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Influence of presentation handout completeness on student learning in a physical therapy curriculum

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Abstract: Students and faculty have disparate opinions on how complete lecture materials should be to optimize learning. The purpose of this study was to investigate the influence of lecture handout completeness and content area on Doctor of Physical Therapy student recall/retention in foundation level courses. These findings suggest there may not be a best practice for lecture slide completeness and may be course/content dependent. In this study students performed better with complete handouts in physiology and research courses and with less complete handouts in biomechanics.

Keywords: PowerPoint, Lecture Format, Health Science Education

I. Introduction.

There are consistent discrepancies between physical therapy student and faculty attitudes and beliefs regarding the completeness of lecture/presentation material provided to students. Anecdotal evidence gathered through informal surveys of students enrolled in the Doctor of Physical Therapy (DPT) program at Regis University suggest that students have a preference for access to complete presentation slides/handouts prior to and during the actual teaching sessions. Student comments on course and faculty evaluations also reflect this preference. Informal discussions that provided motivation for this study indicated that some students' rationale for this preference is note taking during a presentation interferes with their ability to listen, and they are afraid of missing critical information. An informal survey of faculty in the School of Physical Therapy indicates a conflicting belief that note taking, rather than interfering with understanding, helps support student learning through the process of encoding information. In addition, some faculty members believe that providing incomplete presentation slides/handouts facilitates student engagement and encourages class participation. These anecdotal findings are in accordance with what has been published in the literature, where survey studies have shown dissonance in faculty/student beliefs surrounding handout completeness (Marsh & Sink, 2010; McClennan & Isaacs, 2008). Many investigators have found the majority of students prefer to have access to course presentation materials prior to classroom sessions (Marsh & Sink, 2010; Murphy, Gray, Straja, & Bogert, 2004; Yilmazel-Sahin & Oxford, 2010); however, few studies have investigated the influence of access to incomplete or complete handouts on learning outcomes (Achterberg, Duquiane, Huebbe, & Williams, 2007; Larson, 2009). Furthermore, few studies in this area have focused on graduate education (Yilmazel-Sahin & Oxford, 2010), and even fewer have been conducted in the area of physical therapy education.

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A. Traditional Lecture Presentations in Physical Therapy Education.

Traditional lecture presentations are not the primary instructional method employed in most physical therapy programs; however, some lecture presentations are frequently used (Willett, Sharp, & Smith, 2008), especially in foundation level courses, to introduce new concepts and provide background/basic knowledge that is necessary for students to advance to higher level application and synthesis activities. While traditional lecture may comprise a part of the content delivery in a course, it is important to understand that this may not be the most effective instructional strategy and should be used sparingly (Day, 1985; Hyland, 2010; Lake, 2001; Sellheim, 2006; Venglar & Theall, 2007; Wait et al., 2009; Wong & Driscoll, 2008). Many studies have been conducted investigating differences between teacher-centered (passive lecture) and student-centered (active learning) instructional approaches, and it is well accepted that an emphasis on student-centered learning is preferred (Day, 1985; Hyland, 2010; Lake, 2001; Sellheim, 2006; Venglar & Theall, 2007; Wait et al., 2009; Wong & Driscoll, 2008). However, traditional presentation style lectures are still often used, as one instructional component, particularly to present basic content in foundation science courses (Brahler, Quitadamo, & Johnson, 2002; Maring, Costello, & Plack, 2008; Sellheim, 2006). Ideally, traditional presentations comprise only a part of the content delivery, with case studies, facilitated group discussions, and hands on activities used in subsequent sessions to apply and reinforce concepts and promote critical thinking (Brahler et al., 2002; Chester, 2011; Zipp, 2010). Regardless of whether a classroom session is based around traditional lecture or more interactive activities, the use of visual materials such as PowerPoint slides has become ubiquitous. In the context of a traditional teaching presentation, the main purpose of PowerPoint slides is to guide and provide structure for the presentation, and ultimately clarify main concepts with the goal of improving student understanding (Achterberg et al., 2007; Brown & Manogue, 2001; Hill, Arford, Lubitow, & Smollin, 2012). In the Regis University School of Physical Therapy curriculum, PowerPoint slides are routinely used as described for the purpose of providing structure to a lecture presentation.

