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Learning preferences towards computerised competitive modes

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Abstract An online domain-independent competitive gaming system, called JOYCE, was devised to engage students in drill-and-practice exercises. In this paper, theories underpinning the system design are explained. As in the system students are allowed to compete with others in a face-to-face situation, and in network situations where an opponent's identify is revealed or concealed, a preliminary study was conducted to examine students' preferences towards different competition modes and satisfaction towards the learning experience. Results supported JOYCE's incorporation into the learning process and the design and development of the system. Based on the obtained data it was suggested that to increase its intrinsic value and to lessen the negative emotional states which is more easily exhibited in a face-to-face competition situation anonymity is a promising feature to be included in a competitive learning system. Furthermore, various competition modes should be built into e-learning environments to satisfy peoples' different learning mode preferences.

Keywords: Anonymity; Competition; Games; Networks; Questionairre; School; Secondary

Introduction

Psychologists have been successful in identifying major components in the learning process which almost always facilitate learning. One of the most important elements for effective instructional outcomes, as viewed by many, is practice (Gagne, 1985; Gagne *et al*., 1992; Dick *et al*. 2001). For instance, Gagne (1985) has concluded that there are several necessary conditions for effective learning of each type of objective. The one condition that pertains to all domains of instructional objectives (e.g. intellectual skills, psychomotor skills, verbal information, attitudes, cognitive strategies, etc.) is practice of the desired skills. Hence, a project geared towards developing an online domain-independent system, which can engage students in the 'practice' activity to promote better learning, was launched.

In the following sections, theories underlying the system design together with many of its motivational enrichment design features are explained. As nonface-to-face synchronised competition was not possible until the advent of networking technologies, two nonface-to-face synchronised computerised competition modes were built into the enhanced version of a system called JOYCE. They exploit two

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aspects of telecommunications media, that is, anonymity and decreased proximity. Results from a preliminary study focusing on examining student preferences towards different synchronised competitive computerised modes and satisfaction towards the learning experience are presented.

Theoretical foundations underpinning JOYCE

Several theories guide the general design and development of the system. First, computers are chosen as the delivery medium to provide an un-intimidating environment for drill-and-practice exercises and to provide instant feedback to students as a positive reinforcement for their learning (Alessi & Trollip, 2001; Heinich *et al*., 2002).

Secondly, 'gaming' is chosen as the instructional method because instructional games have been suggested as a powerful technique to capture and hold student interest (Sweeters, 1994; Lockward *et al.*, 1997). By providing a playful environment in which the learners follow prescribed rules as they strive to attain a challenging goal, 'gaming' intrinsically motivates the player and creates a desire for learning (Heinich *et al*. 2002; Sweeters, 1994). Hence, the devised system adopted a board-game format.

To further promote the motivational appeal of the system, an element of competition is included. Competition has been suggested as a way to foster learner involvement and excitement in the activity. It is widely believed to be a motivational-enrichment strategy in play, work, and education (Deci *et al*., 1981; Malone, 1981; Malone & Lepper, 1987; Butler & Kedar, 1990). Based on these arguments, a computerised competitive gaming environment, called JOYCE, was developed to support learning through practice.

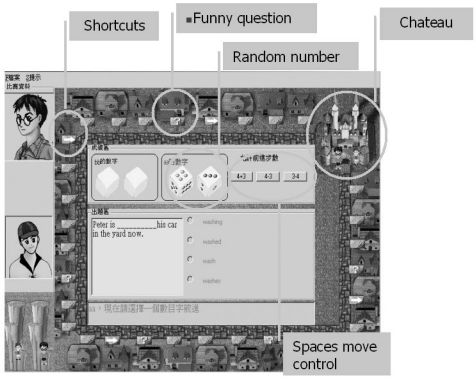

Fig. 1. JOYCE Design Features

In addition to these general design principles, specific design features were built into JOYCE to increase its intrinsic motivational values to users. Malone & Lepper (1987) proposed a conceptual framework for thinking about features of activities that might determine their intrinsic value to children. They suggested that there are four sources of intrinsic motivation that an activity might provide for an individual. These sources are challenge, curiosity, control and fantasy. Following their proposals various functions and rules were built into JOYCE (see Fig. 1). For example, bumps, shortcuts, funny questions and random number were incorporated to introduce a chance variable into the activity and, thus, increase uncertainty (Deci *et al*., 1981;

Malone & Lepper, 1987). Each of the features is described below.

Bumps. If a player moves to the same stop where his/her opponent resides, the opponent will be bounced 10 steps back.

