Soaring to Successful Synthesis Writing: An Investigation of SOAR Strategies for College Students Writing from Multiple Sources

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Abstract: Synthesis writing is a common college requirement. It is a reading-to-write task that involves selecting, organizing, and connecting information from more than one source to construct a new text. College students struggle with synthesis writing because they fail to organize and connect ideas. The present study investigated the synthesis writing benefits of a strategy system called SOAR that helps students select, organize, associate, and regulate information. Experiment 1 investigated the efficacy of SOAR-provided instructional materials. College students studied four texts with or without SOAR supplements in preparation for writing a synthesis essay. SOAR-aided students produced more complete essays (selecting), better categorically organized essays (organizing), and essays containing more intertextual connections (connecting) than non-SOAR-aided students. Experiment 2 investigated the trainability of SOAR and the effect of student-generated SOAR materials on synthesis writing. College students first completed a baseline synthesis writing task. Next, they either received SOAR training or did not receive SOAR training, instead practicing their preferred strategies. Finally, they performed another synthesis writing task. SOAR-trained students produced more complete and better organized essays than non-SOAR-trained students. Underlying cognitive mechanisms, study limitations, future research directions, and practical implications were discussed.

Keywords: synthesis writing; SOAR strategy system

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1. Introduction

Synthesis writing is a common academic requirement (Addison & McGee, 2010; Cumming, Lai, & Cho, 2016; Massengill, 2015). It is a reading-to-write task that involves the processes of selecting, organizing, and connecting information from more than one source to construct a new text (Spivey & King, 1989). For example, students might read two source documents, each about a different learning theory, and compose a comparative essay, or they might select, organize, and connect information from several articles about note taking to compose a literature review about that topic (Torraco, 2016).

Although synthesis writing is a common academic requirement, most students are ineffective synthesis writers (Addison & McGee, 2010; Cumming et al., 2016; Massengill, 2015). Imagine students are assigned to read the three texts in Figure 1 and to write a synthesis essay comparing the three types of creativity. How might students go about this assignment?

Adaptive Creativity
Adaptive creativity is the ability to use past knowledge and strategies to accommodate problem-solving situations. Examples include any of the day-to-day problems that a homemaker or a skilled person in a profession or vocation would have to solve. For example, a homemaker may have to use adaptive creativity to plan and execute a new house-cleaning and meal preparation strategy when it is learned that unexpected guests will soon be arriving. The motivation of the adaptively creative person is to maintain the status quo or to slightly improve the status quo. Adaptive creativity can be mastered over 3-5 years.

Innovative Creativity
Innovative creativity refers to a person's ability to significantly change or alter a major process, product, or school of thought. Quite often an innovator's motivation stems from dissatisfaction, which results in a desire to make a significant change. The time demand for innovative creativity is 5-10 years. Examples of innovatively creative people include inventors who significantly improve products or produce new products, such as Steve Jobs, who was the founder of Apple Inc.

Emergent Creativity
Throughout history, there have been people who have given rise to intellectual, social, or political revolutions. For example, Einstein's groundbreaking theory of relativity, along with his contributions to the development of quantum theory, laid the foundation of modern physics. Emergent creativity refers to the person's ability to profoundly change existing ideas, beliefs, or styles. The change is so profound that the whole direction of a discipline is reshaped. Obviously, such a significant change involves a lifetime of experience and thinking in a particular field. Emergently creative people's motivation stems from their bent to attack basic assumptions: They are more concerned with their own ideas than the underlying assumptions of a discipline.

Figure 1. Creativity texts.

Some students might use patchwriting, where they build the essay based mainly on one text and add one or two ideas from the other texts (Barks & Watts, 2001). An example of patchwriting is shown in Figure 2's left frame: the essay is mostly about adaptive creativity and only mentions the definitions of the other two types of creativity at the end.

Some students might use tag-all writing, where they include important ideas from all texts but report them in a disjointed fashion (Britt, Perfetti, Sandak, & Rouet, 1999). An example of tag-all writing is shown in Figure 2's middle frame: the essay includes all the important ideas about the three types of creativity, but there is no organization or connection among these ideas.

Other students might use separate representation writing, where they summarize each text and compile the three summaries one after another but never synthesize them (Britt et al., 1999). An example of separate representation writing is shown in Figure 2's right frame: the essay consists of three separated summaries about adaptive, innovative, and emergent creativity, but there is no discussion about how these types are alike or different.

Patchwriting

There are three types of creativity: Adaptive, Innovative, and Emergent. Adaptive creativity is the ability to use past knowledge and strategies to solve day-to-day problems. For example, a homemaker may use adaptive creativity to clean the house or cook a meal when he learns unexpected guests will soon be arriving. The motivation for this type of creativity is to maintain or slightly improve the status quo. This type of creativity can be developed in 3-5 years. Innovative creativity is the ability to invent something, like the type of creativity that Steve Jobs demonstrated. Emergent creativity is the type of creativity that brings revolution, like Einstein exhibited.

Tag-all Writing

Adaptive creativity uses past knowledge and strategies to solve day-to-day problems. One example is a homemaker getting the house ready and preparing a meal upon short notice of unexpected guests arriving. The motivation is to maintain or slightly improve the status quo. The time demand for adaptive creativity is 3-5 years.

Innovative creativity significantly changes a major process, product, or school of thought. The motivation is to make a significant change after experiencing dissatisfaction. The time demand for innovative creativity is 5-10 years. An example of innovative creativity is Steve Jobs's Apple products.

An example of emergent creativity is Einstein's groundbreaking theory of relativity. Emergent creativity profoundly changes existing ideas, beliefs, or styles. The time demand for emergent creativity is one's lifetime. The motivation for emergent creativity derives from the creative person's concern with their own ideas.

Separate Representation Writing

Adaptive creativity uses past knowledge and strategies to solve day-to-day problems. An example is a homemaker getting the house ready and preparing a meal upon short notice of unexpected guests arriving. As shown in the example, the motivation is to maintain or slightly

improve the status quo. The time needed to develop adaptive creativity is 3-5 years.
Innovative creativity is the ability to significantly change a major process, product, or school of thought. An example is Steve Jobs's Apple Inc. The motivation for this type of creativity is to make a significant change after experiencing dissatisfaction. The time needed to develop this creativity is 5-10 years.
Emergent creativity is the ability to profoundly change existing ideas, beliefs, or styles. An example is Einstein's groundbreaking theory of relativity. Like Einstein, emergently creative people attack basic assumptions in their field and have more faith in their own ideas than the assumptions of the field, which is their motivation for this type of creativity. The time demand for emergent creativity is one's lifetime.

Figure 2. An example of patchwriting, tag-all writing, and separate representation writing.

None of the Figure 2 examples represent effective synthesis writing. According to Spivey and King (1989), synthesis writing involves the processes of selecting, organizing, and connecting information from multiple source texts to construct a new text. Selecting involves the writer deciding which information from each text should be included. Organizing involves the writer arranging selected information according to logical relationships across topics. Connecting involves the writer linking and integrating information from multiple texts to produce a new text (Spivey, 1991). Table 1's first three columns show why patchwriting, tag-all writing, and separate-representation writing are ineffective: They fail to engage all three processes. Patchwriting engages none of the processes; tag-all writing engages only the selecting process; separate representation writing engages the selecting and organizing processes but not the connecting process.

Table 1. Types of Synthesis Writing with respect to Writing Processes

	Patchwriting	Tag-All Writing	Separate Representation Writing	Effective Synthesis Writing
Selecting	-	+	+	+
Organizing	-	-	+	+
Connecting	-	-	-	+

An example of an effective synthesis essay about the three creativity types is shown in Figure 3. The essay selects all relevant information about each type of creativity, organizes it by categories (i.e., outcomes, examples, time demands, and motivation) cutting across the creativity topics, and connects that information across the texts (e.g., the three types of creativity increase in sophistication), thereby comparing the three types of creativity.

