Examining Reading and Writing Processes in a Graduate Level Multiple Text Task: A Think-Aloud Study

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Abstract: Writing from multiple texts is among the most common yet challenging tasks for higher education students. However, limited research has examined the strategies used by these highly competent readers and writers. The present descriptive study examines reading strategy use, writing strategy use, and writing performance in a sample of higher education students enrolled in graduate-level education classes. Students completed a scholarly multiple texts reading-to-write (S-MTRW) task, asking them to read three short research articles and to write a research report while thinking aloud and sharing their screen. Results indicate that students commonly reported evaluating, elaborating, and paraphrasing content during reading. During writing, students commonly engaged in summarizing, composing, and rereading information from the texts provided. Furthermore, the majority of students produced emergent documents models, reflecting limited attempts at synthesis in their writing about the research articles they read. A medium positive correlation was found between the number of instances students reported paraphrasing content while reading and the number of instances of multiple-text integration in students' writing.

Keywords: academic writing, multiple text integration, reading and writing, graduate writing

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1. Introduction

Learning to read and write in accordance with academic conventions is critical for students' undergraduate, graduate, and professional success. On average, university freshmen are asked to write 44.2 pages per year, while seniors write 74.2 pages per year (Center for Post-secondary Research, 2021). Common university assignments include synthesis writing, requiring students to demonstrate their understanding of complex topics based on information drawn from multiple texts and to formulate novel products, expressing their understanding through writing (Luo & Kiewra, 2019; Tardy, 2005). Academic life after college requires graduate students to engage in even more complex writing, such as composing research papers, literature reviews, critiques, theses, and dissertations (Lavelle & Bushrow, 2007; Torrance et al., 1994).

Although studies have begun to examine how students write syntheses based on multiple texts, still limited work has robustly examined the links between the reading and writing processes involved, particularly among students advanced in their academic careers. That is, the majority of studies on synthesis writing have examined high school and undergraduate-level samples (e.g., Anmarkrud et al., 2014; Du & List, 2020; Holdinga et al., 2021), despite graduate students frequently needing to engage in synthesis writing at a high level and reporting challenges and limited support for doing so (Carlino, 2012; Colwell et al., 2011; Walter & Stouck, 2020). Furthermore, studies examining reading and writing based on multiple texts have focused on students' writing based on brief and generally accessible texts (e.g., De La Paz & Felton, 2010; List & Du, 2020) or have used standardized assessments of reading to write (e.g., Kim et al., 2021, SAT; Plakans et al., 2019, TOEFL). A particularly necessary area for investigation is how students, even at the graduate level, write based on scholarly texts (i.e., research articles). Such texts are distinguishable because of their focus on abstract constructs, distinct organizational structures, and reporting of detailed methodological and statistical information (Castelló & Iñesta, 2012; Harmon & Gross, 2009). In this study, we aim to identify the processing strategies associated with reading-to-write based on multiple scholarly texts, within an advanced student sample.

1.1 Reading-to-Write Tasks

Often referred to as discourse synthesis tasks (Horowitz, 1986; Spivey, 1983), multiple-text reading-to-write (MTRW) tasks demand that learners iteratively interrelate the processes of reading and writing. Spivey (1997) suggests that there are three cognitive processes involved in discourse synthesis (i.e., generating a new written product based on existing texts): selection, organization, and connection, with these processes occurring across both reading and synthesis writing. While reading, learners identify and *select* the content relevant to the demands of the writing task; utilize their knowledge of discourse (i.e., understanding of writing structure) and understanding of task features (e.g., audience, objectives, genre) to *organize* the selected content, and create a mental representation of the information included

in texts. Then, they *connect* information across texts and with their prior knowledge, resulting in integrated understanding. While writing, learners engage in selection, which involves determining the importance of information identified during reading and deciding whether to include some or all of this information in writing. Based on the information selected for writing, students create their own *organizational* structure for text, to follow while writing; this includes grouping ideas together and arranging these hierarchically. Finally, students draw on their mental representations of a topic, to connect information from different texts when writing. Throughout this entire process of discourse synthesis, students use structural cues (e.g., headings) from the texts to organize and integrate information. Students may reflect such structures within their integrated understandings of a topic or may develop these into other structures that are personally formed. Students' organized and integrated understanding is then expressed in their writing.

Various investigations focused on examining the strategies used by students when reading have followed Afflerbach & Cho's (2009) reading strategy taxonomy. For instance, Anmarkrud et al. (2014) classified reading strategies as involving (a) *identifying and learning important information* (i.e., elaborating information in relation to the task or to learners' prior knowledge or across documents), (b) *monitoring comprehension* (i.e., identifying and resolving comprehension problems), and (c) *evaluating text content* (using information about a document's source to evaluate content). In addition to the three categories established by Afflerbach & Cho, the category of *linking strategies* (i.e., implicitly or explicitly connecting information from multiple texts) was also identified, with such linking supporting information identification, comprehension monitoring, and the evaluation of texts. In their study, the majority of utterances that students produced were classified as reflecting their evaluating texts' content and identifying important information while reading, with monitoring comprehension constituting the strategy category reported least of all. Furthermore, Anmarkrud et al. (2014) examined the relationship between students' strategic processing and argumentative writing performance. Their findings showed a positive correlation between the total number of multiple-text strategies that students used and students' specific use of evaluative, metacognitive, and linking strategies, and argumentative writing performance. Similarly, in this study, we inform our examination of reading strategies by Afflerbach & Cho's taxonomy.

Much prior work on source-based writing has focused on students' writing based on a single text (e.g., Holdinga et al., 2021). In such single text contexts, students have been found to use strategies like planning, writing in short but frequent spurts, and metacognitive activities when writing. A still limited number of studies have examined the processes involved in students' synthesis writing based on multiple texts (Graham, 2020; van Ockenburg et al., 2019), with such writing presenting unique demands regarding the need to process and integrate a broader span of information (Britt et al., 1999; Perfetti et al., 1999). In a qualitative study, Solé et al. (2013) examined the processes and products resulting from college students (n=10) completing a multiple-source synthesis task while thinking aloud. Specifically, students were asked to read three texts in order to write an essay highlighting key information about

the Spanish Civil War. Students' writing process was analyzed in two primary ways. First, actions were coded based on whether participants engaged in (a) reading or rereading the source texts, (b) copying information from the source texts, (c) writing notes, (d) writing essays, or (e) making revisions (i.e., modifying text content or spelling). Second, think-alouds were analyzed for instances when students made connections or integrated information within or across source texts. Solé's et al. (2013) analyses of students' writing process demonstrated that students failed to select sufficient information to include in their essays, leaving them highly dependent on the structure of the original source texts when writing. Additionally, students included major errors in their interpretations of the original source material. Indeed, none of the students were able to produce a complete synthesis of the source texts provided, fully transforming the structure of the texts read. Linking writing processes with outcomes, Solé et al. found that students who engaged more frequently in elaborative patterns when reading, connected more information across texts and produced texts of better quality; still, more work is needed to further link reading processes to outcomes, as we aim to do in this study.

In an examination of the cognitive processes involved in completing MTRW tasks, Segev-Miller (2007) used a combination of interviews, think-aloud protocols, and process logs to identify the most common processes performed by 12 female university students, with a particular focus on those involved in students' intertextual linking or integrating of information presented across texts in their writing. Three main types of intertextual processing strategies were identified: conceptual transforming, rhetorical transforming, and linguistic transforming. Conceptual transforming involved the identification of thematic connections among sources (i.e.., comparing sources) and the use of a macroposition to represent this connection (e.g., "All — Salomon, Kubabi, Rogers — are very similar" Segev-Miller, 2007, p. 238). Rhetorical transforming referred to students' restructuring of multiple texts, and their connections, during writing. This took a number of forms ranging from students summarizing only a single text, to students listing source texts sequentially, to students using one main text as a framework for incorporating other texts, all the way to true multiple text synthesis (i.e., wherein more than two texts were decomposed and recomposed into a novel, coherent whole). This last form of rhetorical transforming, referred to as synthesizing, consisted of reorganizing multiple texts by their ideas, rather than by author. Finally, linguistic transformation referred to the specific use of intertextual linguistic devices to connect sources (i.e., speech acts and lexical repetition; for example, consistency in term use). However, Segev-Miller did not examine the explicit connection between reading and writing strategy use and writing performance.

