An Evaluation of a Contract Management Simulation Game for Architecture Students

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Abstract

Architects are currently grappling to exploit new forms of communication made possible with developments in internet communication. At the same time, the construction industry is in a state of flux as novel project management systems are being introduced. Students need to understand the first principles of project management within the context of our changing environment. One of the best ways for students to learn about the legalities of the construction process is through role play and simulation but there is a Catch 22. Unless students have a basic understanding of project management, the contractual process can be confusing and intimidating. Even fifth and sixth year architecture students are reluctant to ask practitioners questions for fear of appearing ignorant. This paper presents an evaluation of the cost and benefits of a web-based simulation game to deliver the Architecture studies curriculum. The web-based game allows students to critically observe the transformation of designs into buildings through the exploration of the contract management process. A questionnaire survey was used to assess how the computer simulation operates as a group exercise, how it compares with more traditional approaches and the best and worst features of the web-based system. The students found the game to be practical, enjoyable, motivating and effective in stimulating the learning process. The benefits of the web-based game were also found to outweigh the costs, thus providing support for its use as an active learning tool in Architectural Education.

Keywords: Architecture Education, Active Learning, Simulation Game, Evaluation

Introduction

A simulation is "an activity whose rules tend to generate in the total behaviour of the participants a model of some real world process" (Heyman, 1975, p. 11). A game on the other hand is "a contest in which people agree to abide by a set of rules" (Heyman, 1975, p. 11). A game, unlike a simulation, pits learner against learner. Games allow competition between participants and the decision of one participant does not only affect themselves, but also the behaviour and decisions of the other participants playing the game (Saunders, 1997). A simulation game, as described in this paper, is an activity that integrates characteristics of both a game and a simulation. It imitates some part of reality and is a contest (Heyman, 1975). There are many advantages claimed for simulation games.

Saunders (1997) noted that the activity allows students to be involved in a variety of tasks and Heyman (1975) argued that simulation games are useful for developing written and verbal skills. In addition, simulation games minimise the opportunities for collusion as no unique solution exists (Knechel, 1989).

Web-based simulation games can be used as part of an active learning approach that encompasses role play in a scenario-driven environment. Lucas (1997, p. 189) described active learning as having four distinct features, namely:

> a search for a meaning and understanding; a focus on student responsibility for learning; a concern with skills as well as knowledge; and an approach to the curriculum that extends beyond graduation to wider career and social settings.

The active learning approach has been recommended to architectural educators as a way to meet the demand for a broad architecture education which promotes interpersonal skills such as communication, problem-solving and colloboration (Egan, 1998). The use of active learning methods is also consistent with the recommendations of several professional organisations, including the Royal Institute of British Architects (RIBA). The RIBA's strategic study of the profession (1995) and the Stansfield Smith review of Architectural Education (1999) have suggested that architecture curricula should focus on promoting students' communication, problem-solving and inter-personal skills.

While the need for change in methods of architectural instruction has been acknowledged, there still appears to be some resistance to the implementation of such changes. Architectural Education has been criticised for promoting an introspective culture dominated by design studio teaching that delimits self-responsibility in learning (Nicol and Pilling, 2000); over-emphasises teaching over learning (Lawson, 1999), de-emphasises inter-disciplinary learning (Andrews and Derbyshire, 1993); and restricts the development of transferable skills, such as communication, teamwork and co-operation (Egan, 1998).

Nicol and Pilling (2000) have recommended a re-alignment of the learning environment around different relationships that emphasise communication, collaboration and self reliance, through a combination of active learning, reflection, collaborative learning, authentic learning tasks and self and peer assessment. Nevertheless, there seems to be little evidence that active learning methods have been widely adopted within architecture education.

The focus of the game under discussion in this paper is centred on the delivery of some aspects of the ARB/RIBA Part III curriculum. This syllabus is arguably somewhat dry and theoretical in content and it was thought that the development of a scenario based set of simulations could provide a more effective and engaging mechanism for the deployment of teaching resources. The game provides a competitive or team working environment within which students can explore the management of practice, project management or (as in the current test case) the intricacies of contract legislation. The format of the game provides not only an holistic view of the process under discussion but also a useful context within which to mount associated learning materials.