The three types of creativity—adaptive, innovative, and emergent—differ with respect to outcomes, examples, time demands, and motivation. With respect to outcomes and examples, the three types—going from adaptive to innovative to emergent—increase in sophistication. Adaptive creativity involves solving a common problem in a new way such as an efficient way to get a house and meal ready for unexpected guests. Innovative creativity is more sophisticated. It involves inventing or improving a product such as Steve Jobs's Apple products. Emergent creativity is the most sophisticated. It involves reshaping an entire discipline. When Einstein proposed the theory of relativity and developed quantum theory, he laid the foundation of modern physics.

In line with this progression of outcomes is the progression of time demands necessary to achieve those outcomes. As the type of creativity grows in sophistication, so does the number of years necessary to become creative: adaptive, 3-5 years; innovative, 5-10 years; and emergent, a lifetime. Thus, the more sophisticated the outcome, the longer the time demand to become creative.

The motivation for the types of creativity stems from either internal or external sources. The source of motivation is external for adaptive and innovative creativity, but internal for emergent. The source of motivation is consistent with the outcome. Adaptively creative people and innovatively creative people are concerned with solving problems that arise from the environment—an external source. Emergently creative people, by contrast, are concerned with their own thoughts and ideas about a discipline—an internal source.

Figure 3. An example of effective synthesis writing.

Synthesis writing tasks are difficult for students at all levels (Spivey & King, 1989; Lenski & Johns, 1997; Mateos, Martín, Villalón, & Luna, 2008). Such difficulty is not surprising because synthesis writing is a complex hybrid task that requires students to alternate their roles between reader and writer (Martínez, Mateos, Martín, & Rijlaarsdam, 2015; Spivey, 1997). According to Martínez and colleagues (2015), successful synthesis writing requires three cognitively demanding processes. First, during reading, students must integrate the source texts by extracting key information and comparing and contrasting the information to build semantic relationships among texts. Second, during composing, students must alternate between tasks such as reading, note taking, and developing a rough draft. Third, throughout the synthesis writing process, students must monitor, review, and revise the already written text. The hybrid and complex nature of synthesis writing, though, has epistemic benefits because it yields knowledge transformation (Moran & Billen, 2014; Tierney & Shanahan, 1996; Tynjälä, 2001).

1.1 Strategies for Synthesis Writing

Although synthesis writing is a knowledge-transforming task (Wiley & Voss, 1999) and has epistemic benefits (Moran & Billen, 2014; Tierney & Shanahan, 1996; Tynjälä, 2001), many college students adopt a knowledge-telling writing approach and simply report what they read (Addison & McGee, 2010; Dovey, 2010; Mateos & Solé, 2009; Neuwirth & Kaufer, 1989; Solé, Miras, Castells, Espino, & Minguela, 2013). Not surprisingly, their essays do not demonstrate information synthesis. In one study

(Spivey, 1991), students' synthesis essays were compared with source texts, and 58% of essay sentences were derived from source text sentences via paraphrasing or direct quotation, 35% were summaries of a single source text, and only 7% were the synthesis of two or more source texts. These findings reflect the knowledge-telling approach students commonly use.

Student writers commonly use two strategies: note taking and summarization. Both strategies are inadequate to aid all key processes of synthesis writing and are, therefore, associated with knowledge telling and weak synthesis essays (e.g., Anmarkrud et al., 2014; Dovey, 2010; Mateos & Solé, 2009; Segev-Miller, 2007).

Note taking

Note taking is a commonly used synthesis writing strategy (Dovey, 2010; Mateos & Solé, 2009; O'Hara, Taylor, Newman, & Sellen, 2002; Segev-Miller, 2007). Most students take notes spontaneously to extract important information from texts during reading (Dovey, 2010; Segev-Miller, 2007). In one case study (Mateos & Solé, 2009), researchers observed students completing a synthesis writing task and reported their two simple steps: select information using note taking and then use notes to compose essays. Their prototypical steps resembled how novices approach writing (Neuwirth & Kaufer, 1989) and resulted in low quality synthesis writing. Note taking alone is not sufficient for good synthesis writing. Students who simply select information without further organizing and connecting it produce synthesis essays that are no better than the essays of students who do not take notes (Gil, Vidal-Abarca, & Martínez, 2008).

Summarization

Another commonly used, yet inadequate, synthesis writing strategy is summarization (Dovey, 2010; Mateos & Solé, 2009). In one study (Dovey, 2010), college students wrote literature reviews, and their primary strategy was summarizing each source text in turn and then stacking those summaries one after another in their final writing product. Their literature reviews naturally failed to synthesize source information. Even though summarization is an effective strategy for single-text comprehension (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Thiede & Anderson, 2003), summarization alone does not enhance multiple-text comprehension (Bednall & Kehoe, 2011), which is the basis for synthesis writing. When summarizing each text, students select important main ideas and supporting details and organize selected information in a new text. The resulting text, though, does not organize information in a comparative way or connect information across texts (Newell, 2006). In fact, summarizing each source text in turn promotes piecemeal processing with minimal integration (Garner, 1987; Mateos & Solé, 2009).

1.1.1 Effective Synthesis Writing Strategies

Successful synthesis writing depends on students selecting, organizing, and connecting information from multiple texts (Spivey & King, 1989). Therefore, synthesis writing strategies must help students select important text information, organize it according to inherent relationships (e.g., hierarchical, temporal, comparative), and connect information across texts to reveal intertextual relationships. As reviewed in the previous section, most college students use strategies such as note taking and summarization to select information (Dovey, 2010; Mateos & Solé, 2009). However, these strategies alone are not enough to produce successful synthesis writing, because they do not aid organizing and connecting information across texts. Thus, strategy instruction research has focused on teaching students to organize and connect information when they write a synthesis essay. Two more integrative synthesis strategies are reviewed next: graphic organizers and relationship prompting.

Graphic organizers

Graphic organizers such as concept maps (Novak, 1990), networks (Dansereau & Holley, 1982), and matrices (Kiewra, 2012) spatially organize ideas so that relationships among ideas are evident (Kiewra, 2012). Graphic organizers also enhance students' synthesis writing. In one study (Risemberg, 1993), students read two texts before writing a synthesis essay. Half had been trained to use graphic organizers for writing; half had received no training. The graphic organizer group produced higher quality synthesis essays than the no-training group. In another study (Hammann & Stevens, 2003), middle school students wrote synthesis essays under one of these treatment conditions: graphic organizer instruction only, summarization instruction only, graphic organizer plus summarization instruction, or no instruction. The three treatment groups practiced their group-specific strategies over six consecutive days and then completed a post-intervention comparative essay. The two groups receiving graphic organizer instruction composed essays with better comparative text organization than the other groups.

Graphic organizers were also incorporated in multiple-component interventions to improve synthesis writing (Kirkpatrick & Klein, 2009; Reynolds & Perin, 2009). In Kirkpatrick and Klein's (2009) study, seventh and eighth graders in four classes participated in a three-week intervention study during regular class periods. The intervention group first received instruction about comparative text structure and was next trained to use a planning strategy called IAPN, an acronym for "I Am Planning Now." Specifically, IAPN-instructed students practiced creating a matrix-like table to select and organize information from two assigned texts. The control group practiced some genre-specific writing but did not practice comparative writing. Following the three-week intervention, students were assigned to write a comparative essay contrasting black bears and polar bears. More essays from the IAPN group were scored as "true comparison" in terms of organization than from the control group. Furthermore, true-comparison essays received higher holistic quality scores than other essays.

Reynolds and Perin (2009) compared two interventions, one featuring graphic organizers and one featuring summarization, with a no-instruction practice-only intervention among middle school students. Following the three-week training, students were assigned to write a comparative essay after reading two texts about funerals. Five days later, students were assigned to write another comparative essay (a near-transfer task) based on two texts about Alexander the Great. Seven days after that, students were assigned to write a third comparative essay (a far-transfer task) based on reading three texts about digestive systems. The graphic organizer group's essays received higher holistic quality scores than the essays of the other two groups on all three writing tasks. Furthermore, the graphic organizer- and summarization-trained groups included more source texts ideas than the control group. Therefore, both strategy interventions enhanced idea selection, but only the graphic organizer intervention improved overall synthesis writing quality.

