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The Impact of Guided Notes on Post-Secondary Student Achievement: A Meta-Analysis

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The common practice of using of guided notes in the post-secondary classroom is not fully appreciated or understood. In an effort to add to the existing research about this phenomenon, the current investigation expands on previously published research and one previously published meta-analysis that examined the impact of guided notes on post-secondary student achievement. Specifically, this study examines the different variables that moderate the effect of using guided notes in the classroom, the impact of guided notes relative to professor-provided notes or student-generated notes, and unlike previous studies, the present meta-analysis, includes both published and unpublished research and some previously unexamined variables. Results indicate that overall, guided notes can produce a moderate impact on student achievement. The study discusses the implications and limitations of this research.

Student Engagement

The concept of student engagement has received considerable attention in the last two decades in response to declines in academic achievement and student motivation (Fredricks, Blumenfeld & Paris, 2004). Engaged students can be described as students who are actively participating in their college learning experience (Bomia et al., 1997). Astin's (1984) theory of student involvement suggests that students who are actively engaged in the learning process experience greater learning, more personal growth, and increased satisfaction, and they are more likely to be retained. Unfortunately, many post-secondary classes today encourage passive learning, as opposed to active learning, through traditional lecture presentations. According to Leong (2006), these traditional lecture-based classes are no longer the "most effective" (p. 66) approach in reaching today's student. Guided notes have been suggested as one low-cost and "low-tech" (Heward, 1994) approach for bridging the gap between the professor's lecture and the students' level of engagement.

Heward (1994) maintains that guided notes can facilitate increased student focus and engagement in lectures. Guided notes, according to Heward (1994), are defined as "teacher-prepared handouts that 'guide' a student through a lecture with standard cues and prepared space in which to write key facts, concepts, and/or relationships" (p. 304). These note guides are provided to students as handouts, electronically, or as PowerPoint slides, in which main ideas are included as prompts with blank space for students to fill in additional information. Guided notes have been shown to provide a number of beneficial effects in the post-secondary learning arena, including increased student verbal engagement in lectures (Austin, Lee, Thibeault, Carr, & Bailey, 2002; Rieland, 2008) and a higher quality of note-taking (Austin, Lee, & Carr, 2004; Neef, McCord, & Ferreri, 2006).

Post-secondary students, according to Austin et al. (2004), are "notoriously poor note takers" (p. 314) and were found to record only about 50% of the main ideas being presented during lectures. In response to this, some instructors have tried giving students complete lecture notes, but complete notes do not encourage students to become more actively engaged (Cook, 2009; Konrad, Joseph, & Eveleigh, 2009). However, these researchers found that when guided notes were introduced, students became more engaged in the lectures by becoming more active responders to the lecture and the prompts provided by the guided notes. Subsequently, with the provision of guided notes, Austin, et al. found that the quality of the note taking improved. Neef et al. (2006) found that when provided with guided notes, students recorded 90% of the lecture information correctly. Research has demonstrated that the quality of note-taking has been found to be related to increased student achievement (Hamilton, Seibert, Gardner, & Talbert-Johnson, 2000; Neef et al., 2006; Peverly et al., 2007; Williams & Eggert, 2002).

A number of researchers have examined the impact of guided notes for post-secondary students as an approach to improve student engagement, and subsequently, student achievement (Austin et al., 2004; Austin et al., 2002; Bahadourian, Tam, Greer, & Rousseau, 2006; Katayama, 1997; Katayama, Crooks, & Weiler, 2000; Ketchum, 2007; Lawson, Bodle, & McDonough, 2007; Lewis, 2009; McCann, 2008; Musti-Roa, Kroeger, & Schumacher-Dyke, 2008; Narjaikeaew, Emarat, & Cowie, 2009). And, although guided notes have been found to have a positive effect in most studies, the impact of guided notes is not always found to be significant or positive. This makes it very difficult to draw clear-cut conclusions about the impact of guided notes in post-secondary education. A meta-analysis of these studies would be an appropriate and effective approach to synthesizing and integrating the sometimes conflicting results from this quantitative research, and it would provide a general measure of the impact of guided notes on student achievement. It also would be beneficial to an overall understanding of the impact of guided notes on student achievement. The present project will conduct such a meta-analysis.

Glass, McGaw, and Smith (1981) define meta-analysis as the "analysis of analyses." Glass et al. (1981) propose the use of meta-analysis as a means for effectively aggregating any number of studies in the research literature. With this technique, the findings of a number of smaller research studies can be pulled together to enhance the overall sample size and statistical power. It is a method by which studies that might not otherwise be easily integrated can be compared and contrasted with each other.