This paper presents an evaluation of the cost and benefits of the web-based simulation game from the students' and tutors' perspective. If it is possible to substantiate the view that a computer based simulation game helps promote inter-personal skills, such as communication, collaboration and team work amongst architectural students then this will add to our knowledge about the use of interactive web-based game systems in Architectural Education. The paper is divided into three sections. A description of the contract management class where the simulation used is presented together with an outline of the game itself. Based on a questionnaire survey of students and tutors involved, the paper then assesses how the computer simulation worked as a group exercise, how it compares with more traditional approaches and the best and worst features of the web-based game. Finally, conclusions are drawn on the effectiveness of the game as a learning tool, limitations noted and suggestions for further research proposed.

Description of the Educational Context

The application of this scenario simulation finds a role within the taught course element of both the ARB/RIBA Part II and Part III curricula. The basic objective is to provide an introduction to the systems and documentation which are necessary for the implementation of an architectural project in the practice setting; more specifically, to demonstrate to students the nature of construction law, of contracts and of concepts of responsibility and liability. To this end the system aims to provide an interactive learning setting for the understanding and development of skills of management, team working and decision making.

Description of the Simulation Game

Previously, the format of this game had been developed by Robert Smart, formerly of the Architecture School at the Edinburgh College of Art. This was a paper based exercise that had been run successfully over a number of years.

We are indebted to his generosity in permitting the development of the computer based simulation from his original concept. The simulation is based around a series of tasks relating to the deployment of JCT98 building contract.

The contract management simulation is essentially a game of question and answer, the purpose of which is to familiarise students with the intricacies of contract administration and the legalities of the construction process. The students' objective is to manage the construction process in response to a series of events as set out by a chronology of likely on-site scenarios. To this end they enter into a real-time correspondence with the client, contractor and other consultants as required (see Figure 1).
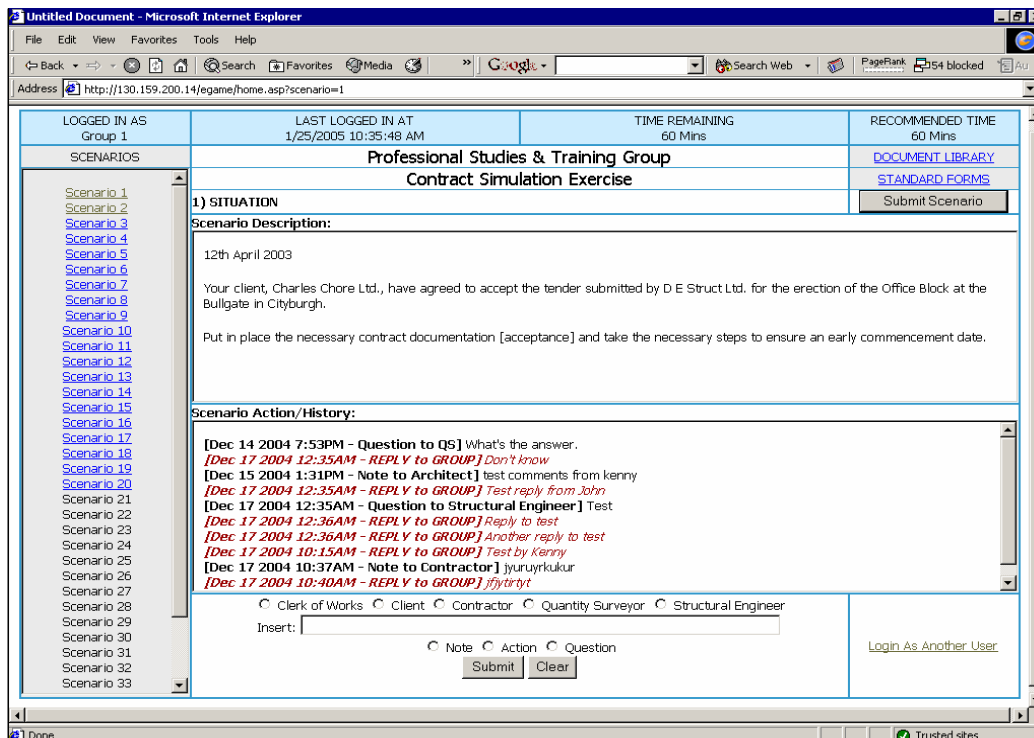

Figure 1: A screenshot of the Contract Management Simulation game

The scenarios within the game are typical of those that an architect would meet in practice. The students are divided into teams, typically comprising 4-5 participants, who vie with each other to see who can achieve the highest score of correct answers to a wide range of scenarios. The size of the group was not pre-determined but it was felt that 4-5 participants per team was ample given the nature of the electronic game. The student assumes the role of an architect overseeing a hypothetical office construction

project and acts as the contract administrator. The scenarios are grouped around three broad aspects of running a job, including:

- Carrying out of the works;
- The programme of works; and
- Financial and contingent matters.