Relationship prompting

Relationship prompting, such as asking "why" questions or giving students explicit instruction to look for relationships, improves associative learning from texts (e.g., Dornisch, Sperling, & Zeruth, 2011; Ozgungor & Guthrie, 2004; Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987; Woloshyn, Willoughby, Wood, & Pressley, 1990). In a three-day synthesis writing study (De La Paz & Felton, 2010), high school students were assigned to either an intervention group or a control group prior to writing an historical argumentative essay using a primary and secondary text about an historical event. The intervention prompted students to look across the sources for common and different text ideas. The control group did not receive relationship prompting. Both groups also practiced writing argumentative essays and received writing feedback. Three days later, both groups wrote a final argumentative essay. Relationship prompting helped students connect information. The intervention group wrote longer and more persuasive essays that included more elaborate claims and rebuttals than the control group.

1.1.2 Strategy Systems for Synthesis Writing

The aforementioned studies found that graphic organizers facilitated selecting and organizing information and that relationship prompting facilitated connecting information. However, neither strategy facilitated all three synthesis writing processes. It might not be realistic to find one strategy that aids all three processes. Thus, a multiple-component strategy system that includes strategies for maximizing each synthesis writing process might better help students write synthesis essays than any single strategy.

One study (Martínez et al., 2015) tested the effects of a synthesis writing strategy system called SWSL (Strategies for Writing Syntheses to Learn) among sixth grade students. The SWSL system included instruction on five strategies: selection,

elaboration, organization, prior knowledge integration, and integration across source texts. Students either received the SWSL instruction or traditional synthesis writing instruction. Both groups wrote similar quality synthesis essays prior to instruction, but the SWSL group wrote better synthesis essays than the comparison group following instruction. This study showed that a multiple-component strategy system that aids all three synthesis writing processes (i.e., selecting, organizing, and connecting) improved synthesis writing among sixth grade students. More studies are needed to test synthesis writing strategy systems for various levels of students. One strategy system that shows potential to improve synthesis writing for college students is SOAR (Kiewra, 2005, 2009).

1.2 SOAR

The SOAR strategy system was developed to help instructors teach (Kiewra, 2009) and help college students learn from texts (Daher & Kiewra, 2016; Jairam & Kiewra, 2009, 2010; Kiewra, 2005). SOAR is an acronym for the system's four components: Select, Organize, Associate, and Regulate. The first component, select, refers to selecting and recording complete notes from texts and lectures. Research shows that note taking while learning leads to higher achievement than simply reading (e.g., Kiewra, 1985; Kobayashi, 2009; Peverly, Brobst, Graham, & Shaw, 2003) or listening (Kiewra et al., 1991) and that note completeness is positively correlated with achievement (Baker & Lombardi, 1985; Kiewra, 1987).

The second component, organize, refers to arranging selected notes in a graphic organizer. Table 2 shows a matrix graphic organizer for the creativity materials, where information from the three texts is presented in one place, organized by categories (such as outcome and motivation), and ready for comparison. A matrix is more effective than linear notes because the matrix better localizes related information (Kauffman & Kiewra, 2010; Larkin & Simon, 1987). Matrices also display information in economical and visual ways that allow relationships to be quickly identified, whereas linear notes obscure relationships (Kiewra, 2012; Larkin & Simon, 1987).

The third component, associate, refers to connecting multiple ideas to learn meaningful relationships among them, rather than examining one fact at a time in a piecemeal fashion. For example, examining Table 2's first row, it is easy to see that creative outcomes appear progressively more sophisticated going from adaptive (solving a common problem) to innovative (creating a new product) to emergent (starting an intellectual revolution). Association strategies, such as prompting students to find relationships and asking elaborative questions (e.g., How do the motivations to become creative change across the three types?), improve learning over piecemeal techniques (e.g., Atkinson et al., 1999; Kobayashi, 2009; Pressley et al., 1987).

Table 2. Matrix Organizer for Sample Creativity Materials

	Adaptive Creativity	Innovative Creativity	Emergent Creativity
Outcome	Solving a common problem in a new way	Creating a new product or altering a major school of thought	Starting intellectual, social, or political revolutions
Motivation	Maintaining or improving status quo	Dissatisfaction with current products or thoughts	Reshaping a field in line with one's own thoughts
Time Demands	3-5 years	5-10 years	Lifetime
Example	Homemaker uses new meal strategies for unexpected guests	Steve Jobs's Apple products	Einstein's groundbreaking theory of relativity

The fourth component, regulate, refers to assessing learning using retrieval strategies like self-testing, rather than rote learning strategies like re-studying, re-reading, and re-copying notes. Returning to the creativity materials, students might assess their learning by asking these questions: (a) Which type of creativity is used most in day-to-day problem solving? and (b) What is the motivation for emergent creativity? Retrieval practice (e.g., self-testing) leads to higher achievement than repeated learning opportunities such as rereading notes (e.g., Frase & Schwartz, 1975; Karpicke, 2012; Roediger & Butler, 2011).

Thus far, four studies (Daher & Kiewra, 2016; Jairam & Kiewra, 2009, 2010; Jairam, Kiewra, Rogers-Kasson, Patterson-Hazley, & Marxhausen, 2014) have investigated the integrated SOAR system for text learning among college students. These studies compared the achievement of SOAR-aided students and non-SOAR-aided students who studied various prose passages. Across the four studies, SOAR-aided students consistently achieved more on fact, concept, and relationship tests. Relationship differences were most pronounced—usually 30-40% higher. Specifically, Daher and Kiewra (2016) extended SOAR investigations into multiple-text learning and tested the trainability of SOAR. College students were assigned randomly to either the SOAR group or the preferred-strategy group. Both groups participated in a 30-minute training session: the SOAR group received SOAR training and practiced SOAR using three texts. The preferred-strategy group received the same practice texts but was instructed to use their preferred strategies to study them. Following training, participants studied five new texts, created their own study materials, and took an achievement test covering fact, relationship, and concept learning. An examination of participant-generated study materials revealed that the SOAR group recorded more notes (selection), created more graphic organizers (organization), and generated more associations (association) and practice questions (regulation) than the preferred-strategy group. The SOAR group also

outperformed the preferred-strategy group on all three tests: fact (74% vs. 65%), concept (57% vs. 46%), and relationship (70% vs. 39%), with the largest effect seen for relationship learning. In conclusion, SOAR training positively impacted study behaviors and achievement.

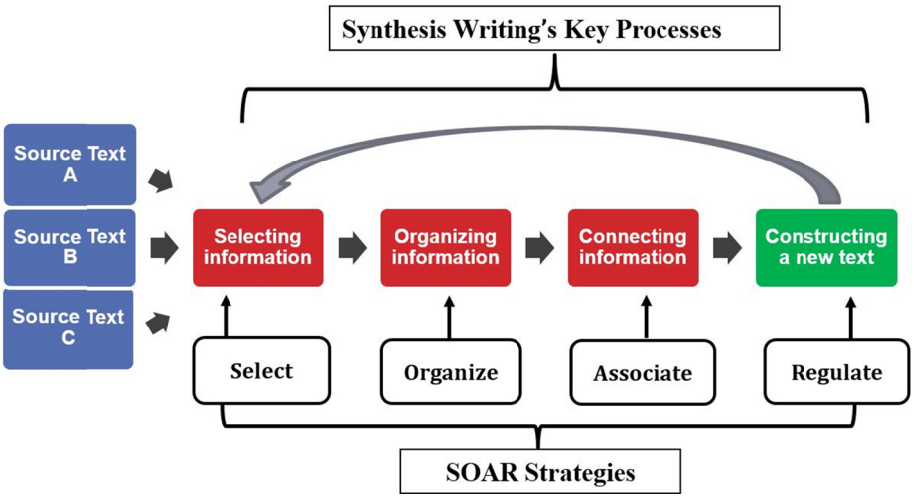

Figure 4. Key processes for synthesis writing and corresponding SOAR strategies.