A review of the existing literature reveals that only one study has attempted to synthesize the existing research examining the impact of guided notes on post-secondary student achievement (Konrad et al., 2009). This investigation of post-secondary data was limited to three published studies; however, these three studies indicate a relatively positive impact.

Publication bias is a concern when performing a meta-analysis (Wolf, 1986). Publication bias occurs when studies that find significant results for an effect being investigated are more likely to be published than studies that do not find significant findings. Publication bias has the potential of inflating the effect size estimates (Glass et al., 1981; Hedges, 1986; Hunter & Schmidt, 2004; Rosenthal, 1979), and therefore it is important that unpublished information be included when conducting a meta-analysis.

Thus, the current meta-analysis addresses the issue of publication bias by including all available studies on the impact of guided notes on post-secondary student achievement. The current investigation includes 12 studies, seven (58.3%) of which were published and five (41.6%) of which were not published. These research studies include published, peer-reviewed journal articles and theses. In doing so, this current study is able to do a thorough investigation of this phenomenon by examining all available research for inclusion in the synthesis; therefore, more appropriately representing the population of quantitative research on the impact of guided notes on post-secondary student achievement.

Method

There are a number of recommended procedures for conducting a meta-analysis (e.g., Glass et al., 1981; Hedges, 1986; Hunter & Schmidt, 2004; Rosenthal, 1979; Wolf, 1986) which offer slight variations from one another but essentially share much in common. Glass et al. (1981) recommends the following steps for conducting a meta-analysis. First, studies should be gathered on the topic or phenomena of research. The studies which can be included in the meta-analysis must fit within the defined parameters for analysis, while representing as much of the population of data available on the research area. The research must be quantitative. Glass et al. (1981) maintain that a thorough search must be conducted of the subject area. This step can potentially introduce the "most serious form of bias" (p. 57) into the meta-analysis, because it is difficult to evaluate the impact of the search bias. The more exhaustive the search, the more likely it is that search bias will be minimized.

The next step, according to Glass et al. (1981), is to describe, classify, and code all the research studies to be included in the meta-analysis. In this step, measurement consistency is imperative. Glass et al. (1981) suggest that studies should be coded independently, so that inter-rater agreement can be established. The moderator variables that have been included for consideration must be clearly defined so that raters are able to make clear distinctions between the various classifications. For the purposes of this meta-analysis, a random sample of studies was coded at least twice in order to establish the reliability of the coding procedures. Moderator variables have been tested for inter-rater reliability and were found to be reliable classifications $\kappa = .95$ of the time.

The final step in performing the meta-analysis, according to Glass et al. (1981), is the analysis of the overall mean effect size measures and the mean effect size measures for each moderator being examined. Once the effect size measures have been calculated, interpretation and reporting of results follows.

Sample of Studies

Studies included in this meta-analysis were obtained initially through an extensive electronic search. Various electronic databases were searched over a six month period of time. These include Academic Search Complete, Digital Dissertations, Educational Resources Information Circuit (ERIC), EBSCO, Electronic Journal Center, JSTOR, GoogleScholar, and PsychInfo. The search examined research spanning the years 1980-2011. The descriptive search criteria employed to identify related materials included such combinations as guided notes, partial notes, and note guides, as well as each of these criteria with the addition of college, university, or college students. Similar to the Konrad et al.'s (2009) meta-analysis, an article did not have to use the term "guided notes" specifically; however, the article was included only when the notes being used adhered to the definition by Heyward (1994). Abstracts of articles were inspected, and those articles that did not appear to meet the initial inclusion criteria were discarded. The inclusion criteria were: (a) articles examining the use of guided notes with post-secondary students, (b) research that includes a measure of academic performance, and (c) research focused on the use of guided notes during lecture in comparison to no guided notes, full lecture notes, or some other note strategy, and finally, (d) research making use of some form of experimental or quasi-experimental design.

The literature meeting the criteria that was electronically available was printed, and other sources were ordered through the Youngstown State University and the Kent State University library systems. Next, the reference list of each article was searched in an effort to find any additional pertinent studies. All obtained articles, dissertations, presentations, and project reports were reviewed, and those primary-level studies which included the participant population and treatment population of interest, as well as the necessary statistical information, were included in this meta-analysis. In all, more than 35 studies were identified by these methods, and examined for possible inclusion in this meta-analysis.

