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ABSTRACT

The purpose of this study was to investigate the interaction of student learning style and presentation mode on student learning in an introduction to computer science class. The learning styles studied were sensing and intuiting, as identified by the Myers-Briggs Type Indicator. The presentation mode was either traditional lecture or hypermedia. Research has suggested that multimedia methods enhance student learning and that multimedia methods particularly enhance student learning for students with a sensing cognitive style. Therefore, it was hypothesized that students who receive multimedia instruction would perform better on examinations than students who receive traditional instruction. It was further hypothesized that students with a sensing cognitive style would benefit more from multimedia instruction than would students with an intuitive cognitive style. This study did not find a significant interaction between presentation mode (lecture or multimedia) and learning style (intuitive or sensing). Nor did it find a significant difference in posttest scores by learning style. There was, however, a significant difference in posttest scores by presentation mode, with the multimedia group doing significantly better than the control group. (Author)

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Paper Session

Interaction of Presentation Mode and Learning Style in Computer Science

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Abstract

The purpose of this study was to investigate the interaction of student learning style and presentation mode on student learning in an introduction to computer science class. The learning styles studied were sensing and intuiting, as identified by the Myers-Briggs Type Indicator. The presentation mode was either traditional lecture or hypermedia. Research has suggested that multimedia methods enhance student learning and that multimedia methods particularly enhance student learning for students with a sensing cognitive style. Therefore, it was hypothesized that students who receive multimedia instruction would perform better on examinations than students who receive traditional instruction. It was further hypothesized that students with a sensing cognitive style would benefit more from multimedia instruction than would students with an intuitive cognitive style. This study did not find a significant interaction between presentation mode (lecture or multimedia) and learning style (intuitive or sensing). Nor did it find a significant difference in posttest scores by learning style. There was, however, a significant difference in posttest scores by presentation mode, with the multimedia group doing significantly better than the control group.

Introduction

In recent years, researchers have investigated the use of multimedia in higher education in many fields, including English literature (Barnes, 1994), composition (Brown, 1994), computer science (Brown, 1988; Crosby & Stelovsky, 1995), sociology (Jacobson & Spiro, 1993), English as a Second Language (Liu & Reed, 1995), business law (Quade, 1993) and photography (Shih & Alessi, 1996). In using multimedia, teachers integrate text, graphics, animation, and other media into one package. Teachers can choose the best media to explain a given topic—for example, a dynamic process may be best understood by viewing an animation (Crosby & Stelovsky, 1995). At the current time little is known about the relative effectiveness of multimedia in the classroom; therefore, it is important that researchers determine whether multimedia presentations have advantages relative to traditional teaching methods.

Of particular interest is the value of multimedia instruction for students having

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different learning styles. There is some evidence that multimedia presentation is especially useful for students with a sensing learning style (Crosby & Stelovsky, 1995). Research has shown that people with a sensing learning style learn through practical experience and repetition, while people with an intuitive learning style prefer learning abstract concepts and are bored with repetition (Keirsey & Bates, 1984). Since multimedia offers the possibility of illustrating abstract concepts with concrete visual examples and also provides opportunities for embedded exercises with feedback that students can do at their own pace, multimedia may be especially valuable to students with a sensing learning style.

Statement of the Problem

The purpose of this study was to investigate the interaction of student learning style and presentation mode on student learning in an introduction to computer science class. For the purpose of this study, student learning style consisted of two learning styles identified by the Myers-Briggs type indicator: sensing and intuiting. Presentation mode was either traditional lecture or hypermedia presentation. Student learning was operationally defined as the score on a test given after the presentation.

Review of Related Literature

Multimedia system designers can create learning environments that promote the active, personal exploration of information for both comprehension and information locating and retrieval (Welsh, 1995). In a multimedia environment, logically and semantically related information can be linked together to form a network (Liu & Reed, 1995). Multimedia can be used to demonstrate complicated processes in a highly interactive, animated fashion (Brown, 1988; Borning & Duisberg, 1986). Students can see, in a natural and intuitive way, how the instructional material connects with other related information (Crosby & Stelovsky, 1995).

Some researchers think that multimedia knowledge structures are similar to how the human memory system stores information. The user can "jump around" within a program—that is, access more detailed information if desired or access a graphic display of information or access totally unrelated information (Reed & Rosenbluth, 1992). Multimedia systems can be a tool that lets learners construct their own knowledge bases by making meaningful connections among the ideas they perceive (Liu & Reed, 1995). People assemble knowledge by examining ideas from different perspectives and in different contexts (Barnes, 1994). Within multimedia, hypertext and video sources combine in ways that students can impose their own framework on a complex and ill-structured domain. For that reason, Jacobson and Spiro (1993) view hypertext systems as very suitable for representing complex knowledge.

