# AC 2004-734: TEACHING AN ONLINE TECHNOLOGY COURSE THROUGH INTERACTIVE MULTIMEDIA

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# Teaching an Online Technology Course Through Interactive Multimedia

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**Abstract**
Technology is having a dramatic effect on colleges and universities, producing what may be the most challenging period in the history of higher education. One form of the convergence of technology and education is distributed learning. The World Wide Web (WWW) provides alternative means for delivery of the courses and services, providing learners with an extraordinary range of options. Distance learning methods are being developed and implemented to offer educational opportunities to those who are unable or choose not to attend an educational institution on a conventional, scheduled basis. There are few, if any, studies that have attempted to evaluate the learning achieved through interactivity of students with the online contents using interactive multimedia in online environments, perhaps because of the difficulties in designing rich multimedia contents, a tight experiment for such studies and the fact that confounding variables can easily become significant. The purpose of this study would be to investigate the effectiveness of learning through interactive multimedia and present the results.

This research report provides information on the design and development of an online *Computational Methods in Engineering Technology* course. The course will be interactive multimedia-based including 3D animation, simulation, video, graphics, and audio. The research considers information on the theoretical framework for designing the course, the process of developing the multimedia and developing the course. The results of the study on the effectiveness of the course will be reported in the presentation.

Major points of emphasis studied in this research include:
1. Discussing the need for multimedia-rich courses for teaching technology-based subjects in online environments
2. Developing multimedia based online courses
3. The effects of using Multimedia in teaching technology-based concepts
4. The results of the study on the effects of using multimedia in an online environment
5. Results of student attitudes toward learning through multimedia

## Introduction

The advancement in technology is shaping every aspect of our life, including education. One decade ago, the Internet was not critical to education. However, now, it has become an integral part of learning process. Internet technology is having a dramatic effect on colleges and universities, producing what may be the most challenging period in the history of higher education. One form of the convergence of Internet technology and education is distributed

learning. The World Wide Web (WWW) provides alternative means for delivery of the courses and services, providing learners with an extraordinary range of options. Distance learning, as a subset of distributed learning, focuses on students who may be separated in time and space from their peers and the instructor. Distance learning methods are being developed and implemented to offer educational opportunities to those who are unable or choose not to attend an educational institution on a conventional, scheduled basis.

Although distance education has evolved over the past number of years and has assumed a prominent position among educational options for students, many issues still remain. The issues of design, accessibility, and the pedagogy of distance learning, interactivity, and educational outcomes are of concerns to both students and the instructors. Additionally, we still have much to learn about online learning environments, as research studies have demonstrated them to have both negative and positive impacts in terms of effectiveness and achievement of outcomes. As a result, it is critical that high quality online courses are developed to assure that online learners have the same quality of learning as the traditional face-to-face students[1].

Without a doubt, one important feature of distance education is "technology". Distance education is much more than an online substitute for lectures. It has been claimed that we retain 10% of what we read, 20% of what we hear, 30% of what we see, 50 % of what we hear and see, 70% of what we say, and 90% of what we say and do[2]. This being the case, in remote environments, where the students have to depend on the technology to interact with the other students, instructor, and the content through the computer interface, we might have the opportunity to increase online student knowledge retention and learning by using multimedia and existing technology efficiently.

Thus, another important feature of distance education is "Interactivity"[3]. The issue of interactivity has always been an important factor in education. However, the focus on interactivity has become even more important in Web learning environments. A review of the literature on the concept of interactivity reveals that interaction has always been an important aspect in distance education, even in independent or correspondence study format[3]. Dohoney and his colleagues[4] have stressed the importance of including well-structured contents in distance learning courses to insure efficiency and effectiveness of distance education materials. One alternative is to present information in auditory and visual format in online environments where students can process the information more rapidly, hence enhancing learning process[5].

A study by Moiduser et al.[6] reviewed 436 educational web sites and found that most were still predominantly text-based and do not yet exhibit evidence of innovative pedagogical approaches such as application of learning principles. According to Kanuka[7], courses often provide objectives, sequence of the content, and presentation of contents not covered in the textbook followed by questions and discussion. In encouraging learners to participate in the interactive experience, interactivities need to be designed to provide experiences that have an appropriate balance between success and difficulty, and between control and discovery[8]. Faradouly[9] suggests that interaction design should be guided by questions such as:

- Who are the learners? What do they need or want to learn, in what environment learning is applied? What do they already know?
- What is the teacher trying to achieve with the instruction?
- What skills, attitudes, and knowledge are you trying to develop?
- How will content be structured?
- What strategies might be used?

Briggs[10] refers to constructive alignment and asserts that; "...A good teaching system aligns teaching method and assessment to the learning activities stated in the objectives, so that all aspects of this system are in accord in supporting appropriate student learning. The system is called constructive alignment, based as it is on the twin principles of constructivism in learning and alignment in teaching[10]".

**Objectives and Significance**

Simply presenting non-interactive text-based information to online learners may not be the best way for distance learning to occur in some abstract subject areas. In order to provide learning opportunities to online students, educational institutions continue to develop online courses that represent electronic versions of text-based traditional classes. These electronic versions often contain materials that lack any significant level of creativity and/or interactivity. This issue is magnified in some area such as Science and Engineering that require hands-on work. Additionally, the traditional text-based formats in online environments sometimes fall short of conveying the complexity of the subject matter that needs to be mastered. Between the changing tools available and the possible social modifications, educators are being challenged to come up with new ways of instructing which may provide some much-needed insight into how people learn. In online courses, modules cannot be modified to fit online delivery systems without modifications in main areas such as visualization, user friendliness, interaction, feedback, and assessments.

