Addressing Students' Learning Styles through Skeletal PowerPoint Slides: A Case Study

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Abstract

During this generation of millennial learners, who are heavily stimulated by visual and active involvement, there is a need to create innovative, pedagogical approaches that effectively utilize technology and meet students' needs. Therefore, the purpose of this paper was to illustrate the process of specifically addressing students' learning styles through a case study approach. PowerPoint (PPT) and an online course management system were utilized to make interactive skeletal (partial) slides available to students in five required courses in coaching. Students' learning styles, exam scores, and perceived value of interactive skeletal PPT slides were assessed and then compared between students who elected to use the PPT slides and those who did not. This preliminary investigation revealed that the skeletal slides did not provide enough assistance to significantly increase exam scores when all courses were combined. However, when looking at each type of course separately, significantly higher exam scores were found among the students who elected to use the PPT slides in the higher-level coaching courses. Therefore, future research measuring the impact of this technology among different levels and types of university courses is recommended.

Keywords: skeletal notes, partial notes, learning styles, technology, and note taking

Introduction

The educational world predominant today is one in which both teachers and learners continually employ various modes of technology for communication and interactive engagement. Such diversity for both delivering and understanding content has provided educators and this "Digital Native" generation of students (Prensky, 2001a, p. 1) a unique opportunity to maximize use of stimulating and creative methods of exchanging information. In fact, this era, characterized by visual and interactive technologies, as well as multi-tasking, signifies a paradigm shift in teaching and learning promoting the need to develop innovative strategies to connect to students in diverse ways. Due to the fact that this generation of "digital natives" has had more experience with technology than those 20 years ago (Salopek, 2003), varied pedagogical approaches that effectively maximize its benefits must be implemented to meet students' needs.

At the same time these technologically innovative teaching and learning strategies are being developed, it is imperative for educators to preserve learning outcomes. Using technology just for the sake of innovation and creativity is simply not warranted (Hooper & Rieber, 1995). In addition to selecting teaching methodologies that align with learning outcomes, it is equally critical to take into account the way in which students learn. Not all students take in and process information in the same manner and the traditional lecture format of delivering content may not be best suited for this generation of learners, often referred to as millennial learners (Oblinger, 2003). According to Sutliff and Baldwin (2001), combining various teaching styles is recommended in order to better meet the diverse learning needs of students. More specifically, Prensky (2001b) advocates the use of visual stimuli and multimedia approaches to actively engage learners.

Previous research on learning style theory has indicated that students learn in three ways, visually, auditorily, and tactilely (or kinesthetically) (Clark, 2000). This VAK (visual, auditory, kinesthetic) learning style model has been previously tested in technology-enabled teaching methodology research by Jones and Mungai (2003).These investigators discussed the challenge involved in matching the students' learning styles with the teacher's teaching style. Boldly stated, they believed that, "Technology can be the answer to filling the gaps caused by the differences between learning and teaching styles" (Jones & Mungai, 2003, p. 3499).

The challenge in the present case study was to narrow this gap and optimize use of technology to improve exam scores by addressing the students' predominant style of learning. Researchers from a previous study with this type of student, specifically those in motor-based courses (coaching), found that 80% fell into the visual (58%) and tactile (kinesthetic) (22%) learning style categories (Jones & Mungai, 2003). With the visual and tactile learners comprising such a large percentage of the students, the authors of this case study determined the need to extend this research and investigate the most effective use of technology for these learning styles.

Use of Technology in Teaching

Multiple ways of using technology in teaching and learning have been utilized to creatively deliver and organize course content. Interactive educational games (Mungai & Jones, 2003; Jones, 2006), digitized video clips, hands-on websites, on-line self-assessments, online course management systems, simulations, and interactive PowerPoint slides are all examples of methods in which educators attempt to make effective use of technology to actively engage millennial learners and address their learning styles. Specifically, researchers have reported that the use of PowerPoint presentations are the students' preferred method of content delivery over transparencies (Cassady, 1998; Perry & Perry, 1998; Susskind & Gurien, 1999; West, 1997) and over a whiteboard or blackboard (Frey & Birnbaum, 2002). Students perceive PowerPoint slides to be helpful in taking notes and in studying for exams. In addition, students perceive professors who deliver PowerPoint lectures to be more organized (Frey & Birnbaum, 2002). Therefore, the major emphasis of this case study was to continue the development of PowerPoint materials to optimize learning (Bartsch & Cobern, 2003; Montgomery, 1995; O'Connor, 1997; Godwin-Jones, 2002; Lewis, 2003)