Shortcuts. Four shortcuts are built into the game. When a player stops at these locations, he/she will be transferred to one stop ahead of the next shortcut location.

Funny questions. In addition to questions that are matched with instructional content, players also have to answer trivial questions when arriving at a funny question stop. There are five funny question stops on the route map.

Random number. Whenever a player answers the posted question correctly, a rolling dice will randomly generate a number from of one to six.

Spaces move control. Only after a player answers two questions correctly, can he/she move his/her icon around the board. The exact steps a player can move correspond to a combination of the two numbers rolled after each question (say, for example, 2 and 4). Three values are possible by the arithmetic operators of addition and subtraction of the two numbers (i.e. 2 + 4, 2 – 4, 4 – 2). To increase a player's sense of control and chance of winning, a player can decide which location is best to land on so as to beat his/her opponent in the game. For instance, considering his/her opponent's present location, a player may want to choose a specific combination of the two numbers accumulated to bounce their opponent 10 steps back. A player can move his/her icon forward or backward depending on which combination of the two numbers he/she chooses.

Icon selection and change function. A sense of fantasy and an environment for pretend play is introduced into JOYCE by including a set of icons with different characteristics (e.g. gender, looks, age, etc.). A player can choose and change different icons to represent him/her anytime during the game.

Ranking list. Two kinds of web-based ranking lists (i.e. the top five players who answered the most questions correctly in a game, and the top five players who won the most number of games) are accessible to the player after the competition to check their current ranking in the board-game. Who is in front in the class and what a student's performance is in relation to the other players in the class can be checked at anytime on the web.

Non-face-to-face online synchronised competition modes. Synchronised competition between individuals and teams was only possible in face-to-face situations in the past. Nonface-to-face synchronised competition was not possible until the advent of networking technologies. Previous research suggested that competition has an adverse effect on interpersonal relations and group processes (Hammond & Goldman, 1961; Dunn & Goldman, 1966; Weigel *et al*., 1975; Garibaldi, 1976; Johnson *et al*., 1983). For instance, Hammond & Goldman (1961) found that face-to-face groups were less favourable for group process. Weigel *et al.* (1975) found that face-to-face team competition in traditional classrooms tends to generate negative attitudes towards competing groups, and hence towards competing groups' members. Thus, two nonface-to-face synchronised computerised competition modes were built into the enhanced version of the JOYCE system. They exploit two aspects of telecommunications media, that is, anonymity and decreased proximity. A preliminary study examining students' preferences towards face-to-face and nonface-to-face competition modes as well as student satisfaction towards the learning experience was conducted in May of 2001. Details of the study are described in the following sections.

Methodology

One class of senior high school students (n = 36) majoring in business management in one vocational senior high school in the southern part of Taiwan participated in the preliminary study. Following whole class instruction, students in pairs were instructed to compete with their randomly assigned opponents in answering multiple-choice questions within JOYCE which was introduced into the school as a learning tool for drill-and-practice exercises in English. Working within the limitation of socially intact groups, all students from the same class were exposed to the same order of the three competition modes. These were randomly chosen before the commencement of the study. Thus, readers should be aware of the possibility that order of presentation may have an effect on the study's findings.

Students participated in the study for three instructional sessions for three consecutive weeks. In each week students were exposed to a different kind of competition mode. In Week 1 students were exposed to the 'Anonymity mode', in which the identities of the opponents were concealed by using a list of pseudo names from which the player chose. In Week 2 students competed with their randomly re-assigned opponents in the 'Face-to-face mode.' Competitors were sitting next to each other during the competition in face-to-face mode. In Week 3 students competed with their randomly re-assigned opponents in the 'Decreased proximity mode.' During this mode, the identity of the opponents was revealed, but competitors were geographically distant from each other while competing in the system.

Though in JOYCE competitors can take turns answering questions, in the preliminary study both players were instructed to compete to see who gets the correct answer more quickly. The winner of the game is the one who passes through the chateau twice more quickly. All interacted with computers by keying in their choice of options with the help of a patented input device, called 'Edu-click' (Chang *et al.*, 2001). Edu-click allows unlimited number of students to interact with a computer simultaneously.