There were a few studies obtained through this search process that initially appeared as suitable candidates for inclusion, but careful inspection revealed that they did not meet the criteria discussed above. Many of the articles simply did not provide any usable data and presented results qualitatively. Additionally, a number of studies suggested that effects were measured; however, only average test scores were provided (without necessary standard deviations or group sample sizes). In order to include studies in a meta-analysis, data must be sufficiently reported so that an effect size can be calculated. Specifically, studies must provide sufficient descriptive and inferential data, such as means, standard deviations, sample sizes, variances, *t* tests, *f* tests, as well as chi-square information, in order to allow for the calculation of effect sizes. If the necessary descriptive and inferential data were not provided, an attempt was made to contact the author of the study in an effort to acquire such information. Studies which failed to provide the necessary information, either in the original form or via supplemental data provided by the author, were excluded from the meta-analysis. Once studies were examined and studies were eliminated for insufficient data, a total of 12 useable studies remained for inclusion in the current investigation. From these 12 studies, 27 independent effect sizes were calculated. These studies comprise a total of 1,529 participants.

Coding of Studies

Each study was coded according to the following information: (a) year of study, (b) source of research study, (c) type of intervention, (d) the research design, (e) the type of course, (f) sample size of the study, and (g) the achievement measurement provided. Student level (undergraduate or graduate) was considered, but all of the useable studies included undergraduate students. The primary data and study characteristics are maintained in The Statistical Package for the Social Sciences (SPSS 18).

Year of Study

The first study characteristic is the year of the research publication. Studies included in this meta-analysis include research from 1997 through 2011. Publication year was organized into half-decade categories of: 1997-2000, 2001-2005, and 2006-2011.

Source of Research

The second study characteristic is the source of the research. Studies included in this meta-analysis can be classified as published journal articles, unpublished dissertations/thesis, and unpublished presentations. As indicated above, this meta-analysis differs from prior meta-analytic studies on guided notes (e.g., Konrad et al., 2009) in that it includes research on guided notes from published and un-published sources.

Intervention Type

Research studies were categorized as having one of two different interventions. Some studies compared data from groups using their own notes, relative to groups using guided notes, while other studies looked at student groups who used complete lecture notes, relative to groups using guided notes. Complete lecture notes, for the purpose of this investigation, are copies of the professor's lecture notes that are provided to the students prior to lecture.

Research Design

Research design categories include random assignment to multiple groups with a control group and without a control group, and non-random assignment to multiple groups with a control group and without a control group, or single group designs with pre and post test measures.

Type of Course

The fifth study characteristic of this meta-analysis is type of course. Studies were categorized according to the discipline area described as providing the course.

Sample Size

The sixth characteristic of this meta-analysis is sample size. This describes the reported sample size for each study. Sample sizes were organized into the following categories: (1) less than 30 participants, (2) 30 to 100 participants, and (3) more than 100 participants.

Achievement Measure

A last study characteristic for this meta-analysis is achievement measure used. Achievement measure categories include (a) course grade point average, or final grade; (b) final test or quiz score; (c) an exam; and/or (d) a quiz score. Achievement measures were categorized as one of these four types according to the study author(s') descriptions. The dependent variable for all studies is the measure of student achievement provided by the authors. For most studies, authors have provided a mean achievement measure score for the students from the experimental group and for the students in the control groups.

Research Questions

The present meta-analysis examines the following questions:

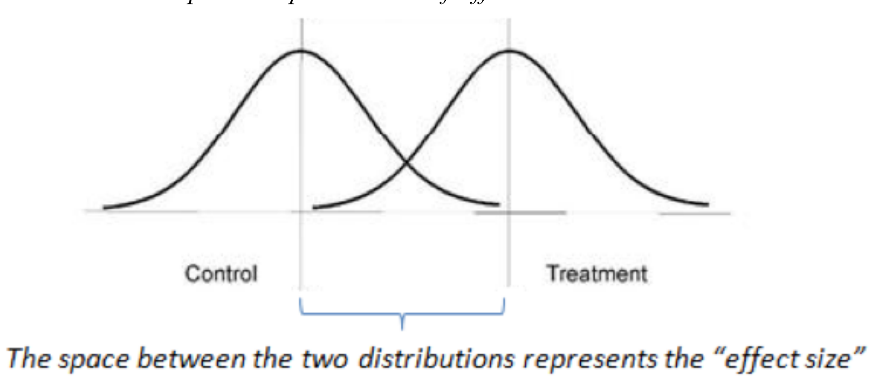
1. What is the impact of the use of guided notes on student achievement in post-secondary courses when compared to students who do not receive guided notes?
2. Does the impact of guided notes differ by the publication year of the study?
3. Does the level of impact of guided notes differ by the source of the study (e.g., dissertation or theses, journal article, presentation, internet posting, project report)?
4. Does the impact of guided notes differ depending on the intervention type (e.g., student notes vs. guided notes, or full lecture notes vs. guided notes)?
5. Does the impact of guided notes vary by research design (e.g., random assignment to multiple groups with a control group)?
6. Does the impact of guided notes differ by the type of course (i.e., discipline area)?
7. Does the impact of guided notes differ by the sample size of the study?
8. Does the impact of guided notes differ by type of achievement measure used (e.g., final course grade, final exam, unit quiz, pre-post test change)?