The research on hypermedia in higher education is still in the very early stages. The work of Reed and Rosenbluth (1992) and Lieu and Reed (1995) shows that students do learn using multimedia documents. Other researchers have found significant differences in student learning when the use of multimedia is contrasted with more traditional teaching methods (Barnes, 1994). Crosby and Stelovsky (1995) found significant differences between an experimental group that used hypermedia and a control group that used traditional teaching methods; the differences were particularly strong among a subgroup of learners who had a learning style (determined using the Myers-Briggs Type Indicator) that was not addressed as well using traditional methods.

The Myers-Briggs Type Indicator categorizes cognitive styles on the basis of a set of test scores received on four separate preference dimensions. One dimension preference is how students receive information (sensing or intuitive). A sensing student prefers concrete presentations and many examples of how rules and principles are applied, while an intuitive student prefers abstract presentations and is bored with repetition (Myers 1962; Lawrence, 1984).

Keirsey and Bates (1984) have noted that the distribution of people with different cognitive styles is not uniform among different professions or academic majors. For example, in computer science, Crosby and Stelovsky (1995) have found that students with a sensing cognitive style outnumber intuitive students in introductory classes, but students with an intuitive learning style are in the majority in upper-level classes. They have observed that a substantial percentage of computer science majors fail to pass introductory courses—it may be that the methods used in computer science education, primarily lecture, do not benefit students with sensing cognitive styles. Their research has indicated that current teaching styles in computer science favor intuitive students, while sensing students improve dramatically under multimedia instruction.

This research is consistent with other research that has demonstrated that individual differences in personality and learning style affect learning. Cognitive styles have been used in many studies to differentiate how people perform in various academic fields (Crosby & Stelovsky, 1995). Schurr and Ruble (1986) suggest that personality tests are correlated with differences in grades of students with similar intelligence and aptitude. Pinto and Geiger (1991) found that students' learning preferences were relatively stable. A study of computer-based instruction by Hofmann, Waters, and Berry (1981) indicates that personality traits were the most important contributor to learning. There has been some computer science education research in the area of individual variation. It has been shown that some students learn more successfully with specific types of representation (Merrill, 1987). Vincente, Hayes, and Willeges (1986) have found that user abilities, such as spatial visualization, can affect learning in computer environments. Kelly (1993) discovered considerable individual variation among student users of hypertext systems.

Statement of the Hypothesis

Research has suggested that multimedia methods enhance student learning and that multimedia methods particularly enhance student learning for students with a sensing cognitive style. Therefore, it is hypothesized that students who receive multimedia instruction will perform better on examinations than students who receive traditional instruction. It is further hypothesized that students with a sensing cognitive style will benefit more from multimedia instruction than will students with an intuitive cognitive style.

Subjects

The sample for this study consisted of 32 undergraduate students enrolled in two

Introduction to Computer Science classes at the College of Saint Rose, a liberal arts college in Albany, New York. The subjects ranged in age from 18 to 27 and represented diverse ethnicity. Sixty percent of the subjects were female. The majority of subjects were not computer science majors. The subjects were divided into two groups (sensing and intuiting) determined by their learning style as measured by the Myers-Briggs Type Indicator. There were 16 students in each group. Nine subjects from each group were randomly assigned to a multimedia presentation (the experimental group); the other seven subjects from each group were assigned to a traditional lecture (the control group). It is quite possible that the subject pool was not adequate to find a significant interaction between presentation method and learning style.

Instrument

There were two instruments used in this study. The Myers Briggs Type Indicator was used to categorize learning styles on the basis of test scores on four dimensions. The four dimensions are an individual's exploratory attitude toward the environment (judging or perceiving), the individual's social interactions (introvert or extrovert), how the individual prefers to receive information (sensing or intuitive), and how the individual processes information (thinking or feeling). For the purposes of this study, the only score of interest was whether subjects were sensing or intuitive.

The other instrument was developed to test knowledge of Boolean operations and circuits. Two independent experts in computer science education, who indicated that it was a valid test of knowledge in this subject area, reviewed this instrument. The instrument consisted of 10 1-point short-answer questions on Boolean expression evaluation, 16 1-point short answer questions on circuits, and 5 2-point questions that required construction of a circuit from a Boolean expression. The 1-point questions were graded as either correct or incorrect (1 or 0 points per question). Students received full credit for the 2-point questions if the circuit was completely correct, half credit if the circuit had one error, and no credit otherwise (2, 1, or 0 points per questions). The sum of the scores on all the questions determined the score for knowledge in the subject area.

Experimental Design

The experimenter chose the posttest-only, control-group design (see Figure 1). The two independent variables were learning style and method of instruction. The dependent variable was knowledge of subject matter from the lesson on computer circuits.