1.3 SOAR and Synthesis Writing

Although previous SOAR studies examined SOAR for prose learning (Daher & Kiewra, 2016; Jairam & Kiewra, 2009, 2010), it is reasonable to propose that SOAR might also be effective for synthesis writing. Empirically, SOAR was especially robust for relationship learning, which is the crux of synthesis writing (Spivey, 1991). Theoretically, SOAR supports all three key processes necessary for good synthesis writing as shown in Figure 4. SOAR's first two components, select and organize, aid synthesis writing's selecting and organizing processes. SOAR's third component, associate, aids synthesis writing's connecting process. SOAR's fourth component, regulate, can help writers monitor other writing processes. For example, as writers compose, they might ask themselves: "Am I selecting important information from texts?" or "Am I organizing it?" Although Spivey and King (1989) did not specify regulating as a key synthesis writing process, self-regulatory strategies, such as planning, monitoring, and self-evaluation, are related to successful synthesis writing (e.g., Dovey, 2010; Segev-Miller, 2007).

2. The Present Study

The present study extended previous SOAR research by applying SOAR to synthesis writing. Previously, SOAR has only been investigated as a means for bolstering study behaviors and achievement (Jairam & Kiewra, 2009; Jairam et al., 2014). Experiment 1 assessed SOAR's full potential as a writing strategy by providing students with complete and optimal SOAR materials to help them in their synthesis writing task. Experiment 2 extended Experiment 1 by examining the potential of SOAR training for improving synthesis writing. Previous SOAR research showed that brief SOAR training (as little as 30 minutes) helped students learn information from multiple texts (Daher & Kiewra, 2016).

2.1 Experiment 1

Experiment 1 examined the effectiveness of SOAR materials for synthesis writing and addressed the research question: Does providing SOAR supplements improve synthesis writing? To answer this question, we assigned college students to study four texts about creativity with or without SOAR supplements in preparation for writing a synthesis essay that compared the four types of creativity. It was predicted that students who received SOAR supplements would write better essays (regarding information selection, essay organization, and intertextual connections) than students who did not receive SOAR supplements.

2.1.1 Methods

Participants and design

Participants were 32 college students enrolled in an educational psychology course at a large Midwestern university who participated to receive course credit. Seventy percent were female. Most were juniors (38%) and seniors (27%). The average age was 20 years old. Most (82%) held grade-point averages of 3.0 or higher out of 4.0. Participants were assigned randomly to either the SOAR experimental group (n = 16) or the preferred-strategy control group (n = 16).

Apparatus and materials

Apparatus included thirty-two 19-inch, flat-screen, desktop computers in a university computer lab. Computers contained Microsoft operating system Windows 10. Microsoft Word software was used to complete the writing task, and a Google Chrome browser was used to complete a Qualtrics online survey. Materials included: (a) texts, (b) SOAR materials (for the SOAR group), (c) writing task, and (d) survey.

1. Four *print-based texts* about creativity were used. These were longer and more detailed versions of the creativity texts found in Figure 1. Each text described a different type of creativity on a separate and single page: expressive (380 words), adaptive (352 words), innovative (323 words), and emergent (443 words). For each creativity type, 10 categories of information were presented: definition, time to

display creativity, time to develop creativity, goal, means to reach the goal, distinguishing characteristics, dimensions, examples, myth, and myth expelled. For example, a section in the expressive creativity text presented the goal and means to reach the goal as follows:

> The goal of the expressively creative person is to create a momentary flash of brilliance that fits the immediate situation yet stands apart from typical responses. In order to do so, the expressively creative person has mastered a calculated style.

The order of presented categories was varied in each text. The four texts contained a total of 81 idea units about creativity. Each idea unit contained a single fact such as "the goal of emergent creativity is to set trends" as suggested in Kintsch's (1988) model of text comprehension.

2. The *print-based SOAR supplements* contained a matrix that displayed all important idea units from the four creativity texts (covering SOAR's select and organize components), a list of association prompts (covering SOAR's associate component), and a self-regulation checklist (covering SOAR's regulate component). The matrix contained all 81 creativity facts organized in a two-dimensional table. In the matrix's top row, the four creativity types were displayed as topics and marked by number (1, 2, 3, 4). In the leftmost column, the 10 categories were listed and marked by letter (A, B, …, J). Each matrix cell contained a topic-category intersecting fact. For example, cell 1-A contained the Definition (A) of Expressive Creativity (1): The ability to generate a rapid yet brilliant response in a spontaneous situation.

   A list of 10 association prompts directed students to examine multiple matrix cells to identify intertextual relationships. An instruction and example were provided on top of the association page:

   > By examining the matrix organizer and using the prompts below, try to create associations that connect information from multiple texts. Here is an example:
   >
   > Association #1 (See 1-A, 2-A, 3-A, and 4-A): Creativity appears progressively more sophisticated, going from expressive (creating a momentary brilliance) to adaptive (solving a day-to-day problem) to innovative (creating a product) to emergent (reshaping a discipline).

   The remaining association prompts did not include sample associations. Prompts, rather than completed associations, were provided because SOAR studiers had access to SOAR materials during synthesis writing. If associations were provided, students could directly copy the associations in their writing.

   The self-regulation checklist helped students monitor and evaluate their writing. An instruction was given on top of the checklist: Use the checklist below to

monitor your writing process, evaluate your written product, and make revisions. Example items were: Did I include important information from all four texts? Did I write about how the creativity types are alike and how they are different? Previous SOAR studies (Daher & Kiewra, 2016; Jairam & Kiewra, 2009, 2010; Jairam et al., 2014) used self-testing as the regulate component because students were preparing for a test. The present study used a writing checklist instead because students were preparing for a synthesis writing task. Previous studies showed that asking students self-regulation questions (like those used here) improved their writing performance (MacArthur, Philippakos, & Ianetta, 2015; Schunk & Swartz, 1993).

3. The *writing task* involved writing a comparative essay about the four creativity types. A Microsoft Word document was left open for students to write the essay. At the top of the document was the writing instruction:

   In the next 30 minutes, write an essay to compare and contrast the four types of creativity you just read about. In your essay, be sure to discuss the similarities and differences among the four creativity types. You may use any materials you have to write the essay.

4. The *online survey* had three parts. Part 1 was a typing task to assess participants' typing speed. Typing speed was assessed because it might affect students' performance on the computer-based writing task. A 76-word passage about Japanese paper folding appeared on the screen and students were instructed to type the passage in a blank textbox below. The software recorded each student's typing time.

Part 2 was a demographic survey that asked participants to report their gender, age, ethnicity, class standing, and approximate cumulative GPA. Participants were asked whether English is their native language and asked about language proficiency because the learning task included reading and writing in English. Last, participants' prior knowledge about creativity was assessed using this question: How familiar were you with the texts' topic—creativity—before you read the texts? (a. I was not very familiar with the four types of creativity and most of the information from the texts was new to me; b. I had some knowledge about the different types of creativity, but still learned something new from the texts; c. I knew almost everything presented in the texts about creativity.)

Part 3 was an open-ended post-experiment questionnaire. The preferred-strategy control group was asked to describe in detail the steps they followed when writing the essay. The SOAR experimental group was asked a series of questions related to SOAR materials. The first question asked whether they used the provided SOAR materials. If they answered "No," two follow-up questions asked them to (a) explain why they chose not to use the SOAR materials, and (b) describe the steps used to complete the writing task. If they answered "Yes," three follow-up questions were posed related to: (a) how

they used the SOAR materials, (b) the helpfulness of the SOAR materials for completing the writing task, and (c) whether they would like to receive SOAR materials for future comparative writing tasks.