Calculation of Effect Sizes

There are a number of methods for calculating effect sizes (Glass et al., 1981; Hedges & Olkin, 1985; Hunter & Schmidt, 2004; Rosenthal, 1979; Wolf, 1986). For this meta-analytic study, all statistics from each study will be converted to Hedges *d.* Hedges *d* statistic is defined as the difference between the means of the experimental and control groups divided by the inter-group standard deviation. The use of the inter-group, or pooled standard deviations, is used in an effort to reduce positive bias that can result with computing effect size measures (Grissom & Kim, 2005). The overall effect size measures and research category effect size measures were calculated by hand and with comprehensive meta-analysis (Biostat, 2009; see http://www.meta-analysis.com/), a software package used for meta-analytic review of research.

Effect size measures were calculated with means and standard deviations using the formula from Johnson (1989). With this approach, the mean for the control group is subtracted from the mean for the experimental group, resulting in a mean difference, and this value is divided by the pooled standard deviation for both groups. The result is the effect size measure associated with that study, as demonstrated in the graphical representation found in Figure 1.

Figure 1
Graphical Representation of Effect Size Measure



Once the effect sizes are calculated for the individual studies, the overall effect size measure for all the studies combined can be calculated. This can be done, according to Glass et al. (1981), by simply calculating the mean of the individual effect size measures. However, this approach does not take into consideration the fact that the studies vary in sample size. Hedges and Olkin (1985) provide a formula for calculating the overall mean effect size as an unbiased weighted estimate (weighted by sample size) of the population effect size. With this approach, an overall effect is calculated by weighting individual studies by sample size, or the amount of information a study has to contribute, by using the inverse variance which is roughly proportional to the sample size. The overall mean effect sizes for this meta-analysis were calculated according to the procedures recommended by Hedges and Olkin (1985).

Next, a homogeneity test was conducted in order to determine if all studies share a common effect size (Hedges & Olkin, 1985). The statistical test for the homogeneity of effect size tests the null hypothesis that states all effect sizes in the study are equal. If the test of homogeneity of the effect size measure, more commonly referred to as the *Q* statistic (Hedges & Olkin, 1985) reveals that the studies do not share a common effect size, the contrast between the means within and between each study characteristic is investigated. It is through this process that the impact of individual characteristics on the effect size measures can be more fully understood.

Interpretation of Effect Sizes

There are a number of different approaches to interpreting effect size measures (Glass et al., 1981; Hedges, 1986; Wolf, 1986). For the purpose of this meta-analysis, studies with several independent effect sizes were calculated as several individual samples (Glass et al., 1981; Kulik, 1983a, 1983b). This approach allows the researcher to integrate all of the available effect sizes in the meta-analysis, thus including as much information as possible in the final analysis. Effect size measures were calculated for each study. An overall mean effect size measure was calculated for the group of studies in the meta-analysis, and mean effect size measures were computed for each research category. This was accomplished using random effects models as opposed to fixed effects. The assessment data used in the current investigation was identified as a record of exam and quiz scores from varied situations; fixed effects models are used when all studies are assumed "functionally identical" (Borenstein, 2007).

Post hoc analyses were conducted in order to examine specifically where significant differences exist between the mean effect size measures for each level in each research category. Post hoc analyses were also conducted to determine if significant differences exist within each of the levels of the categories.

Results

The purpose of this meta-analysis was to investigate the impact of guided notes on student achievement in postsecondary coursework. The study also examined a number of variables that could potentially impact or mediate this relationship. This meta-analysis included a number of studies identified by a computerized literature search across many disciplines. With a total of 12 useable studies, we calculated 27 independent effect sizes. These studies comprise a total of 1,529 participants. The range of the effect sizes is 1.67, with a minimum effect-size measure of -.008 and a maximum effect-size measure of +1.67. The overall mean effect measure for this group of effect sizes was $d = 0.546$, $p < .001$, a moderate effect size according to the rough standards established by Cohen (1977).

These findings indicate that the use of guided notes can have a moderate impact on student achievement in post-secondary coursework. A 95% confidence level ranges from 0.342 to 0.749. This confidence interval does not contain the value of zero, implying that the treatment of using guided notes had a significant impact (Johnson, 1989). This effect size suggests that the average student participating in the guided notes conditions exceeds the academic achievement of approximately 72% of the students in the non-guided note conditions. Figure 2 presents a graphical representation of this impact of guided notes on student achievement.