Mateos et al. (2007) used surveys to examine the reading and writing strategies most commonly reported by undergraduate students enrolled in different university courses when completing MTRW tasks. Specifically, Mateos et al. asked students to report which strategies they used throughout the year, from a list of 15 reading and writing strategies provided, as well as to report whether the use of each strategy was of their own volition or compulsory. Additionally, students were asked to report the degree of difficulty, interest, and usefulness

of each strategy. Results showed that note taking, organizing notes, and identifying main ideas were the most common strategies reported. In contrast, commenting on the content of a text, arguing, and reflecting on learning were the three strategies least commonly reported. At the same time, students rated all of the strategies reported as moderately difficult and moderately interesting to perform. For instance, taking notes had a mean interest rating of 3.03, on a four-point scale, while arguing had a mean interest rating of 3.30.

Du and List (2020) looked at a larger sample of college-aged writers (N=32), across two different writing tasks. In their study, students were provided with a library of six digital texts on the topic of overpopulation and asked to read them in order to write either a research report or an argumentative essay, while doing a cued think-aloud. In addition to think-aloud data, Du and List collected log data, screen captures, and participants' notes composed while reading. Strategies used during the reading phase of the study were classified into six main categories: a) surface-level strategies (i.e., direct recording of information from texts), b) deep-level strategies (i.e., involving transformation of information from texts), c) text selection, d) text evaluation, e) affective reactions, and f) metacognitive strategies. Moreover, Du and List classified students' writing strategies into three main categories: product composition (i.e., planning, writing, organization, and revision), information use (i.e., source use, reviewing notes, content generation, argument formation, and prior knowledge engagement), and metacognition. The texts produced were scored in three different ways: a) holistically, based on the number of arguments included and the extent to which these reflected the integration and elaboration of information across texts, and b) based on the number of discourse connectives, and c) based on the number of citations included in students' writing.

Their results showed significant correlations between surface-level and deep-level reading strategies and participants' holistic writing scores, corresponding to a moderate effect. Moreover, when looking at writing performance levels, participants who obtained higher holistic writing scores tended to spend a longer time reading and to use a higher amount of product composition and information-use related strategies. A regression model showed that using product composition strategies was a significant predictor of students' holistic writing scores. Still, Du and List (2020) and Mateos et al. (2007) are among an unfortunately limited number of studies examining university students' processing during reading and synthesis writing and linking this to performance.

As an added limitation, studies of MTRW tasks have focused on the experiences of high-school and college-aged writers, writing from generally accessible texts (e.g., Alkema et al., 2023; Tarchi & Casado-Ledesma, 2024) . In one of the few studies on graduate students, Sala-Bubaré et al., (2021) examined the writing regulation process of writing a dissertation. While this study focused on only one doctoral student, it uncovered that regulation processes varied based on sections and challenges faced. In an attempt to design a curriculum to support graduate student writing, Dovey (2010) revealed that the integration of process-based strategies, such as using graphic organizers to facilitate organizing, selecting, and integrating

information, led to improved student performance in writing more coherent and well-structured academic texts.

In this study we seek to contribute to the literature by examining MTRW process among a sample of advanced higher education students enrolled in graduate-level courses, and composing syntheses based on demanding scholarly texts. Our focus on this sample of students is motivated by both the demands (Castelló et al., 2017; Lavelle & Bushrow, 2007) and the professional stakes involved in graduate-level academic writing (Kamler, 2008; Park & Schallert, 2019). Our focus on scholarly texts comes from the complexity and peculiarity of such text, written for an expert audience (Lavelle & Bushrow, 2007), and the demand that writers not only summarize and synthesize these texts, but also critique and use these texts, as a basis for spurring further academic work (Frantz, 2022; List & Campos Oaxaca, 2023).

1.2 Documents Model

The Documents Model Framework (DMF: Britt et al., 1999; Perfetti et al., 1999) is among the most prominent conceptions of how students cognitively represent information across multiple texts, with the cognitive representations of multiple texts described in the DMF also examined as externalized or represented in students' writing (Butterfuss, 2020; List & Du, 2020). While the DMF describes cognitive representations when applied to writing it suggests that novice students are able to represent texts in one of three ways, with these varying in their degree of citation use (i.e., tagging of content to source) and integration (Britt et al., 1999; Perfetti et al., 1999). In a mush model, writers create an integrated representation of the information from texts, without identifying the sources of information. In a separate representations model, writers create unconnected representations of the information from each text processed (e.g., listing these). In a documents model, writers create connections between information from different texts, and tag information to sources of origin (Perfetti et al., 1999).

The creation of a Documents Model requires the generation of intertextual connections. Hence, when writing, students must engage in the transformation of knowledge (Mateos et al., 2014).The intertextual connection formation, required for students to form a documents model, requires that they transform information across texts or link this in novel ways. In this way the DMF aligns with reflecting knowledge telling vis-à-vis knowledge transforming described in prior work (e.g., Wiley & Voss, 1999). The *Knowledge telling,* characteristic of novice writers, involves students directly relaying content from prior knowledge, with "the writer's attention...occupied only with the problems of thinking of enough to say and of how to express it" (Bereiter et al., 1988; p. 262); *knowledge transforming,* characteristic of expert writers, involves constant problem solving based on what is known about the content and the demands of the task, resulting in students adapting and modifying their knowledge to complete the writing task goals.

1.3 Present Study

In this study, we examined synthesis writing based on scholarly research articles, within a sample of higher education students, with this constituting a particularly demanding academic task. We use research articles because they are distinguishable from other academic texts (e.g., textbooks or Wikipedia), because they are typically written by experts who aim to contribute to the scientific community by transforming information and generating new knowledge(i.e., rather than principally explaining or synthesizing information to a more novice audience; Pare, 2019; Castelló, 2022). This means that, compared to other types of academic texts, research articles introduce abstract concepts, often idiosyncratically defined, include detailed methodological and statistical information, often conveyed through external representations such as tables and figures, follow a distinctive structure (e.g., abstract, theoretical frame, methods, results), and adhere to linguistic and epistemic conventions (e.g., passive voice, citation use) rarely encountered in non-academic work (Tarone et al., 1981; Flowerdew, 2012; Park & Schallert, 2019). Moreover, they are commonly assigned reading materials in graduate school. All of these characteristics jointly make research articles particularly difficult for students to comprehend and write about, as compared to other academic texts. Yet, writing based on such scholarly texts is essential for graduate students' professional success (Walter & Stouck, 2020). Such writing has rarely been examined (Lavelle & Bushrow, 2007). Thus, in this study, we examine multiple text synthesis writing based on scholarly research articles among a sample of higher education students enrolled in graduate courses.

Research Questions

We have the following research questions:

1. What are students' most commonly reported reading processes when completing a scholarly multiple text reading-to-write (S-MTRW) task?
2. What are students' most commonly reported writing processes when completing a scholarly multiple text reading-to-write (S-MTRW) task?
3. What is the association between reading processes, writing processes and writing performance?
4. Are there differences in reading and writing processes across the different multiple texts models generated by students in their written responses?

2. Method

2.1 Participants

Participants were 24 students enrolled in graduate-level education classes (age: *M*=32.69*, SD*= 11.08) at a large public university in the Northeastern United States. Twenty participants identified as female (83.33%) and four (16.66%) identified as male. The majority of students were completing their Master's degree (n=15). A small portion of the sample were doctoral students (n=2), undergraduates (n=5), or were taking additional courses post-graduation (n=1). On average undergraduate students have been in their program for 2.60 years, master's students have been in their program for 1.87 years, and all doctoral students have been in their program for a year.

Students participating in the study identified as White/Caucasian (n=17), Asian (n=2), African American (n=1), and Native American (n=2). One of the students did not provide demographic information, and percentages were computed based only on students reporting demographic information. All participants received extra-credit for participating in this study.

2.2 Procedure

Participants completed the study fully online, via Zoom, with a researcher present. Each session began with the researcher providing students with the study instructions (see Appendix D) and reading these aloud, as well as asking students to share their screen, with each Zoom session (and participants' shared screens) recorded. At the beginning of each session participants were instructed to open a personalized Google Doc, which served as the core data collection instrument in this study. This Google Doc contained an overview of the study instructions, links to the three short research articles for the study, with these opening in a separate browser window, and the research report prompt that students would be asked to complete, as an outcome of the task.