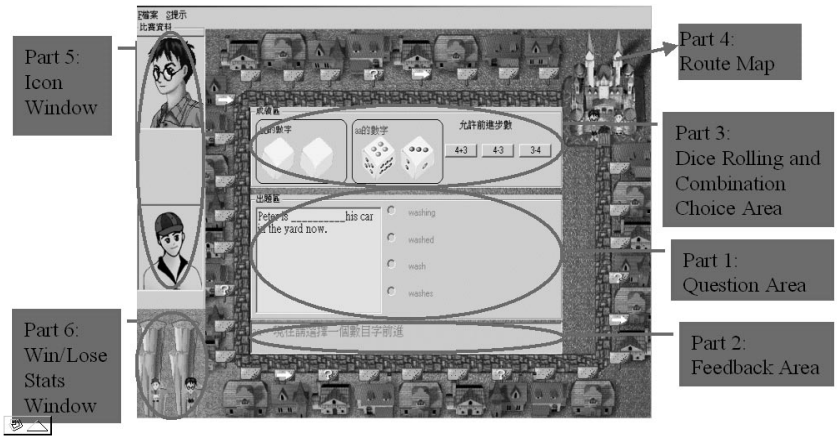

Fig. 2. The JOYCE learning environment

The main interface of the JOYCE System (see Fig. 2) is divided into six parts. Part 1, the 'Question area', presents the question and four alternatives through a pop-up window. At present multiple-choice is the only question type used in the system. Part 2, the 'Feedback area', provides information on players' responding status, for

instance, who has not keyed in their answers to the posted question yet, time it took for the players to answer the previous question, and the correct answer for the question, etc. Part 3 is the 'Dice rolling and combination choice area.' After answering each question correctly, a simulated dice gives a random number from one to six. After two questions answered correctly, students can determine the exact number of steps that the icon can move around the board via the three different combinations of numerical operators on the two numbers. Part 4 is the 'Route map'. There are 31 stops in each circuit. In addition to general questions, there are five funny questions and four shortcuts, which are included in the route map. Part 5, the 'Icon window', allows the player to choose and change the icon to represent him or herself during the game. Part 6, the 'Win/Loose status window', shows the number of games won by either side of the competing parties. When the player wins a game, he/she is escalated to a higher ladder.

In the last class session, a post-session questionnaire was administered to students and was completed individually. The questionnaire consisted of two sections and three open-ended questions. The '*Student preferences towards different competition modes*' consisted of four items. These were:

1. Which of the following three competitive modes do you like most?
   - Anonymous competition (Network competition where the competitor's identity is not revealed),
   - Face-to-face competition,
   - Decreased proximity competition (Network competition where the competitor's identity is known.
2. Why is that?
3. Which of the three competitive modes do you dislike most?
4. Why is that?

The *Student satisfaction scale* consisted of a number scales. These were assembled and adapted to make the items fit the learning situation and target population involved. In total 12 questions were included. Students rated on a five-point Likert scale whether they 'strongly disagree' 'disagree', 'no-opinion', 'agree', or 'strongly agree' to statements. The internal consistency reliability (coefficient alpha) was 0.84. To counteract possible response-set tendencies, both positive and negative statements were included in the *Satisfaction scale* (see Table 2 for details).

The final three question were:

1. What is your perceived chance of winning? (Very likely, likely, uncertain, unlikely, very unlikely)*;*
2. Which of the following features in JOYCE do you like? Mark all that apply (Competing to answer the question, bump, funny questions, correct answer the question, honour list, shortcuts, and dice combination.);
3. Any comments you had about JOYCE.

Results and discussion

Learning preferences towards different competition modes

The data showed that students preferred the anonymous mode best (80.56%) and disliked the face-to-face mode most (65.71%) — see Table 1 for details. A one-group χ^2 test also showed that participants' preferences towards different competition modes were $\chi^2 = 36.5$, d.f. = 2, and $\chi^2 = 18.1$, d.f. = 2, for liked and disliked, respectively, and both were statistically significant at the 0.0005 level.

Students' responses to the question asking why they liked the anonymity mode best indicated anonymity is '*more exciting*', '*mysterious and thus more stimulating*',

'*much fun*', '*more challenging*', '*less stressful*', '*less harmful to friendships*', and '*easier to overcome stereotyping usually prevailing in the classroom as to who is performing well and bad*', etc. Student responses to why they disliked the face-to-face competition mode most, on the other hand, showed that participants tended to perceive this arrangement as not fun and not exciting because '*it is easier to be in quarrel with competitors, which may have an negative effect on interpersonal relationships*', '*it is very stressful to compete with those who generally perform well in class*', '*it is terrifying and strained*', '*you know what your opponent's performance level is*', '*competitors might overhear my answers*', '*you may not like your competitor personally already*', etc.

The results showed that anonymous competition was the most preferred mode, compared to the face-to-face and decreased proximity competition modes.