Twenty-one of the 27 effect sizes (77.7%) included in these analyses were positive, indicating that guided notes had a positive impact on student learning. These analyses also reveal that 14 (51.8%) of the 27 effect size measures had an effect size of 0.5 or greater, indicating that the effect of guided notes on student achievement was at least moderate. One study demonstrated neither a positive or negative effect. The remaining five studies (18.5%) revealed a negative effect, indicating that traditional approaches of having students generate their own notes or providing students with professor-generated full lecture notes produced a greater impact on learning than the guided notes. Table 1 provides a breakdown of the studies meeting the inclusion criteria.

The grand mean analyses also revealed a $Q(26) = 158.99$, $p < 0.001$ statistic, indicating significant heterogeneity across the 27 effect size measures included in this investigation. Therefore, further analyses are necessary to understand the variegation in effect sizes across the different studies. Specifically,

Figure 2
Graphical Representation of the Impact of Guided Notes on Student Achievement

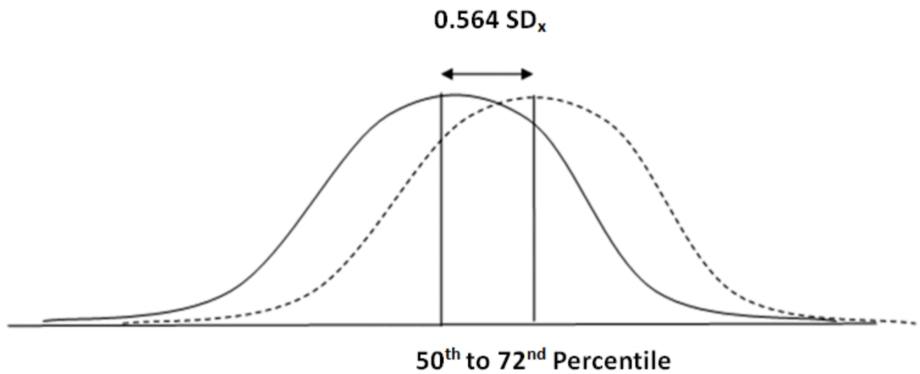


Table 1
Studies Included in Meta-Analysis

Study	*n* of ES	ES range
Austin et al. (2002)	1	0.734
Austin et al. (2004)	3	0.987 to 0.989
Bahadouria et al. (2006)	2	1.383 to 1.680
Katayama et al (2000)	3	0.222 to 0.849
Katayama (1997)	4	0.008 to 1.286
Ketchum (2007)	2	1.286 to 1.409
Lawson et al. (2007)	2	0.143 to 1.315
Lewis (2009)	1	-0.142
McCann (2008)	2	-0.342 to -.0370
Musti-Roa et al. (2008)	2	.926 to 1.055
Narjaikaew et al. (2009)	1	0.614
Neef et al. (2006)	4	-0.248 to 0.312

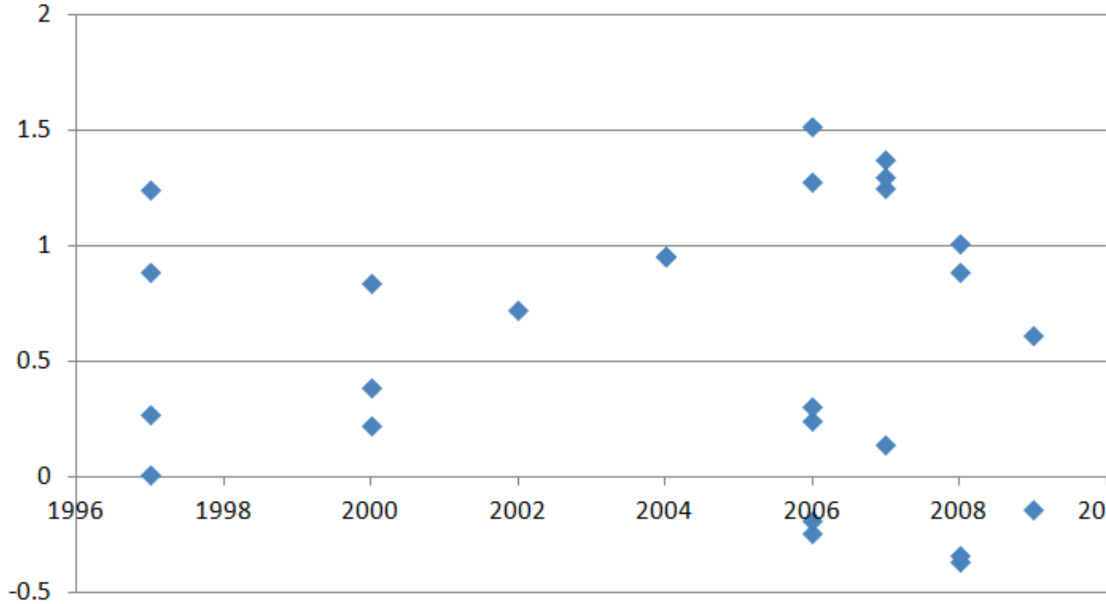
these analyses explore the potential relationship between study characteristics and effect-size measures to determine which study characteristics influence the effect-size measures and which do not. Further analyses were conducted to explore the individual research characteristics and their potential influence on effect-size measures in an effort to explain this inconsistency across the individual effect-size measures.