The written instructions asked participants to read three short research articles while thinking aloud. The researcher provided examples of the think-aloud process by modeling. When participants were silent for more than 15 seconds, the researcher reminded students to think-aloud (e.g., "*You have been quiet for 15 seconds, please remember to think aloud").* Once participants indicated that they had finished reading all three research articles, they proceeded to type their research report in the Google Doc provided. Participants could freely navigate among the research articles and their research report, via the Google Doc, throughout reading and writing. Although participants completed the study in a largely autonomous fashion (i.e., self-determining when to switch from reading to writing), the researcher was available throughout to answer logistical questions (e.g., *"Should I cite following APA guidelines?"*).

Students were allowed to take as much time as desired to complete the S-MTRW task. After finishing their research report, researchers instructed students to access a supplemental Qualtrics survey via a link. This link led students to a demographics questionnaire. In total, the

study took participants approximately 50 minutes to complete, however, there was not an established time limit to complete the study.

2.3 Design

This study followed a correlational design. Students completed a scholarly multiple-text reading to-write task. First, students read three research articles or brief scholarly texts. Then, they composed a written response, completing both tasks while thinking aloud. Students' reading strategies and writing strategies were used to predict performance.

2.4 Materials

Short Articles

Three short research articles, addressing college students' social media use, were designed for the purposes of this study. All research articles were written in English and were also used in a prior study (i.e., List & Campos Oaxaca, 2023). Each article presented the results of a single research study, utilizing one of three research designs (i.e., qualitative, correlational, or quasi-experimental). Although the short research articles were constructed for the purposes of this study, these were based on published work (i.e., qualitative – Stirling, 2015; correlational – Foroughi et al., 2021; quasi-experimental – Cuesta et al., 2015). The short research articles were introduced as: *short reports published in peer-reviewed journals. Unlike full-length journal articles, short reports are meant to quickly communicate research findings to a broad audience*. We modified the original articles, in order to make research articles shorter and avoid the possibility of fatigue, and to display a similar structure across the three reports. See table 1 for an overview of the research articles' content.

The organizational structure of each research article consisted of title, name of the journal, author information (e.g., university affiliation and department), an introduction with research questions, methods, results (i.e., narrative results and a summary table), a discussion, and two references.

The three studies used all described the academic and social outcomes of students' social media use; however, these presented discordant results. For example, while Banks and Pitt found social media use to improve academic performance, Cochran and Kramer found that social media use was negatively associated with GPA[1]. Additionally, these were purposefully designed to include certain limitations (e.g., sample size, issues with randomization). All of these studies were composed to be accessible to a competent audience and interesting to our sample, who were both education students and, themselves, likely social media users and, formerly, undergraduates. Flesch Kincaid analyses indicated that the research articles had a Flesch Kincade readability grade level between 11.9 and 14.1, suggesting that these were appropriate for a graduate audience (Kincaid et al., 1975). Specifically, Flesch Kincaid scores

[1] GPA refers to grade point average and indicator of academic performance in most U.S. institutions.

indicate the US school grade level needed to understand a text, college-level materials typically range between grade 12 and 15. The length of the short research articles was comparable or longer to other studies that have examined multiple text comprehension and writing in higher education. (e.g., Bråten & Strømsø, 2010 [231 to 362 words]; Gil et al., 2010 [299 to 464 words])

Students were provided with links to each of the three short research articles. Before clicking on the link students were only able to see the title of the article and the authors' last names, consistent with APA format. When students clicked on the links these opened in a new browser tab in a PDF format. The presentation of the links was counter-balanced to avoid any order effects; however, students were allowed to freely select the articles in any order and could access these as many times as needed. See Appendix A -C for screenshots of the reading materials.

Table 1 Description of Short Research Articles

Disguised Study	Original Research	Design	Number of Words	Readability
Exploring the Role of Facebook Among First-Year College Students in the U.S. (Ayala & Fields)	Technology, time and transition in higher education – two different realities of everyday *Facebook* use in the first year of university in the UK (Stirling, 2015)	Qualitative	792	11.9
Using Social Media to Promote Collaboration in Higher Education (Banks & Pitt)	Using *Facebook* as a co-learning community in higher education (Cuesta et al., 2015)	Quasi-experimental	649	14.1
The Influence of Social Media on Students' Academic Performance and Life Satisfaction (Cochran & Kramer)	Associations Between Instagram Addiction, Academic Performance, Social Anxiety, Depression, and Life Satisfaction Among University Students (Foroughi et al., 2021)	Correlational	561	13

2.5 Measures

Measures collected as part of this study included students' screen recordings and think-alouds while completing an S-MTRW task and students' written responses.

Reading Processing Behaviors

Students' utterances during reading were transcribed in two steps. First, recordings were uploaded to an online transcription service. Second, written transcriptions were manually cleaned by two researchers. In particular, transcripts were cleaned while watching the original recordings. Then , utterances were segmented and coded while watching screen recordings of each participants' reading. Segmentation was done based on students' pauses or manifest behaviors (e.g., changing documents). Each utterance that students produced was classified into one of six primary categories: (a) paraphrases, (b) elaborations, (c) evaluations, (d) personal connections, (e) affective reactions and, (f) other. This coding scheme was developed in a bottom-up fashion, by creating and reconciling categories of students' utterances; however, the utterance categories identified were developed based on authors' knowledge of prior research (Afflerbach & Cho, 2009; Wolfe & Goldman, 2005).

Paraphrases referred to students' utterances confirming the meaning of previously read content by repeating or restating content to themselves. *Elaborations* referred to students' connecting of information in texts with prior knowledge that was relevant to support comprehension. *Evaluations* referred to students' judgments of the quality of the sources or content introduced. Content evaluations typically reflected students' generation of research-methods based critiques, including their appraisals of sample size, methods, or overall study design. *Personal Connections* referred to students' invocation of personal or out-of-school knowledge in connection with information in texts; such connections were largely incidental to comprehension. *Affective reactions* referred to students' utterances reflecting an emotional response to the information read (e.g., "this is interesting!"), without further elaboration. Utterances that could not otherwise be coded were placed in the *other* category. This included style-related and metacognitive statements, and students' intratextual and intertextual connection formation, as these categories were relatively under-represented in students' think-alouds. See Table 2 below for examples.

Table 2 Examples of Reading Strategies

Reading Strategy	Example
Elaboration	"Kinda wonder what constantly active means, if that means that they're always getting notifications or they're always on Facebook?"
Evaluation	"I'm also wondering what the reliability is for the college student satisfaction scale. They didn't report that."
Paraphrase	"Oh ok, so it looks like the Facebook group did, performed better, compared to the comparison group, well, for course, satisfaction."
Personal Connection	"I certainly was glad that it wasn't around when I went to my undergrad (referring to social media)."
Affective Reaction	"Oh, that is kind of creepy!"
Other (stylistic)	"These are a lot shorter than I thought they were going to be, so that's not bad."
Other (intertext)	I'm also thinking that. There is value, I think, when I eventually have to write this, but there's qualitative [text 1] and quantitative.[text 2]
Other (metacognitive)	It's really hard for me to read and talk.
Other (intratext)	So they use correlation to makes sense because the research questions were relationship.

Writing Processing Behaviors

Students were also asked to think-aloud during writing. In coding students' writing processes, both transcripts of their think-alouds and screen recordings of their writing were simultaneously used. This is because students commonly navigated between study texts and their written products during writing, with this navigation often not verbalized. This is in contrast to reading, which students typically did in a linear fashion. Furthermore, analyzing students' screen recordings, alongside their think aloud transcripts, allowed us to observe when students engaged in screen splitting, note taking, or other composition-supporting behaviors.

We coded students' think-alouds including the portion (in time) of utterances during the writing phase. Think-alouds were segmented according to students' pauses, the content of

the utterances they produced, and the behaviors reflected in the screen recordings. We coded utterances based on prior work done by Solé et al. (2013) and Du & List (2020). We used the software MAXQDA 2022 (VERBI Software, 2021) to support our coding of utterances.

Utterances, alongside behaviors observed on each screen recording, were coded into seven main categories: (1) summarizing, (2) composing, (3) rereading, (4) revising, (5) citing, (6) checking sources, and (7) reading notes. Unlike with reading, because students' utterances often reflected behaviors (e.g., composing) rather than only cognitive strategy use, the duration of these was recorded. For instance, students sometimes said out loud the information they were typing, with the duration of this writing behavior (i.e., categorized as composing) captured.

