A support model for question answering

A support model for question-answering

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Abstract. Tutors have only limited time to support the learning process. In this paper, we introduce a model that helps answering the questions of students. The model invokes the knowledge and skills of fellow students by bringing them together based on the combination of questions posed and their study progress; it supports the process with text fragments selected from the material studied. We will explain the model and the use of Latent Semantic Analysis (LSA) to select and support the peers. Finally, we will discuss the results of a calibration and simulation of the model and present the first results of an experiment.

Introduction

In modern learning settings, students typically spend a significant amount of time learning online. The advent of the knowledge economy and the individualisation of our society are two leading factors that underpin the increasing demand for flexibility: students want to be able to study at the place, time and pace of their own choosing (logistic flexibility); also, students are unwilling to submit themselves to pre-planned, rigid programmes, but want their prior competences honoured and their specific study plans catered for (subject matter flexibility). However, as in regular settings, students will have questions on where to start, how to proceed, how to understand and apply the available study material or will want to have their contributions assessed. In this paper, we will concentrate on one element of this challenge, to wit, answering questions related to the content studied. For a tutor, this is considered a time-consuming and disruptive task (De Vries *et al*, 2005). Yet, learning may improve if learners can ask questions and receive timely and relevant feedback (Howell, 2003).

In our model (Van Rosmalen *et al*, 2006; Kester *et al*, 2007) we seek to solve content-related questions by involving peers in answering them (peer tutoring).

To that end, we identify appropriate and available students as well as documents, and bring these together in a so-called *ad hoc, transient* community. Such a community is *ad hoc* in that its only purpose is to solve a particular question; it is transient in that it vanishes the moment the question has been solved. The model distinguishes (Table 1) six main steps of which step 2 depends on LSA. In the following section we will introduce the current implementation, next we will discuss the results of a calibration and simulation of the model and finally we will conclude with the first results of a still ongoing experiment with approximately 100 students in a Learning Network on 'Internet Basics'.

Table 1: The main steps of the model.

Pre-condition	A Learning Network (LN) with a set of Activity Nodes (ANs) and a set of users with their profiles indicating their progress with regard to the topics
Main steps	1. *Anne* poses a question. 2. The *system* determines: - the most relevant text fragments; - the appropriate ANs; - the most suitable users. 3. The *system* sets up a wiki with the question, the text fragments and guidelines. 4. The selected *users* receive an invitation to assist. 5. *Anne and the users* discuss and phrase an answer in the wiki. 6. If answered (or after a given period of time) *Anne* closes the discussion and rates the answer.
Post-condition	The answer is stored.

Model implementation

The prototype of the model (Figure 1) consists of five modules. For the students we have a course (LN), its topics (ANs) and a question interface (AskCQ) in Moodle (http://www.moodle.org). Additionally, each time a question is posed, a wiki is made available that includes the question and three documents selected from the course material. The wiki is populated with a selection of users who are invited to help. In addition, in the background, we have three modules: a general text parser (GTP; Giles *et al*, 2001), a GTP calibrator (GTP Usability Prototype – GUP-; De Jong *et al*, 2006) and a tutor locator (ATL; Brouwers *et al*, 2006). We use GTP, an LSA implementation, to map the questions on the documents in the course. The GTP module returns correlations between the question and documents. The GUP module has been built to ease the calibration. Finally, the ATL module takes care of the selection of the peer users who will assist. The selection is based on a weighted sum of four criteria that are derived from the users' background and performance. The designer can adjust the weights.

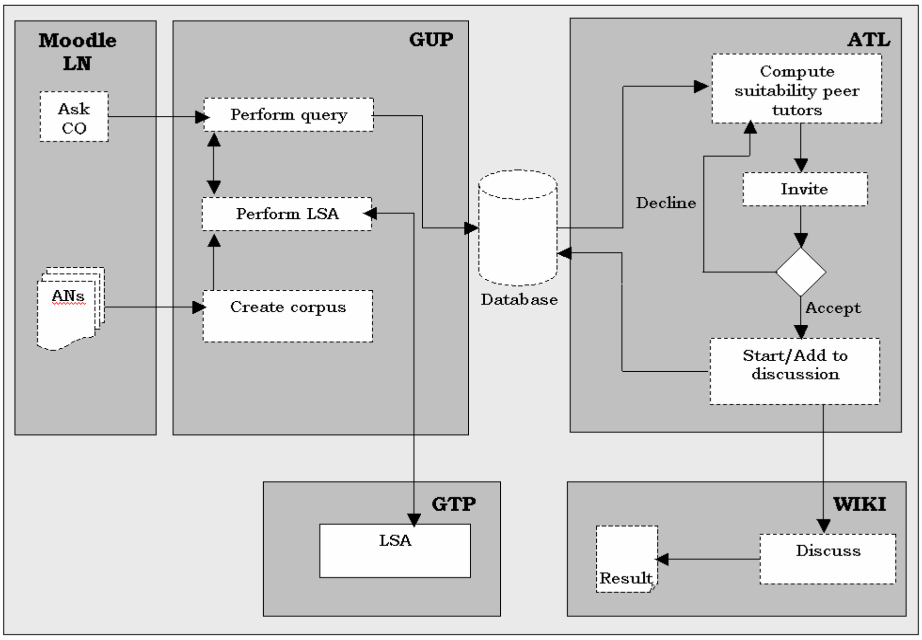

Figure 1. The main modules of the model.