Instructional Challenge

The use of technology may be beneficial to learners, especially if the content is more complicated (e.g. use of pictures/graphics in PowerPoint), however, students still need help with note-taking (Potts, 1993). Kiewra (1985) reported that even successful students are missing many important concepts covered in lectures. Many students struggle to copy down all of the information, with little or no emphasis on understanding the material presented. Often, the resulting notes contain information that is incorrect or missing the most important points, thus leading to confusion later in the learning process (Aiken, Thomas, & Shennum, 1975; Baker & Lombardi, 1985; Locke, 1977). Unfortunately, college-level note-takers, who are presumably the best note-takers, only include less than three-quarters of a lecture's critical ideas in their notes. In fact, Kiewra (1985) found that the notes of first year college students contained only 11% of critical lecture ideas, a problem definitely worth exploring for potential solutions.

Given that some critical lecture information fails to translate into students' notes, educators must examine ways to help students optimize their note-taking skills without just providing word-for-word copies of their lectures notes (i.e., PowerPoint presentations). In two separate reviews, Kiewra (1985) and Potts (1993), discussed the literature in this area and emphasized the need to determine ways to improve the quality of student notes. Although mixed research evidence exists regarding the effectiveness of the note-taking process, the importance of reviewing notes is unequivocal (Kiewra, 1985). Researchers demonstrated that students who were given the instructor's complete lecture notes to review, but did not even attend lecture, scored higher on exams than those who attended lecture and reviewed their own notes. It is evident that, unlike the students' notes, the instructor's notes contain all the critical ideas of the lecture.

This does not necessarily mean that the instructor's lecture notes should simply be provided to the students, as this may rationalize student absence from class, which will certainly not optimize learning. In fact, according to the theory of encoding specificity (Thompson & Tulving, 1970), students tend to recall more of their own notes than those provided by the instructor, so there is some benefit to the process of note-taking. In addition, with either providing the instructor's notes or having students review their own notes, no differences in the ability to stimulate higher order thinking have been found. Developing such a level of thinking, which includes application, analysis, synthesis, and problem solving, rather than just factual regurgitation, can be beneficial to learning (Bloom, 1956).

Therefore, the goal is to strike a balance between assisting students with note-taking, while not encouraging passive learning and absence from class. A beneficial solution that has been investigated by several researchers is for instructors to provide skeletal (or partial) note outlines. This type of note taking involves providing blank lines on the PowerPoint slides (based on learning outcomes) for students to fill in during lecture. Skeletal notes lead to better recall than either the student's own notes or the instructor's notes (Hartley & Davies, 1978) and have gained extensive support (Russell, Caris, Harris, & Hendricson, 1983; Kiewra, 1985).

Hartley (1976) has reported the superiority of utilizing the skeletal note format over providing the instructor's complete notes. Several formats for skeletal (or partial) notes such as lecture outlines, matrices, and skeletal guides have been utilized, yet more research regarding their effectiveness is still warranted. In the skeletal format, the main ideas of the lecture are provided, usually illustrating their hierarchical relationships (e.g., arrangement in outline or schematic form), and spaces are left for students to fill in relevant information, such as definitions, clarifications, or elaborations, as they listen to the lecture. Kiewra (1985) suggests the benefits of this format include helping the students listen to the lecture and focus on what is being said, and providing a framework to aid in taking more organized and complete notes during lecture. Essentially, this type of note-taking should relieve some of the cognitive load experienced during listening to a lecture (finding the main ideas, copying terms from the board or overhead, deciding how lecture ideas fit together), allowing for more focus on understanding and encoding (Kiewra, 1985). Using skeletal course notes encourages active learning by shifting the student's focus on what should be captured in the notes to reflecting upon the material presented in the lecture and/or formulating and asking questions (Wirth, 2003).