Additional scenarios in the game relate the other responsibilities to any of the other parties involved in the construction process, including issues relating to their contractual implications.

The Evaluation Process

The evaluation presented below relates to the combined class of Part 3 students from the Schools of Architecture at Strathclyde and Dundee Universities who played the computer simulation game as part of the contract management course for the first time, in March 2005.

The success of the simulation activity could not be assessed using as a comparison student performance in the game across the years, as these data were either not available, or not in a form that would make for meaningful comparison. All students on the course participated in the game, so it was not possible to construct a control group for evaluation purposes. This is not necessarily a weakness of the study, as Lucas (1997) has suggested that the measurements of differences in student grades over time has limited value given the changing nature of student cohorts from one year to another. As an alternative, Lucas (1997) recommended obtaining feedback on student and tutor perceptions of a learning activity as a means of assessment.

On the basis of these recommendations, two questionnaire tools were developed to elicit perceptions of the simulation game system from students and tutors involved in the course. The survey tools utilised *Likert Scales* of 1 to 5 (1 represented strong disagreement and 5 strong agreement) and open-ended questions to assess how the computer simulation worked as a group exercise, how it compared with more traditional approaches and to identify the best and worst features of the web-based system.

To evaluate whether the simulation had succeeded in making the learning process more effective in accordance with the course objectives, we posed a number of questions to the student body relating to the understanding of the contractual process; ability to apply contractual concepts, relevance of the course lecture material and the development of written and communication skills. We also asked the tutors involved similar questions in order to gather their perceptions of the simulation game, but also as a means for cross –comparison.

The questionnaires were issued to all the student and tutorial staff at the end of the course, who were asked to complete the survey prior to their departure from the computer laboratory. A total of 55 questionnaires were issued to students and 5 to the

tutors. Of the total number of questionnaires administered, responses were received from 40 students and 4 from staff, representing a response rate of 73% and 80% respectively.

A breakdown of the students' and tutors' responses and a discussion of the results are presented in the section below.

Discussion of questionnaire survey results

The results of the questionnaire survey indicate that the simulation game helped students understand and apply contractual concepts and principles as 64 percent of students agreed with question 1 and 2 (see Table 1). Nevertheless, for many students the activity did not help them understand the course material as only 43 percent agreed with question 3 (see Table 1). This suggests the tutors did not link the activity sufficiently to the course content.

Table 1: Students' views of the Simulation game

		Mean	Frequencies (n = 40)				
Question No.			Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1	It helped me understand the intricacies of legal contracts and the contractual process	3.67	0	64	30	6	0
2	It enhanced my ability to apply contractual concepts and principles	3.66	0	64	29	7	0
3	It helped me understand the relevant lecture material	3.28	0	43	40	17	0
4	It increased my written communication skills	3.49	0	51	28	21	0
5	It increased my verbal communications skills	3.43	0	47	43	9	0
6	It increased my ability to read contract documents	3.52	0	62	18	20	0

There was only moderate agreement with the proposal that the simulation game increased written and verbal communication skills with 51 percent of students agreeing with question 4 and 47 percent agreeing with question 5 (see Table 1). The comments about group work were more encouraging (see Table 2). The results indicate that 58 percent of students said each member of the group contributed equally to the exercise,

and 68 percent of the respondents said there was a high level of cooperation in their group. This is evidence of the development of team working skills, although a change in these is not measured by the questionnaire survey.