The content development for engineering online courses has to be treated differently than the traditional classroom teaching. Due to the complexity and the abstract nature of engineering courses, just posting of lecture notes, assignments and the solutions does not help the online students. Overall, the purpose of this study is to investigate whether engineering students' learning, attitude, and knowledge retention is enhanced if the content is interactive and the students are actively engaged in the online learning environment. The attempt is to challenge the idea that simply transferring masses of lecture notes in a text-based format onto the web will provide a satisfactory online learning experience for Engineering students. So, the outcome of this research is to give instructors a new tool in making more effective online course material that will eventually replace text-based contents.

**Methodology**

Despite the research on interactivity, the potential of interactivity, student-content interaction in particular, in an online learning environment has not been investigated. Therefore, the factors in the unique environment of asynchronous online learning in terms of their relationship to student attitude, perceived learning and knowledge retention after a period of time, and relating these findings to the notion of interactivity needs to be investigated.

Most courses lack any means of interaction between the student and the content. In technology-based subject matters, this issue can become a barrier to learning. However, there also appear to be broader issues of design necessary to incorporate within a constructivist paradigm. Successful interaction design, which engages learners in actively exploring knowledge and experiences, is the result of careful analysis of the learner and the learning outcomes. The aim of this research was to design an interactive online course to investigate the effectiveness of student-content interaction on students' learning, attitude and knowledge retention after a period of time. An interactive computer based program, CompuTek$^{TM}$, was developed for the use in an online environment for teaching the fundamentals of computer technology. As part of the course, a module was designed to teach the basics of computer networking. The main aim was to provide the online students with a self-paced interactive learning system, which act like a virtual tutor.

At the initial stage of the development, one of the most important assumptions was to make the components of the module reusable. Today's instructional designers are challenged to build high quality online content that can not only be delivered to many people across different platforms but can also be reused by many other instructional designers and educators through media libraries. An approach to instructional technology based on "learning objects" is currently changing the way online educational materials are designed, developed, and delivered to distance learners due to the potential of the learning objects for reusability, generativity, adaptability, and scalability.

In the first phase of the research, in order to calibrate and validate the developed modules, a pilot test was conducted during which the following data were collected: achievement scores on posttest, Likert scores on attitudes toward the topic as well as using interactive multimedia, and retention scores. They had a posttest after completing the module. The module was locked from students before the post-test. The retention scores were collected 3-4 weeks after the treatment where the students were given the identical post-test.

In order to increase the capability of students to interface with the technical contents and transmission of data, the course did not require extensive computer knowledge and/or . Everything in the course was self-explanatory and easy to use. In the experimental condition, participants were presented with a module, which included interactive text, audio, animation, and 3D animation. The control group had access to the non-interactive text-based version with the exact same content. Since scores on the instrument were used for research purposes only, an $\alpha$ of at least .50 was desired[11].

**Data Analysis**

The data for the effectiveness and attitude part of this study are shown in Table 1. This table consists of two sections with each one showing the two groups (contro and study). The data from the study were analyzed in two separate procedures using ANOVA and Pearson product-moment correlation. Pearson correlation was used to measure the degree and the direction of linear relation between the two variables and ANOVA was used to detect if differences exist for two or more treatments. A probability level of .05 was set for statistical significance. First, chi-square was conducted to determine if any relationship exists between the dependent variables and the mediating variables of gender and prior computer

experience. If significant differences were found then ANCOVAs with the correlated variable as a covariate were employed to determine if mean differences existed between and within the experimental groups and the control group for the three dependent variables of test achievement, learner attitudes, and retention. The gender and prior experience data were obtained via the student demographic and background sheet.

**Results and Conclusion**

The results of the pilot test on a fairly small group of students (20 in all) did not show a significant improvement in learning within the experimental group over the control group or vice versa. That is an optimistic result. Nevertheless, if the results in a similar study with a larger sample size turn out the same, this research is an indication that the interactive multimedia is a reasonable substitute for traditional style of teaching in a technical environment. The challenge; however, still remains in careful consideration of designing and developing the right interactive multimedia tools. The authors plan to continue this study with a larger sample to see the true effect of design aspects in learning and teaching environments. To explore the effects of time on the change in test scores, ANOVA with repeated measures will be performed. The "within" variable will be time with two levels representing posttest and the follow-up test, respectively.

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**Table 1.** Data for the effectiveness and attitude

| **Group A (10 Students) – Control Group** | | | | | |
|---|---|---|---|---|---|
| | Satisfaction | Effectiveness | Efficiency | Value | Attitude |
| Satisfaction | 0.656 | | | | |
| Effectiveness | 0.316 | 0.746 | | | |
| Efficiency | 0.318 | 0.408 | 0.689 | | |
| Value | 0.264 | 0.254 | 0.257 | 0.703 | |
| Attitude | 0.360 | 0.107 | 0.241 | 0.490 | 0.789 |
| **Group B (10 Students) – Study Group** | | | | | |
| Satisfaction | 0.645 | | | | |
| Effectiveness | 0.331 | 0.754 | | | |
| Efficiency | 0.333 | 0.421 | 0.656 | | |
| Value | 0.254 | 0.266 | 0.238 | 0.714 | |
| Attitude | 0.374 | 0.098 | 0.240 | 0.483 | 0.798 |