paper). Once all teachers

fulfilled the questionnaire, they were interviewed individually to gather comment, suggestion or incident arisen during the survey. The aim was to detect the doubts or problems that teachers had while fulfilling the survey (for example, whether it was too long or difficult to understand), and to know their view about the different parts of the questionnaire. The questionnaire was developed using Google Docs due to its presentation characteristics and allowed types of questions.

3.2 Results

The most remarkable results for questions studied in each particular block of the questionnaire are summarized in this section.

Teaching context. The Context block refers, among other aspects, to the functionalities that teachers use in educational tools. As stated in the Introduction, we expected that *the more students teachers had, the more support they would seek from educational tools.* Therefore, the influence of classroom size was studied in comparison to the available functionalities that teachers commonly use for tutoring purposes. Results show that the use of blogs, global alerts and file uploading are highly related to the amount of students involved in the course; $R^2 = 0.99$, $F(3,5) = 318{,}02$ and $p < 0.05$.

Planning of Learning Sessions. Our goal was to test whether *planning optional subjects was generally more flexible than planning compulsory subjects. This phenomenae would require replanning more frecuently.* In order to observe this effect, the different courses were compared to the planning requirements. However, no significant correlation was found between them. This fact could be due to the small group of participant in the pilot test. In future, we might test this hypothesis in a bigger sample. In any case, we will take into account the possibility that the number of students could influence this hypothesis, because generally the optional subjects have fewer students. For the time being, we have not found any other remarkable information in the planning of learning sessions.

Interactions with students. One of the aspects observed in this block was the evaluation of students. One of the goals has been trying to deduce how the evaluation processes are carried out and whether a tool for managing evaluations would help teachers. Different types of evaluations and resources were studied. Surprisingly, many teachers (56%) still use paper to register students' evaluations. We tested the hypothesis that *the younger teachers tend to use more technology support than the older ones when recording student evaluations*. A significant correlation was found between the use of paper and pencil strategies for evaluation coding and teacher age range $r_s = 0.67$ and $p < 0.05$.This fact becomes even more remarkable bearing in mind that the participant teachers are computer engineers.

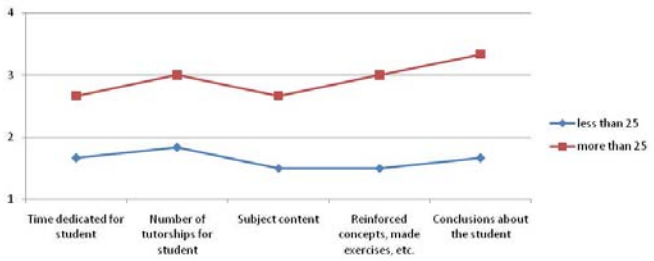

Fig. 2. Teachers' evaluation for registration of the different aspects in tutorships regarding the teaching experience

Technological Necessities/Help. Teachers have rated their needs for recording resources for several aspects of students by means of a helping tool in the range: "not at all interesting, not very interesting, fairly interesting and very interesting". Teachers' answers show some remarkable information.

The preliminary expectation was that *the more teaching experience teachers have, the more interest they would show in recording the interactions happened in tutorships.* Although the descriptive study of the data (see Fig. 2) showed certain tendency to confirm our expectations, we did not found any correlation between the teaching experience and the registration of the different aspects in tutorships.

On the other hand, in terms of coordination between teachers, the expectation was that te*achers would be more interested to be helped mainly with awareness about students academic workload in other subjects.* Friedman's ANOVA was applied to observe differences in the evaluation of these aspects. Significant differences were found in terms of interest, $\chi^2(2)=12.56$ and $p < 0.05$ (see Fig. 3). Academic workload produced higher measures than Students' personal characteristics ($Z = -2.41$, $p < 0.05$) and Students' progress in other subjects ($Z = -2.21$, $p < 0.05$). Finally, differences were also found between Students' personal characteristics and Students' progress in other subjects ($Z = -2.33$ $p < 0.05$). Therefore, we reach the conclusion that teachers are very interested in having some type of help mainly in academic workload, which is a very good clue to focus on in our effort to discover their necessities.