Summarizing referred to students writing about content directly found in the reading materials provided (Plakans et al., 2019). In contrast, *composing* referred to students' writing content related to but not directly summarizing information from study texts. This included students composing introductions, conclusions, and seeking to transition between or otherwise link research studies. *Rereading* referred to students returning to the available research articles to either reread large segments of these or to identify specific information (Plakans et al., 2019; Mcnamara et al., 2024). When students returned to the articles provided only to check their source or author information, this was specifically categorized as *checking source.* Students' rereading or looking for information within the notes they generated was categorized as *reading notes* (Du & List, 2020). Students' inclusion of source information when writing was categorized as their *citing.* Students rereading the text they generated, adding information, or otherwise editing previously generated content was categorized as *revising* (Du & List, 2020*).* In addition, students' utterances reflecting their evaluation of text-based content, metacognition, intertextual connection formation, or self-regulation, were coded as *higher-order thinking (HOT)*. For example, a student engaged in rereading the text produced, reflected on the content and enunciated: "Oh but then I might be misleading", this utterance reflected self-evaluation. Another student enunciated: "right now I'm just writing to make sure I'm staying focused" while summarizing, this reflected self-regulation. Importantly, HOT utterances were often not actually expressed in the written responses that students composed. While the majority of the writing strategies coded (e.g., summarizing, composing, citing) had both a cognitive and behavioral component that students both verbalized and demonstrated on the screen, the higher-order thinking category referred to students' reports of cognitive strategy use when thinking aloud.

Research Reports

Research reports were coded in four primary ways: inclusion of integrative statements, number of switches, number of citations, and type of documents model generated.

Students' writing was first coded for its inclusion of statements reflecting connection formation or integration across two or more texts (i.e., integrative statements). Integration was classified as *generic* or *specific*. *Generic integration* reflected a generalized statement

relating two texts, at the documents level, without detailed information within them considered. *Specific integration* reflected a localized and more definite connection drawn between two or more texts. Thus, generic and specific integration were distinguished by the former typically drawing document-level relations (e.g., specifying texts as agreeing or disagreeing with one another), with the latter considered details rather than the main ideas introduced in texts. Cohen's Kappa interrater reliability for generic integration was 0.63 and 0.74 for specific integration, suggesting substantial agreement (Landis & Koch, 1977). While Cohen's Kappa for generic integration was on the lower end, we considered it acceptable given that a prior review of studies on multiple text integration found Cohen's Kappa interrater reliability to fall between 0.62 and 0.94 (Barzilai et al., 2018). See Table 3 for examples of integrative statements.

Table 3 Examples of Generic and Specific Integration

Type of Integration	Example	M(SD)
Generic	"The three articles specifically focus on the social media platform of Facebook"	1.46 (1.18)
Specific	[…] However, social media has been found to also hinder academic performance **(***Cochran & Kramer, n.d.)* as well serve as a distraction or stressor for students *(Ayala & Fields, n.d.).- Connections regarding the harms of social media*	1.17(1.52)

Second, we coded the number of switches between texts reflected in students' writing. A switch was defined as any instance where a student shifted from discussing one test to another distinct text (e.g., moving from Text 1 to Text 3). We counted each occurrence of a shift, with students receiving one point per occurrence. For example, if a student discussed Text 1, then Text 3, and then returned to Text 1, this sequence would count as two switches, and the student received two points. Prior studies have examined the number of switches in students' writing as a sign of their flexible use of text-based information and cross-textual connection formation, reflecting integration (e.g., Britt & Sommer, 2004; List et al., 2019).

Further, the number of explicit references (i.e., citations) students included in writing, referring to research articles by author or title, was coded for.

Lastly, students' written responses were categorized following the Documents Model framework according to the type of multiple-text model these reflected. While prior work has examined students' writing as correspondent to four different types of multiple text representations (i.e., mush models, separate representations models with and without citations, documents models; Barzilai et al., 2021; List et al., 2019), all of the students in our sample produced either separate representations models (with citations) or documents models. This was not unexpected given participants' comparatively advanced academic status and the fact that they had research articles available to them during writing (i.e., fostering citation use). Given that various participants reflected a model close in quality to a documents model but still lacking detailed integration, an additional response category was added to score students' writing, the *Emergent-Documents model* . That is, students' writing was coded as either reflecting a (a) separate representations, a (b) documents model, or an (c) emergent documents model of multiple texts. *Separate representations* models reflected students' one-by-one presentation of text-based information, with no integration across texts evidenced. *Documents Models* reflected students' inclusion of substantial generic and specific integration in writing. Finally, an *Emergent-Documents Models* reflected citation use and only one or two instances of, typically, generic integration Cohen's Kappa interrater reliability for multiple texts model featured in students' written responses was 0.80. See appendix E for examples of models produced.

3. Results

The S-MTRW task required students not only to engage with a complex academic task but also to verbalize their thoughts as they completed the readings and composed their reports. At the beginning of the task, some participants highlighted the challenge of thinking aloud while writing as it is something not typical. Others described their overall approach to completing reading tasks. As participants dug deeper into the articles, they started elaborating on the content of the texts with their prior knowledge and experiences or evaluating the information presented. While some students finished reading all the articles before moving into writing their reports, others took notes or screenshots of important information.

Similarly, while writing, students engaged in a variety of strategies including going back to the content of the readings, summarizing information from each reading, or composing texts based on multiple readings. Despite these varied strategies, many participants struggled to synthesize the information across multiple texts, a challenge that became more apparent in their produced reports. This indicates a disconnect between their reading comprehension strategies and their ability to integrate this information into cohesive, well-structured written work.

In the following sections, we present the results of the analyses of students' think-aloud during reading and writing, as well as analyses of the texts produced based on our research questions.

3.1 Research Question 1: Students' Most Commonly Used Reading Strategies

On average, students spent 16.15 (*SD*= 5.56) minutes on reading. Students produced a total of 642 utterances during reading, corresponding to an average of 27 (*SD=16.93*) utterances per student. Students most commonly reported elaborating content *(M*=9.21, *SD*=7.84), followed by their engagement in evaluating (*M*=4.13, *SD*=3.19), and paraphrasing content (*M*=4.08, *SD*=3.63). The least frequently reported categories were the formation of personal connections to the material (*M*=3.00, *SD*=3.74) and affective reactions (*M*=1.96, *SD*=1.39). A total of 105 utterances did not fit into any of the established categories. Cohen's Kappa agreement was 0.69, suggesting substantial agreement (Landis & Koch, 1977), based on the coding done by two raters of 25% of the participants' files (n=6). See Table 4 for descriptive statistics.

Table 4 Descriptive Statistics of Reading Strategies

Reading Strategy	n	*M (SD)*	Range
Elaboration	221	9.21 (7.84)	24
Evaluation	99	4.13 (3.19)	13
Paraphrase	98	4.08 (3.63)	13
Personal Connection	72	3 (3.74)	13
Affective Reaction	47	1.96 (1.39)	5
Other	105	4.38 (5.09)	21

Note. Mean represents the average number of utterances that one student produced within each category. For instance, individual students produced an average of 9.21 elaborations during reading.

Additional Behaviors Identified

In addition to the previous strategies, we coded for instances when students reflected paying attention to the sources, to the task, and engaging in note-taking. Half of the students examined source information when reading (n=12). Over half of the students (58.33%, n=14)

engaged in task analysis, asking questions about or making comments beyond reading the task instructions provided. Half of students engaged in notetaking (n=12).

3.2 Research Question 2: Students' Frequently used writing strategies

On average students spent 28.48 minutes (*SD*=9.86) writing. Students spent most of their time *summarizing* content from the reading materials provided (*M*=43.39% of writing time, *SD*= 13.35%), followed by students spending their time on *composing* (*M*=23.84% of writing time, *SD*=11.54%). In addition to summarizing and composing, students used portions of their writing time to *reread* the research reports provided (*M*=13.19% of writing time, *SD*= 9.43%) and to *revise* the text they produced (*M*=10.18% of writing time, *SD*=10.676). The least amount of writing time was spent *citing* (*M*=3.45% *SD*=4.25%), *checking notes* (*M*=2.18%, *SD*=4.424), and *checking source information* (*M*=1.60%, *SD*=2.80%). Additionally, students spent on average 3.47% of the time making HOT utterances (*SD*=4.17%). Figure 1 shows the patterns of the most common writing strategies. Descriptively, students often started their writing by composing. This was followed by an interleaving of rereading the content from the scholarly texts and summarizing it. The majority of the students finalized their writing process by engaging in a revision of the text produced. Cohen's Kappa inter-rater agreement for students' writing behaviors was 0.85, suggesting almost perfect agreement (Landis & Koch, 1977). Cohen Kappa was calculated based on the total coding of four participants done by two raters. The establishment of categories was done in two steps. Initially, two coders performed a preliminary coding together to identify the main themes among the strategies. Once strategies were clearly defined, one of the initial coders trained a second coder, and agreement between the coding of four participants was performed. Disagreements were resolved by discussion among coders. See table 5 for descriptive statistics of writing strategies.