B. The Role of Note Taking.

Students rely heavily on notes taken during a class session to study from later, and typically instructors expect that students are taking notes during class sessions, especially when a traditional presentation format is being used. It has been suggested that note taking enhances learning through the process of encoding information and providing a record for students to refer to later during studying (DiVesta & Gray, 1972). It has also been shown that college students do not always take quality notes, and that as little as half of the critical information from a presentation may be recorded (Anderson & Armbruster, 1991). Different formats and methods for content delivery have been proposed to address the potentially competing goals of facilitating student engagement and encoding and allowing for an accurate and complete record of the content. Providing an outline or incomplete notes to supplement a teaching presentation has been suggested to help guide the student in note taking while facilitating encoding (Katayama & Robinson, 2000; Kiewra, 1985a). While providing a complete set of notes to students solves the problem of students not having an accurate external record for study (Kiewra, 1985a, 1985b), some faculty believe that this method may reinforce passive modes of learning and student disengagement.

C. Differences in Undergraduate, Graduate and Health Sciences Students.

Most of the empirical research surrounding this topic has been done with a focus on undergraduate students, and therefore these findings may not generalize to physical therapy students enrolled in graduate programs. Yilmazel-Sahin and Oxford (2010) compared perceptions of graduate and undergraduate students in a teacher education program regarding completeness of handouts (downloadable presentation slides) accompanying traditional lecture presentations. It was determined that undergraduates took fewer notes than graduate students when handouts were provided, and also experienced greater stress when handouts were not provided. Graduate students reported using handouts to prepare for class in advance and stated this enabled them to engage with the course material more deeply. Graduate and undergraduate students alike reported both learning and note taking were improved when incomplete, guided outline handouts were provided compared to when complete handouts or no handouts were provided. The Yilmazel-Sahin and Oxford study was limited to the investigation of students' perceptions and did not empirically test the impact on learning of different handout/slide formats.

While studies comparing instructional methods are prevalent in the physical therapy education literature, no studies were found that investigated the influence of varying completeness levels of instructional materials on physical therapy student performance. One study conducted with dental students showed a preference for visual and read/write learning modalities, indicating higher satisfaction with incomplete Power Point presentations that necessitate note taking (Murphy et al., 2004). Unfortunately, this study did not evaluate the relative effectiveness of different slide presentation formats on student learning.

D. Purpose and Hypotheses.

The question of how to optimize teaching presentations to best facilitate student learning is certainly not new. However there remains a lack of empirical research, specific to the physical therapy student population, to guide educators in best practices for designing traditional teaching presentations and access to presentation handouts. The primary purpose of this study was to investigate whether presentation handout completeness influences learning in entry-level DPT students. Also of interest was whether handout completeness would impact immediate recall and longer-term retention of concepts. Finally, we aimed to investigate potential interactions between presentation handout completeness and course content. We hypothesized that less complete presentation handout formats would result in better learning, demonstrated on both immediate recall and longer-term retention quiz performance, than complete presentation handout formats. We also expected that the influence of presentation handout completeness on quiz performance would be similar between courses.

II. Methods.

This was a repeated measures, counterbalanced experimental design. Three School of Physical Therapy faculty members, each with primary responsibility for a foundation science course, as well as an Instructional Designer for the Regis University Rueckert-Hartman College of Health Care Professions participated in this study. The courses included: Management Applications of Physiology 1 (MAP1), Critical Inquiry (CI), and Biomechanics (BIOM). These courses were selected for inclusion in the study as they are lower division courses taken during the first term

of the DPT program, contain foundation science level information, and the course structures all include traditional lecture presentations as a portion of the content delivery. The Regis University School of Physical Therapy curriculum follows the Normative Model of Physical Therapist Professional Education (*A Normative Model of Physical Therapist Professional Education: Version 2004*, 2004) and is therefore expected to be similar and comparable to other physical therapy programs.

A. Subjects.

A cohort of 66 entry-level DPT students beginning the first term in the School of Physical Therapy at Regis University were included in this study. Students in this program complete all of their coursework as a cohort, and take all classes together (no sectioning). The Regis University IRB determined the study to be exempt (assessment using standard educational practices) and therefore did not require consent to be obtained. Students were informed through standard statements in their course syllabi that Regis University faculty have an ongoing interest in investigating the effectiveness of instructional methods, and that quiz and test scores might be used for research purposes with all data de-identified. Signed learning contracts were obtained from each student, indicating agreement with course learning objectives and evaluative activities.