Subjects were assigned to an odd-numbered or even-numbered group based upon their learning style (sensing or intuitive) as measured by the Myers-Briggs Type Indicator; the treatment students received was randomly determined. This design was chosen because it controls for many sources of invalidity and because random assignment to groups was feasible. Mortality, a potential threat to this design, proved not to be a problem, as no subjects dropped out of the study.

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Group	Assignment	n	Treatment	Posttest
1	Sensing; Random	7	Lecture	Learning Measure
2	Intuitive; Random	7	Lecture	Learning Measure
3	Sensing; Random	9	Multimedia Lesson	Learning Measure
4	Intuitive; Random	9	Multimedia Lesson	Learning Measure

Figure 1. Experimental design

Procedure

Thirty-two undergraduate students enrolled in two Introduction to Computer Science classes at the College of Saint Rose were administered the Myers-Briggs Type Indicator to determine whether they had sensing or intuitive learning styles. Sixteen of these students had the sensing learning style, and half had the intuitive learning style. Nine of the "sensing" subjects and nine of the "intuitive" subjects were randomly assigned to a multimedia presentation on computer circuits (the experimental group); the other subjects were assigned to a traditional lecture (the control group).

The treatment was a lesson on computer circuits. Subjects had previously learned about Boolean expressions, but computer circuits had not yet been covered in class. Both the control and experimental treatments lasted exactly 50 minutes. The control group's lecture contained the same factual material as the experimental group's multimedia presentation. The only difference was the medium of instruction. The lecturer of the control group created the multimedia presentation. The multimedia presentation included text, hotwords, drill-and-practice exercises, animations of functioning circuits, animations to show how computer circuits are constructed, and opportunities for students to build their own circuits. The lecture included verbal explanation of the material, questions posed to students, examples drawn on a whiteboard showing how computer circuits function, and examples drawn on a whiteboard showing how computer circuits are constructed. During either treatment, subjects could ask questions of the instructor. After the treatment, both groups were administered an examination, which consisted of short-answer questions on Boolean expressions and computer circuits, and longer questions where students had to build computer circuits.

Results

A two-way analysis of variance was used to analyze the data. The two fixed, categorical, independent variables were learning style (sensing and intuitive) and presentation method (lecture and multimedia). The continuous, random, dependent variable was posttest score. Table 1 presents the means and standard deviations for the study. Table 2 summarizes the analysis of variance.

Examination of Table 2 indicates that there was not a significant two-way interaction ($F = 0.48$; $df = 1,28$; $p > .05$) between learning style and presentation method. Nor was there a significant difference by learning style ($F = 1.58$; df = 1,28; $p > .05$). However, there was a significant difference by presentation method ($F = 10.83$; df = 1,28; $p < .05$). Posttest scores for the multimedia group (mean = 30.44) were greater than posttest scores for the lecture group (mean = 22.71). Overall, eta squared strength of association indicated that 26.5% of the variability in posttest score could be accounted for by the presentation method.

Table 1. Means and Standard Deviations for Presentation Method by Learning Style

			Learning Style	
			Intuitive	**Sensing**
Presentation Method	Multimedia	mean sd n	31.111 5.776 9	29.778 7.645 9
	Lecture	mean sd n	25.000 7.326 7	20.429 5.159 7

Table 2. Analysis of Variance for Posttest Score on Presentation Method by Learning Style

Source	**SS**	**df**	**MS**	**F**
Presentation Method	470.57	1	470.57	10.83*
Learning Style	68.64	1	68.64	1.58
Presentation Method x Learning Style	20.64	1	20.64	0.48
Error	1216.16	28	43.43	

* $p < .05$

Discussion

This study did not find a significant interaction between presentation mode (lecture or multimedia) and learning style (intuitive or sensing). Nor did it find a significant difference in posttest scores by learning style. There was, however, a significant difference in posttest scores by presentation mode, with the multimedia group doing significantly better than the control group.

It appears that students of both learning styles benefit from multimedia instruction. It is quite possible that different aspects of the multimedia lesson helped different types of students. As the researcher anticipated, sensing students benefited from being able to see the animations of abstract concepts. Sensing students were also helped by the repetitive drill-and-practice exercises. But the self-paced nature of the multimedia lesson may have been more effective for intuitive students, as they could continue with the lesson as soon as they understood a concept (and proved to themselves that they could apply the concept) rather than have to wait for their slower sensing classmates to get it. This would help prevent boredom and loss of focus among these students. Although time on task was not measured in this experiment, the researcher did observe that intuitive students tended to finish the lesson in less time than sensing students.

Although there was no significant interaction between presentation mode and learning style, it was noted that there was a smaller difference in mean posttest scores between the two learning styles groups who had the multimedia lesson. Since the sample size was only adequate to yield a power of .54, repeating the study with a larger sample size may be warranted.