This additional analysis revealed significant variation in the secondary variable year of research study, $Q_w = 0.668$, $p < 0.05$. Specifically, a greater mean effect size is seen for the 2001-2005 period of research ($d = 0.933$) relative to the other study periods (1997-2000, $d = 0.540$; 2006-2011, $d = 0.460$). As demonstrated in Figure 3, examination of the year of research study characteristic reveals no substantive pattern in the data across the time periods investigated. Subsequently, the significant effect size difference may have resulted because of sample size differences across the 2001-2005 research period ($n = 4$) relative to the 1997-2000 ($n = 7$) and 2006-2011 periods ($n = 16$).

Another secondary moderator, type of control group, also revealed significant within group differences, $Q_w = 0.462$, $p < 0.05$. Specifically, this moderator separated out whether the control group participants in each study generated their own notes ($d = 0.781$, $n = 15$) or had completed notes provided for them by their instructor ($d = 0.265$, $n = 12$). These results suggest that achievement results of students using guided notes were significantly higher when compared to students generating their own notes, relative to the achievement results of students using guided notes when compared to students who were provided with professor generated notes. Although both groups demonstrated a significant, positive effect ($p < 0.05$) the impact of using guided notes had the greatest effect relative to the students generating their own notes.

Additionally, significant variation was revealed for the primary variable, discipline area of the research, $Q_w = 0.432$, $p < 0.05$. This moderator revealed that guided notes have a significant positive effect on student

Figure 3
Scatter Plot of Year by Mean Effect of Guided Notes



achievement in the discipline areas of psychology (*d* = 0.603), physics (*d* = 0.614), and education (*d* = 0.749); a significant negative effect on the achievement of students in mathematics (*d* = -0.355); and a non-significant negative effect for dentistry students (-0.142).

Finally, the primary variable sample size of study revealed significant within group variation, $Q_w = 0.519$, $p < 0.05$. Specifically, nine smaller sample studies ($n \leq 30$) revealed the largest significant impact (*d* = 0.892), followed by seven large sample studies ($n \geq 101$) revealing a large significant impacts (*d* = 0.631). Eleven studies with sample sizes of 31 to 100 participants revealed a non-significant positive results (*d* = 0.231). A further breakdown of this moderator revealed that one study (Narjaikeaew et al., 2009; *d* = 0.614) had a sample size that was significantly larger than all the other studies (*n* = 1002). Since this was suspected to be an influential outlier, this study was removed, and the sample size moderator was re-analyzed. This process reduced the overall effect size measure (*d* = 0.498 relative to the original *d* = 0.546), but this reduction was not significant. The resultant analysis generated a minimal change in the mean effect size measure of the largest sample size group ($n \geq 101$) from the original effect of *d* = 0.631 to a effect of *d* = 0.642. Figure 4 demonstrates a breakdown of the mean effect size measures across the different sample sizes of the studies (without Narjaikeaew et al., 2009).

Finally, no significant different effect-size measures were found across the categories for the primary variables of research design (e.g., experimental, repeated measure, quasi-experimental) and type of assessment (e.g., exam or quiz) or the secondary variable source of research (e.g., publication, presentation, or thesis) and published or not. Table 2 presents the summary of these analyses.

Discussion

The purpose of the current investigation was to examine the impact of guided notes on post-secondary student achievement, by incorporating all available quantitative data through a meta-analytic synthesis of the existing research. To date, only one other meta-analysis has examined this research question, and as such, these researchers only incorporated three studies, all published studies, into their analysis (Konrad et al., 2009). Thus, the present study significantly expands the scope of what was examined, both in terms of research reviewed and moderator variables considered, over and above the one prior meta-analytic investigation of the impact of guided notes on student achievement in post-secondary-level education.

