Self-Arrangement of Fleeting Student Pairs

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RESEARCH ARTICLE

Self-Arrangement of Fleeting Student Pairs: a Web 2.0 Approach for Peer Tutoring

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Abstract

This paper presents a Web 2.0 approach for the arrangement of peer tutoring in online learning. In online learning environments, the learners' expectations of obtaining frequent, one-to-one support from their teachers tend to increase the teachers' workloads to unacceptably high levels. To address this problem of workload a self-organised peer allocation mechanism is proposed for the easy arrangement of instant tutoring by fellow students. The approach is based on a computational model which selects the most appropriate peer from a population of learners. A software prototype has been developed and tested with learners in two different educational settings. The evaluation shows that the use of a self-organising, synchronous peer-allocation system is not self-evident. It may be successful, but context variables have great impact on its functioning. Although the system technically functioned appropriately, students often appeared to use alternative ways for asking for help. In view of its potential for the efficient arrangement of distributed online support recommendations are given for successful appliance of the approach.

Keywords

Peer tutoring; online support; self-organisation; Web 2.0; peer allocation

Introduction

In online learning contexts, frequent one-to-one communications with students greatly raises the workloads of teachers and tutors (Westera, 2007; De Vries et al., 2005). Indeed, through the ease of internet connectivity, students (or learners in general) expect instant support when they experience any problems with their learning tasks. Also, the diversity of the calls for help increases dramatically because of highly individualised learning routes and different paces of learning, which are advocated as the distinguishing features of online delivery. Another contributing factor is that contemporary constructivist pedagogies which

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suggest complex, open learning tasks, require intensive, tailored tutoring rather than standardised support (Brown, Collins & Duguid, 1989; Gergen 1995; Westera 2001). These factors all effect increased workloads of teachers and tutors. Simply appointing more teachers would make online education unaffordable; conversely, limiting the amount of support would inevitable harm the quality and effectivity of online learning. As a consequence, online learners cannot always be provided with the required assistance at the right volume and at the right time. Naturally, in case of encountering any problems students will try to figure these out themselves (which can be very informative as such), but after a while a remote tutor will be necessary to provide assistance in order to avoid pointless wasting of time. Indeed, the ample availability of appropriate support for learners is an important determinant of study success (Mory, 2003).

A viable alternative of support by teachers would be peer tutoring. Various researchers reported that peer tutoring is often found to produce higher learning outcomes (Fantuzzo, Riggio, Connelly & Dimeff, 1989; Gyanani & Pahuja, 1995; King, Staffieri & Adelgais, 1998; Wong, Chan, Chou, Heh & Tung, 2003) and to have positive effects on motivation, reflection, self-esteem and commitment (Fantuzzo et al., 1989; Anderson et al., 2000). Indeed, receiving help from fellow learners may be an interesting alternative. Van Rosmalen et al. (2006, 2008) report that students are positive about supporting each other in content related questions. But the appliance of fellow consultation is not self-evident: even when online learning may incorporate some group work or communities of learners, the common notion of cohorts is not necessarily preserved, which positions online learning as a quite solitary, individualised mode of learning that is not necessarily linked with peers. Although synchronised cohorts not always exists in online education, there may be many students working at the same domain, module, problem or topic, who are possibly not aware of each other and may even not know each other. They may follow different learning routes, have different learning objectives and study at different paces and times. This invisible community of fellow learners, however, engage in the same subject matter and share the same interests and the same problems. It yields the social and intellectual force to provide peer tutoring as a powerful means to address the ever-growing need for online assistance. For being able to tap these resources without raising the teachers' workloads, an efficient mechanism for the arrangement of peer support is required.