Table 5 Descriptive Statistics of Writing Strategies

Writing Strategy	Mean % Writing Time (*SD*)	Mean Duration in minutes (*SD*)
Summarizing	43.39% (13.35)	12.21 (6.35)
Composing	23.84% (11.54)	7.10 (4.44)
Rereading Articles	13.19% (9.43)	3.77 (3.42)
Revising Text Produced	10.18% (10.76)	2.90 (3.18)
Citing	3.45% (4.25)	0.92 (1.14)
Checking Notes	2.18% (4.24)	0.67 (1.26)
Checking Source	1.60% (2.80)	0.39 (0.64)
Higher Order Thinking (HOT)	3.47 (4.17)	0.99 (1.24)

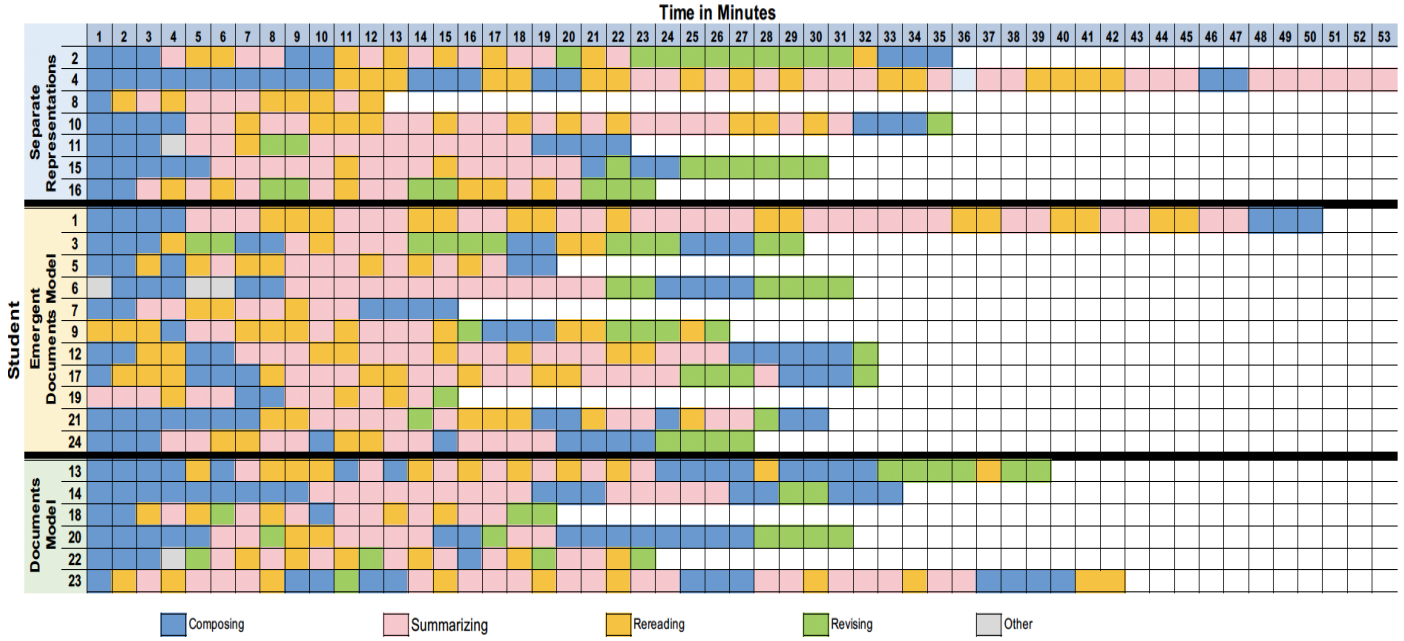

Figure 1 Time Distribution in Minutes of Most Common Writing Strategies for Each Student by Model Created

Note. In this figure every, minute one represents starting time and every cell is one minute.

3.3 Research Question 3: Association between reading and writing strategies and writing outcomes

Our third research question examined the relationships between reading and writing processing strategies and the quality of students' written products. The three quantitative indicators of writing quality examined included the volume of integration, switches, and citation use reflected in students' writing. Only the three most commonly reported reading strategies and all of the writing strategies, measured by duration, were analyzed.

With regard to reading strategies, a positive association was found between the number of instances students reported engaging in paraphrasing content and the volume of multiple-text integration reflected in the research reports produced, $r(22)=0.42$, $p=04$. With regard to writing strategies, a positive association was found between the percent of time students spent composing and the number of switches reflected in their research reports, $r(22)=0.41$, $p=0.048$. No other significant associations were identified among the common reading and writing strategies and the product characteristics. However, a negative association was found between two common writing strategies, composing and rereading $r(22)=-0.49$, $p=0.02$. See Table 6 for correlation coefficients.

Table 6 Association between most common processing strategies and products

	1	2	3	4	5	6	7	8	9
Elaboration (R)	1								
Evaluation (R)	.51*	1							
Paraphrase (R)	.15	.07	1						
Summarizing (W)	.20	.32	-.06	1					
Composing (W)	-.24	-.33	-.19	-.37	1				
Rereading (W)	.20	.01	.26	.02	-.49*	1			
Switches (P)	-.05	.02	.02	-.07	.41*	-.15	1		
Citation (P)	.07	-.01	.13	.12	.26	-.16	.90**	1	
Total Integration (P)	-.16	-.13	.42*	-.10	.00	.16	.56**	.54**	1

Note. R = Reading, W=Writing; P= Performance; * : p<0.05, ** : p<0.01

3.4 Research Question 4: Documents models Reflected in Students' Responses, in Association with Reading and Writing Strategies Used

On average, students' research reports were 457.25 (SD=221.25) words in length. Across the 24 research reports produced, seven of them (29.20%) reflected separated representations models, eleven of them reflected emergent documents models (45.80%), and only six of them reflected full documents models of multiple texts (25%).

A series of one-way ANOVAs were run to examine whether students' most frequently used reading strategies and most extensively used writing strategies differed across the three documents model types that students produced. Only the three most commonly used reading strategies and those writing strategies to which students devoted more than 10% of writing time were analyzed. No significant differences were found in students' engagement of reading processes or writing process duration across the documents models reflected in students' responses, *p*s > 0.47.

However, descriptively, students who produced documents models engaged more frequently in paraphrasing during reading, as compared to students who produced separate representations models. See Table 7 for descriptive information.

Table 7 Means and Standard Deviations of common processing strategies across multiple text models produced

	Separate Representations *M (SD)*	Emergent Documents Model *M (SD)*	Documents Model *M (SD)*
Elaboration (R)	10.43 (7.41)	8.45 (8.70)	9.17 (7.88)
Evaluation (R)	4.00 (3.32)	4.45 (3.83)	3.67 (1.97)
Paraphrase (R)	3.86 (3.29)	3.00 (2.68)	6.33 (4.97)
Summarizing (W)	42.41% (19.59)	45.20% (9.04)	41.19% (13.47)
Composing (W)	24.04% (7.56)	22.06% (12.26)	26.87% (15.01)
Rereading (W)	12.27% (9.83)	14.10% (10.37)	12.59% (8.64)

4. Discussion

The present study explored the reading and writing strategies of advanced higher education students and their relation to performance and products when completing a S-MTRW task. Specifically, the main research questions aimed to identify the most common reading and writing strategies reported by advanced post-secondary students and the extent to which these were able to predict writing performance. Each research question is discussed in turn, as are limitations, implications, and future directions.

4.1 Common Reading Strategies

The first research question examined students' strategy use and behaviors while reading scholarly research articles and using these to compose a research report. A total of five reading strategies were identified.

The most common strategies identified were students elaborating, evaluating, and paraphrasing texts. These results are consistent with findings from previous research. For instance, Anmarkrud et. al. (2014) found evaluation to be the most commonly reported strategy category used by college students thinking-aloud about a controversial scientific issue described across multiple online documents. Wolfe & Goldman (2005) found elaboration and paraphrasing to be the most commonly reported reading activities by high schoolers learning about a historical issue using multiple texts. Both evaluation and elaboration reflect deep-level processing or students' engagement of prior knowledge to better comprehend and judge the quality of information in texts. Like the high-school and undergraduate students in Anmarkrud et al. (2014) and Wolfe & Goldman's(2005) studies, advanced higher education

students, here, drew on their prior knowledge to elaborate and evaluate texts. However, due to our small sample size, there are concerns regarding the extent to which the use of reading strategies might generalize to the larger graduate student population.