Evidence exists supporting the use of the skeletal note-taking format in teaching and learning. Hartley and Davies (1978) found that skeletal notes led to better recall than either the student's own notes or the instructor's notes, with the best recall occurring when students receive skeletal notes prior to the lecture and the instructor's detailed notes afterward (Hartley & Davies, 1978). Using a skeletal matrix framework, Kiewra and colleagues (Kiewra, DuBois, Christian, & McShane, 1988) demonstrated that students with matrix or outline notes achieved higher scores on recall performance than students given complete text notes. This reveals that there is value in having students participate in the note-taking process, however incomplete their notes may be (Kiewra, 1985).

Therefore, the purpose of the present case study was four-fold:

1) To determine the impact of multimedia learning materials (i.e., interactive skeletal PowerPoint slides) on exam scores.
2) To determine the impact of interactive skeletal PowerPoint slide use on exam scores for each of the three learning styles.
3) To determine the relationship between the students' learning styles and the elective use of interactive skeletal PowerPoint slides.
4) To determine students' perceived value of interactive skeletal PowerPoint slides.

Methods

Participants

Students enrolled in five sections of two different courses in the Coaching Minor at the University of Wisconsin-Whitewater during the fall of 2006 and spring of 2007 were invited to participate in the study. Both were introductory level, required courses in the coaching minor, while also serving as electives for other students. One of the courses, *Introduction to Coaching* (COACHING-240), is the first required class for the coaching minor students. This course is offered every semester, with 35 students enrolled in each section. Two sections of COACHING-240 were utilized during the fall of 2006 and one section in the spring of 2007. Students from the other course, *Psycho-Social Aspects of Coaching* (COACHING-256), consisted of one section in the fall of 2006 and one in the spring of 2007. Of the two courses, learning outcomes of this course involved meeting higher levels of thinking (Bloom, 1956).

Procedures

A researcher explained to the students that the purpose of the study was to examine learning outcomes as measured by their exam scores. Then, after careful review of confidentiality and the informed consent, students interested in participating signed the consent and completed the Barsch Learning Style Inventory (Barsch, 1991) the first day of class. This 24-item questionnaire was scored by assigning points to each Likert-type scale response, with the highest score indicating the individual's learning style (visual, auditory, or kinesthetic).

Three applications of technology were utilized to achieve the four purposes of this case study. An online course management system (Desire2Learn, D2L) was utilized to electronically disseminate the interactive skeletal PowerPoint slides, and a PowerPoint slide presentation of the lecture material was utilized to engage students in the note-taking process in class. The interactive skeletal PowerPoint slides were developed with an emphasis on the learning outcomes of these two motor-based coaching courses. For example, the learning outcomes for goal setting in the COACHING-256 course included the following: Students will be able to: 1) list and define the three types of goals, and 2) provide an applied example of the three types of goals. As shown in Figure 1, the interactive skeletal PowerPoint slides for this set of learning outcomes included a heading, "Types of Goals," on a slide with three blank lines. Then, during lecture, students would interact with the material by filling in the blanks that identified the three kinds of goals (also shown in Figure 1).