Table 2: Students' views of their group

	Mean	Frequencies (n = 40)				
		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
All members contributed equally to the work	3.45	0	58	20	22	0
There was a high level of co-operation in my group	3.71	0	68	19	13	0

Table 3: Students' views comparing the Simulation game with other exercises

	Mean	Frequencies (n = 40)				
		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
It motivated me to a greater extent	3.67	0	67	25	8	0
It was more practical	4.06	0	84	12	4	0
It enabled me to learn more	3.64	0	62	30	8	0
I enjoyed doing the exercise more	3.97	0	77	16	7	0
I found the exercise more difficult	2.73	0	15	44	41	0
It was more work	3.43	0	45	38	17	0
It took more time	3.51	0	45	38	17	0
Group work was more difficult	2.85	0	50	35	15	0
There was a greater level of participation by group members	3.48	0	54	32	14	0

Students were asked to compare the contract simulation game exercise to other class activities. Their opinions (shown in Table 3) were that the exercise was more practical (84% agreed), more enjoyable (77%), more motivating (67%), and that it allowed more

learning (62%). The majority of students did not find it more difficult or more work, but almost half agreed it took more time. The activity was obviously extremely popular with students, as shown in Tables 4 and 5. When asked for their preference, 96 percent of students chose the simulation game over 'traditional' exercises and 92 percent recommended it for use in course the next year.

Table 4: Students' views on whether the exercise should be repeated in the following year

Would you recommend that the exercise be repeated in 2006?	Number	Percentage (%)
Yes	37	92
No	3	8
Total	40	100

Table 5: Students' views on whether they prefer the Simulation game or traditional exercises

Overall, given the choice between the Simulation game and more traditional exercises which one would you prefer?	Number	Percentage (%)
Simulation Game	38	96
Traditional exercises	2	4
Total	40	100

The open-ended questions in the survey asked what were the best and worst aspects of the web-based simulation game; and given the choice between the web-based system and a traditional type of assignment which would you prefer and why? The responses, shown in Tables 6 and 7 supports the results in Table 3 and indicate that students preferred the simulation game to 'traditional' class exercises. A large number of students commented on the fun and practical nature of the exercise. When commenting on the worst aspect of the activity, only 42 percent of students who responded to this question (33% of total questionnaire respondents) said that the exercise was too much work given time constraints (see Table 8). These results support those of Anderson and Lawton (1991) who found students have strong preference for simulations over case study teaching methods.

Table 6: Students' views: best aspects of the simulation game [a]

What do you believe were the best aspects of the computer-based exercise?	Number	Percentage (%)
Fun	13	38
Practical	9	26
Preparing the contract documentation	7	21
Improving generic skills	3	9
Uniqueness	1	3
Other comments	1	3
Total comments	34	100

(a) 25 students responded to this question (63% of total respondents) with 34 comments being made (some students made more than 1 comment)

Table 7: Students' views: why students prefer the computer –based simulation game[b]

Overall, given the choice between the computer-based simulation game and the traditional type of exercises which one would you prefer and why?	Number	Percentage (%)
More interesting and enjoyable	12	50
More practical	4	17
Facilitates learning process	3	13
More interactive	1	4
More motivating	2	8
Other comments	2	8
Total comments	24	100

(b) 18 students responded to this question (45 % of total respondents) with 24 comments being made (some students made more than 1 comment)

Table 8: Students' view: worst aspects of the computer simulation game[c]

What do you believe were the worst aspects of the computer-based simulation game?	Number	Percentage (%)
Too much work given time constraints	13	42
Preparing contract documentation	7	23
Having the group member selection process being restricted to tutorial group	5	16
Other comments	6	19
Total comments	31	100

(c) 26 students responded to this question (65 % of total respondents) with 31 comments being made (some students made more than 1 comment)

In response to questions 1 – 6 of Table 1, tutors' views were similar to those of students as shown in Table 9. It should be noted, however, that direct comparisons between responses are not *strictly* possible given the student to tutor sample ratios: only 4 tutors responded to the questionnaire. Nevertheless, the largest difference of opinion appears to relate to question two, where tutors agreed more strongly than students that the simulation game enhanced students' ability to apply contract management concepts and principles. When comparing the simulation game to a 'traditional' exercise, again the tutors and students had similar views. However the tutors agreed more strongly than students that the simulation game motivated students more and enabled them to learn more effectively. Other comments from tutors were that the activity was fun and interesting, and generated student interest.

Additional tutor observations were made which confirmed the enthusiasm generated by the simulation game. They noted many discussions between students and tutors about the exercise. Possible disadvantages of the activity for tutors were the onerous nature of coaching and coordinating group activity. This aspect was identified by tutors as a major disadvantage of the computer simulation game when compared to more traditional approaches of assessing understanding of course material.