Particular to this study and perhaps reflective of the graduate student and advanced undergraduate sample used, when evaluating content in texts, students commonly rendered methodological evaluations. For example, one student reported: *"Find it interesting that they wanted the students to self-report their GPA because students could lie about that might not be the most accurate*," when reading the correlational research article. Another student reported: *"0 is a pretty small number as far as the student population from a large university*.". This type of content evaluation, focused on assessing the processes used to determine the research findings introduced in each research article, has largely not been documented in prior work but may reflect the nature of scholarly reading. At the same time, this type of evaluation was largely not found to carry forward to students' synthesis writing. This might be the case due to the majority of the sample being master's students and advanced undergraduates whose focus on writing might not be as strong as doctoral students, this is reflected in the larger variability in strategy use observed.

4.2 Common Writing Strategies

Among the writing strategies identified, summarizing, composing, and rereading were the most common strategies reported. Collectively, these strategies captured students efforts at content generation during writing. Two approaches to content generation seemed to emerge. First, rereading and summarizing seemed to reflect students close paraphrasing of information from texts, with these two being commonly performed in the middle of the writing process and being interleaved with each other. Second, composing corresponded to students generation of novel contextualizations for and connections among texts. These two approaches to content generation seem to echo Bereiter and Scardamalia's (1987; Scardamalia & Bereiter, 1992) distinction between academic tasks requiring *knowledge telling* and *knowledge transforming*. As evidenced in this study, the advanced post-secondary students in this sample engaged in both knowledge telling and knowledge transforming during writing, with knowledge telling the more commonly engaged writing behavior of the two. This is consistent with Dovey (2010) who argued that while summarizing is a primary strategy used by graduate students when writing from multiple sources of information it is often not enough when completing complex writing tasks. Walter and Stouck (2020) also noted that graduate students struggled to distinguish between summarizing and synthesizing texts. Furthermore, the limited engagement in HOT suggests that while students are engaging with the material, they may not be fully synthesizing or critically evaluating the information during the writing process. Thus, as suggested by these results and prior work, students even at the graduate level need support for how to integrate texts and apply higher-order thinking, beyond just knowing how to summarize the information introduced.

Interestingly, our results also showed a negative relationship between composing and rereading, suggesting there might be a trade-off effect between time spent transforming

information recalled while writing, and time spent returning to the source to aid recall. Students who spent more time rereading might have over-relied on the information from texts and restated it in their writing rather than transforming it (McGinley, 1992), this is also consistent with Solé et al. (2013) description of undergraduate students being extremely dependent on the structure and content of the reading materials when writing.

Beyond content generation, planning and revising – the other two phases of the writing process, were evidenced by students to a comparatively limited extent. This is a troubling finding, given that Flower and Hayes (1981) identified revision as among the most important processes in composition. Du and List (2020) determined a similar pattern of findings, with revision strategies accounting for only 2.26% of the product composition strategies that undergraduates used. Interestingly, Torrance et al. (1994) found graduate students to have an awareness of the importance of revising multiple times during writing, and to understand the connection between revision and the quality and style of texts produced. Yet, our this study, graduate students either did not show the motivation or the strategies (e.g., rereading) to engage in revising. , this could be a related to a Hawthorne effect in which students modified the traditional writing behaviors to adjust to a time slot (Graham & Perin, 2007). Additionally, students' performance could have been influenced by their motivation to complete the task (White & Brauning, 2005). That is, students might have higher motivation to write an article for publication compared to wrting a report for extra credit.

4.3 Writing Performance

In analyzing students research reports, strengths and weaknesses in students' scholarly multiple text writing can be identified. On the one hand, all students research reports included citations. This is an encouraging finding, as prior work has found students to struggle with citation use in writing (Britt & Aglinskas, 2002; List et al., 2019). Badenhorst (2019) suggests that students often use citations at the moral level rather than at a discursive level, focusing on avoiding plagiarism accusations rather than to "reflect a scholarly identity" and engage in flexible use of the content from texts. Citation use in this study was supported either by the competent, graduate-level nature of the sample or by the availability of texts to students during writing. Still, only moderate multiple-text integration was reflected in students research reports. Students, even at the graduate level, most commonly generated only emergent documents models, with only six students (25.00%) in the sample producing documents models of multiple texts, featuring more substantive integration. Prior work has found students to produce similar patterns of multiple text representations (List et al., 2019; Barzilai et al., 2021). List et al. (2019) found only 34% of college students to produce a documents model in their sample, with students generating an average of 1.11 cross-textual connections when completing a MTRW task about overpopulation. Similarly, Barzilai et al. (2021) found 9th-grade students argumentative essays to reflect, on average, 3.80 instances of intertextual integration. The moderate amount of integration in this study was somewhat

surprising as graduate students may be expected to have more experience with source-based synthesis writing.

4.4 Implications

Based on the research questions explored in this study, at least three main conclusions can be drawn. First, these findings suggest that graduate students follow distinct processes when completing MTRW tasks, students engaged in evaluations while reading, however, these were not reflected either in their writing processes or writing products. Thus, interventions should be developed to help even graduate students translate their critical reading strategies into their written products. Second, two modes of text-based writing were documented in this study, summarizing and composing. These modes of writing parallel Bereiter and Scardamalia's (1987) distinction between knowledge telling and knowledge transforming. Here, all students were found to extensively engage in summarizing but to be more limited in their composing. Still, the interaction between summarizing and composing needs further investigation, as summarizing may support students' engagement in the more sophisticated composition process. Third, results indicate the importance of attendance to sources during writing from multiple texts. It is imperative that more research is conducted in this area, given that when students write based on multiple texts, citation constitutes a key means of sharing the basis for students' conclusions and creating intertextual connections to more richly and completely describe the content. In other words, more than just an academic convention, citation is a means for students to relay the evolution of their thinking based on the perspectives of texts read. Finally, the totality of these results and their similarity to previous studies of reading and writing conducted with younger samples, evidences that even at the graduate level scholarly reading and writing is a formidable task. Although this study was conducted under contrived conditions with researcher-created texts, this may be concerning, given that writing from multiple texts is one of the most common academic activities required during graduate school. Struggling with writing can extend beyond academic outcomes to have detrimental effects on students' careers. Thus, further efforts should be made to support and provide even graduate students, as advanced learners, with appropriate strategies to read and write from multiple scholarly texts.

4.5 Limitations

Despite the strengths of this study, innovative in analyzing multiple text reading and writing among a sample of higher education students writing based on scholarly research articles, a number of limitations must be acknowledged. First, while the sample size was larger than a number of prior studies examining synthesis writing (e.g. Segev-Miller, 2007; Solé et. Al., 2013), a comparatively small sample was used in this study, additionally our sample was composed of a combination of undergraduate students taking graduate level courses, master students and novice doctoral students. That is, our results are not meant to be generalizable across the larger graduate student populations, but rather provide an initial overview of the processes involve in reading and writing at the graduate level. A larger and more defined

sample of students should be analyzed in a future study to further explore the influences of reading and writing processes on writing performance of graduate students. A larger sample could provide more insights on under-observed strategies in this study such as intertextual connections and metacognitive utterances made while reading which were categorized as other. Second, asking students to complete a S-MTRW task while thinking aloud could have been intrusive and interfered with overall performance (Ericsson, 1988; Magliano & Millis, 2003; van Gog et al., 2005), this could go in hand with students not having received full training on thinking aloud. Conversely, students' engagement in thinking aloud, may have played a supporting role in helping them better process the information being read, or better revise content when writing. Third, the lab-like setting of the study, with a researcher present, might have interrupted students' regular reading and writing practices. Relatedly, although students were not given a time limit for the task, the study was taxing and students may have felt pressed to finish in an hour because of the scheduling spots being an hour, perhaps limiting the amount of revision observed in the sample. Indeed, the length of the short research articles provided could have limited the degree to which students selected information considering that journal articles are typically longer. Moreover, students written performance may also differ when students are given a choice in what to write (Aitken & Graham, 2023). Finally, a variety of individual difference factors (e.g., prior knowledge, writing experience, motivation) were not considered, leaving open the question of the influence of these on students MTRW task performance.

