Benefits of applying digital interactive technology to teaching

Xuewu Hui

University of Science and Technology Liaoning
Anshan, Liaoning, People's Republic of China

ABSTRACT: Digital multimedia-assisted teaching has become an important method in teaching, as technology matures and permeates teaching practices for various subjects. A digital interactive technology teaching methodology is adopted to direct teaching activities for architecture majors and to conduct experiments, the results of which are reported in this article. To carry out the experiments, teaching was reorganised. Several kinds of evaluation indices were defined, and a back propagation (BP) neural network method used to analyse the results. Students using digital interactive technology obtain superior results as compared to students taught with traditional methods. The superiority was manifest in each index and in the test assessment. Thus, adopting digital multimedia technology in architecture classes enables teachers to better disseminate knowledge and assists students' comprehension.

INTRODUCTION

Interaction is a common psychological and social phenomenon. In a broad sense, interaction is the interplay and influence between the interacting objects and players. In a narrow sense, interaction refers to *the interplay and influence involving form and extent between persons or between persons and objects in specific situations and social environments* [1].

In pedagogy, teachers and students interact to achieve teaching goals in certain teaching situations or environments. Purposeful, organised, interactive two-way communication should be integrated into teaching using computers or other teaching tools to alter the knowledge, attitude and behaviour of students. Teaching methods refer to the interactive teaching activities between teachers and students required to accomplish teaching tasks and achieve teaching goals, and which are guided by teaching principles and devices, the latter being tools, equipment or media [2].

Interactive teaching methods are informed by interactive teaching theories that use computer technology to achieve teaching tasks. Adopting interactive teaching methods gives full play to the subjective initiative of teachers and students [3].

Digital interactive teaching methods have the following advantages:

- They are vivid, which motivates students to concentrate in class;
- The teaching materials are effective in assisting teachers to teach;
- These methods encourage student interaction and acquisition of knowledge;
- These methods allow a more efficient use of teaching resources [4].

Architecture involves numerous and multifarious subjects and categories, each of which has different characteristics and features. Thus, a unified teaching method is difficult to identify. Since the 1990s, innovative IT and educational reforms have led to the development of digital multimedia-assisted teaching as an important teaching method that has permeated the teaching practice of many subjects [5]. Teachers now employ Flash software in developing classroom presentations, which improves students' comprehension and teaching efficiency.

With developments in constructing IT teaching resource and curriculum reform, teachers are coming to realise the importance of digital interactive technology in teaching. Digital interactive teaching methods have become a focus of research and application by several university and college scholars. Researchers attempt to combine case teaching and digital interactive teaching methods for design courses. Teachers have investigated novel scripts, navigation and interface designs of man-machine and man-man interactions to generate digital media courseware for teaching [6].

The teaching of architecture should make extensive use of computer-assisted interactive teaching. Experiments can be carried out on the advantages of digital interactive teaching. Reported here are investigations of redesigned teaching models involving computer-assisted interactive teaching. Several kinds of evaluation indices to determine the effect of the teaching were adopted. A BP (backward propagation of errors) neural network was used in evaluating the results. These evaluations were then used to analyse the application of digital interactive technology to teaching, and provide a theoretical basis and practical reference for further investigations.

EVALUATION OF DIGITAL INTERACTIVE TEACHING

Digital media technology is a branch of computer science that combines art with IT, but is focused mostly on technical quality. Students using digital media technology need to adapt to art creation, perhaps using Flash software, in a network multimedia environment. Digital media technology can be used for advertising, movies, cartoons and mass media. Teachers need to teach digital media technology, animation design and interactive multimedia Web site development. Digital media technology curricula should be designed so that students are able to use various aspects of theoretical knowledge in analysing problems.

The architecture course featured in this study, incorporated digital media technology and, thus, was a combination of strong science and subject features that required the use of knowledge from various disciplines. The experiment reported here was designed to validate the effect of digital interactive teaching methods on solving practical problems.

Experiment's Subjects

A total of 240 students were randomly selected from six digital media technology college classes in 2012. The students were divided into two groups: an experimental group (120 students from classes 1 to 3) and a control group (120 students from classes 4 to 6). The control group was taught using the traditional teaching method, whereas the experimental group was taught using digital interactive technology teaching.