Another tutor considered the time constraints on playing the game in tutorial sessions and giving up three tutorial classes for the activity, as one of its worst features. Two tutors commented on the need to widen the range of contract management issues considered and the need to better link the course material and the activities of the simulation game.

Table 9: Tutors' views of the web-based computer simulation game

Question No		Mean	Frequencies (n = 4)				
			Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1	It helped students understand the intricacies of legal contracts and the contractual process	3.25	0	50	25	25	0
2	It enhanced students' ability to apply contractual concepts and principles	4.00	0	100	0	0	0
3	It helped students understand the relevant lecture material	3.00	0	25	50	25	0
4	It increased students' written communication skills	3.75	0	75	25	0	0
5	It increased students' verbal communications skills	3.50	0	50	50	0	0
6	It increased students' ability to read contract documentation	3.00	0	25	50	25	0

Table 10: Tutors' views comparing the simulation game and other, more traditional exercises

	Mean	Frequencies (n= 4)				
		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
It motivated students to a greater extent	4.0	0	100	0	0	0
It was more practical	4.00	0	75	0	25	0
It enabled students to learn more	3.75	0	75	25	0	0
Students enjoyed doing the exercise more	3.75	0	75	25	0	0
Students found the exercise more difficult	3.00	0	25	50	25	0
It was more work for the students	3.75	0	50	25	25	0
It took more time for the students	3.50	0	50	50	0	0
Group work was more difficult	3.50	0	50	50	0	0

Conclusions and Limitations

This paper has assessed the cost and benefits of a computer simulation game used to deliver the Architectural Studies Curriculum from the students' and tutors' perspective. The main benefit from using the game was that students found it fun and practical. When these comments are linked with responses about understanding and applying contractual concepts and principles, it is clear that most students benefited from the introduction of the simulation game. An expected benefit of the game was that it would improve students' acquisition of technical and other skills. While some tutors believed that this occurred, students' evaluation did not support the idea that the game improved interpersonal skills. The tutors also agreed more strongly than students that it assisted in acquiring technical skills. This is an interesting area for further research since tutor resistance has previously been cited as an impediment to the further use of simulations in architecture studies courses. In this case, all tutors responding agreed that the activity had positive outcomes for students, and most recommended the game be used again. Most students preferred the game to other types of class exercise, though some suggested changes to the allocation of time. The time taken for the exercise was a cost for some students. A suggestion for further research would be to compare

students' views where one group of students used a simulation game, and another a traditional paper-based approach. A limitation of this research was that such a control group was not used.

A cost for tutors when comparing a simulation game with other, paper exercises was the increased role in the co-ordination of the activity. Other tutors may consider amending the exercise to lessen their input if they were concerned that the time spent on coaching and group coordination was too great. Tutors could also consider coaching students in group work skills given the tutors' views that group work was more difficult to manage. A limitation of this study is that it did not measure whether the simulation game improved students' acquisition of communication, problem solving and group work skills. The study has reported only student and tutors' perceptions of the effects of their participation in the simulation game. The respondents' provide their opinions of the learning process but this does not inform us whether communication, problem solving and group work skills have actually been acquired. However, the evaluation has shown that a majority of students viewed the game as practical, enjoyable, interesting, and commented that they learned more. Tutors agreed strongly that students benefited from the game because it was practical, they were motivated, and they enjoyed it. Thus the simulation game was clearly "fun". The increase in time required to co-ordinate and coach group work was identified as a major cost by tutors. However, many students had profited from the activity in terms of acquiring (new) technical skills.

For tutors considering the use of an active learning method as described in this paper they should consider how it could be used to further develop communication skills. In addition, they need to convey to students how the simulation exercise is linked to the aims and objectives of the specific course.

End Note

The web-based system was taken to trial at Dundee & Strathclyde Schools of Architecture, Glasgow's Mackintosh School of Architecture and the Edinburgh College of Art in 2005 with very successful outcomes. On this basis, the Centre for Education in the Built Environment (CEBE) awarded the Strathclyde team funding to take the system through a further phase of development to enable it to become a practical teaching tool for use in all the UK's Architecture Schools. An updated version of the e-game, encompassing Standard Building Contract 2005 conditions, is currently under development and will be available to Schools on a trial basis in 2006. Please contact Andrew Agapiou (andrew.agapiou@strath.ac.uk) at Strathclyde University for further information.

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