B. Study Protocol.

PowerPoint presentation slides were provided to the students prior to the class session as downloadable handouts, and were organized in the following manner. The three levels of handout completeness were: complete, fill in the blank, and incomplete. Complete handouts were defined as PowerPoint slides that contained all concepts for the presentation with no new information introduced verbally by the instructor, these handouts exactly mirrored the presentation slides. Theoretically, note taking would not be necessary and students would be free to listen to the instructor without the distraction of note taking. Fill-in-the-blank handouts were defined as PowerPoint slides that were 75% complete, with selected blanks, indicated by an underline, where students would need to fill in a missing word or concept. Incomplete handouts were defined as PowerPoint slides that contained 50% of the information for the presentation, necessitating note taking to fill in content gaps and expand upon concepts. These handouts were typically constructed as bullet-point headings, requiring the students to fill in additional information. Representative examples of the three-slide/handout formats are included in Appendix 1. All handouts of presentation slides were posted on a web-based learning management system (ANGEL) a minimum of 24 hours prior to the teaching session per standard SPT policy. Additional readings (journal papers and/or textbook) were recommended for each class session in the respective course syllabus. This study did not track student adherence with completing the additional readings.

Each of the three faculty members selected three sessions within their respective course for inclusion in the study, and provided a standard 50-minute presentation for each session, one each of the three PowerPoint formats (complete, fill in the blank and incomplete) for a total of three presentations in each of the three courses. The format for the first presentation was randomly assigned to each course, and subsequent order was counterbalanced to ensure that each course used a different order for the three formats to minimize order effects. Table 1 contains the topic area and presentation format that was used for each course.

Table 1. Topic areas for each course and counterbalanced presentation order.

Management Application in Physiology I (MAP 1)	Critical Inquiry (CI)	Biomechanics (BIOM)
Complete Physiologic Responses to Exercise	Fill in the Blank Evidence Based Practice	Incomplete, Bone Biomechanics
Incomplete Metabolism	Complete Levels of Measurement	Fill in the Blank, Hip Biomechanics
Fill in the Blank Neuromuscular Physiology	Incomplete Comparison Between Means (*t*-test)	Complete, Thoracic Spine Biomechanics

Any information that was missing in the handout was provided during the class session providing the students the opportunity to take notes during the session. The Instructional Designer reviewed the handouts and slides prior to each session to ensure they met the criteria/definitions for each given format and to attempt to minimize disparity in handout/slide construction between faculty members.

The dependent variables for this study were performance on immediate recall and longer-term retention quizzes (percent correct). Quizzes consisted of five to seven multiple choice questions administered with fill in the bubble answer sheets. Quiz questions were written at the comprehension, application, analysis and synthesis levels, similar to expectations for examination questions within each of the three courses (Appendix 2). Immediate recall and longer-term retention quizzes were given for each slide format and consisted of the same questions presented in a different order. Immediate recall quizzes were given directly following the presentation, and longer-term retention quizzes were given at the start of the next course session (between two and seven days later). Quizzes were reviewed in advance by the Instructional Designer to help ensure the questions for each course and slide format were similar in design and level of difficulty. The timing of quizzes was not disclosed to the students in an attempt to prevent confounding effects of differences in advance preparation. The students were told that the quizzes were for the sole purpose of faculty feedback on student learning and were not counted towards the student's course grade.

Quiz scores (percent correct) were entered into a 3x3x2 within factor ANOVA, with factors of slide format (three levels: complete, fill in the blank, incomplete), course (three levels: MAP1, CI, BIOM) and quiz timing (two levels: recall, retention). Students who were absent from a class and missed a quiz had their data excluded from the analysis. Significance criterion was set at $\alpha = .05$. Pairwise comparisons using *t*-tests (with Bonferroni adjustment for multiple comparisons) were used for *post hoc* analyses when necessary. Statistical analyses were performed using SPSS version 18.0 (IBM, Amonk, NY).