The construct of 'challenge' in Malone and Lepper's theory of intrinsic motivation helps explain how anonymous competition might appeal more to participants. Malone & Lepper (1987) suggested that the optimal challenging activity is one whose attainment is uncertain. Since participants in the anonymity condition did not know with whom they were competing with during the game, it introduced additional source of intrinsic motivation challenge, due to uncertainty of success. Since competitors did not '*know what their opponent's performance level is*', they tended to respond to anonymous competition mode better because it was '*more exciting*', '*mysterious and thus more stimulating*', '*much fun*' and '*more challenging*.' Based on this finding, it is suggested that anonymity is a promising feature to be included in a competitive learning system to increase its intrinsic value to the player.

Moreover, in any kind of competition for a person to win it means another person must loose. In the face-to-face competition mode the opponent was identified and sitting next to them. Festinger (1950), Williams (1977) and Pepitone (1980, pp. 118–119) argue that defensive reactions are more commonly aroused in face-to-face groups, and that nonverbal cues, such as, gestures and facial expressions, etc. are more easily detected in face-to-face situations and are more prone to induce tension on competing parties. As a consequence of that, in face-to-face competition '*it is terrifying and strained*' and '*it is easier to be in quarrel with competitors, which may have an negative effect on interpersonal relationships*'. In contrast the anonymous mode appeared to be '*less stressful*', and '*less harmful to friendships'* as reflected in students' responses to questions on why they liked or disliked a particular mode of competition most. In other words, competition in the anonymous mode was more likely to reduce the tension, stress, anxiety, nervousness or other similar negative emotional states on the players as usually exhibited in the face-to-face competition mode. Furthermore, considering that face-to-face competition might lead to negative attitudes towards competing opponents (Hammond & Goldman, 1961; Weigel *et al*., 1975; Johnson *et al*., 1983), teachers should be aware of the possibility of network competition where anonymity is ensured. The suggestion is especially relevant when competition involves socially intact groups in which everyone knows each other already.

Finally, the data analysis showed that, despite the fact that a greater proportion of the participants preferred a specific type of competition mode some of the students still expressed a preference towards the other modes (see Table 1). Thus, with the support of network technologies where opponents' physical presence and identity

Table 1. Student preferences toward different competition modes

Competition mode	Like most *n* (%)	Dislike most *n* (%)
Anonymous competition	29 (80.56%)	3 (8.57%)
Face-to-face competition	5 (13.89%)	23 (65.71%)
Decreased proximity competition	2 (5.56%)	9 (25.71%)
Total	36 (100%)	35 *

* One respondent indicated that he/she liked all three modes.

can be easily concealed, competition modes besides face-to-face, i.e. anonymous and decreased proximity, should be built into e-learning environments to satisfy various learning mode preferences.

Satisfaction towards the learning experience and responses to system design

Overall, it was found that between 66.67% and 91.67% of the participants agreed or strongly agreed to the statements on the satisfaction scale. For instance, 10 participants marked 'strongly agree' and 22 marked 'agree' to statement: '*It feels good to be able to participate in this event.*' Analysis with one-group *t*-tests, using 3 as the expected mean, found that all were statistically significant at the 0.0005 level (see Table 2).

Table 2. Frequencies, T- and *P*-value of student satisfaction

I think…		1*	2*	3*	4*	5*	*T*-value	*P*-value
1.	It's enjoyable to be able to participate in this activity.	0	0	3	21	12	12.42	< 0.0005
2.	I like this kind of gaming environment.	0	1	9	23	3	7.321	< 0.0005
3.	It is very effective to learn this way.	0	2	7	25	2	6.932	< 0.0005
4.	Practice answering questions in the game gives me a sense of satisfaction.	0	1	8	25	2	7.897	< 0.0005
5.	I do not like this activity.	13	17	3	2	0	8.720	< 0.0005
6.	I can have ample opportunities to practice English through the kind of gaming instructional method.	0	1	5	26	4	9.113	< 0.0005
7.	I like to learn English through this kind of instructional method.	0	1	8	22	5	7.570	< 0.0005
8.	I hope all courses can integrate this kind of gaming instructional method to practice.	0	1	7	20	8	7.932	< 0.0005
9.	It feels good to be able to participate in this event.	0	0	4	22	10	11.49	< 0.0005
10.	This kind of gaming environment suits me pretty well.	0	0	12	21	3	7.46	< 0.0005
11.	I am satisfied with my performance in the activity.	0	3	9	21	3	5.29	< 0.0005
12.	This kind of activity gives me a sense of under-achievement.	6	21	7	2	0	6.78	< 0.0005

*1 = Strongly disagree; 2 = Disagree; 3 = No Opinion; 4 = Agree; 5 = Strongly Agree

No participants marked 'very likely', or 'very unlikely', whereas 55.89% participants marked 'uncertain' to the question, '*What is your perceived chance of winning.*' These findings provided evidence substantiating the success of the developers of JOYCE on building an optimal challenging task. By including various features into JOYCE they have developed a learning environment whose attainment is uncertain for the majority of participants, and, based on Malone & Lepper's intrinsic motivational theory, should increase student motivation and learning.