To protect the students' academic freedom and maintain an ethical research methodology, they were able to self-select interactive skeletal PowerPoint slide use. Students were given access to the interactive skeletal PowerPoint slides via D2L, where the slides could be printed for use during class lectures.
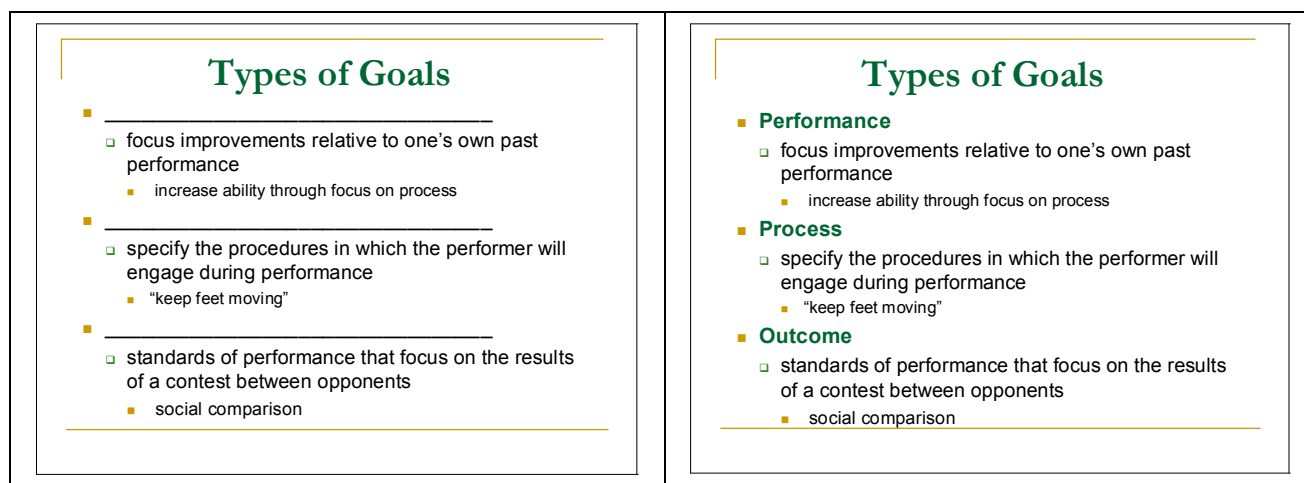
Figure 1. Sample interactive skeletal PowerPoint slide and slide shown during lecture.

On the sixth day of class, the students that elected to use the slides were asked to complete a survey (Table 1 contains the survey questions) on their perceived value of the interactive skeletal PowerPoint slides. The students responded to the questions using a five-point Likert scale (1: Strongly Agree to 5: Strongly Disagree)

Table 1. Survey Questions

I am using the PowerPoint slides because:
The instructor suggested using the PowerPoint slides.
I felt it will help me study for the exams.
I do not feel my note-taking skills are good.
I can pay attention better in class and write less.
I believe reviewing the teacher-generated notes are better than reviewing my own notes.
The PowerPoint slides help me stay organized in my note-taking.
Other reasons you are using the PowerPoint slides:

To determine the impact of interactive skeletal PowerPoint slide use on academic achievement, computerized exam 1 scores in both courses were used, and the exams were the same both semesters. SPSS (Version 15.0, Chicago, IL) was the statistical software package utilized to analyze data. The significance level was set at .05.

Results

Participants included 70 students from COACHING-256 (2 sections of 35) and 105 students from COACHING-240 (3 sections of 35), resulting in an N of 175. Learning style scores were calculated according to the procedures developed by Barsch (1991). This resulted in 23.4% auditory learners (n = 41), 15.4% tactile learners (n = 27), and 61.1% visual learners (n = 107). Students with dual learning styles were eliminated from the study.

Table 2 shows the percentage of students from all five courses electing (PPT Use) and not electing to use the PowerPoint slides (No PPT Use). When combining all five courses and comparing mean exam scores for PPT Use (M = 78.99, SD = 6.28) and No PPT Use (M = 78.13, SD = 5.57) using an independent-samples t-test, no significant difference was found, $t(173)$ = .95, p = .343 (two-tailed).

Table 2. Percentage of PowerPoint (PPT) Use and No Use

Courses	Students (n)	PPT Use (%)	No PPT Use (%)
240-01 F-06	35	37 n = 13	63 n = 22
240-02 F-06	35	17 n = 6	83 n = 29
240-01 SP-07	35	49 n = 17	51 n = 18
256-01 F-06	35	60 n = 21	40 n = 14
256-01 SP-07	35	60 n = 21	40 n = 14
5 Courses	175	45 n = 78	55 n = 97

When separating out the exam scores for each course, a significant difference was found for only the COACHING-256 (Psycho-Social Aspects of Coaching) students, $t(68)$ = 2.47, p = .016 (two-tailed). Mean exam scores for these students for PPT Use and No PPT Use were M = 77.48, SD = 7.03, n = 42 and M = 73.43, SD = 6.19, n = 28, respectively. However, for the students in the introductory COACHING-240 course, no significant difference in exam scores was found between students electing to use the PowerPoint slides and those who did not $t(103)$ = .807, p = .422 (two-tailed). The mean exam score for the PPT Use students in COACHING-240 was M = 80.75, SD = 4.78, n = 36. The mean exam score for the No PPT Use was M = 80.04, SD = 3.97, n = 69.