III. Results.

Of the 66 students in the cohort, 14 were excluded due to class absences, leaving a sample of 52 students. The number of students that were absent for a given session varied from zero to three, with an average absentee rate of 2.3%. The student cohort was 45% male. 70% were in the 20-25

year age bracket, 23% in the 26-30 year age bracket, and the remaining 7% were older than 30 years. Summary descriptive statistics for recall/retention quiz performance (% correct) for each of the three slide formats in the three courses are provided in Table 2.

Table 2. Recall and retention quiz results for each slide format for the 3 courses.

Course	Handout Format	Recall % Correct Mean (SD)	Retention % Correct Mean (SD)
Management Applications in Physiology 1 (MAP1)	**Complete**	86.0 (14.3)	88.5 (12.7)
	Fill in the Blank	72.5 (17.4)	72.8 (21.4)
	Incomplete	76.9 (15.8)	80.2 (15.8)
Critical Inquiry (CI)	**Complete**	88.1 (15.0)	87.3 (16.8)
	Fill in the Blank	60.8 (16.3)	66.2 (16.6)
	Incomplete	48.1 (23.5)	70.1 (24.6)
Biomechanics (BIOM)	**Complete**	75.3 (21.0)	76.0 (21.5)
	Fill in the Blank	88.1 (13.7)	86.2 (15.4)
	Incomplete	88.5 (15.7)	86.9 (14.5)

There was a significant 3-way interaction between handout format, course, and quiz timing ($F_{4,204} = 9.652$, $p < .001$). There were also significant 2-way interactions between course and handout format ($F_{4,204} = 42.3$, $p < .001$) and course and quiz timing ($F_{2,102} = 12.6$, $p < .001$). To investigate the interactions of interest, nine pairwise comparisons were made using paired *t*-tests for each. Students performed best with the complete slide format, in both immediate recall and longer-term retention, in the MAP1 and CI courses, while they performed worst with this format for the BIOM course. Student performance on immediate recall was significantly different in all three courses for fill-in-the-blank; however, longer-term retention scores were similar between MAP1 and CI. Immediate recall quiz scores were also different between all three courses for the incomplete handout format, with the only difference persisting on longer-term retention being between CI and BIOM. Immediate recall and longer-term retention quiz scores were stable with all three handout formats for both MAP1 and BIOM, as well as for the complete handout format for CI. In the CI course, students improved in their longer-term retention quiz scores for both the fill-in-the-blank and incomplete handout conditions. The 3-way interaction is shown in Figure 1. For clarity, Figures 2 - 4 depict the findings by each course.

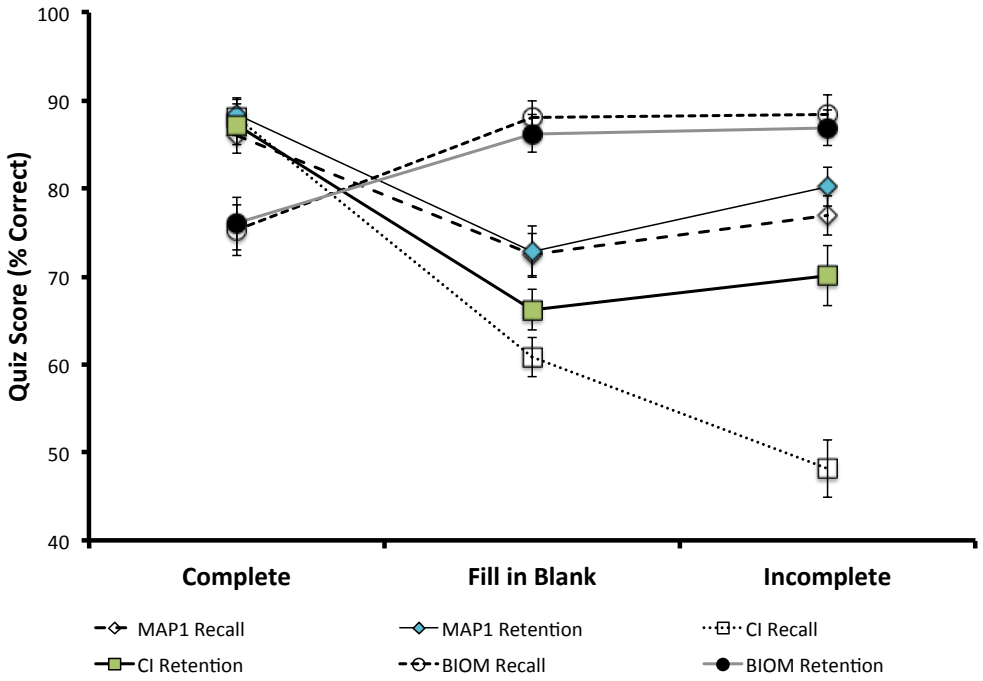

Figure 1. The 3-way interaction between course (Management Applications in Physiology 1 [MAP1], Critical Inquiry [CI], Biomechanics [BIOM]), handout/slide format (Complete, Fill in Blank, Incomplete) and quiz timing (Recall, Retention).