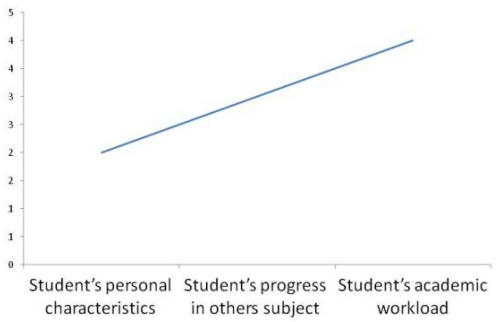

Fig. 3. Teacher coordination interest median measures

Finally, the last question suggests several potential functionalities in a novel helping tool. The last hypothesis anticipates that the *the most interesting issues for teachers would be the coordination between themshelves and the detection of students with problems in their learning process*. Friedman's ANOVA was applied to observe interesting aspects in several functionalities in a helping tool. Significant differences were found in terms of interest, $\chi^2(5)=18.61$ and $p < 0.05$ (see Fig. 4). Statistics deduction produced lower measures than Coordination between teachers ($Z = -2.53$, $p < 0.05$) and Problems detection ($Z = -2.27$, $p < 0.05$). Individual evolution graphs produced lower measures than Coordination between teachers ($Z = -2.12$, $p < 0.05$) and Problems detection ($Z = -2.23$, $p < 0.05$). Finally, Help to form groups produced lower measures than Coordination between teachers ($Z = -2.15$, $p < 0.05$) and Problems detection ($Z = -2.25$, $p < 0.05$). Therefore, as we set out in the hypothesis, teachers show more interest in coordination between themselves and the detection of students with problems in their learning.

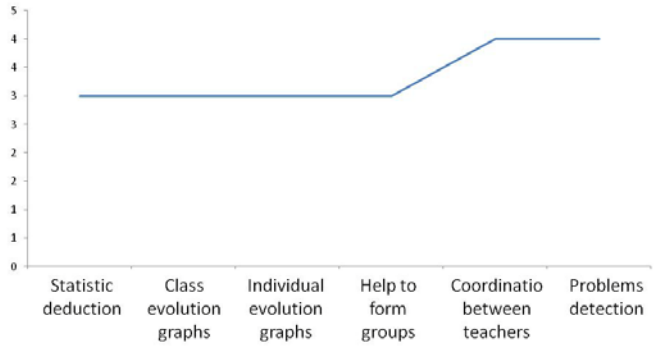

Fig. 4. Potential functionality interest median measures

4 Conclusions and future work

The work here presented aims to model interactions among teachers and students in traditional sessions in order to build supporting learning-teaching tools applicable to face-to-face interactions in a blended context.

In this paper we have described the experimental process carried out to capture information about significant teaching behavior used by teachers to make strategic teaching decisions. The process has included the design and application of a pilot test for teachers, the analysis of teacher answers, and the individual interviews post-test. Its results show some interaction mechanisms among teachers and students. We have studied some hypothesis and we have confirmed some aspects, such as: (1) *The more students teachers had, the more support they would seek from educational tools. Concretely, the use of blogs, global alerts and file uploading are highly related to the amount of students involved in the course*. As teachers are not capable of tutor the students individually by themselves, they seek support in learning system and with this affirmation they show their willingness in being help, which encourage us to

discover the main necessities they have regarding the interactions between their students with the purpose of adapting the learning process to each student. (2) *The relation of the teacher age with the use of paper and pencil strategies for evaluation. The younger teachers tend to use more technology support*. As most of the current teachers are not digital natives, we reach the conclusion that this mentioned aspect and others similar could occur due to this generational gap, which impedes teachers to deal with all the information that education systems treat and many times they get lost and renounce to use these systems. Our aim is to discover these types of problems in order to help teachers in the best possible way. (3) *Regarding the coordination between teachers, they are very interested in having some type of help mainly in student academic workload*; This is a very good clue about the problems that teachers have to deal with in their day by day. It seems that the little communication between teachers can derive in problems for students and due to their interest in this aspect we will study the possibility of helping teachers in this sense. (4) *The most interesting issues for teachers are the coordination between themshelves and the detection of students with problems in their learning process*. Finally, as a summary of the questionnaire we present both aspects, coordination between teachers and problems detection, as the most interesting ones to teachers, through which we could provide help. We will study these facts deeply with the general test.

As a consequence of the teachers' answers to the test, the opinion shown in the interviews and the statistical analysis carried out we detected some difficulties that we improved by modifying several aspects of the questionnaire: (1) Although the teacher opinion about the comprehension and the length of the questionnaire was mainly positive, we found some redundancy between two questions so we decided to remove one of them in future. (2) We had some technical problems when it came to interpret the data automatically and because of that we varied the approach of some questions. (3) We fixed several expression misconceptions.

At the moment and once improved the questionnaire, the next step will be to pass the general test to a significant sample group. Teachers from technical and social science fields will take part in the forthcoming study. This way, several teaching viewpoints will be taken into account because of the different characteristics of careers considered. Students' needs differ also according to the characteristics of the career, be technique or humanistic, so the behaviors and interactions will be different too. These differences will be also analyzed in the general test.

The study of the general test will allow us to confirm the preliminary pilot test results shown in previous sections, and to get more significant data. Besides, we will seek more patterns in the teachers' behavior in function of their features by means of a more in depth study to reach a rich and sound set of conclusions. The final goal is to define a Model of Teacher-Student Interactions. On one hand, this model will be the base of a future helping tool for teachers and students in the management of their interactions, and on the other hand will enrich the current student models providing useful information to learning systems.

Another aspect to take into account is the opinion and needs of students. Teachers and students viewpoints are to be considered to develop a powerful tool to helps teachers and students in the same way. Therefore, we will carry out a survey with

students for this purpose once we have finished the proposed study about the teachers' viewpoint.

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