Procedure

Prior to the experiment, 32 students signed up for participation. A randomization procedure using Excel function *rand ()* was performed for group assignment. Half of the participants were assigned to the SOAR experimental group, and the other half were assigned to the preferred-strategy control group. Upon arrival to the computer lab, each participant was seated in front of a desktop computer. Participants were informed that they would study materials about the topic of creativity for 25 minutes and then write a comparative essay about creativity. The preferred-strategy control group received only the texts and blank paper for note taking. They were told that they can take notes on the creativity texts and blank paper and later use those texts and notes for writing their essay. The SOAR group received the texts, blank paper for note taking, and SOAR supplements. They were told that they can take notes on the creativity texts, blank paper, and SOAR supplements, and later use those texts, notes, and supplements for writing their essay. Following the 25-minute study period, participants were instructed to log onto the computer and to write a comparative essay in the open Word document. They were allotted 30 minutes for writing. Following writing, participants clicked the link to the online survey and responded to the survey. Experiment 1 took about one hour.

Essay scoring

Essays were scored with respect to information selection, essay organization, and intertextual connections. Information selection was determined by counting number of idea units included in the essay. Number of idea units was established by assigning one point for each noted idea unit based on a rubric that included all 81 idea units.

Essays were judged to have one of three organization structures: topical, categorical, or mixed. If an essay primarily listed text ideas and grouped them text by text (e.g., expressive, adaptive, etc.), it was a topical essay organization. If an essay organized information from different texts category by category (e.g., time to develop, goal, etc.), it was a categorical essay organization. If an essay combined ideas from each source text by alternating, but not integrating them, or if an essay included some comparisons but did not organize the comparisons by category (e.g., time to develop, goal, etc.), it was a mixed essay organization. Sample participant essays representing topical, categorical, and mixed organization are provided in Appendix A.

Intertextual connections were determined by the quantity and quality of across-text associations included in the essay. A list of 10 associations served as the scoring key. These associations corresponded to the association prompts the SOAR group received. An association connected information from two or more horizontally adjacent matrix cells and stated a meaningful relationship. One point was assigned for each accurate

and complete association and half a point for each accurate but incomplete association. For example, an accurate and complete association that compares the goal of each type of creativity is: The goal of creativity becomes progressively more profound going from expressive (creating a momentary brilliance) to adaptive (solving a day-to-day problem) to innovative (creating/improving a product) to emergent (reshaping a discipline), as the creativity appears progressively more sophisticated. An accurate but incomplete association about the goal of different creativity types is: The goal of emergent creativity (reshaping an entire discipline) is more profound than the goal of adaptive creativity (solving a day-to-day problem).

All essays were coded for the number of idea units, number of associations, and type of essay organization by the first author. In addition, two thirds of the essays were coded by a trained independent rater. The training process was as following: First, the independent rater read all four creativity texts, along with the rubric for information selection, example essays of topical, categorical, and mixed organization, and the association scoring key. Next, the independent rater scored three creativity essays from a previous pilot study with the first author who answered questions and clarified the scoring rubric and guidelines. Next, the rater and first author independently coded five essays, compared results, and then resolved disagreements. Following training, the rater independently coded 20 essays (not knowing their group affiliation). Intraclass Correlation Coefficient (ICC) was .97 for idea units and .93 for associations. Kappa was .70 for essay organization. These indices indicated good inter-rater agreement (Cohen, 1988). Disagreements were resolved by discussion.

2.1.2 Results

Preliminary analyses were conducted on demographic characteristics, prior knowledge, and typing speed. Chi-square tests assessed group differences for categorical variables (i.e., gender, class standing, ethnicity, GPA, English speaking, and prior knowledge). Independent *t* tests assessed group difference for continuous variables (i.e., age and typing speed). The control group and SOAR group did not differ with respect to demographic characteristics, prior knowledge, and typing speed, meaning that potential group writing differences were unaffected by these variables. Table 3 provides group statistics for these analyses.

Essay scores

A MANOVA was conducted on continuous essay variables: number of idea units selected and number of associations. These dependent variables were correlated with each other at a low level, $r = .218$, which was appropriate for using MANOVA. The multivariate test revealed a significant difference between the SOAR group and control group, $F\ (2, 29) = 8.64$, $p = .001$; Wilk's $\Lambda = .63$, partial $\eta^2 = .37$. Next, univariate ANOVAs were examined to determine how groups differed on idea units and

associations. Essay organization is a categorical variable, therefore a Chi-square test was conducted for organization.

Table 3. Experiment 1 Group Statistics for Demographic Variables

	Control	SOAR	Chi-square test	
	n (%)	n (%)	χ^2	p
Gender			.16	.69
Male	5 (31)	4 (25)		
Female	11 (69)	12 (75)		
Class Standing			4.62	.20
Freshman	3 (19)	1 (6)		
Sophomore	2 (12)	5 (31)		
Junior	8 (50)	4 (25)		
Senior	3 (19)	6 (38)		
Ethnicity			0	1.0
White	15 (94)	15 (94)		
Black	1 (6)	1 (6)		
Overall GPA			5.33	.15
3.5-4.0	7 (44)	6 (38)		
3.0-3.4	4 (25)	9 (56)		
2.5-2.9	2 (12)	1 (6)		
2.0-2.4	3 (19)	0 (0)		
Native English Speakers			NA	NA
Yes	16 (100)	16 (100)		
No	0 (0)	0 (0)		
Prior Knowledge			1.20	.55
Low	13 (81)	13 (81)		
Medium	2 (13)	3 (19)		
High	1 (6)	0 (0)		

	Control	SOAR	*t* test	
	M (SD)	M (SD)	t	*p*
Age	20.38 (.89)	20.56 (1.15)	.52	.61
English Class Taken	1.75 (.68)	1.86 (.96)	.42	.67
Typing Speed (WPM)	35.60 (8.22)	34.73 (6.61)	.33	.74

Table 4 presents test statistics for selection, organization, and association. Regarding information selection, SOAR writers included more text ideas than non-SOAR writers in essays. Regarding essay organization, the Chi-square test revealed a significant group difference. Ten SOAR writers used categorical organization (ideal comparison), four used mixed organization (inadequate comparison), and two used topical organization (non-comparison). In contrast, only two non-SOAR writers used categorical

organization, five used mixed organization, and nine used topical organization. Regarding intertextual connections, SOAR writers included more intertextual relationships in their essays than non-SOAR writers.

Table 4. Experiment 1 MANOVA and Chi-Square for Essay Scores

	SOAR (n = 16)	Preferred strategy (n = 16)	MANOVA		
	M (SD)	M (SD)	*F* (1, 30)	p	η^2
Information selection	40% (15%)	29% (12%)	5.29	.030	.15
Intertextual connections	3.5 (1.82)	1.8 (1.48)	8.28	.007	.22
			Chi-square test		
	n (%)	n (%)	χ^2 (2, N = 32)	p	
Organization			9.90	.007	
topical	2 (12.5)	9 (56.3)			
mixed	4 (25.0)	5 (31.3)			
categorical	10 (62.5)	2 (12.5)			

Survey responses

Participants described how they wrote the synthesis essay. For the control group, participants described the steps they followed when completing the essay. These responses were coded for the strategies mentioned, such as underlining, note taking, and reviewing. Ten out of 16 control participants said that they first underlined important information in the source texts and then wrote the essay based on the underlined information. Five participants took notes as they read and then used notes for constructing the essay. Although most participants mentioned looking for similarities and differences in the source texts, or comparing and contrasting different types of creativity, many of these responses were general and vague (e.g., "I then compared and contrasted each creativity with one other creativity," or "I just started with information that I remembered was the same and/or different between the types…"). Only two control group participants described specifically how they tried to compare the different creativity types. These two students reported that they identified common themes and compared each creativity type with respect to common themes.

For the SOAR group, 15 of 16 participants reported that they used SOAR supplements for the writing task. For those who reported using SOAR supplements, they described how they used the SOAR materials. Eight of the 15 participants mentioned using the matrix to compare information across all types of creativity or to help them organize the essay. Five participants only generally reported that they used SOAR for writing. On average, SOAR's helpfulness for the writing task was rated 4.3 out of 5.

Furthermore, 14 of 15 SOAR participants said that they would like to receive SOAR supplements for similar writing tasks in the future.
In summary, the control group reported primarily using selecting strategies such as underlining and note taking. Even though they also reported comparing the four types of creativity, few actually specified how they compared information. The SOAR group, on the other hand, reported benefiting from SOAR, especially the matrix, to help them compare creativity topics and organize the essays accordingly.