5. Conclusion

This study cataloged reading and writing strategy use to explore its impact on performance in a scholarly MTRW task; however, the results did not reveal a significant association between strategy use and performance. In particular, this study utilized a think-aloud methodology to describe higher education students' strategy use while reading multiple short research articles and writing a research report. Results from this study provide confirmatory evidence for reading and writing patterns described in prior work (e.g., Du & List, 2020; Franco, 2023; Plakans et al., 2019) . For instance, students commonly elaborated and evaluated studies during reading, largely summarized texts during writing, and had limited integration in the written products that they composed. Furthermore, this study is distinct in finding substantial evidence of students reactions and research-methods-based (i.e., rather than source-based) evaluations while reading and distinguishing text-based summarizing and composing during writing. Most of all, the contribution of this study is in documenting how advanced post-secondary students write from challenging scholarly texts and in line with Dovey (2010), suggests that even at the graduate level students need different types of support to develop their writing skills ensuring that students not only generate content but also critically engage with that content.

Author note:
The data that support the findings of this study are available at: https://osf.io/6cgph/

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Appendix A Correlational Research Article

THE INFLUENCE OF SOCIAL MEDIA ON STUDENTS' ACADEMIC PERFORMANCE AND LIFE SATISFACTION

COMPUTERS IN HUMAN BEHAVIOR (SHORT REPORT)

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1 Introduction

A recent survey of 3,000 students from across the United States revealed that 75% of college students use Facebook and 70% use Instagram (Dahlstrom et al., 2019) as a means of staying engaged in the college environment. As such, social media (SM) has an impact on not only students' social interactions, but also on academic achievement at university. While social media sites may provide students with community and access to resources, social media can also distract students from academic work (Beer & Burrows, 2018). The purpose of this study is to examine this seeming contradiction between social media use as a benefit and a limitation. In particular, in this study we explore the relationship between social media use, students' academic performance, and students' satisfaction with college life.

1.1 Research Questions

1. Is there a relationship between time spent on SM and students' academic performance?
2. Is there a relationship between time spent on SM and students' college life satisfaction?

2 Method

The sample included 340 undergraduate students, enrolled in a variety of business school courses at a large private university in the South Western United States. Data were collected via Qualtrics. Survey questions measuring each of the constructs of interest [i.e., time spent on SM (TS), academic performance (AP), and college life satisfaction (LS)] were drawn from measures used in prior work. Students answered a total of 15 survey questions.

2.0.1 Time Spent on Social Media (TS)

Students were asked to report the number of social media sites they visited per day and the number of hours spent on each SM site.

2.1 Academic Performance (AP)

Students were asked to self-report overall GPA, grades in their most recent face-to-face and online classes, and their perceptions of their own academic performance.

2.2 College Life Satisfaction (LS)

The Student Life Satisfaction scale (Huebner et al., 2011) was used to measure life satisfaction. The scale asked students to rate their agreement with each of seven items using a five-point Likert scale, ranging from strongly disagree to strongly agree. Sample items included: "My life in college is going well."

3 Results

First, we calculated composite scores to capture students' responses to questions taping TS, AP, and LS.

Second, we performed correlation analyses to answer our two research questions. Results indicated that there was a significant negative correlation between time spent on social media, and academic performance, $r(338) = -.65$, $p < .05$. That is, the more time students reported spending on social media, the lower their academic performance. In contrast, regarding the relationship between TS and LS, we found a significant positive correlation. Specifically, students who reported spending more time on social media, also reported having greater student life satisfaction, $r(338) = .56$, $p < .01$. See Table 1

Table 1: Correlations among time spent on social media, academic performance and student life satisfaction

	1	2
1. Time spent of SM	-	
2. Academic performance	-0.65*	-
3. Student life satisfaction	0.56**	0.17

* significant at $p<0.05$, * * significant at $p<0.01$

4 Discussion

Our results highlight the already controversial influence of social media use on college students' academic performance and life satisfaction. Interestingly, our analyses showed that while social media use appeared to have a detrimental influence on academic performance, it had a positive association with students' life satisfaction. There was no significant correlation between these latter two outcomes. Further research should examine other factors influencing students' academic performance and life satisfaction in university.

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Appendix B *Quasi-Experimental Research Article*

USING SOCIAL MEDIA TO PROMOTE COLLABORATION IN HIGHER EDUCATION

JOURNAL OF REMOTE LEARNING (SHORT REPORT)

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1 Introduction

Faculty have long considered class discussion to be a valuable tool for learning. However, class size and timing do not always allow faculty to incorporate class discussion into university courses. Asynchronous discussion is a form of online discussion that allows students to post, read, and reply to others' comments, outside of class and at a time of their choosing (Black, 2015). In this way, asynchronous discussion has the potential to both foster social connections among classmates and allow students to receive academic support (Tilly, 2016). Nevertheless, the benefits of asynchronous discussion, relative to other types of academic engagement, have yet to be directly examined. In this study, we analyze whether providing students with the opportunity to engage in out-of-class asynchronous discussion through a social media platform improves learning.

1.1 Research Questions

1. Does having a class discussion thread on social media significantly improve students' final exam scores, relative to a comparison group?
2. Does having a class discussion thread improve students' course satisfaction, relative to a comparison group?

2 Method

Participants were 140 college students enrolled in two sections of an introductory sociology course at a large public university in the North-Western United States. One section of the course was assigned to participate in a class Facebook group (Section A), while the other section completed weekly, course-related questions independently (Section B). At the beginning of the semester, all participants took a diagnostic test on the topics covered in the course. The two sections did not differ in their diagnostic test performance and received the same in-class instruction, throughout the semester.

2.1 Facebook group

For participants in Section A, assigned to the Facebook group, a TA was designated to post weekly questions about class topics. However, the TA was asked to avoid providing students with the "right" answer and instead to encourage students to actively search for information themselves and to ask others. Students were required to participate in all discussions.

2.1.1 Comparison group

Rather than participating in discussion threads, students in Section B answered the same weekly questions as students in Section A, but did so on their own.

At the end of the semester, students in both sections completed a final exam covering all of the material in the course. Additionally, students completed a five-item survey reporting their course satisfaction. Students in the social media group were also asked to share the pros and cons of participating in a discussion thread throughout the semester.

3 Results

An independent samples t-test demonstrated that participants in Section A (i.e., the Facebook group) obtained significantly higher scores on the final exam as compared to participants in the comparison group, $t(138) = 7.70$, $p < .01$. See Table 1 for descriptive information.

An independent samples t-test was also used to compare students' course satisfaction. Students in the comparison group reported significantly higher levels of course satisfaction, as compared to students in the social media group, $t(138) = 2.46$, $p < .05$. Students in the social media group (i.e., using Facebook) reported feeling constantly stressed when receiving notifications about new discussion posts and felt that such notifications invaded their private lives, even when not completing homework for the specific class.

Table 1: Means and standard deviations of group performance and satisfaction

	Diagnostic Test (M, SD)	Final Assessment (M, SD)	Course Satisfaction (M, SD)
Group A (SM)	65.96, 1.65	85.23, 4.42	3.39, 1.50
Group B (Comparison)	66.01, 1.64	80.02, 3.54	4.01, 1.48

4 Discussion

In this study, social media was used to facilitate asynchronous class discussion in an introductory sociology course and was found to contribute positively to students' learning. However, social media use for course-work appeared to have a negative effect on students' course satisfaction, fostering a sense of urgency to participate and interfering with students' time off. Further research should examine whether synchronous, rather than asynchronous, discussion (i.e., without notifications) can also provide benefits for learning.

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Appendix C Qualitative Research Article

EXPLORING THE ROLE OF FACEBOOK AMONG FIRST-YEAR COLLEGE STUDENTS IN THE U.S.

JOURNAL OF LEARNING, MEDIA AND TECHNOLOGY (SHORT REPORT)

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1 Introduction

Social media is pervasive and ubiquitous in the lives of undergraduate students in the United States. Social media platforms, like Facebook, represent a "virtual" or imagined community where students can meet and connect with one another. Madge et al. (2017) found that 55% of respondents made virtual friends before they started attending university and that students primarily used Facebook for developing social networks, including to discuss prospective majors and academic work. When students make transitions, such as between high school and college, these are not only physical transitions (e.g., moving) but also virtual and metaphorical transitions, whereby students may update their friendship networks, both literally and figuratively, to signal a new set of connections (Woodley & Meredith, 2012).

In the present investigation, we aim to explore undergraduates' use of Facebook when transitioning, throughout their first year of college, and perceptions of Facebook as a social and academic tool.

