Contest-Kid: a competitive distributed social learning environment

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ABSTRACT

Social learning systems encompass a range of emerging learning environments which involve various combinations of agents: 'virtual learning companions' or real human students with different levels of knowledge. These agents compete against each other or work together across connected machines with or without intervention of a real or computerized teacher. Contest-Kid is a distributed social learning system in which learning activities have two phases: the learning phase and the testing phase. In the learning phase students are in a personal space and learn by watching some video. In the testing phase students are in social space and engaged in a competition game. In this paper we discuss the design and implementation issues of this distributed competitive learning environment and show how learning companions may make a difference. Some preliminary empirical experiments will be reported.

Main conference themes:	learner centred learning, distance learning
Educational areas:	
Study topics:	
Secondary keywords:	collaborative learning, competitions, games, motivation, networks

INTRODUCTION

As a move away from the traditional one-on-one Intelligent Tutoring Systems (ITS) Chan and Baskin [1, 2] proposed a triad model, the learning companion system. They suggested that in interaction with the student the computer can play the role of two co-existing agents: a learning companion and a teacher. The learning companion, a virtual agent, learns together with the student under the guidance of another virtual agent, the computerized teacher. Thus the learning companion performs the learning tasks at about the same level as the student and both the student and the companion exchange ideas getting presented the same material by the teacher. Integration-Kid [3], the first learning companion system prototype, explores various patterns of interactions in a certain protocol of learning activity, for example: cooperation, competition and modelling. Learning companion systems are not limited to centralized systems; multiple agents, artificial or human, may take various roles to interact over connected machines. Distributed West [4] is a system with two machines connected for two groups of students; the students either compete with each other or collaborate together to compete against the computer. Learning in such game oriented activities takes places as a side effect. Reciprocal-Tutoring-Kids [5] includes both centralized and distributed systems versions. In the distributed version two students work separately on two connected machines and take turns taking the roles of tutee and tutor for different problems. In the centralized version the student and the computer play the roles of tutee or tutor. When the student takes the role of tutee, the system is a traditional ITS. When the student plays the role of tutor and teaches the virtual learning companion, the model is an inverted model of ITS: learning by teaching (see [1], p. 199).

Simply speaking learning companion systems, or more in general social learning systems, are learning environments in which multiple agents, virtual or human, taking various roles to participate in a variety of protocols of learning activities, either in centralized or a distributed environment. Computer supported social learning systems are getting more and more attention [6, 7. 8] and are more feasible than ever. Emerging multimedia technology provides powerful devices to simulate peer dialogue, gestures, etc. and networking and telecommunication technology can bring school to the home.

Competition and motivation

In 1981 a sample of 122 studies was meta-analysed [9]. It was concluded that all forms of collaborative learning were more effective than individual or competitive learning. Furthermore collaboration without competition between groups was more effective than collaboration which included this type of competition. Learning is therefore different from sports or commercial behaviour where competition or competition between groups are common. However, the analysis and its sweeping conclusions quickly came under methodological criticism. Studies appearing at the same time reached less clear conclusions. The phobia of applying competition in education is mainly due to the possible harmful social effects. In general competition may lead to large incongruities in interpersonal perceptions, because students' gains or rewards are negatively related.

Contrary to the above pessimistic view a preliminary evaluation of Distributed West which is a competition oriented game, showed that students for the larger part prefer competition against each other above collaboration against the computer. Both human competition and human collaboration took place over the network and the ratio of

preference was 3 to 1. This finding suggests that competition is a powerful motivator. The moral support among group members and the narrow bandwidth of communication between the two groups of students over the network are believed to reduce the possible negative social effects of competition.

Learning needs effort, but willingness to make an effort is not in human nature. Only when all the students put in the same amount of effort, judgement of their performance will be fair. Motivation is important since it decides whether the students will learn, not whether they can learn. If students are making efforts to learn without knowing, then the motivational goal of the system may be achieved. The ultimate goal perhaps is continuing motivation: a student returning to use the system again without external constraints to do so [10]. Going beyond this type of spontaneous action is love for the subject matter itself. It is true that motivation is a means and learning is the end; but continuing motivation is so crucial an educational outcome that the converse of the statement may also be valid: learning is a means and continuing motivation is the end.

Some design issues
In general a student at a computer site in a distributed social learning environment may have a companion who is usually fellow-student. This site may collaborate with or compete against other sites. An interesting type of distributed social learning system is created when there are some virtual companions or pseudo sites. Virtual companions do not really exist, but rather are simulated by a server. In the extreme case where all other sites are pseudo sites the system becomes a centralized system. The computer simulates multiple learning companions, for example in a group learning protocol such as reciprocal teaching for reading comprehension [11] where several participants in turn are required to take different cognitive roles. If there are not enough students on-line, pseudo sites can always serve to play the needed roles. Also pseudo sites sometimes can help mediate the process of learning. For example if the teacher (simulated or human) would like the students to raise an important question and unfortunately no real students do, a virtual companion may do that instead. Finally, depending on the purpose of the system students may know or may not know which sites are pseudo. In the current version of Contest-Kid students do not know which companions are virtual.