2.1.3 Discussion

SOAR supplements improved synthesis writing. The SOAR group selected more idea units from source texts and included more intertextual relationships in essays than the control group. Furthermore, more SOAR group participants organized their essays categorically than control group participants. In terms of survey responses, control group students largely reported using underlining as a selection strategy to extract important information from source texts and then writing essays based on that selected information without further organizing or associating ideas. The control group's reported strategy use (i.e., only selecting information) reflected what other writing researchers have found (e.g., Anmarkrud et al., 2014; Barzilai et al., 2015; Dovey, 2010; Mateos & Solé, 2009). Meanwhile, SOAR group survey findings showed that most SOAR participants found SOAR helpful for synthesis writing, especially the matrix for comparing types of creativity, and would like to use SOAR materials for future writing tasks. It should be noted, however, that the control and SOAR groups received different survey questions: the control group received one question asking them to describe their writing steps in detail, whereas the SOAR group received a series of questions asking them about SOAR-components use. Using different questions made it difficult to compare the groups' reported strategies reliably. In addition, Experiment 1 did not examine participants' study materials to check whether reported strategies and employed strategies matched. Experiment 2 improved both situations by asking both groups the same questions about strategy use and by examining participants' study materials.

Experiment 1 confirmed the efficacy of SOAR for synthesis writing when college students receive optimal SOAR materials aimed at facilitating the selecting, organizing, and connecting processes inherent in synthesis writing. Because it is unlikely that students would regularly receive complete SOAR supplements from college instructors when assigned a synthesis writing task, the next step was to train students to generate their own SOAR materials. That was the focus of Experiment 2.

2.2 Experiment 2

Experiment 2 investigated the effect of SOAR training and resulting student-generated SOAR materials on students' synthesis writing. The research question was: Does SOAR training improve synthesis writing? To answer this question, Experiment 2 used a

randomized controlled trial design. Participants first completed a baseline synthesis writing task (Time 1), then either received SOAR training or did not receive SOAR training but instead practiced their preferred strategies, and then performed another synthesis writing task (Time 2). It was predicted that SOAR training would facilitate synthesis writing at Time 2: Students who received SOAR training would write better synthesis essays than students who did not receive SOAR training. Furthermore, students who received SOAR training would improve their synthesis writing from Time 1 to Time 2, but students who did not receive SOAR training would not improve.

2.2.1 Methods

Participants and design

Participants were 116 college students drawn from the same research pool as those in Experiment 1 but who did not participate in Experiment 1. The average age was 20 years old. Twenty-eight percent were male, and 72% were female. The students were 18% sophomores, 43% juniors, and 38% seniors. Most (89%) held grade-point averages of 3.0 or higher out of 4.0.

Participants were assigned randomly to either the SOAR group (n = 58) or control group (n = 58), and each group completed an essay writing task at Time 1 and Time 2. This resulted in a 2 x 2 factorial design, where time was a within-subjects factor (Time 1 baseline and Time 2 post-training) and training was a between-subjects factor (SOAR training or no training).

Apparatus and materials

Experiment 2 took place in the same computer lab using the same apparatus as in Experiment 1. Materials included: (a) texts, (b) training materials, (c) writing tasks, and (d) surveys.

1. Two sets of *print-based texts* were used. One set included three texts about temperament adapted from Goldsmith et al. (1987) and from Zentner and Bates (2008). Each text described a unique approach to temperament research on a separate page: naturalistic approach (392 words), behavioral approach (373 words), and genetic approach (351 words). For each approach, 10 categories of information were presented: definition, dimensions, examples, first appearance, stability, view on difficult temperament, interactions with the environment, time origination, study methods, and major contributions. Category order differed among the texts. The three temperament texts contained a total of 68 idea units. The other set included three of the four creativity texts (i.e., expressive creativity, adaptive creativity, and innovative creativity) that were used in Experiment 1. The creativity texts used contained a total of 63 idea units. Three creativity texts were used in Experiment 2 for two reasons. First, we wanted to make the creativity materials similar to the temperament materials in terms of number of idea units. Second, Experiment 2 involved an additional participation task and longer 2-day time commitment than

Experiment 1. Reducing the number of source texts and the resulting writing tasks was a means for reducing student participation time and fatigue. In addition, we believed that synthesis writing could be assessed just as well using three texts as four texts.

2. *Training materials* for both groups were delivered via a computer-based PowerPoint presentation that advanced slides automatically and required 27 minutes to complete. Training materials were adapted from the 30-minute training materials Jairam and Kiewra (2016) successfully used to teach students to apply the SOAR system. Participants were provided with notepaper and pens to use during training.

   SOAR training began with an introduction of the SOAR strategy system. Next, participants were presented with three sets of materials in the following order: (a) Symbiosis, (b) The Study of Animal Behavior, and (c) Wildcats. First, the presentation showed the symbiosis text (84 words) along with a demonstration on how to use SOAR to study this text. Specifically, the select component was a complete set of notes about the three types of symbiosis. The organize component was a matrix of the selected information. The associate component was a list of associations about the different types of symbiosis. Each association and its related matrix cells were color-coordinated to show participants how the association was formed. The regulate component included two parts: an essay outline to guide the writing process and a checklist to evaluate the written product. The first SOAR demonstration took five minutes.

   Next, SOAR participants were provided with guided SOAR practice using two texts about the study of animal behavior: comparative psychology (64 words) and ethology (60 words). Participants practiced using each SOAR component to study the two texts with ongoing feedback. For select, participants practiced note taking. After select practice, a complete set of notes appeared on the screen as feedback. For organize, participants practiced creating a matrix to organize information about the two animal behavior study approaches. After organize practice, a completed matrix was shown as feedback. For associate, participants practiced connecting information as they examined the matrix. After associate practice, a list of associations was shown as feedback. For regulate, participants practiced creating an outline for a comparative essay about the two animal behavior study approaches. After regulate practice, a sample outline was shown as feedback. The guided SOAR practice took 10 minutes.

   Last, SOAR participants practiced SOAR uninterruptedly using the wildcat materials. The wildcat materials included four texts and each described a type of wildcat: tiger (143 words), lion (132 words), bobcat (92 words), and cheetah (76 words) with respect to physical features (call, weight, and lifespan) and lifestyle (habitat, range, and social behavior). Participants created their own study materials using all SOAR steps. Complete feedback showing how each SOAR step could be

used was provided at the end. The uninterrupted SOAR practice took 10 minutes. Participants did not write any essays during training.

The control group did not receive SOAR training, but they too had a PowerPoint presentation instructing them to practice their preferred strategies while studying the same three sets of materials as the SOAR group. Control group participants were told to study these materials as if they were going to write a comparative essay about the information, but they did not write any essays during training. They spent the same amount of time with the practice materials as did the SOAR group.

3. Two synthesis *writing tasks* were administered: a baseline writing task on Day 1 and a post-training writing task on Day 2. Writing task instructions were the same as described in Experiment 1.

4. Two *online surveys* were administered at different times. Survey 1 was administered following the baseline writing task to all participants and was identical to the survey given to Experiment 1's preferred-strategy group. It gathered participants' demographic characteristics, prior knowledge about the writing topic, and typing speed. Survey 2 was administered following post-training writing. Survey 2 assessed all participants' prior knowledge about the writing topic, either creativity or temperament. In addition, participants reported their prior knowledge about the SOAR strategy system by rating their familiarity with SOAR. Participants also rated their personal experiences using group-specific strategies for post-training writing. Both groups rated their training/practice activities in terms of effectiveness, enjoyment, and potential future use, with all ratings done using a 5-point scale with 1 representing least and 5 representing most. Furthermore, both groups responded to an open-ended question asking them how they studied the texts and wrote the essay. SOAR group participants were further prompted to identify any SOAR components they used, as well as the most and least useful SOAR components.