It may also be interesting to see if there are differences between learning style groups in time on task in a multimedia lesson. This would verify the assumption that sensing students appreciate the repetitive and animating features of the lesson, while intuitive students appreciate the ability to work faster. Such a study could also examine any interaction between time on task and learning style—it appeared to the researcher that those intuitive students who spent the least time doing the multimedia lesson did worse than intuitive students who took a moderate amount of time to finish. It would also be interesting to see whether there are differences in liking different features of the multimedia lesson among students of different learning styles.

In summary, we note that students who used a multimedia lesson on computer science did significantly better than students who studied the same concepts using traditional methods. The implication of this finding is that computer science students would benefit if their instructors would either create or find such materials for them. In recent years, some computer science departments, such as Carnegie Mellon and George Washington University, have made such materials available free on the World Wide Web. Organizations such as the ACM's Special Interest Group on Computer Science Education have also started to collect animations relating to computer science education. Commercial products of this nature are now available on CD-ROMs. It is important that computer science education researchers study the effectiveness of such products and whether they benefit certain students especially.

References

Barnes, W.G. (1994). *Constructing knowledge from an ill-structured domain: Testing a multimedia Hamlet.* Paper presented at the meeting of the American Education Research Association, New Orleans, LA. (ERIC Document Reproduction Service No. ED 372 743)

Borning, A., & Duisberg, R. (1986). Constraint-based tools for building user interfaces. ACM *Transactions on Graphics*, 5(4), 345–374.

Brown, G. (1994). *Multimedia and composition: Synthesizing multimedia discourse.* Paper presented at the meeting of the World Conference on Educational Multimedia and Hypermedia, Vancouver, BC. (ERIC Document Reproduction Service No. ED 388 227)

Brown, M.H. (1988). *Algorithm animation*. Cambridge, MA: MIT Press.

Crosby, M., & Stelovsky, J. (1995). From multimedia instruction to multimedia evaluation. *Journal of Educational Multimedia and Hypermedia*, 4(2/3), 147–162.

Hofmann, S., Waters, K., & Berry, M. (1981). Personality types and computer assisted instruction in a self-paced technical training environment. *Research in Psychological Type*, 3, 81–85.

Jacobson, M., & Spiro, R.(1993). *Hypertext learning environments, cognitive flexibility, and the transfer of complex knowledge: An empirical investigation.* (Report No. 573). Champaign, IL: University of Illinois at Urbana-Champaign. (ERIC Document Reproduction Service No. ED 355 508)

Kelly, A. (1993). Designing instructional hypertext for use in lecture note review: Knowledge engineering and preliminary testing. *Journal of Educational Multimedia and Hypermedia*, 2, 149–176.

Keirsey, D., & Bates, M. (1984). *Please understand me: Character & temperament types*. Del Mar, CA: Prometheus Nemesis.

Lawrence, G. (1984). A synthesis of learning style research involving the MBTI. Journal of Psychological Type, 8, 2–15.

Liu, M., & Reed, W. (1995). The effect of hypermedia-assisted instruction on second language learning. *Journal of Educational Computing Research*, 12(2), 159–175.

Merrill, M.D. (1987). An expert system for instructional design. *IEEE Expert*, 2, 25–37.

Pinto, J., & Geiger, M. (1991). Changes in learning style preferences: A prefatory report of longitudinal findings. *Psychological Reports*, 68, 195–197.

Quade, A.M. (1993). *An assessment of the effectiveness of a hypertext instructional delivery system when compared to a traditional CAI tutorial*. Paper presented at the meeting of the Association for Educational Communications and Technology, New Orleans, LA. (ERIC Document Reproduction Service No. ED 362 195)

Reed, W., & Rosenbluth, G. (1992). *The effect of HyperCard programming on knowledge construction and interrelatedness of humanities-based information.* (ERIC Document Reproduction Service No. ED 355 908)

Schurr, K., & Ruble, V. (1986). The Myers-Briggs Type Indicator and first-year college achievement: A look beyond aptitude test results. *Journal of Psychological Type*, 12, 25–37.

Shih, Y., & Alessi, S. (1996). Effects of text versus voice on learning in multimedia courseware. *Journal of Educational Multimedia and Hypermedia*, 5(2), 203–218.

Stanton, N., & Baber, C. (1993). An investigation of styles and strategies in self-directed learning. *Journal of Educational Multimedia and Hypermedia*, 3, 147–167.

Vincente, K., Hayes, J., & Willeges, S. (1986). Assaying and isolating individual differences in searching hierarchical file system. *Human Factors*, 29, 349–359.

Welsh, T.M. (1995). Simplifying hypermedia usage for learners: The effect of visual and manual filtering capabilities on efficiency, perceptions of usability, and performance. *Journal of Educational Multimedia and Hypermedia*, 4(4), 275–304.

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