The lower half problem
In using Distributed West one quarter of the students preferred human collaboration to human competition; the reason for this is up till now unknown. But one quarter is a substantial proportion—it makes use of competition for all students questionable. There is yet another more fundamental problem. If we assume that students have different competencies in a given domain, then half of the population of students is always less competent than the other half. The existence of this less competent half is referred to as the lower half problem. While we intend to utilize every student's potential in learning, we do not want to maximize their differences in performance. In particular we do not want the result of every student in the lower half to always be inferior.

The first strategy which can be followed, is to show students that making efforts will assure better performance. In other words, you do not have to be in the lower half part if you spend enough effort. To this end students can be encouraged to spend time in a centralized system before participating in human competition. To reinforce the message that effort will pay dividends in the centralized system, we may assign values to attributes

of the learning companions, such as background, personality and so on. For example, one companion from a school of high reputation may be smart but lazy, while another from an unknown school is slow but hard working. Now, when competing the student in the beginning be not as good as the first companion, but better than the second one. But as the student is catching up with the lazy companion, the hard working companion is found to be a threat.

The next strategy is to give students an excuse for their failure. For example, in the distributed core system students can choose their own learning companions of different competence levels. Choosing a more competent companion will have a higher penalty on their scores, and vice versa. Thus in facing competition each student has to make a decision from a range of choices or tactics in order to win. If they lose, the wrong choice of companion is to be blamed not the student's ability.

The last strategy is to fool the students. At first glance this strategy challenges the sanctity of education where honesty is always honoured. To be honest or to tell the truth sometimes is a dilemma in real life. Doctors may not tell the whole truth to their patients out of good intention. It is hard for a teacher to be honest if incapable students ask about their ability. Contest-Kid varies the competence levels of the learning companions in order to minimize the performance differences as far as the students' result is concerned; the system brings in some degree of unfairness or hides some facts. In a recent field test of Distributed West an experimental psychologist simply told the subjects that they were connected to other students whereas they were actually using a stand alone computer. In intelligent tutorial dialogue system research Gutwin and McCalla [12] argue that:

> "... saying something other than the system's conception of the truth is the best pedagogic course of action. Misrepresentation is a strategy for tailoring a learning environment such that it provides the best information for a learner's needs—and the best information is not always the truest or the most complete information."

Let us apart from these philosophical issues examine the feasibility of this strategy. If there no two sites which know each other, for example if connection is through satellite and each site is in a different country, then we can adjust every student's position by displaying a fake performance statistics. To produce proper fake performance statistics we have to know what sequence of the student's performance is best for the individual. For example should students be always superior, progress from the lower half to the upper half or fluctuate between these two halves for them to stay highly motivated? Moreover we may need to know whether one pattern is good for all students or just for some types of students. Finally the sequence of these fake statistics shown to a student has to be convincing enough so that the student will believe it. However, the above assumption of isolation from other sites is not realistic. A more common situation is that the students of some sites may know each other, but they may not be able to know how many sites are connected. In this case we can sneak a set of pretended, virtual companions into the system and pretend that these are real human students. The participation of these virtual companions may alter the performance statistics in such a way as to meet the motivational needs of most real human students. As can be seen fooling students, though interesting and controversial, is not a simple matter.

IMPLEMENTATION

Contest-Kid has been implemented on several connected MacQuadra 800s connected with the internal built-in EtherNet (Fig. 1). We used SuperCard to implement the server. For each client we use HyperCard to control the video playing and the interface interactions between the student and the computer Other multimedia tools used include Photoshop, Premier, SoundEdit, a video grabbing card and a video camera. In the learning phase of Contest-Kid the server will synchronize the starting time of video playing. Currently data passed on the network is always control data rather than video data. The server sends a message to trigger clients synchronously to play the video prestored in each client (existing technologies still cannot support such a transmission load). After a client has played the video, the server will be acknowledged. When all acknowledgements have been received, the server will set up the environment before entering the contest phase. In the testing phase the server stores and analyzes the students' performance data and sends the statistics back to the clients.
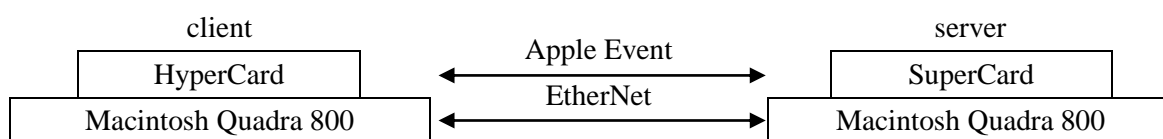Client server

