The Impact of Instructor's Instant Handwriting Using Tablet PC on Student Learning

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ABSTRACT

Projected electronic slides are the most common tool used in classrooms recently. However, electronic projection slides such as PowerPoint® slides do not provide sufficient flexibility to augment the displayed materials, so instructors are not able to adjust their instruction instantly in response to audience reaction and needs. Accordingly many studies suggested the use of tablet PC-based presentation tools in order to enable real-time handwritten annotations on the pre-developed materials. Based on this rationale, the present study was designed to examine the effects of a tablet PC (iPad in this study)-based instructors' digital handwriting on students' learning. Participants were 36 undergraduate students: one half of the students were instructed using typical PowerPoint-based presentation without instructor's digital handwriting and the other half of the students were instructed using tablet PC-based presentation with instructor's digital handwriting. Results from a MANCOVA revealed a significant main effect for the presentation mode. Two follow-up ANCOVAs revealed that the students in the tablet-PC-based instructor's digital handwriting condition significantly outperformed the students in the animated PowerPoint-based presentation lecture for conceptual knowledge acquisition, even though there was no statistical difference for factual knowledge acquisition.

Keywords: Digital handwriting, Tablet-PC, iPad-based lecture

INTRODUCTION

We have long been using presentation technology, such as blackboard and overhead projector, to deliver instruction and maintain a shared view between the instructor and students to provide context for discussion. More recently, projected electronic slides are the most common tool used in classrooms. Advantages of such electronic media are as follows: Instructors tend to prepare slides in advance, and therefore the chance of improving the structure of the lecture increases. Also, information-rich contents including complex tables, diagrams, high quality examples and illustrations are more easily integrated. Instructional slides are easily shared and reused (Anderson, Anderson, Simon, Wolfman, VanDeGrift, & Yasuhara, 2004). Other benefits using electronic slides include instantaneous display, avoiding the inaccuracy and the time of copying material onto an overhead projector or whiteboard.

However, there is a limitation in using electronic slides created by presentation software such as PowerPoint®(hereafter, PowerPoint). Even though instruction should be adjusted instantly in response to audience reaction and needs, electronic projection of PowerPoint slides do not provide sufficient flexibility to augment the displayed materials. Accordingly many studies suggested the use of tablet PC-based presentation tools in order to enable real-time handwritten annotations on the pre-developed materials (Anderson et al., 2004; Clark, 2004; Golub, 2004, Mock, 2004; Toto, Lim, & Wise, 2007). That is, instructors use the tablet PC as a device integrating digital ink with slides, allowing annotation with natural handwriting.

Anderson et al.(2004) noticed that there are some important usage patterns in instructors' digital handwriting in classroom: 1) adding instant attention marks drawing students' attention to specific content on the slides including grouping, emphasis, navigation, indication of progress, and identification of key points; 2) instructor notes scaffolding the instructor's discussion of a slide, reminding the instructor of discussion topics to raise in class, or leave 'blanks' in the slides to encourage student note-taking; 3) interactive writing to note for summary of student comments or answers; and 4) diagrammatic use of ink for conveying the dynamic nature of hierarchical path. Brophy and Walker (2005) reported that students were more likely to pay attention during the lecture and recognized more salient points of the presentation when instructors annotated on the slides on-the-fly. Also, Clark, Taylor, and Pickring (2007) concluded that students perceived the instructor's use of the tablet PC supported their learning. However, little research examines the impact of instructors' *instant digital handwriting* on students' achievement. Given that a new type of tablet PC such as iPad or Galaxy Tab is recently available and this new device is similarly used as a flexible presentation device, it is worth investigating the impact of a tablet PC-based instructors' digital handwriting on students' learning, which is the goal of this study. Specifically, this study was designed to answer following two questions: (a) Does instructor's tablet PC-based digital handwriting lead to students' better acquisition of factual knowledge compared to an animated PowerPoint-based presentation lecture? (b) Does instructor's tablet PC-based digital handwriting lead to students' better acquisition of conceptual knowledge compared to an animated PowerPoint-based presentation lecture?

METHODOLOGY

Participants and Treatment

The participants were 36 junior level college students. One half of the participants, that is, 18 students were instructed using typical PowerPoint-based presentation without instructor's digital handwriting as a control group, and the other half of the participants were instructed using tablet PC-based presentation with instructor's digital handwriting as an experimental group. In this study, the instructor used an iPad for the tablet PC-based presentation and PDF Note® application for instant digital handwriting. The contents of the study dealt with learning theories including behaviorism and cognitivism and were identically delivered for control and experimental groups. The annotated information provided for iPad group was included as animated information in PowerPoint-based slides for control group. Thus, the critical difference in treatment was the instantaneous handwriting during lecture.

Measurement Instruments and Procedure

Before the instruction, all of the participants took pre-test consisting of 10 items that required learners to match theorists to related terminologies, in order to control participants' prior knowledge on the contents. The pre-test was reviewed by two content experts and revised based on a careful review of 'corrected-item-total correlation' of a pilot-test. The reliability of the test items using Cronbach's alpha was .84.

In order to measure students' learning outcome, a 20-item test was administered. The two content experts also reviewed this post-test, and revised some of the items based on a review of 'corrected-item-total correlation' of a pilot-test. This instrument included two types of knowledge: factual and conceptual. The first half 10 items tested students' knowledge of specific terms and definitions relevant to the instruction. The second half 10 items tested students' understanding of the contents instructed. The reliability of the test items using Cronbach's alpha was .78 (see Table 1).