The percentage of students in COACHING-240 electing to use the PPT slides was calculated to be only 34% (36 out of 105 students), while the percentage in COACHING-256 was 60% (42 out of 70 students). Therefore, a Pearson's Chi Square analysis was performed to determine if there was a

significant association between the specific course and elected PPT Use. The value of Pearson's Chi Square, with one degree of freedom, was shown to be 11.241, with a two-tailed significance level of $p <$ .001. The two variables were significantly associated with each other, which means that students in COACHING-256 were more likely to use the skeletal PPT slides than those in COACHING-240.

For the purpose of determining the interaction among interactive skeletal PowerPoint slide use, exam scores, and each of the three learning styles, a one-way analysis of variance (ANOVA) was performed. The mean exam scores (and standard deviations) for auditory, tactile, and visual learners were $M =$ 77.17, $SD = 5.82$, $n = 41$, $M = 78.22$, $SD = 5.12$, $n = 27$, and $M = 79.10$, $SD = 6.06$, $n = 107$, respectively. No significant differences in exam scores were found among each of the learning styles $F(2, 172) = 1.64$, $p = .196$.

Table 3 illustrates the percentage of students in each learning style electing to use the PPT slides. The visual learners comprised the greatest percentage of elected PPT users (46%), with auditory learners the greatest percentage of non-PPT users (59%).

Table 3. Learning Styles and PowerPoint (PPT) Use

	Auditory	**Tactile**	**Visual**
PPT Use ($n = 78$)	41% $n = 17$	44% $n = 12$	46% $n = 49$
No PPT Use ($n = 97$)	59% $n = 24$	56% $n = 15$	54% $n = 58$

The survey results of the students' perceived value of interactive PowerPoint slide use are presented in Table 4. Question 2, "I am using PowerPoint slides because I felt it will help me study for the exams" represented the highest mean score, at 4.64 (see Rating Scale below Table 4). Question 6, "I am using PowerPoint slides because the PowerPoint slides help me stay organized in my note-taking" had the second highest mean score, which was 4.58. The lowest mean score, 3.00, was found for Question 3, "I am using the PowerPoint slides because I do not feel my note-taking skills are good".

Discussion

Due to the prevalence of online teaching and learning in education, the uniqueness of the current generation of college students, and previous research on student note-taking (Kiewra, 1985), the purpose of this case study was to take a preliminary look at the relationship among these variables. Millennial learners, or the so-called "Digital Natives" (Prensky, 2001a), were raised using technology and are more likely to be stimulated by visual and tactile (kinesthetic) methods of teaching (e.g., multimedia approaches). If instructors take the time to develop and implement diverse teaching methods encouraging these modes of stimulation, students will become more engaged in the material and expand their critical thinking skills (Hooper & Rieber, 1995). However, there is more to success in a college-based academic course than engagement in the learning material. Kiewra (1985) reviewed the literature and found that students are missing anywhere from 30% to as much as 89% (freshmen) of the critical lecture information when note-taking in class.

Table 4. Mean Scores for Perceived Value of Interactive Skeletal PowerPoint Slides

Course	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
240-01 (F-06) *n* = 13	4.38	4.92	3.00	4.54	4.23	4.69
240-02 (F-06) *n* = 6	3.83	4.83	3.17	4.50	4.50	4.83
240-02 (SP-07) *n* = 17	3.82	4.47	3.18	3.41	4.41	4.00
256-01 (F-06) *n* = 21	4.32	4.53	2.74	4.37	4.21	4.68
256-01 (SP-07) *n* = 21	4.24	4.67	3.38	4.33	4.24	4.81
TOTAL *n* = 78	4.16	4.64	3.00	4.18	4.29	4.58

Note. Rating Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree.