This paper describes a self-organising social networking system for the arrangement of online support by fellow learners. It is assumed that individual learning routes and progress are logged by the system. That is, each time a student completes a learning task or (any task component) and starts with a new one the learner positioning data are updated. These positioning data may either be aggregated by automated tracking routines or be controlled by the users themselves. In the pilots described below for practical reasons the positioning data were forwarded by the learners themselves. When an individual in the population calls for assistance, the allocation mechanism uses the positioning data and performance data to select the most appropriate fellow tutor from the population.
First, we will outline the peer-allocation model. Subsequently, we will describe the software prototype that has been developed and the two preliminary pilots and their evaluation. In conclusion, we will discuss the outcomes and list our recommendations for successful appliance.

The peer-allocation model

Rather than letting learners post their requests in forums or shared workspaces, the proposed model opts for self-organised peer tutor allocation. When a learner asks for assistance, the model selects the most appropriate peer candidate from the population of learners: it creates fleeting "pairs" of learners by taking into account the nature of the request and the expertise and past performance of peer candidates. Such mechanism would be highly self-regulating and would reduce the teachers' workloads.

The model rests on straightforward logging data of the learners' current and past activities. It does not include the semantics of the calls for assistance, which would be possible for instance by using technologies like latent semantic analysis (VanBruggen et al., 2004; VanRosmalen et al., 2005). The generality of the model, however, doesn't obstruct the use of semantic tools per se. Rather than applying established ontologies for the representation of the domains and strategies to traverse the domains, the model uses only simple navigational data to decide whether a particular peer should be selected to address a particular call for assistance, or not.

We consider a population of students that are individually and remotely working on a number of learning tasks or activities that make up the course. These tasks or activities can reflect any collection of components, e.g. learning modules, themes, assignments, domain nodes, chapters, "pages", paragraphs, exercises or learning units. These components are used to establish what part of the course each student is working on at a certain moment. It acts as an improvised taxonomy or pseudo-ontology of the domain, which only purpose is the direct locating of students in the course. It is assumed that individual learning routes and progress of students are logged by the system, that is, each time a student completes a learning module and starts with a new one the learner positioning data are updated. As has been explained above, in the present study these data were controlled and forwarded by the users themselves.

When a student of the population calls for assistance, the allocation mechanism uses the learner positioning data to select the most appropriate peer tutor from the population. The algorithm is assumed to meet criteria in two separate dimensions:

- Quality: Select a competent tutor. The peer tutoring system would fail when incapable tutors were assigned. Therefore, first the appropriateness of the peer tutor has to be established.

- Economy: Achieve a fair workload distribution amongst students. The peer tutoring system would fail when only the sub group of highly qualified students were involved as a tutor. Therefore, the quality criterion should be balanced to produce a fair distribution of workload over the students.

So, in order to be successful, the peer allocation algorithm has to balance these conflicting demands. This problem is solved by defining two separate filtering mechanisms which are put in sequence. First the quality filter selects appropriate candidates. Criteria for appropriateness are proximity (students that are working on the same component of course) or completion (students that just have finished the very component). For these criteria mathematical expressions have been applied, which include time differences, in order to produce appropriate filtering weight functions. For instance, the completion algorithm provides a score for each student which takes into account the time passed since completion: recent completers are assumed to provide a better match. Second, the economy filter preserves a fair distribution