<Table 1> Measurement instruments

Constructs	Number of items	Reliability(α)
Prior Knowledge	10	.84
Knowledge acquisition		
Factual Knowledge	10	.68
Conceptual Knowledge	10	.62
Total	20	.78

Data Analysis

Data were analyzed using a Multivariate Analysis of Covariance (MANCOVA), followed by two analyses of Covariance (ANCOVA). Factual knowledge acquisition and Conceptual knowledge acquisition were the dependent variables for the MANCOVA. In order to control the prior-knowledge of the students, the pre-test scores were used as covariate. The significant MANCOVA *F* was followed by two ANCOVAs to independently evaluate the dependent variables, factual knowledge and conceptual knowledge. For all statistical analyses a level of significance at .05 was chosen. To validate the use of the parametric tests, the respective test assumptions were examined and results showed that none of the assumptions were violated.

RESULTS

Students' performance in the pre- and post-test for each of the two groups are presented in Table 2. One-way ANOVA for the pre-test results indicated that the two conditions were comparable regarding students' prior knowledge ($F(1, 34) = 2.330$, $p = .136$, partial $\eta^2 = .064$).

Results from the MANACOVA revealed a significant main effect for the presentation mode regarding the two dependent variables of the post-test (Wilk's Lambda: ($F(2, 32) = 3.599$, $p = .039$, partial $\eta^2 = .184$)). To determine whether the two dependent measures differed under the two conditions independently, two follow-up ANCOVAs were conducted with pre-test scores entered as the covariate. There was no statistical difference for factual knowledge acquisition ($F(1, 33) = .344$, $p = .561$, partial $\eta^2 = .010$). However, for conceptual knowledge acquisition, the students in the tablet-PC-based instructor's digital handwriting condition significantly outperformed the students in the animated PowerPoint-based presentation lecture ($F(1, 33) = 6.287$, $p = .017$, partial $\eta^2 = .160$).

<Table 2> Means and standard deviations for knowledge acquisition

		Tablet PC-based instructor's digital handwriting			Animated PowerPoint-based presentation lecture		
		M	*SD*	*n*	*M*	*SD*	*n*
Pre-test		3.33	3.25		4.88	2.84	
Post-test	Factual	7.77	.14	18	7.72	.21	18
	Conceptual	7.94	.16		6.72	.21	

CONCLUSION

This study was designed to determine the effect of a tablet PC based instructor's digital handwriting versus an animated PowerPoint-based presentation lecture on students' learning. The results revealed that the tablet PC-based instructor's instant digital handwriting was more effective than the animated PowerPoint-based presentation lecture on students' conceptual knowledge acquisition but there was no difference on students' factual knowledge acquisition.

Brophy and Walker (2005) reported that instructor's annotations on the slides helped students pay more attention and recognize more important points of the lecture, but the results of the present study suggests that animated PowerPoint-based presentation lecture is also successful to get students attention on specific contents. However, more important finding of this study is that students' conceptual comprehension has been improved when instructor's instant handwriting was provided during instruction. This notion reminds us of the discussion of the effectiveness of chalk and blackboard. When instructors use chalk and blackboard, learners are able to see the progressive development of the contents (Hulls, 2005), meaning that learners are able to follow the instructor's cognitive process, which might be disappeared in PowerPoint-based presentation. After all, tablet PC-based instructor's instant digital handwriting is a mixture of electronic projection that we often benefit from using PowerPoint and instant handwriting that we used to benefit from traditional chalk and blackboard.

The significance of this study lies in the research focus investigating learners' achievement, rather than perception that previous research examined, when instant digital handwriting was provided as instructional intervention.

REFERENCES

Anderson, R., Anderson, R., Simon, B., Wolfman, S. A., VanDeGrift, T., & Yasuhara, K. (2004). Experiences with a tablet PC based lecture presentation system in computer science courses, *Proceedings of the 35th SIGCSE Technical Symposium on Computer Science Education*, March 03-07, 2004, Norfolk, Virginia, USA.

Brophy, S. P., & Walker, D. G. D. (2005). Case study of the pedagogical impact of tablet PCs as a presentation medium in large-scale engineering classrooms, *Proceedings of the 2005 American Society for engineering Education Annual Conference & Exposition*, Portland, OR, USA.

Clark, C. (2004). *Notre Dame Tablet PC Initiative*. Retrieved from http://www.nd.edu/~learning/tabletpc/

Clark, S., Taylor, L., & Pickering, J. (2007). Understanding the impact of tablet PCs on students' learning and academics' teaching. *Proceedings of the Second Innovation in Accounting and Corporate Governance Education Conference*, 31 January – 2 February, Hobart, Tasmania.

Golub, E. (2004). Handwritten slides on a Tablet PC in a discrete Mathematics course, *Proceedings of the 35th SIGCSE Technical Symposium on Computer Science Education*, March 03-07, Norfolk, Virginia, USA.

Hulls, C. C. W. (2005). Using a Tablet PC for Classroom Instruction, *Proceedings of the 35th Annual Conference of Frontiers in Education*, Oct. 19-22, Indianapolis, IN, USA.

Mock, K. (2004). Teaching with Tablet PC's, *The Six Annual Consortium for Computing Sciences in Colleges Northwest Regional Conference*, October 8-9, 2004, Salem, OR.

Toto, R., Lim, K. Y., & Wise, J. (2007). Supporting Innovation: The Diffusion and Adoption of Tablet PCs in The College of Engineering, in D. A. Berque, J. C. Prey, & R. H. Reed (Eds.), *The Impact of Tablet PCs and Pen-based Technology on Education*, Purdue University Press.