Based on previous findings from Jones and Mungai (2003), who reported that 80% of the students in motor-based coaching courses were visual (58%) and tactile (22%) learners, this case study sought to specifically address these two learning styles by offering the use of interactive skeletal PowerPoint slides for assistance in note-taking in class. Normative data for these two types of learners was 65% and 5%, respectively (Mind Tools, 2002), thus illustrating that students in coaching courses do have different learning styles than the norm (lower in auditory and higher in tactile); more specifically indicating a need for more interactive teaching styles that involve graphics, pictures, colors, models, and experiential learning.

In this case study, all of the students were given the option to utilize the instructor-developed interactive skeletal PowerPoint (PPT) slides that emphasized key learning outcomes and stimulated visual and tactile learning styles. Forty-five percent of the students elected to use the PPT slides, while 55% did not. No significant difference in exam scores was found between these two groups (PPT Use vs. No PPT Use) when analyzing two college coaching courses at a midwest university. This is inconsistent with Kiewra's (1985) review indicating that providing partial outlines (skeletal notes) prior to lecture can facilitate student learning.

However, one consideration, as discussed by Kiewra, is that some instructors are unable or unwilling to provide partial outlines prior to lecture as well as provide complete notes following lecture. In this study, to encourage attendance, complete notes were not given to the students after the lecture. This practice is supported by Kiewra, DuBois, Christian, and McShane's (1988) findings that students given matrix notes or outline notes had better recall performance than those students given complete text notes. At the same time, the students given matrix notes had significantly higher transfer performance (synthesis and application) than those with the text notes. Therefore, distributing complete text notes following lecture may not be as beneficial to learning as once thought (Kiewra, 1985).

Nevertheless, when considering only the students in the higher-level coaching course (Psycho-Social Aspects of Coaching, COACHING-256), a significant difference in exam scores was found between the students who elected to use the PowerPoint slides and those who did not. The interactive skeletal PowerPoint slides did not provide enough assistance to significantly increase exam scores when both courses were combined. Future researchers may need to consider the specific course, since the students in the COACHING-256 sections did perform significantly better on the exam if the PowerPoint slides were used. It is possible that in an introductory-level course such as COACHING-240 (Introduction to Coaching), interactive skeletal PowerPoint slides do not make enough of an impact on academic success since the material is more basic. However, in a course that requires more critical thinking (such as in COACHING-256), the interactive skeletal PowerPoint slides could really make a difference in performance on exams.

The students in COACHING-256 were more likely to use the skeletal PPT slides than those in COACHING-240 (60% vs. 34%). Each course required different exams so academic performance could not be equitably compared, but it is evident that there was a difference in PPT use between the two different courses. Therefore, future research among different levels (and types) of college courses to determine the impact of interactive skeletal PowerPoint slides on exam scores is warranted.

The results also indicated no significant differences in exam scores among each of the three learning styles, visual, auditory, and tactile (kinesthetic). It is interesting to discuss that there was a greater number and percentage of students in each learning style category that elected not to use the interactive skeletal PowerPoint slides (n = 97 [55%] vs. n = 78 [45%]). Possible explanations for this could be that the students were unable to make an informed choice about the benefits of this type of note-taking assistance due to a potential lack of understanding of their learning style and the work load involved. The students in this study completed the Barsch Learning Style Inventory (Barsch, 1991), but were not provided with an explanation of the scored results and potential implications for learning.

Therefore, future research could focus on determining the effectiveness of educating students about each learning style prior to making a decision about which note taking option is most suitable. Another future study design, which was not utilized in this case study in order to uphold the students' academic freedom, would be to randomly assign students to PPT Use or No PPT Use (with a control group) to strengthen the analyses and control for extraneous variables that may have had an impact on students' exam scores. It is unknown in this case study how the non-PPT users were preparing for the exams or what other study methods the PPT users may have implemented.