of tutors' workloads. Here, also two distinct mechanisms are used. The uniformity principle selects the student with the lowest number of tutoring acts so far. It procures that providing assistance is evenly distributed over the students. The favour-in-return principle selects frequent callers for assistance, as to let them "pay" for previous benefits. All these filter types are combined in order to maximise the chance of finding an appropriate peer tutor. When the filtering algorithm fails, the requests for assistance are redirected to the teacher. The general filter-layout is displayed in figure 1.
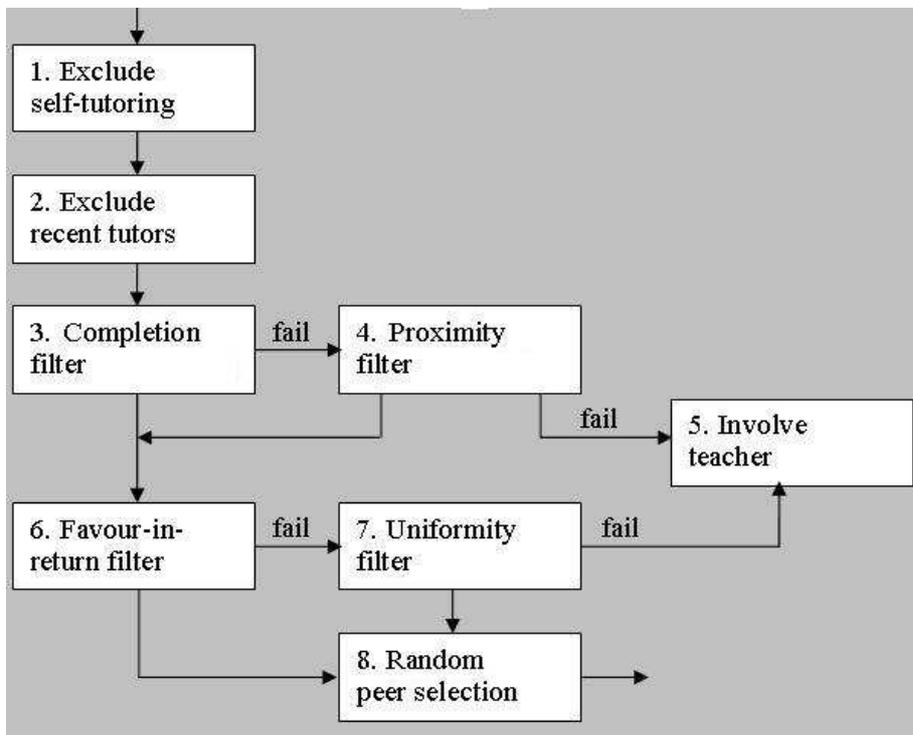

Figure 1. Basic lay-out of the allocation algorithm

An extensive explanation of the algorithm, the balancing of the filter types and the mathematics behind it, can be found in Westera (2007). The paper also presents the outcomes of various simulations which explain the conditions for achieving system stability.

The software prototype

The proposed system has to act as a match maker between students; a question raised by one student (the tutee) has to be allocated to the most appropriate fellow student (the tutor) which is filtered out of the student population by the logic of the conceptual model. Next, the system has to support a chat dialogue between the two and keep track of the dialogue's effectiveness.

In order to investigate the feasibility of the model a software prototype has been developed. The system architecture comprises a client-server solution which is based on TCP connection, a central database for user data and a management module for the arrangement and monitoring of course runs. Important motives for the TCP-based client-server solution rather than a web application or a peer-to-peer solution were 1) reducing user-side firewall problems, 2) easy checking whether students are online or not, and 3) easy and complete user logging for system dynamics analyses. The prototype was developed in Borland Delphi 7 and

uses some existing closed source and open source tools, amongst which Indy (network), NextSuite (GUI), lvkActiveScript (scripting) and svCom (NT-service).

The client prototype has been made available to students and teachers via a web-based installer. The client features automated login, authentication, automated reconnect to the server and automated web-update and needs only very limited local disk space. Its user interface has been kept simple and displays MSN-like appearance and operation (figure 2).
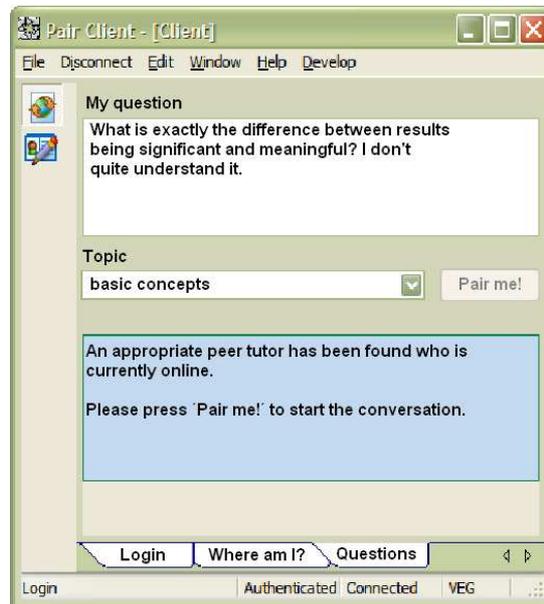
Figure 2. The client window.