Research Method

- The experiment was conducted over two terms in 2013 and 2014. Each term had 64 sessions, including 32 sessions of theoretical study and 32 sessions of on-line study. The session is equivalent to that spent on traditional teaching.
- For digital media technology courses, the traditional teaching mode is mostly by cramming, with teachers talking to the class, which does not motivate students. By contrast, digital interactive technology teaching has the following innovations: Flash multimedia courseware is used for teaching practical classes; it is student-oriented, i.e. students raise questions, which are answered via group discussion guided by teachers; it provides information feedback, i.e. students raise questions, which are answered by teachers through information-sharing on network platforms outside of class.

Evaluation Method

Examinations are used to evaluate student achievement in the traditional teaching mode. This makes students focus on grades instead of actual learning. In this experiment, innovative evaluation indices and methods were used. Evaluation indices should measure a student's integrated development. Consequently, the following evaluation indices were set:

- The experimental and control groups completed quizzes at the end of the teaching. The quiz was out of 100. Question types included objective questions (e.g. choice questions, glossaries) and subjective questions (e.g. discuss, case analysis), with each question type accounting for one half of the quiz. Their scores were collected for statistical analysis using SPSS software. The quiz covered digital media, Flash animation design, interactive multimedia Web site development and property rights protection.
- Teachers' evaluation indices of the teaching include classroom discipline, classroom atmosphere, and teaching feedback. Specialists were used and their results combined to evaluate the applications produced to solve practical problems set in the digital interactive technology teaching. The total score for each index was 100 points, and the final grade was the mean of the evaluation indices.
- Each student also evaluated the teaching process. Evaluation indices included learning interest, form of teaching, teaching method, teaching media, teaching effect, and interaction between teachers and students. The evaluation primarily investigated the attitude of students toward different teaching modes. The total score for each index was 100 points, and the final grade was the mean of the evaluation indices.

Experiment's Results

The test scores, teacher evaluations and student evaluations of the control and experimental groups were obtained after one term. The data were normalised according to Formula (1):

$$X = (X_i - X_{\min}) / (X_{\max} - X_{\min}) \quad (1)$$

Where X is the normalised coefficient for the i^{th} coefficient in the X_i data; $X_{\max}$ and $X_{\min}$ are the maximum and minimum coefficients in the X_i data set, respectively. Table 1 is a partial list of the normalisation data.

Table 1: Normalised evaluation data.

Student	Quiz test score	Teachers' evaluation	Students' evaluation
1	88	80	72
2	79	69	78
3	62	64	60
4	70	82	73
5	92	80	65
6	85	87	73
7	57	66	72
8	88	91	83
…	…	…	…

After obtaining the normalised data, the BP neural network model was used to grade the results. The error evaluation function of the BP neural network model is a mean square error given by:

$$E = \sum_{P=1}^{P} E_P = \frac{1}{2} \sum_{P=1}^{P} \sum_{j=1}^{m} (t_{pj} - y_{pj})^2 \tag{2}$$

where E_p is the error of the p sample; and t_{pj} and y_{pj} are the real and model predicted outputs, respectively. The final evaluation score is reached when the result minimises the mean square error. The overall experiment results are shown in Table 2.

Table 2: Comparison of experiment results.

Group	Test score	Teachers' evaluation	Students' evaluation	Synthesis score
Control	53.24*	53.91*	48.94*	51.95
Experimental	72.38	69.91	68.02	70.4
p	0.0087	0.0079	0.0064	0.0077

*$p < 0.01$ is a significant difference compared with the experimental group

Figure 1 displays the results in histogram form.