In an attempt to understand the reasons for elective use of the interactive PowerPoint slides, students' perceived value of these interactive skeletal notes was measured via a self-reported survey (using a Likert scale from Strongly Disagree to Strongly Agree) (see Table 4). Students were asked to rate six statements on why they elected to use the PowerPoint slides, as well as to indicate other potential reasons. The top two highest mean scores were for the statements, "I am using PowerPoint slides because I felt it will help me study for the exams", and "…to help me stay organized in my note-taking". It is evident that students use PowerPoint slides for exam preparation and note-taking organization. Other prevalent reasons included the belief that reviewing the teacher-generated notes was better than reviewing their own notes, and that they can pay attention better in class and write less while using the skeletal PPT slides. Interestingly, the lowest mean score was for the statement "I am using the PowerPoint slides because I do not feel my note-taking skills are good". With Kiewra (1985) reporting that students do indeed have poor note-taking abilities, this is paradoxical. It seems that students perceive their note-taking abilities to be much better than they actually are, and may therefore not elect to use PowerPoint notes when in fact they could really use the note-taking assistance.

Limitations

In addition to the limitations and recommendations explained above, it is important for researchers to consider these findings in context and prepare for future investigations in other educational courses and settings. Generalizability is limited, as the results of this case study are specific to a college-student population enrolled in two motor-based coaching courses at a comprehensive regional university. Additional factors may have influenced exam scores that were not accounted for in the self-selected PPT

use and non-PPT use groups. Lastly, other methods of studying for exams were not identified, and may be helpful in explaining the results of this case study. Future researchers should consider revealing these other methods and how they may contribute to exam success in different types of college courses.

Conclusion and Implications

The main purpose of this case study regarding the impact of elected use of interactive skeletal PowerPoint slides on exam scores was to combine technology with learning style theory to demonstrate a unique teaching and learning process. This study outlined the development of an interactive, technology-based teaching strategy using interactive skeletal PowerPoint slides to specifically address the dominant learning styles (visual and tactile) of university coaching students. Although the exam scores for the students who elected to use the PowerPoint slides were not significantly higher overall, they were significantly better for students in a higher-level (non-introductory) course. This promotes further investigation into various types of courses and the impact of interactive skeletal notes. Motor-based courses may be particularly distinct in that they represent more tactile learners and less auditory, so the use of interactive teaching methods is warranted.

Lastly, from a practical and anecdotal standpoint, the interactive skeletal PowerPoint slides resulted in a reduction of in-class distractions from students asking the instructor to return to a slide so they could write everything down. Students appeared to spend more time learning and thinking about the course material, and less time writing, which should be a goal of any educational endeavor. Using effective and diverse online teaching methodologies to stimulate this millennial generation of technologically-savvy college students, while preserving academic integrity, is a critical instructional challenge for all educators.

References

Aiken, E.G., Thomas, G.S., & Shennum, W.A. (1975). Memory for a lecture: Effects of notes, lecture rate and informational density. *Journal of Educational Psychology, 67*(3), 439-444.

Baker, L., & Lombardi, B.R. (1985). Students' lecture notes and their relation to test performance. *Teaching of Psychology, 12*, 28-32.

Barsch, J. (1991). *Barsch Learning Style Inventory*. Novato, CA: Academic Therapy.

Bartsch, R. A., & Cobern, K. M. (2003). Effectiveness of PowerPoint presentations in lectures. *Computers & Education, 41*, 77-86.

Bloom, B. S. (Ed.) (1956). *Taxonomy of Educational Objectives*. NY: Longmans, Green, 6-8.

Cassady, J.C. (1998). Student and instructor perceptions of the efficacy of computer-aided lectures in undergraduate university courses. *Journal of Educational Computing Research, 19*, 175-189.

Clark, D. (2000). VAK learning styles. [On-line]. Available: http://www.nwlink.com/~donclark/hrd/learning/styles.html#vak

Frey, B.A. & Birnbaum, D.J. (2002). Learners' perceptions of the value of PowerPoint in lectures. *ERIC Document Reproduction Service*: ED467192.

Godwin-Jones, B. (2002). Ten ways to enhance teaching through technology. [On-line]. Available: http://www.wlu.ca/~wwwtlt/10ways.shtml

Hartley, J. (1976). Lecture handouts and student notetaking. *Innovations in Education and Teaching International, 13*(2), 58-64.