It offers online chat, but in extension to this also an off-line chat in case the selected peer-tutor would be temporary off-line.

The prototype system has been tested extensively, both from a technical point of view and a (multi-)user perspective. It provides the basic features for running pilot experiments with real students. For pilots to be arranged the following conditions have to be met:
- Students have to agree to participate
- Students have to install and launch the client
- Teachers have to list course components for student positioning
- Students have to use the client: register their progress, and post and answer requests for help.

Pilot set-up

Two pilots within different educational settings were arranged. The first pilot was carried out with psychology students at the Open University of the Netherlands. This concerned a statistics course about quantitative data analysis. This course was selected because the domain of statistics is notorious for high demands for learning support, and because the student group involved was assumed large enough for enabling an appropriate peer tutoring community. An email invitation amongst students that were going to start with the course yielded 104 students that liked to participate in the pilot. Ages of the students were between 25 and 55 years, which matches the lifelong learning profile of the Open University. As proposed by the funding organisation of the project, SURFfoundation, a second pilot was

arranged amongst students of the educational programme of ICT Media Design at the Fontys University of Applied Science. Here, only 20 students agreed to participate. Yet, it was decided to continue the pilot because 1) these students were assumed to be quite familiar with using computer software, 2) it was arranged that the proposed peer tutoring mechanism would be the only means of support, and 3) it offers a different educational setting which involves more face-to-face contacts. Ages of students were between 19 and 21, which markedly differed from the other pilot group.

Both pilots ran about 3 months. At the start of each pilot, all students and teachers that were involved received an email and a URL-link to the system installer. A written instruction was made available which covered system operation and rules of behaviour. The latter include the request to students to regularly update their study progress (which is used for positioning), to frequently use the system and minimise the use of alternative communication channels, e.g. telephone, MSN, Skype, because these are not linked to the logging and allocation system.

Evaluation set-up

After the pilots, 12 of the students were interviewed to collect their experiences and findings. At an early stage an electronic survey was aimed at, but as one of the big problems of the pilots was the disappointingly scarce use of the system by students, (semi-)structured interviews seemed a better approach. The sample covered students of both pilots; it involved active users as well as users that failed or nearly failed to participate actively. Questions mainly concerned the barriers that exist for using the peer allocation system. Three types of barriers were distinguished:

- Conceptual barriers
  These are barriers associated with the very concept of online peer-allocation.
- Contextual barriers
  These are barriers associated with the pilot context, e.g. the subject matter, the educational setting, the number of students.
- Technical barriers
  These barriers concern the functioning and the usability of the system.

In addition, emails to students were used to find out why some of the students stopped their participation and why so many students initially agreed to participate, but never became online.

Results

During the pilots the peer-allocation system has been monitored continually. All student data were logged. Participation of students, however, was quite limited. Three weeks after the start only 25% of the students had entered their positioning data. Various emails were send to urge students on using the system as much as possible. Although participation improved a bit, large scale use by the students failed to occur. For the first pilot (at the Open University of the Netherlands) 104 students announced to participate, 41 students actually used the system, but only 19 students posted questions. In the second pilot (Fontys University) 9 out 20 students actually installed the system, but no dialogues between students occurred. From these outcomes it was concluded that it was necessary to find out what barriers students experience for applying such system. The structured interviews yield the following findings.