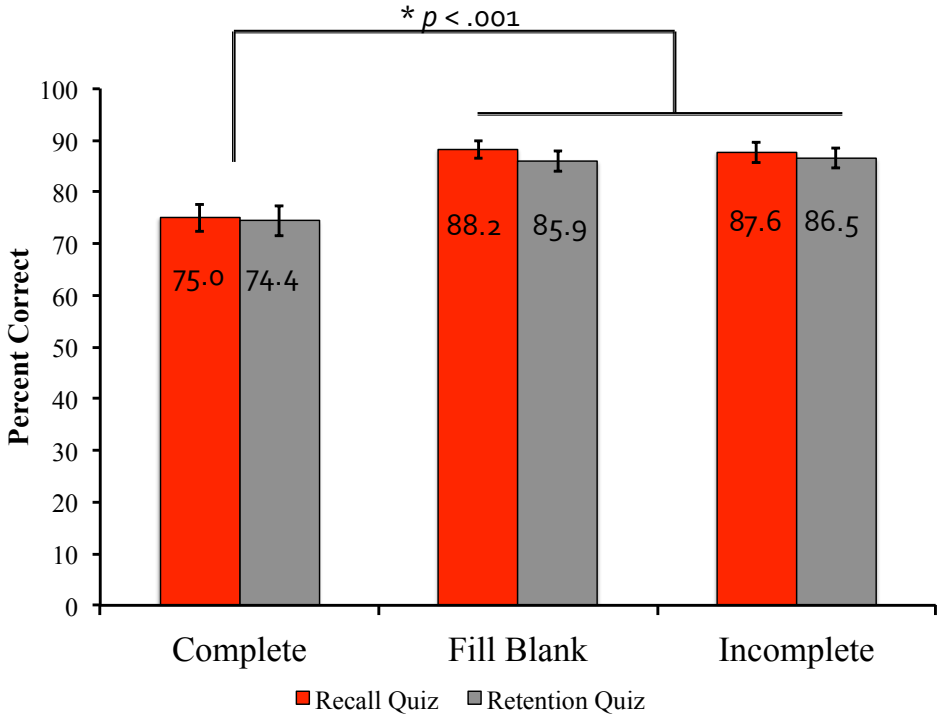

Figure 2. Recall and retention quiz results between handout/slide formats for the Biomechanics (BIOM) course.