1.1 Research Question

What role does *Facebook* play in the lives of students in their first year of college?

2 Method

The study took place over one academic year and examined ten first-year undergraduate students from a large university in the Midwestern United States. Three of the students were local and had strong ties to the university because their parents were alumni; four of the students were from out of state; and three of the students were international. All of the students were living in university dorms.

Students participated in three interviews throughout their first year; at the beginning of their first semester, at the beginning of the second semester, and at the end of the year. During these interviews, we asked students to describe their overall use of social media and their perceptions of its helpfulness to adapt to university life. Additionally, with consent, we kept a detailed record of students' Facebook activity (i.e., liked pages and posts, public posts, and group membership).

To address the research question, interview data were analyzed for common and divergent themes. To establish validity, participating students were asked to confirm identified themes.

3 Results

Our initial data exploration uncovered two major themes: *Connection* and *Disconnection*.

3.1 Connection

Six students described experiences of purposefully using Facebook to form connections as a means of organizing their social and academic activities. Participants identifying Facebook as a means for connection described their Facebook accounts as constantly active. In their interviews, these students described Facebook as an essential tool for their academic and personal success. These reports were validated by log-data; these students followed multiple university accounts, RSVPed to events, and joined class and activity groups to share homework information and reminders about deadlines.

3.1.1 Connection forward/backward

In addition to connection as a theme, data suggested an intrinsic subtopic. Our respondents reported using social media as a means to connect in two ways, forward and backward. Forward connectedness was reflected when social media was used to meet new people in college. Backward connectedness was reflected in participants using Facebook to keep in touch with friends from high school and others they "left behind."

3.2 Disconnection

At the same time, four students experienced disconnection, disengagement, and unrealized expectations. Participants reflecting disconnection interacted on Facebook much less and used the site differently than connected students. One of the students described struggling with adapting to university culture, especially the prevalent dependence on social media. By the end of the year, two of the students, who reflected disconnection, deactivated their Facebook accounts.

Table 1: Examples of interview themes

Theme	Example
Connection	*"I love being able to make new friends from the university clubs through Facebook, I can always be contacted and people are always updating about current school events"*
Forward Connection	*"I missed a musical event because my roomie was not interested, but now I have joined a FB group. I am able to get new information on the latest events and find people to go with."*
Backward Connection	*"I am getting tired of the people here. Luckily, I can complain about them to my friend Leah who is back home."*
Disconnection	*"I never post a status update to say what I'm doing. I don't use it to share how I feel. I don't have anything against Facebook it's just that it cannot be everything, everywhere."*

4 Discussion

These stories represent some of the realities of social media use by first-year undergraduate students, making the transition to college. For some students, Facebook offered a space where the smallest intricacies of student life could be planned and documented for all to join. The "always on" nature of Facebook offered many opportunities for socialization. For other students, themes of disconnection emerged, as students reported their preference to connect with friends face-to-face, as opposed to through the digital site. In future research students' idealized hopes for their in-person and virtual lives should be explored.

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Appendix D Think-Aloud Instructions

Participant 118

Research Study

Welcome! This study will ask you to read and write a research report on the benefits and harms of social media. You will be allowed to use three research sources.

These resources are short reports published in peer-reviewed journals. Unlike full-length journal articles, short reports are meant to quickly communicate research findings to a broad audience.

Resources		
The Influence of Social Media on Students' Academic Performance and Life Satisfaction (Cochran & Kramer)	Using Social Media to Promote Collaboration in Higher Education (Banks & Pitt)	Exploring the Role of Facebook Among First-year College Students (Ayala & Fields)

Think Aloud:
As you complete this study, we will ask you to think-aloud. A think-aloud asks you to say whatever you're thinking or doing. We will ask you to think-aloud as you're reading and writing. If you are quiet for more than 15 seconds, I'll ask you to please remember to think-aloud.

In summary, you will read three short reports in order to write a research report about the benefits and harms of social media while you think aloud. You will type your report underneath the words highlighted below.

Do you have any questions?

Please type your research report on the benefits and harms of social media below. Don´t forget to cite your sources:

Appendix E Examples of Separate Representations, Emergent Documents Model, and Documents Model

Type of representation	Example
Separate Representations	There are many benefits and consequences of utilizing social media. For college students in general, iit'sabout social interaction and belonging to the group*. Social media can act as a distraction but also a resource for students.* Per Ayala and Fields (2*),* students utilized the social media platform to organize their social and academic activities. This means iit'sbeing used as a tool of organization. Like, we used to use paper journals. But more technologically advanced. In addition, students were able to feel ""onnected""to other students. That can be positive and negative. They were reaching out to new friends but also holding on to ties of those they ""eft behind""(Ayala and Fields, 2). One of the consequences of social media is the distraction factor. According to Cochran and Kramer, it was shown that there were detrimental effects with regard to academic success but on the other hand enhanced their social life and ""ife satisfaction""(Cochran and Kramer, 2).
Emergent documents model	According to the articles, social media could be used by college students in various ways producing different outcomes. When used as a tool in college classes to spark discussions and engagement, it is reported to have a positive impact on sstudent'sacademic performance as evident by an increase in final exam grades for students who participated in weekly discussion posts on Facebook (Banks & Pitt*).* However, it is also noted that the students who participated in such social media discussions reported lower levels of course satisfaction (Banks & Pitt). *Similarly, when used as a personal tool for social engagement* to ease the transition from high school to college, social media platforms again present both benefits and harms. Some reported to have maximized the benefits of social media to connect with new social circles and past relationships while others have distanced themselves from social media platforms as they see the ubiquitous nature of social media overwhelming and counterproductive to their social life (Ayala & Fields). Lastly, a study of college student's social media use, academic performance, and college satisfaction reveals that as social media use increases, academic performance decreases while college life satisfaction increases (Cochran & Kramer). *Overall, it seems like social media presents both benefits and harms depending on the way that social media is being consumed.* The results should be further examined as the *methodologies in the three*

	research articles present notable challenges to its validity. In particular, Ayala & Fields only included 10 participants *and* the definition of the construct ""ife satisfaction""laid out by Conchran & Kramer should be clarified so analysis of its results could be better utilized by college administrators.
Documents model	Upon reading three research articles focused on social media in the college context, the researchers present evidence regarding the benefits and drawbacks of social media. *The three articles specifically focus on the social media platform of Facebook.* These articles provide pertinent information for both college students and educators (teachers/professors) *because they examine how social media impacts academics, social perceptions, and classroom discussions*. To begin, according to Ayala & Fields, there are four major roles that Facebook plays in the lives of college students. These four major roles are connection, forward connection, backward connection, and disconnection. After spending one year studying ten students of different backgrounds (alumni, out-of-state, international), the researchers found that Facebook led to a paradox of both connectedness and disconnectedness. Facebook stands to bring people together in seamless ways and provide more awareness and potential engagement with events, while also magnetizing missed social opportunities and/or invitations. Taking this paradox to the next level, Cochran & Kramer examine how social media specifically impacts academics and social perceptions. These researchers found that social media had a negative impact on academics, but it had a positive impact on social life for the 340 business students surveyed. *Cochran & Kramer surveyed many more students than Ayala & Fields, and offered similar conclusions.* Since social media platforms like Facebook constantly broadcast relationships and activities, it stands to reason that these constant interactions can distract from the academics while simultaneously nurturing the social lives of college students. *That said, while Cochran & Kramer explored the negative academic effects in general, Banks & Pitt found that Facebook can positively impact student success in the specific context of discussion forums.*Upon comparing two groups of students, Banks & Pitt found that students who were required to participate in asynchronous group discussions throughout the course outperformed those who completed their assignments individually. However, as academic success increased, Banks & Pitt found there to be a negative effect on course perceptions. In other words, students who were required to talk on social media felt more anxiety throughout the course.

In the end, *these three research studies point to the fact that social media can both benefit and harm college students, depending on the context.*These studies have various implications, and can be particularly helpful to college students and educators as they navigate the waters of social media. Social media can both enhance and detract from the academic and social lives of college students. This means that when social media is being used, it is important for the user to be aware of its benefits and drawbacks to reflect on how it may be affecting them individually. In follow-up studies, it would be helpful to examine the following questions: Does social media play different roles in different majors? What techniques can students and teachers employ with notifications when using social media in class, in order to avoid increased anxiety? Is there always an inverse relationship between the academics and the social implications of social media? Would these studies yield the same results if they looked at social media platforms beyond Facebook (i.e., Snapchat, Instagram)?