Procedure

The experiment occurred over two days, a week apart. On Day 1, participants assembled in the computer lab, with each person seated in front of a computer. Instructions informed participants they would study some materials from which they would write a comparative essay. Half from each group (SOAR or control) studied the creativity texts and half studied the temperament texts. Participants were allotted 25 minutes to study and were permitted to take notes on the texts and notepaper. They were told prior to studying that texts and notes could be used for writing. Following the study period, participants were allotted 30 minutes to write a comparative essay about the topic studied. Following writing, participants responded to Survey 1. The writing activity and survey were completed via computer. Day 1 activities took about one hour. On Day 2, a week later, participants returned to the computer lab and each was seated in front of a computer. During the 27-minute training session, the SOAR group received

SOAR training, and the control group practiced their preferred strategies. Following training, participants were instructed to study multiple texts using the strategies they practiced during training to prepare for later writing. They were told that the texts and any study materials they created could be used for writing. Those who studied creativity on Day 1 studied temperament on Day 2, and vice versa. Following the study period, participants wrote a comparative essay about the topic studied. Following essay writing, participants responded to Survey 2. Day 2 activities took about one hour and thirty minutes. A summary of the experimental design and procedure is provided in Table 5.

Table 5. Experiment 2 Design and Procedure

	SOAR group (n = 58)		Control group (n = 58)	
	Subgroup 1 (n = 29)	Subgroup 2 (n = 29)	Subgroup 3 (n = 29)	Subgroup 4 (n = 29)
Day 1				
Study texts (25 min)	Temperament	Creativity	Temperament	Creativity
Write baseline essay (30 min)	Temperament	Creativity	Temperament	Creativity
Take a survey (5 min)	Survey 1	Survey 1	Survey 1	Survey 1
Day 2				
Strategy training/practice (27 min)	SOAR	SOAR	Preferred	Preferred
Study texts (25 min)	Creativity	Temperament	Creativity	Temperament
Write post-training essay (30 min)	Creativity	Temperament	Creativity	Temperament
Take a survey (5 min)	Survey 2	Survey 2	Survey 2	Survey 2

Scoring

Essays were scored blindly with respect to information selection, essay organization, and intertextual connections as described in Experiment 1. The same trained rater who scored a portion of Experiment 1 essays was trained on the new materials (i.e., temperament) following the training steps described in Experiment 1. The rater independently scored about one third of essays (n = 76) to check reliability for these measures. Half of the essays were on temperament and the other half on creativity. For each topic, a nearly equal number of essays were selected randomly from the four conditions: baseline control, baseline SOAR, post-training control, and post-training SOAR. The reliability rater was blind to conditions. Intraclass correlation coefficients were .95 for the number of idea units and .92 for the number of associations. Kappa was .82 for organization. These indices indicated excellent agreement between raters (Cohen, 1988).

Table 6. Experiment 2 Group Statistics for Demographic Variables

	Control	SOAR	Chi-square test	
	n (%)	n (%)	χ^2	p
Gender			.38	.54
Male	15 (26)	18 (31)		
Female	43 (74)	40 (69)		
Class Standing			1.87	.60
Freshman	0 (0)	1 (2)		
Sophomore	12 (21)	9 (16)		
Junior	26 (45)	24 (41)		
Senior	20 (34)	24 (41)		
Ethnicity			6.52	.16
White	51 (88)	49 (85)		
Hispanic/Latino	4 (7)	3 (5)		
Asian/Asian American	0 (0)	4 (7)		
Black/African American	2 (3)	0 (0)		
Other	1 (2)	2 (3)		
Overall GPA			1.10	.78
3.5-4.0	25 (43)	23 (40)		
3.0-3.4	28 (48)	27 (47)		
2.5-2.9	3 (5)	6 (10)		
2.0-2.4	2 (3)	2 (3)		
Native English Speakers			.10	.75
Yes	52 (90)	53 (91)		
No	6 (10)	5 (8)		
Prior Knowledge			1.33	.51
Low	38 (65)	32 (55)		
Medium	19 (33)	25 (43)		
High	1 (2)	1 (2)		

	Control	SOAR	*t* test	
	M (SD)	M (SD)	t	p
Age	20.45 (1.05)	20.62 (1.04)	.88	.38
English Class Taken	2.00 (1.42)	2.09 (1.25)	.36	.72
Typing Speed (WPM)	36.46 (9.11)	36.69 (10.26)	.13	.90

Study materials created during baseline writing (notepaper and source texts) were examined to see whether participants created any study materials in preparation for the writing task. For training and post-training writing, participants' study materials were scored with respect to select, organize, associate, and regulate. For select, number of text ideas in notes was counted. For organize, whether participants created a graphic

organizer (e.g., matrix) was examined. For associate, number of associations created was counted. For regulate, whether participants created an essay outline was examined.

2.2.2 Results

Preliminary analyses confirmed that the SOAR group and control group did not differ with respect to demographic characteristics, prior knowledge, and typing speed, meaning that potential group writing differences were unaffected by these variables. Table 6 provides group statistics for these analyses.

Essay scores

With respect to continuous essay variables (i.e., number of idea units and number of associations), two-way ANOVAs (time x training) were conducted. ANOVAs, rather than a MANOVA, were used because these dependent variables were not sufficiently correlated with each other, $r = .026$. With respect to the categorical essay variable (i.e., essay organization), a three-way Chi-square test was conducted to determine whether essay organization was independent from time (baseline vs. post-training) and training (SOAR training vs. preferred strategy training). Table 7 displays essay scores for each group at each time. A correlation table for essay scores by groups is provided in Appendix B.

Table 7. Summary of Experiment 2 Essay Scores

		Baseline	Post-training
Information Selection (# of ideas)	SOAR	27% (10%)	35% (12%)
	Control	26% (10%)	32% (14%)
Intertextual Connections	SOAR	2.1 (1.1)	2.2 (1.6)
	Control	2.3 (1.4)	2.1 (1.2)
		Baseline	Post-training
Essay Organization			
Non-comparative	SOAR	50 (86%)	29 (51%)
	Control	50 (86%)	48 (84%)
Comparative	SOAR	8 (14%)	28 (49%)
	Control	8 (14%)	9 (16%)

Regarding information selection, there was a main effect for time on the number of idea units selected, F (1, 226) = 20.90, $p < .001$, partial $\eta^2 = .09$. Post-training essays contained more idea units from source texts than baseline essays. But there was no interaction effect of time and training ($p = .51$) nor main effect for training ($p = .14$).

Follow-up *t*-tests showed that both the SOAR and control groups improved significantly from baseline to post-training. The SOAR group included more idea units in post-training essays than in baseline essays, t (113) = 3.93, $p < .001$. The control group's number of idea units in baseline essays and post-training essays did not differ, t (113) = 2.62, $p = .010$.

Regarding essay organization, the Chi-square test revealed that essay organization was dependent on the two variables: time and training, χ^2 (1, N = 230) = 8.85, p = .003. Because the research focus was to determine whether the number of participants who used categorical organization increased from baseline to post-training, organization levels were reduced to two for analysis: comparative (i.e., categorical organization) and non-comparative (i.e., topical and mixed organization) to simplify interpretation (the full analysis with three organization levels is provided in Appendix C). At baseline writing, SOAR and non-SOAR groups did not differ in terms of number of participants displaying categorical essay organization (both groups had 14%), χ^2 (1, N = 116) = .00, p = 1.00. At post-training, there was a significant group difference favoring the SOAR group, χ^2 (1, N = 114) = 14.45, $p < .001$. About 50% of SOAR writers, compared to only about 16% of non-SOAR writers, organized essays categorically. Figure 5 shows group differences at baseline and post-training writing.