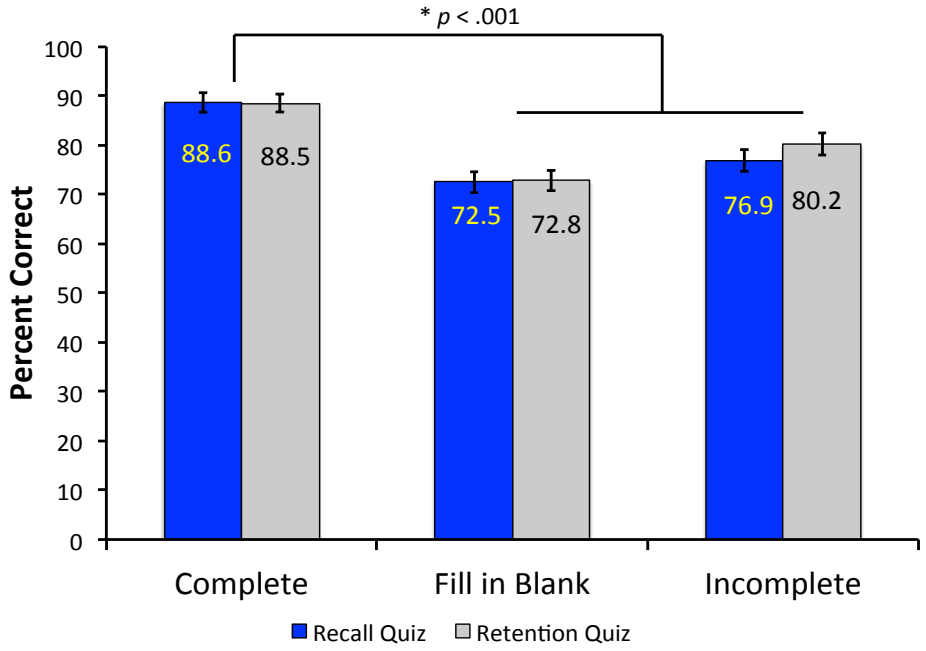

Figure 3. Recall and retention quiz results between handout/slide formats for the Management Applications in Physiology 1 (MAP1) course.

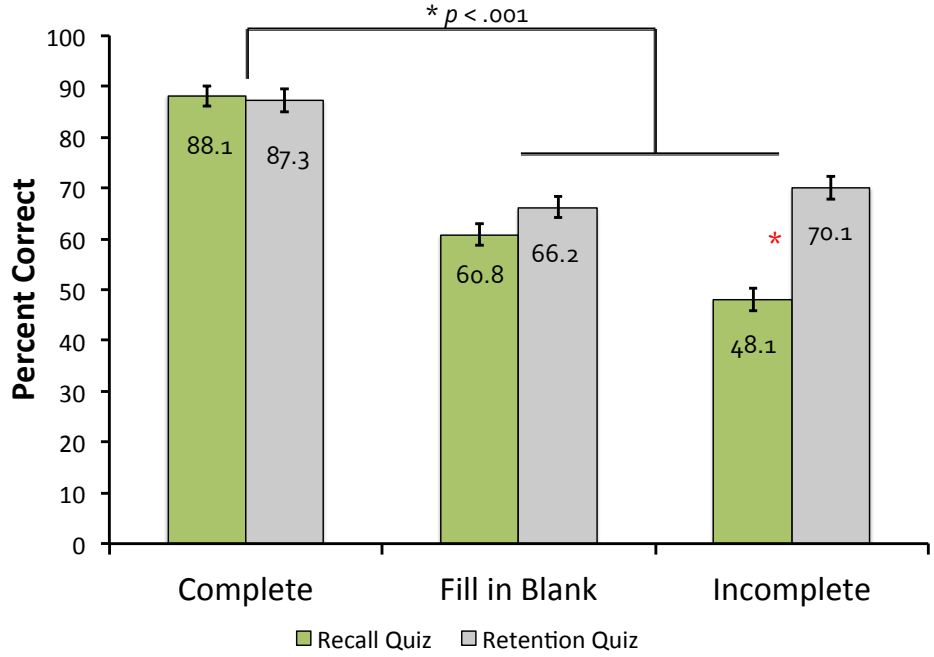

Figure 4. Recall and retention quiz results between handout/slide formats for the Critical Inquiry (CI) course.

IV. Discussion and Conclusion.

The primary purpose of this study was to investigate whether presentation handout completeness influenced learning, assessed by performance on immediate recall and longer-term retention quizzes, in entry-level DPT students with an additional consideration for the influence of differing course subjects. Our hypothesis that students would perform in similar ways regardless of the course, with less complete handout formats being optimal, was rejected as students showed reverse patterns of performance between BIOM and MAP1/CI courses.

It was a surprise in the current study to find differences in student recall and retention between course content areas and handout completeness. In a similarly designed study, Larson (2009) found the highest student recall occurred when incomplete handouts were used, and the lowest recall with complete handouts. These findings were in a different student population, undergraduate business students, and the study was conducted within the context of a single course topic area, learning negotiation skills. The current findings suggest that there may not be a single best practice for handout completeness, and it may vary by type of course or by instructor. A major limitation of the current study design is that differences due to individual instructor presentation styles cannot be separated from differences due to course content. Although efforts were made to ensure that presentation slides and corresponding handout construction were similar between courses, it is certain that presentation delivery was not identical. Additionally, these findings are from one student cohort at a single institution, and while physical therapy students and curricula between institutions are expected to be similar, differences cannot be ruled out which may limit the generalizability of these findings. Another limitation of the study was the length of the quizzes, with only five to seven questions on each quiz. Other studies that have used quizzes to assess learning of concepts have used a similar number of items as this study (FitzPatrick, Finn, & Campisi, 2011; Larson, 2009). Because each quiz only covered concepts from a single 50-minute lecture, the authors felt that the number of items was appropriate for the amount of information covered. The influence of student learning style preferences is not included in the current findings. These data, as well as qualitative data obtained from student and faculty focus groups and surveys, are being analyzed separately as a second aim to this overall research project.