One key addition of this meta-analytic investigation beyond the previous is the addition of non-published research. The Konrad et al., (2009) meta-analysis incorporated only three research studies that appeared in peer-reviewed journals. Thorough inspection of the existing research revealed that there were not only more peer-review studies, but additional research studies that were not incorporated into the

Figure 4
Mean Effect Size Measures by Sample Size of Study

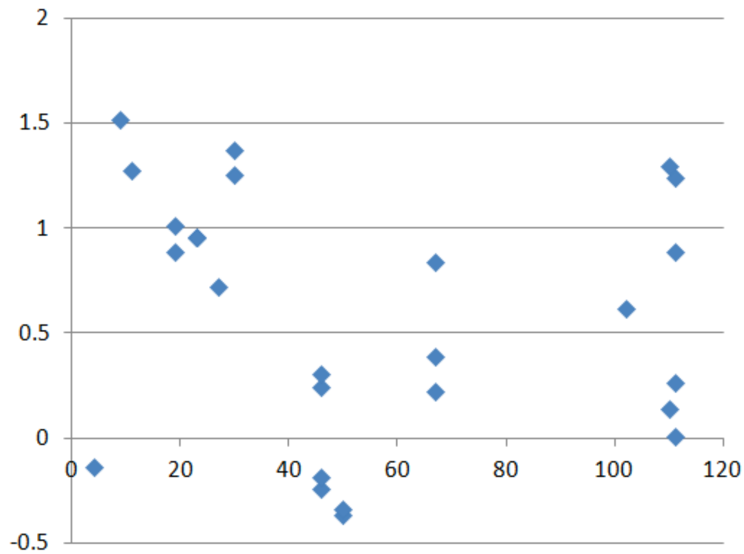


Table 2
Summary of Analysis Results Across Study Characteristics

Variable and Categories	Number of Effect Sizes (n)	Within-Group Effects	Mean Effect Size *d*
Year of Study		0.668*	
2006-2011	16		0.460*
2001-2005	4		0.933*
1997-2000	7		0.540*
Study Source		0.549	
Peer-Review Publication	15		0.644*
Conference Presentation	9		0.320*
Dissertation/Thesis	3		0.807*
Type of Control Group		0.462*	
Student Generated Notes	15		0.781*
Full Lecture Notes	12		0.265*
Study Research Design		0.596	
Experimental Design	12		0.669*
Repeated Measures Design	14		0.434*
Quasi Experimental Design	1		0.734*
Discipline Area		0.432*	
Psychology	12		0.603*
Physics	1		0.614*
Mathematics	2		-0.355*
Education	11		0.749*
Dentistry	1		-0.142
Type of Assessment		0.547	
Exam	15		0.547*
Quiz	12		0.547*
Sample Size of Study		0.519*	
0 to 30	9		0.892*
31-100	11		0.231
101+	7		0.631*

prior meta-analysis, and five additional research studies that, while subjected to considerable review (refereed conference presentations and two Masters' theses), were not published. As indicated above, it is problematic to include only published research (i.e., publication bias), as doing so will generally include only research that has shown to have significant impact, and can potentially inflate the resulting effect size measures (Glass et al., 1981; Hedges, 1986; Hunter & Schmidt, 2004; Rosenthal, 1979). The present study corrects for this potential bias by including both published and non-published studies. The analysis of the impact of guided notes on post-secondary student achievement was found not to be significantly different whether reported by published or non-published research, $Q(2) = 2.180$, $p = 0.336$, so this inclusion indicates that when all available research is included, publication bias does not present a significant threat.

In addition to expanding on a previous meta-analytic study of the impact of guided notes on post-secondary student achievement, the current meta-analysis incorporates some additional dynamics. For example, the current meta-analysis examined the use of guided notes relative to student generated notes and full lecture notes. Four studies in the current study examined the impact of guided notes relative to full lecture notes (Katayama, 1997; Katayama et al., 2000; Lewis, 2009; Neef et al., 2006). Overall, guided notes were found to have a small positive effect on student grades relative to student who used full notes, $d = .265$, $p < 0.001$. This result was significantly smaller than the large impact of guided notes that was found, relative to student generated notes, on student achievement, $d = 0.781$, $p < 0.001$. While the impact of guided notes relative to full lecture notes is small, the result is significant, suggesting that there is some benefit in requiring students to be more actively involved in the lectures which they attend.

Another noteworthy contribution of the current meta-analysis is the incorporation of different disciplines. As indicated earlier, all research satisfying the stated inclusion criteria was incorporated into this investigation. Due to its limited scope, the research of Konrad et al. (2009) included only studies with psychology students. The current investigation includes research from psychology (Austin et al., 2002; Austin et al., 2004; Ketchum, 2007; Neef et al., 2006), physics (Narjaikaew et al., 2009), mathematics (McCann, 2008), education (Bahadourian, 2006; Katayama, 1997; Katayama et al., 2000; Musti-Roa, 2008), and dentistry (Lewis, 2009). The analysis revealed that significant differences existed across the disciplines, and careful examination demonstrated that a small negative impact was found in one study from the area of mathematics and dental hygiene. Both of these disciplines were represented by one study each. Potentially, these results reflect that guided notes are used less often in these disciplines and therefore guided notes are not used as effectively. On the other hand, the large positive effect size measure resulting for the other disciplines—psychology ($d = 0.603$, $p < 0.001$), physics ($d = 0.614$, $p < 0.001$), and education ($d = 0.749$, $p < 0.001$)—were statistically equivalent. The large significant impact found in research from psychology students and Education students might reflect the fact that the two disciplines that are more closely associated with learning and cognition, and they are the two disciplines producing the preponderance of research in the arena of guided note use. The physics effect size measure was generated by one study in that discipline.