The model covers three phases. In the design-phase, the working context is defined. All text of the LN is captured and put into a corpus for further analysis and all parameters, the LSA and the peer selection parameters, are set. The question-phase starts when a user poses a question (e.g. "when I register for a particular chat room, does my registration allow me to use several pseudonyms?"). First, the ANs are identified to which the question fits best. This is done by mapping the question with LSA on the documents of the corpus and to look for the three documents with the highest correlations. Later, the same three documents are given to the ad hoc community to help the users get a quick overview of relevant documents in relation to the question. We chose three documents because three should suffice to be of assistence and should not hinder being all read by the supporting peers. Next, knowing to which topic the question fits best, the ATL module can identify peers who are competent in the pertinent AN(s). ATL selects 2-5 users who, according to a weighted sum of four criteria, i.e. *tutor competency*, *content competency*, *availability* and *eligibility* (Van Rosmalen *et al*, in press) are best equipped to answer the question. Finally, in the answer-phase the peers invited discuss and formulate an answer.

Calibration and a first simulation

To assure that our prototype is viable we calibrated the LSA-parameters, and simulated and tested two key aspects of the model. First, we checked how well we can use LSA to identify the topic of a question (i.e. to which ANs a question belongs) and to select text fragments useful for answering the question. Second, we checked if the peer selection criteria met our expectations. The domain of the LN we used is ‘Internet Basics’, a collection of texts, links and tasks that aim to instigate a basic understanding of the Internet (Janssen *et al*, in press). It contains 11 topics, each of which introduces a different aspect of the Internet. The topics consist of an introduction, exercises, references to external web pages for further study and an assessment.

For the simulation, we formulated a set of 16 test questions, each related to exactly one AN. The prototype identified the correct AN for 12 out of the 16 questions (75%). Moreover, two developers of the Learning Network in question, evaluated the suitability of the text fragments, three for each question, that the prototype suggested. For 7 of the questions, one or more text fragments were identified that in their opinion were useful for answering those questions. The experts also indicated that 5 of the 16 questions posed were beyond the scope of the contents of the AN studied. Taking this into account, the score is 7 questions with useful text fragments out of a total of 11 (about 60%, for details, see Van Rosmalen, 2006).

To test the peer selection criteria we created five learners (Table 2) and we assigned a set of test values to the parameters of the peer selection formula (for details see Van Rosmalen *et al*, in press). Next, we had learner 1 (L_1) twice ‘ask’ one of the 16 question mentioned above. The question was related to AN2. For the first question the learner with the highest rank was selected. The results of the test showed, however, that we can balance the selection of peers with the help of workload and eligibility. In selection 1 the value of eligibility favoured Learner 2 (L_2) over Learner 3 (L_3), i.e., it prioritised the selection of a student in the same study-phase. However, if we pose the question again the balance was shifted due to the workload of Learner 2.

Table 2. Position of learner L_1 - L_5 for AN1 and AN2.

	L_1	L_2	L_3	L_4	L_5
Score AN1	1	1	0.3	0	0
Score AN2	0.3	1	1	0	0
Availability (at the start)	05	05	0.5	0.5	0.5

Experiment

The results discussed in the section above suggested that the model delivers as expected. Therefore, as the next step we set-up an experiment first to verify the hypothesis that the task of staff in answering questions can be facilitated and significantly alleviated by following the peer-user model proposed. The assumption is that it should be possible to solve at least 50% of students' questions without staff support. For the experiment, we organised a course over 8 weeks in the LN on Internet Basics; 109 students volunteered. The students were divided at random over two groups. This, also to study the effect of different parameter settings of the student selection criteria. In group 1, we used a weighted selection of all criteria. In group 2, we only made use of the availability criteria to select peer-tutors. Students received general instructions connected to the LN and a specific instruction on how to use the AskCQ-module for all their content-related questions. To avoid any unclear dependencies, it was decided that for the first experiment the students would not receive any incentives to use the AskCQ-module and also that we would only interfere afterwards with staff-tutors. It means that the staff-tutors would not assist during the course with answering content-related questions but that they would only rate the result of each question-answer pair.

At the moment we are halfway through the experiment. The first results are promising. In total over the two groups:

- 39 questions have been posed;
- Of which 30 questions have been resolved; 6 are being discussed and 3 questions failed because the invited peer-tutors did not react or refused the invitation to contribute;
- 25 students posed one or more questions;
- 30 students assisted in answering one or more questions;
- In total 40 students have been actively involved either posing or answering questions;
- Finally, 19 students did not show any activity, i.e. they never logged in or only looked at the general instructions.

The overall activity level with regard to AskCQ module is fair, disregarding the inactive students, the participation is close to 50%. Moreover, at least from the question poser perspective the majority of the questions have been resolved.

Conclusion

In this paper, we described a model that intends to help the learner with questions that arise while studying. We described how we tested the model on two of its key aspects and the first results of an experiment with students. The test results indicate that we were able to identify the relevant ANs for a question, to select text fragments useful for answering the question, and to apply our peer selection formula to the extent that it warrants carrying out an empirical study with 'real' students. The first results of the experiment suggest that the task of staff in answering questions can be facilitated. Obviously, without a full set of data and a detailed analysis of them it is too early to draw any final conclusions.

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