At the conceptual level it could be established that students would evaluate such

synchronous peer-tutoring system as a practical and convenient way of providing and receiving assistance. Their a priori preparedness to answer questions of peers is high, on the condition that it would not take too much time and it would not interfere too much with their own learning. Critical remarks were made about the lack of personal involvement; working with the prototype never gave the impression of an active community with students that were available to support you. For that reason students preferred to use existing tools like email or telephone to contact fellow students.

About the contexts of both pilots the students noted that the course contents didn't raise much questions that would be suitable for addressing to the peer allocation system. According to the students, both courses were too practical and mainly directed to learning or finding factual information. Most questions involved could easily be answered by using an internet search engine. Non-trivial questions, linked with understanding, problem solving and explanations would be more suitable for applying peer-support. For these types of questions, students admitted to have sufficient alternative channels at their disposal. Despite agreements with teachers to behave unresponsive, these were mostly prepared to answer emails and give appropriate advice. This is probably unavoidable when experimenting in a authentic educational setting, with teachers responsible for educational quality. Also, regular face-to-face meetings of students and their teachers continued to take place and interfered with the pilots aims. Furthermore, the low participation of students in the peer-allocation system was self-establishing, because there were only few students left to find an appropriate peer. Hence, the matching routine failed increasingly to make a match between students. The students of Fontys University established our expectation that such system is unnecessary in a context of low student numbers and frequent face-to-face contacts. The system would be suitable in situations of distributed online learning, where students don't know each other. So, large student populations, deprived of face-to-face contacts, little availability of teachers and content that raises conceptual questions rather than factual questions: that is exactly what the approach is meant for.

Despite some minor problems, the system technically functioned satisfactory. This means that the technical implementation of the peer matching logic and the system architecture was a success. Installation and operation of the client software were simple and clear. In case of problems the available manual came up with the right answers. Occasionally, students dropped out when technical problems occurred. The students of Fontys University, who have a special interest in multimedia and interaction design, would have preferred a less clinical user interface.

The email responses of students showed that students have various reasons for not participating, even after initial promises. Private problems which urged for a study break were the dominant reason for not using the system (18 times). Other reasons: some students changed their course schedule, some students don't like using the computer, some have doubts about the significance of peer support, there were alternative channels like the course forum or face-to-face meetings, the course was easy, technical problems with virus scanner or firewall settings, incompatibility with Apple computers.

Discussion and conclusions

For various reasons the pilots failed to allow large scale testing. The system technically functioned appropriately. But it seems that the number of active students was far too low to test the viability and robustness of the mapping algorithm to full extent. So care

should be taken when generalising the outcomes of this study. For the allocation mechanism to function properly and stable the active participation of more students is required. This is in accordance with simulation studies, which suggest that system stability rapidly decreases when the number of participants drops below 30 to 60 persons (Westera, 2007). The evaluation shows that the use of a self-organising, synchronous peer-allocation system may be successful, but that context variables have great impact on its functioning. Structured interviews and email responses of users suggest the following recommendations for using such a system successfully:

- The context should be distributed online learning rather than face-to-face education.
- Preferably students don't know each other.
- The number of students should be high enough, probably some 100, or even much higher to compensate for passive students and dropouts.
- Students should be actively involved and stimulated to apply the system as much as possible.
- Alternative support mechanisms, like FAQs, teachers, forums, intelligent support agents or conferences are lacking or ineffective.
- Course content raises non-trivial problems and questions, which cannot simply be resolved by using resource search engines or other tools.
- Effortless operation.
- Cross-platform operation and easy co-ordination with firewalls and virus scanners.
- The application fosters group awareness and community feeling.

In this paper the first pilot experiments with a synchronous online prototype for peer tutoring have been explained. It has turned out that non-technical issues are rigorous show-stoppers. A next step in this research would be the unhampered implementation of the system while meeting the requirements listed above. Its future perspective is the viability of a simple and reliable solution for online assistance, which is in full accordance with the Web 2.0 philosophy.

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