The topic areas that were selected by the instructors for inclusion in the study were mainly ‘concept based’, so although BIOM and CI (a course that includes statistics) were included in the study, those presentations did not emphasize equations or mathematical problems. However, concepts presented in MAP1 and CI (evidence based practice, physiological responses) may have been more conceptually abstract than the BIOM content (biomechanics of tissues and specific body regions), which tended to be very literal and concrete, and this could have had an influence on student response. It was encouraging to find that immediate recall and longer-term retention performance were stable for MAP1 and BIOM courses, regardless of the handout format used. Additionally, complete handouts which appeared to be optimal for students in the CI course, resulted in stability between immediate recall and longer-term retention quiz scores. It is possible that students in CI recognized they had performed very poorly on the immediate recall quiz with the incomplete handouts, and engaged in additional review/study of the concepts independently prior to the subsequent class session and retention quiz. These findings suggest that once instructors determine the most effective presentation and handout format for their particular course content, they can be fairly confident that student learning can be optimized in both immediate recall and retention.

Health science educators who teach foundation level curricular content that may be considered to be more abstract or conceptual might find that student learning is enhanced when presentation handout materials have a higher level of completeness. Educators who teach more concrete, problem-based content might improve student performance by providing less complete presentation materials. Given that it is impossible to parse out the influence of instructor style from this study, educators are encouraged to be aware that there may not be a single best practice regarding completeness of presentation materials provided to students a priori. Student learning in response to different presentation and handout formats can be easily assessed through pop-quizzes as a method of ascertaining what the best practice for an individual instructor and student group may be. This can be accomplished by developing handout materials that differ in level of completeness for different teaching sessions (or for sub-sections within the same session), followed by a short quiz over the content that was covered. Comparisons can then be made to provide insight into the most effective approach for the particular course, student cohort, and instructor combination. Because the immediate recall to longer-term retention performance was fairly stable within each course in this sample, it may not be necessary to assess both conditions to determine the best approach.

In conclusion, findings from this study provide evidence that physical therapy student learning varies with level of completeness of supplemental handouts as well as course content/instructor. Incomplete presentation handouts where students are required to fill in missing information through note-taking may be best utilized in concrete, problem-based courses such as biomechanics/kinesiology. Complete presentation handouts that allow students to write less and therefore be more engaged in listening may be best for courses that include a greater degree of abstract or conceptual topics such as physiology/health and wellness applications and evidence-based practice/research methods/statistics. Ultimately, educators should examine the effect of their own presentation slide and related handout format on student learning, particularly if they engage in teaching multiple content areas.