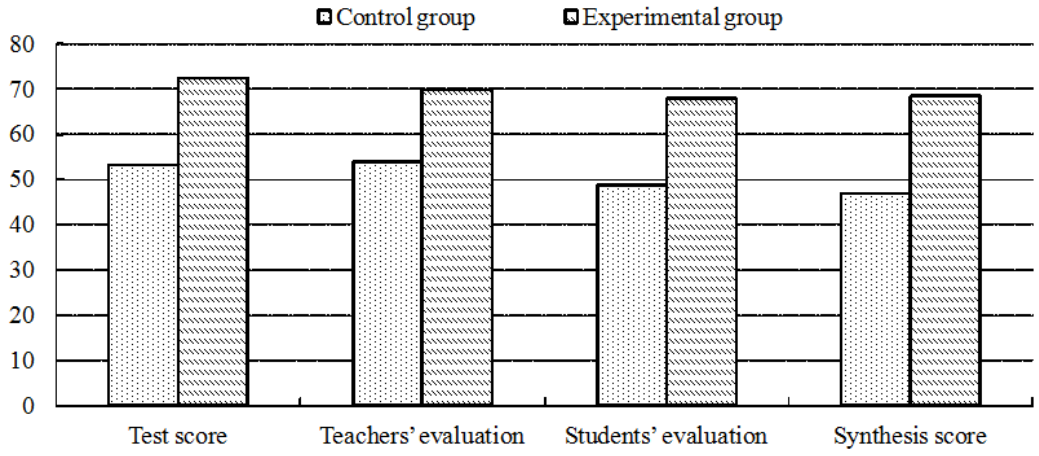

Figure 1: Histogram of experimental results.

Analysis of Results

Based on the experimental data from each evaluation, the experimental group had better scores than did the control group. This indicates that the learning and examination abilities of students are better developed using the digital interactive technology teaching mode. The experimental group also has higher teacher and student evaluation indices than the control group, with the highest score difference being nearly 20 points. This shows that the digital interactive

technology teaching is superior to traditional teaching, which leads to better student results. A more detailed analysis follows.

Most students in the control group considered the test difficult because the traditional teaching mode does not motivate them to learn. By contrast, students in the experimental group found the test to be of moderate difficulty. The students are significantly inspired by the flexible use of teaching resources and vivid content of lectures. Moreover, the teachers and students actively and freely discussed points during lectures, which had a significant effect on students' learning.

Table 3 shows the quiz test scores. There was no difference between the experimental and control groups in terms of answers to objective questions with fixed answers. The average score of the control group for *choice* questions is better than that of the experimental group. However, the experimental group performs better than the control group on subjective questions, especially *case analysis*. Hence, students in the experimental group could use knowledge more flexibly to solve problems.

Table 3: Quiz test scores.

Group	Choice questions	Glossary	Discussion questions	Case analysis	Quiz test score
Control	22.23*	9.33*	10.39*	14.37*	53.24
Experimental	19.15	14.72	15.27	20.16	72.38
p	0.0047	0.0092	0.0086	0.0077	0.0063

*$p < 0.05$ is a significant difference compared with the experimental group

Figure 2 shows the quiz test scores in histogram form.

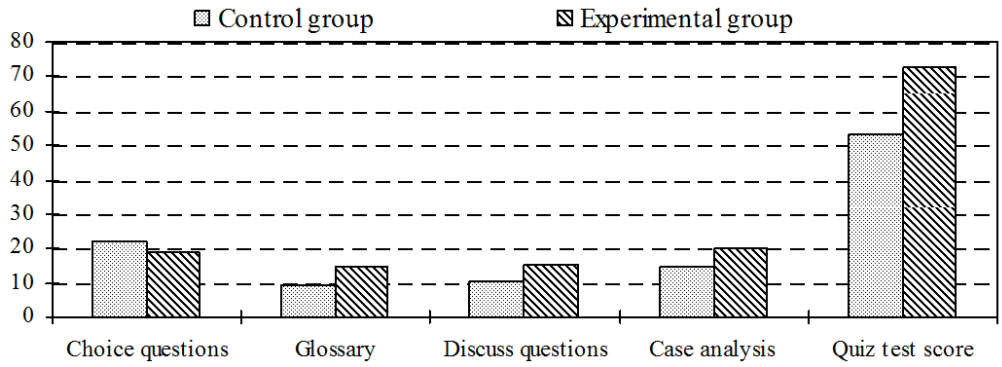

Figure 2: Test score result.