Moreover, the current investigation incorporated a number of other variables not found in the previous meta-analysis. First, year of research is a commonly reported variable in meta-analytic research. For this investigation, research was found that ranged from 1997 to 2011, a fourteen-year span that was divided accordingly: 1997-2000, 2001-2005, and 2006-2011. The analysis revealed that there was a significant difference in the effect sizes computed across these time periods; however, all three time periods revealed significant moderate-to-large effect sizes. Of interest is that the most current research, from 2008 ($d = 0.288$, $p = 0.434$) and 2009 ($d = 0.256$, $p = 0.497$), revealed the smallest and non-significant effect size measures.

Another commonly included variable in meta-analytic studies is the sample size of the research study. The present analysis reveals significant differences were revealed, with the 0-30 and the 100 or more sample sizes resulting in large significant effect size measures ($d = 0.892$, $p < 0.001$ and $d = 0.631$, $p < 0.001$) respectively, while the 31 to 100 sample size group revealed a small non-significant effect size measure. Careful examination of the data discloses that one possible explanation for the difference is that the 31-100 sample size group included 4 of the 5 negative effect size measures.

Other moderator variables that were included in this study did not demonstrate significant differences across levels. Research design, as well as the form of assessment, did not reveal significant differences across the respective levels. Interestingly, the effect size measures for the two assessment levels (exams and quizzes) were statistically equivalent.

Limitations

There were several limitations associated with the present research study. A number of the individual constructs were represented in a small sample of studies. Although this might have occurred as the result of an insufficient computer literature search strategy, that is not the case for the current investigation. The literature search process was thorough and exhaustive, and it revealed a number of additional empirical research studies not included in the past meta-analytic review of this subject area. For example, this initial limitation applies to the variable students' education level. All of the available research on guided notes' impact on post-secondary students' achievement included research with undergraduate-level students while no graduate level studies were available. Additionally, there is considerable research available on students at the K-12 level of education; however this study focused on post-secondary education.

Another limitation of the present study is that it is difficult to sufficiently break down moderator categories enough to examine as much information as possible without creating too much overlap in the results. For example, with the meta-analytic approach, the meta-analytic researcher is at the mercy of the authors who have conducted research in the area. The researcher has to rely on the authors or individual researchers to report results accurately, describe the studies well, report statistics appropriately, and respond to inquiries about their research if there are any questions or discrepancies (Larwin & Larwin, 2011). This results in another layer of concern that has to do with the selection of variables for possible examination in a meta-analysis. It would have been interesting to investigate variables such as gender or student characteristics (traditional versus non-traditional), and the examination of these kinds of variables may have revealed additional insight, complexities, and moderator effects about the effectiveness of guided notes on student performance. However, that data is not available, so these variables could not be examined.

Finally, interpreting the results of meta-analytic studies such as this one can be challenging when the content area is not the focus of considerable quantitative research. There are a number of studies on the use of guided notes that examined their impact qualitatively (Badger, White, Sutherland, & Haggis, 2001; Randolph, 2005; Toole, 2000) or which included very limited quantitative information (Carr, 2004; Kreiner, 1997; Lazarus, 1993). There were studies that found that students have very positive perceptions regarding guided notes (Yilmazel-Sahin, 2007) or found that guided notes are beneficial when used with low-performing students (Austin, 1999) or as a mechanism to encourage increased class participation (Rieland, 2008). While all of this research provides valuable insight as to the use of guided notes, these studies did not provide enough or appropriate data for inclusions.

In spite of the challenges in conducting the current investigation, the results of this study, which is based on a current body of research, are noteworthy. The "low-tech" inclusion of guided notes into the post-secondary classroom can significantly impact student achievement. Many researchers have suggested that the increase in student achievement is due to an increase in student engagement (Austin et al., & Bailey, 2002; Austin et al., 2004; Neef et al., 2006; Rieland, 2008). More empirical research is needed in order to fully understand *if* and *how* the use of guided notes impacts student engagement. Also, while it would seem that engagement may be the mechanism by which guided notes do produce a positive impact on student achievement (Heward, 1994), additional research is needed to further understand the relationship between guided notes and student achievement.

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