In response to the question, '*Which of the following features in JOYCE do you like?'* more than 40% of the players supported the usefulness of various features embedded in JOYCE with the exception of ranking lists (Table 3). At present only two web-based ranking lists were provided in JOYCE (i.e. top five players who answered the most questions correctly in a game, and top five players who won the most number of games). Other types of ranking lists, for instance, top five players who answered the most questions correctly in all games, top five players who answered the most questions correctly per game, and top five players who had the highest accuracy rate, etc. may be added to enhance the intrinsic motivational value of ranking list to users.

Table 3. Frequencies and % of JOYCE design features liked

JOYCE Features	*n*	percentage
Competing to answer the question	27	75%
Bump	25	69.44%
Dice combination	24	66.67%
Shortcuts	17	47.22%
Correct answer to the question	16	44.44%
Funny questions	15	41.67%
Ranking lists	6	16.67%
Others	0	0%

Finally, many comments participants made about JOYCE, for instance, '*establishing more test banks for other subject matters for on-line drill-and-practice*', again supported the idea of integrating computerised gaming systems for the support of student learning. In sum, results from 'Satisfaction scale' and the three open-ended questions at the end of the questionnaire supported JOYCE's incorporation into the learning process and the design and development of the system.

Conclusions

An online competitive board-game, called JOYCE, was devised to support a series of drill-and-practice exercises for a wide array of instructional topics and target audiences. The system allowed learners to practice answering questions with competing opponents simultaneously face-to-face or via network technologies where the opponent's identify is protected or not. The study examined students' preferences towards different modes of competition and their satisfaction of the learning experience.

The findings support JOYCE's incorporation into the learning process and the design and development of the system. Findings from the study suggest that anonymity is a promising feature to be included in a competitive learning system. It increases the intrinsic motivation and lessens the negative emotional states exhibited in face-to-face competition situations. However, because people expressed different preferences towards different competition modes, a range of synchronised computerised competition modes should be built into e-learning environments to satisfy peoples' preferences. They should make use of anonymity and decreased proximity, which are available through telecommunications media.

Classroom observations and student responses to questionnaires provide some insights and directions for future research. First, as mentioned previously, JOYCE was devised in an attempt to support 'practice' exercises, which in turn may promote learning. The effectiveness of JOYCE for student motivation and academic performance should be examined in future studies by comparing JOYCE with the traditional ways of practice (e.g. worksheets).

Moreover, while the results of this study indicated that students exhibited differential preferences towards face-to-face, decreased proximity and anonymous competition modes, its differential effects on student performance in the game and in academic achievement were unknown. The effects of different competition modes on cognitive as well as affective outcomes might be an area worth examining in the future. Furthermore, as research has demonstrated that student preferences towards different instructional arrangements and strategies may influence performance (Freitag & Sullivan, 1995), further studies to investigate the interaction effects of student learning preferences and different competition modes would yield informative insights for teachers.

Finally, while previous research shows that competition has a negative effect on interpersonal relationships and group process (Hammond & Goldman, 1961; Dunn & Goldman, 1966; Weigel *et al*., 1975; Garibaldi, 1976; Johnson *et al*., 1983), these studies were primarily conducted in traditional classrooms involving face-to-face situations. Since competitor's physical presence and identity could not be manipulated until the development of networking technologies, it is an open question whether the negative effects associated with face-to-face competition can be mitigated with the support of anonymity.

Before concluding, the authors would like to call to attention that while the potential impacts of anonymity on freedom of speech in cyberspace have recently provoked debates among legislatures and lawmakers (Lee, 1996), the issues of anonymity have mainly been examined extensively in social psychology area and briefly in the context of group-decision making process. Anonymity in drill-and-practice and testing contexts has rarely been investigated in academic settings. With the great potentials of online competitive gaming systems further research could prove fruitful for designers of educational systems as well as practitioners for the support of student learning in the classroom.

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