Fig. 1 System execution environment

The topology of the network system is a star shape where the central machine is the server and others are clients (see Fig. 2).
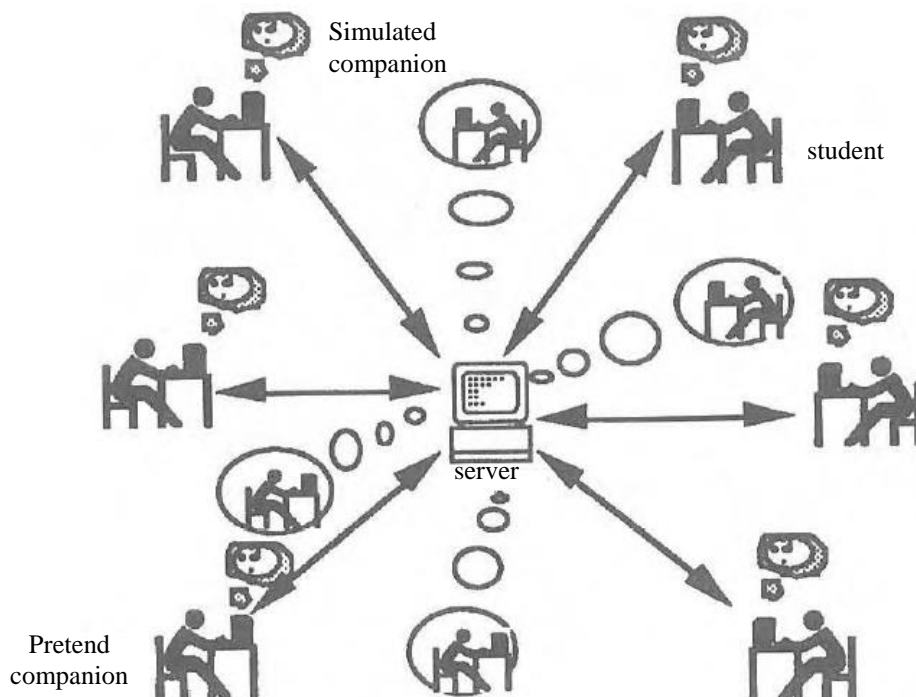

Fig. 2 Topology of contest-kid system

PRELIMINARY EVALUATION AND DISCUSSION

In the current version of Contest-Kid each student occupies a computer which is not shared with other students. The content of the video is about some important applications and social impacts of computers. In the testing phase students are asked a set of questions which are directly or indirectly related to the content of the video. The correct answer will be shown after the students have given their answers. For the purpose of evaluation the testing phase is divided into three parts. In the first set of questions students do not involve in competition, they just answer the computer's questions. No student knows the score of any of the other students. In the second set of questions the students $_{ca}$n decide whether to participate in a competition or not. For those who participate the scores will be known to every participant. In the final set of questions every student's score is known to all other students and the competition is compulsory.

After some formative evaluation we conducted three experiments with twenty-three freshmen in total who used Contest-Kid. The difference between the first and the second experiment was that in experiment two simulated companions introduced social attributes. In the third experiment students were in both one-to-one and in small group competition. Students were asked to fill in the questionnaire after the experiments. The tables below give a summary. Since questions were overlapping, data in some of the tables were accumulated from more than one experiment.

Table 1 Degree of motivation with or without competition

	no competition	*competition*
degree of motivation	20%	80%

Table 2 Degree of motivation and preference for three different types of competition

	no competition	*optional competition*	*compulsory competition*
degree of motivation	13%	67%	20%
degree of preference	13%	80%	7%

Table 1 shows that the majority of the students preferred competition to no competition. Table 2 indicates that optional competition is the most popular. As expected Table 3 illustrates that one-to-one competition is most stressful and that small group competition is most preferred (students did not experience large group competition, they were just asked what they would chose). A possible reason for this is that students can hide themselves in a small group if they are not doing well; but, when performing well, they can still see the difference they made to the group.

Table 3 Degree of stress and preference for different number of participants

	pair	*small group*	*large group*
degree of stress	50%	43%	7%
degree of preference	13%	61%	26%

Table 4 Degree of different measures when the simulated companions associated with or without social attributes

	social attributes	*classmates acquainted*	*classmates unacquainted*	*simulated companions*
degree of motivation	without	29%	57%	14%
	with	29%	42%	29%
degree of stress	without	50%	33%	17%
	with	50%	36%	14%
degree of preference	without	30%	50%	20%
	with	21%	47%	32%
degree of attention	without	67%	33%	0%
	with	43%	21%	36%

From Table 4 we can see that classmates they were unacquainted with are the most motivating to many students. Note that pretty few students found competing against simulated companions stressful. Perhaps for similar reasons the majority of students prefers competing with classmates they are unacquainted with when competing in small groups. There is a significantly higher number of students who prefer competing against simulated companions with social attributes. The dramatic difference because of the learning companions' social attributes is in the attention span. If we assume that the harmful social effects of competition are closely related to stress, one can have learning companions with social attributes as competing candidates without losing the students' attention, if no students they are acquainted with are available on-line.

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