Hartley, J. & Davies, I.K. (1978). Note-taking: A critical review. *Innovations in Education and Teaching International, 15*(3), 207-224.

Hooper, S., & Rieber, L. P. (1995). Teaching with technology. In A. C. Ornstein (Ed.), *Teaching: Theory into practice*, (pp. 154-170). Needham Heights, MA: Allyn and Bacon.

Jones, D. C. & Mungai, D. (2003). Technology-enabled teaching for maximum learning. *International Journal of Learning, 10*, 3491-3501.

Jones, D.C. (2006). Scavenger hunt enhances students' utilization of blackboard. *Journal of On-line Learning and Teaching, 2*(2), 86-99.

Kiewra, K.A. (1985). Providing the instructor's notes: An effective addition to student note-taking. *Educational Psychologist, 20*, 33-39.

Kiewra, K.A., Dubois, N.F., Christian, D., & McShane, A. (1988). Providing study notes: Comparison of three types of notes for review. *Journal of Educational Psychology, 80*(4), 595-597.

Lewis, M. (2003). Interactive multimedia pedagogy: How interactivity supports learning. [On-line]. Available: http://www.thelearningcurve.com/lessons/resources/media/TLC_interactive%20pedagogy.pdf

Locke, E.A. (1977). An empirical study of lecture notetaking among college students. *Journal of Educational Research, 77*, 93-99.

Mind Tools (2002). How your learning style affects your use of mnemonics [On-line]. Available: http://www.mindtools.com/mnemlsty.html

Montgomery, S. M. (1995). Addressing diverse learning styles through the use of multimedia. [On-line]. Available: http://fie.engrng.pitt.edu/fie95/3a2/3a22/3a22.htm

Mungai, D. & Jones, D.C. (2003). Games that teach: A conceptual introduction and practical application". *International Journal of Learning, 10*, 503-513.

Oblinger, D. (2003). Boomers, gen-Xers, & millennials: Understanding the "New" students. *Educause Review, 38*(4), 37-47.

O'Connor, T. (1997). Using learning styles to adapt technology for higher education. [Online]. Available: http://www.indstate.edu/ctl/styles/learning.html

Perry, T., & Perry, L. A. (1998). University students' attitudes towards multimedia presentations. *British Journal of Educational Technology, 29,* 375–377.

Potts, B. (1993). Improving the quality of student notes. Practical Assessment, Research, & Evaluation, 3(8). Retrieved August 19, 2007 from http://PAREonline.net/getvn.asp?v=3&n=8. This paper has been viewed 17,754 times since 11/13/1999.

Prensky, M. (2001a). Digital natives, digital immigrant. *On the Horizon, NCB University Press, 9*(5), 1-6.

Prensky, M. (2001b). Digital natives, digital immigrants, part II: Do they really think differently? *On the Horizon, NCB University Press, 9*(6), 1-7.

Russell, I.J., Caris, T.N., Harris, G.D., & Hendricson, W.D. (1983). Effects of three types of lecture notes on medical student achievement. *Journal of Medical Education, 58*, 627-636.

Salopek, J.J. (2003). Going native: Cross the generation gap by learning to speak game. *Training and Development, 57*(6), 17-19.

Susskind, J. & Gurien, R.A. (1999, June). *Do computer-generated presentations influence psychology students' learning and motivation to succeed?* Poster session presented at the annual convention of the American Psychological Society, Denver, CO.

Sutliff, R.I. & Baldwin, V. (2001). Learning styles: Teaching technology subjects can be more effective. *The Journal of Technology Studies, Winter-Spring*, 22-27.

Thompson, D.M. & Tulving, E. (1970). Associate encoding and retrieval: Weak and strong cues. *Journal of Experimental Psychology, 86*, 255-262.

West, R.L. (1997, August). *Multimedia presentations in large classes: a field experiment*. Paper presented at the annual convention of the American Psychological Society, Washington, DC.

Wirth, M.A. (2003). E-notes: using electronic lecture notes to support active learning in computer science*. ACM SIGCSE Bulletin, 35*(2), 57-60.