According to the teacher evaluation scores, the experimental group absorbs knowledge faster and uses it more flexibly in discussion and communication than the control group. Digital interactive technology saves time for teachers in terms of writing on blackboards, reduces teaching effort and enhances teaching efficiency. When teaching efficiency improves, teachers can personally guide students, initiate critical thinking, and actively discuss and solve problems with students. However, the teaching materials used in the control group cannot be used repeatedly and hence time must be spent on performing repetitive tasks. The overall teacher evaluation scores of the experimental group are better than those of the control group, which are presented in Table 4.

Table 4: Teacher evaluation scores

Group	Classroom discipline	Classroom atmosphere	Teaching feedback	Evaluation of specialist	Comprehensive evaluation
Control	53.34*	65.27*	43.12*	40.39*	53.91
Experimental	68.29	78.24	63.19	69.19	69.91
p	0.0075	0.0082	0.0064	0.0042	0.0031

*$p < 0.05$ is a significant difference compared with the experimental group

According to the student evaluation scores, the experimental group benefited from the improved teaching methods and content. Students generally express that digital interactive teaching deepens their understanding of concepts and contents, and improves their learning. The use of 3D or Flash assists students in fully comprehending and absorbing knowledge. The learning initiative of students is greatly stimulated, and the effect of interaction between teachers and students is highly positive. Most students prefer classes that combine discussion with practice. Students enthusiastically adopt multimedia, which improves their professional skills. However, some students mentioned that the pacing of

digital interactive technology teaching is faster than that of traditional teaching, which affects the teaching. This finding should be addressed. The results of the student evaluation scores are presented in Table 5.

Table 5: Student evaluation scores.

Group	Learning interest	Form of teaching	Teaching method	Teaching media	Teaching effect	Interaction between teachers and students	Students' evaluation (overall)
Control	60.39*	52.31*	29.49*	53.41*	50.39*	47.63*	48.94
Experimental	79.29	65.49	60.17	70.54	69.17	63.47	68.02
p	0.0019	0.0076	0.0082	0.0043	0.0065	0.0051	0.0082

*$p < 0.05$ is a significant difference compared with the experimental group

CONCLUSIONS

The teaching methods of digital interactive technology were found to be better than are the traditional teaching methods, in terms of knowledge acquisition by students. Teaching materials are used repetitively, which saves teachers' time in writing on blackboards and, hence, this raises their teaching efficiency. Digital interactive technology teaching methods also strengthen the communication between teachers and students, both inside and outside class.

Teaching architecture classes using digital interactive technology teaching methods produces *twice the result for half the effort*. Teaching improves with practice, although wide variations occur because different schools have varying levels of resources by which to support teaching. Resources need to be provided according to the teaching mode. Several methods apply to the process of teaching, rather than just a single, fixed method. Teachers should consider the teaching purpose and task in choosing the most appropriate teaching method. Factors to take account of include subject content and characteristics, student ages and abilities, and specific teaching conditions.

REFERENCES

1. Nixon, M.S., Fishman, E.K., Magid, D., Hennessey, J.G. and Ney, D.R., The use of graphic design in an interactive computer teaching program. *J. of Medical Systems*, 15, **2**, 155-170 (1991).
2. Liu, Z., Research summary of interactive teaching. *J. of Distance Educ.*, 18, **6**, 49-51 (2009).
3. Tong, L., Construction and practice of interactive teaching mode in the subject of art design. *Global Educ.*, 41, **3**, 83-86 (2012).
4. Li, G., Probing into the principles to implement interactive teaching. *Theory and Practice of Educ.*, 27, **8**, 60-62 (2007).
5. Hovland, J.A., Duffrin, M.W., Phillips, S., Bowditch, J. and Novak, B., Creating interactive digital lessons for teaching nutrition, math and science concepts to 3rd-5th graders. *J. of the Academy of Nutrition and Dietetics*, 112, **9**, A19 (2012).
6. Agbatogun, A.O., Interactive digital technologies' use in Southwest Nigerian universities. *Educational Technol. Research and Develop.*, 61, **2**, 333-357 (2013).