Acknowledgments

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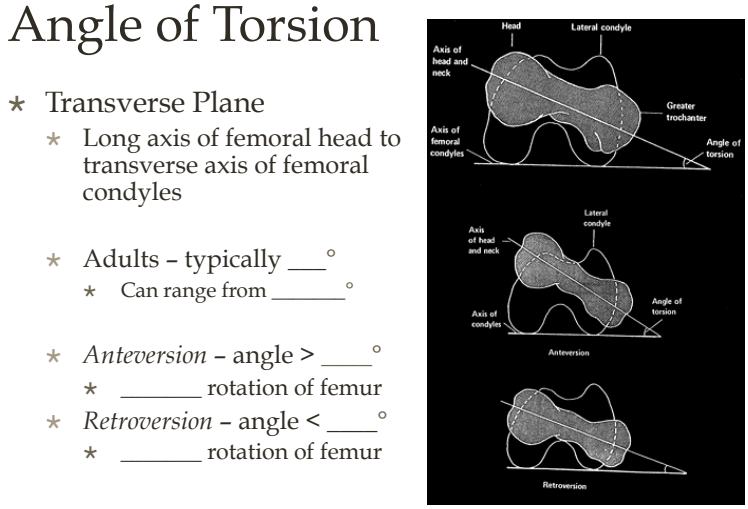
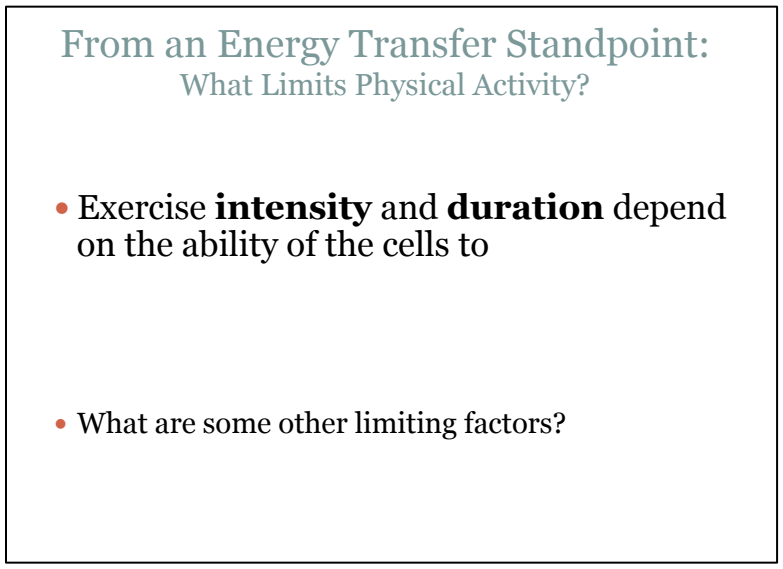
Appendices

Appendix 1. Representative Examples of the Three Handout Formats

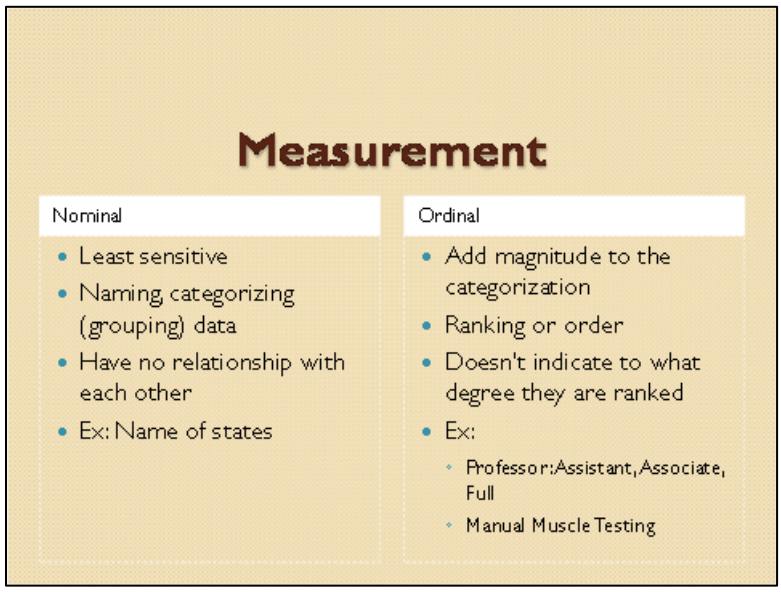
Example Fill in the Blank Slide/Handout – Biomechanics (BIOM), Hip Biomechanics



Example Incomplete Slide/Handout - Management Applications in Physiology I (MAP1), Metabolism



Example Complete Slide/Handout – Critical Inquiry (CI), Levels of Measurement



Appendix 2. Example Quiz Questions for Each of the Three Courses

Biomechanics (BIOM)

A retroverted hip will result in a _____ femur during gait, in order to keep the femoral head in the acetabular cavity.

a. abducted
b. adducted
c. internally rotated
d. externally rotated

Management Applications in Physiology I (MAP1)

What are the 2 determining factors of fuel source in metabolism

a. Intensity and skill
b. Genetics and training
c. Time of activity and skill
d. Intensity and time of activity

Critical Inquiry (CI)

Researchers investigated whether the type of stretching (dynamic vs. static) and the presence of warm up (warm-up vs no warm up) effects the strength of the hip musculature (Manual Muscle Test) in female collegiate soccer players. What is the level of measurement for the dependent variable?

a. nominal
b. ordinal
c. interval
d. ratio

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