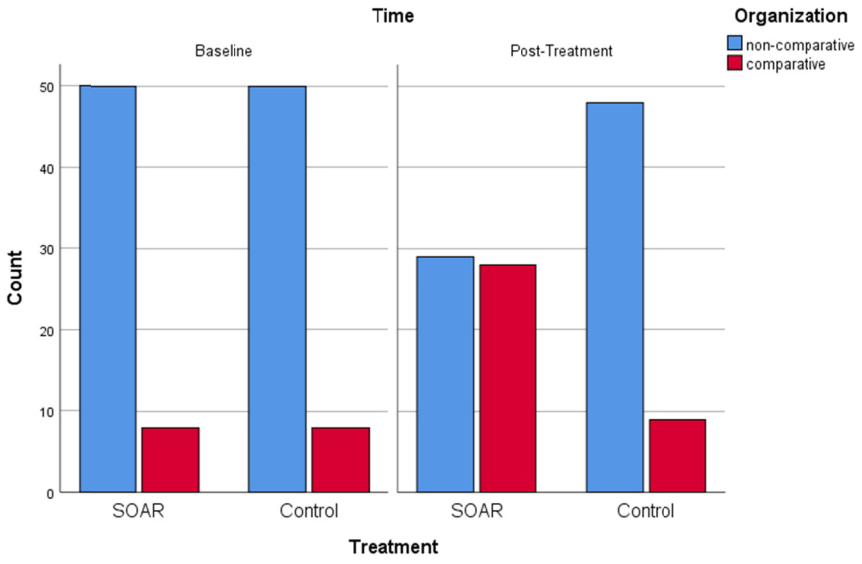

Figure 5. Bar graph for organization results.

Regarding intertextual connections, there was no significant main effect for time ($M_{baseline}$ = 2.22 and $M_{post\text{-}training}$ = 2.16), p = .73, or training ($M_{control}$ = 2.21 and M_{SOAR} = 2.17), p = .83. There was also no interaction effect, p = .27.

Study materials

Three sets of participant-generated study materials were examined: baseline writing, training, and post-training writing. Examining these study materials revealed the type of strategies students used in each experimental phase.

Baseline writing. When participants (n = 116) wrote baseline comparative essays, 23 participants (20%) did not create any study materials or mark source texts. Among the remaining 93 participants, more than half *selected* information from the source texts via either underlining (48%) or linear note taking (9%). Furthermore, 13 participants (14%) attempted to *associate* information by either marking similarities and differences on the source texts or listing comparative points in notes. Only five participants (5%) created a table to *organize* selected information, and four participants (4%) *regulated* their writing by creating an essay outline. A Chi-square test, however, showed no significant SOAR versus non-SOAR group differences in terms of strategy use at baseline writing, χ^2 (5, N = 116) = 6.34, p = .28.

Training. The SOAR group received SOAR training and was instructed to practice using SOAR to study two sets of materials: one guided practice and one independent practice. Examining their notepaper, 40 SOAR participants (70%) practiced the full SOAR strategy system. Seven participants (12%) practiced just the SOA components (i.e., selecting information by note taking, organizing information using a matrix, and associating information across texts), but did not show evidence of regulating (i.e., creating an outline). Ten participants (17%) practiced just the SO components, but did not write down associations or create regulation outlines. In summary, 100% of the SOAR participants practiced selecting information and organizing information in a matrix as directed and about 70% practiced all four SOAR components.

During the training session, control group participants were instructed to practice their preferred strategies on the practice materials as if they were going to write a synthesis essay afterwards. Forty-three participants (75%) recorded linear notes. Nine participants (16%) selected information and organized it in a matrix. Only four participants (7%) showed evidence of associating information by identifying similarities and differences in notes or through text markings. Overall, students from both groups generally applied training procedures as directed.

Post-training writing. Participants were instructed to use strategies they had practiced during training to create study materials for post-training writing. Examining their notepaper and source texts, all participants used some type of selecting strategies. But there were group differences in terms of the selecting strategies used and the amount of information selected. In the SOAR group, 55 of 57 participants (96%) took notes and only two participants used underlining, whereas in the control group, 32 of the 57 participants (56%) took notes and 25 (44%) used underlining, χ^2 (1, N = 114) = 25.67,

$p < .001$. Among those who took notes, SOAR participants, on average, recorded 28 idea units (43%) from source texts, whereas control group participants recorded 21 idea units (32%), t (85) = 2.66, $p = .009$.

With respect to organization, 51 SOAR participants (90%) created a matrix to organize selected information, whereas just four control group participants (7%) created a matrix, χ^2 (1, N = 114) = 77.60, $p < .001$. Among those 51 SOAR participants who created a matrix, most included about six matrix categories (M = 5.8), and three of them created a complete matrix that included all 10 categories.

With respect to association, 15 SOAR participants (26%) wrote associations in their notes, ranging from one association to 10 associations with an average of four associations. Only two control participants (4%) wrote associations (one and two associations, respectively) in their notes. The group difference was significant, χ^2 (1, N = 114) = 13.07, $p = .042$.

With respect to regulation, 27 SOAR participants (47%) wrote a planning outline, compared to three control group participants (5%), χ^2 (1, N = 114) = 26.06, $p < .001$.

In summary, before training, SOAR group and control group students used similar selecting strategies (e.g., underlining, linear note taking) to prepare for synthesis writing. Few used the other SOAR strategies. During training, all SOAR participants practiced selecting information and organizing it in a matrix, and 70% of SOAR participants practiced the full set of SOAR strategies. The control group, on the other hand, mainly practiced linear note taking as their preferred strategy. After training, most SOAR participants (about 90%) used both selecting and organizing strategies to prepare for post-training synthesis writing, whereas control group participants mainly used selecting strategies (underlining and note taking) to prepare for synthesis writing, much like what they did for baseline writing. Moreover, SOAR group notes were more complete than control group notes.

Survey responses

Survey 1 (following baseline writing) asked all participants an open-ended question about the steps they took to complete the baseline synthesis essay. Seventeen participants (15%) did not specify any pre-writing activities. Eleven participants (10%) reported a two-step writing process: reading each source text and then writing the essay. The remaining 87 participants (75%) reported using strategies during reading and writing. Table 8 lists these reported strategies (in the left column) and the number of participants using the strategies (in the middle column). There were no group differences with respect to the types of strategies reportedly used, χ^2 (6, N = 115) = 4.12, $p = .66$.

We also performed a fidelity check of self-reported strategy use in Survey 1 by comparing self-reported strategy use with observed strategy use, using participant-generated study materials during baseline writing. Self-reported and observed strategy use generally matched. As shown in Table 8, both indices showed that selecting strategies were most used and that organizing and outlining strategies were least used.

Both indices also showed similar numbers of unspecified strategies. The number of participants reporting and using certain strategies were sometimes at odds. For example, more participants actually used selecting strategies (46%) than reported using them (28%). Just the opposite pattern occurred for the summarization strategy where 12 participants (10%) reported summarizing source texts, but no summarization evidence was found in participants' notes.

Survey 2 (following post-training writing) assessed attitudes toward training. A multivariate test revealed group differences, F (3, 110) = 6.01, p = .001, Wilk's Λ = .86, partial η^2 = .14. Examining each dependent variable, there was a significant group difference for effectiveness, p < .001. The SOAR group rated SOAR training as "effective" (M = 4.2) for writing the post-training essay, whereas the control group rated their training activities (i.e., practicing preferred strategies) as "somewhat effective" (M = 3.5). The two groups were not statistically different regarding whether they would use the group-specific strategies for future synthesis writing (p = .06). The SOAR group (M = 4.0), though, indicated a somewhat higher likeliness to use trained strategies than did the control group (M = 3.7). Finally, the two groups did not differ with respect to strategy training enjoyment (p = .13), both reported training as "somewhat enjoyable" (M_{SOAR} = 3.4 and $M_{control}$ = 3.2).

Table 8. Comparisons of Participants' Reported Strategy Use in Survey 1 and Observed Strategy Use from Baseline Writing Study Materials

Strategy Use	Number of Participants (%)	
	Survey 1	Baseline study materials
Selecting (e.g., underlining, text marking, note taking)	32 (28%)	53 (46%)
Associating (e.g., looking for similarities and differences)	25 (22%)	13 (11%)
Summarization	12 (10%)	0 (0%)
Outlining	9 (8%)	4 (3%)
Organizing (e.g., making a table)	9 (8%)	5 (4%)
Did not specify	28 (24%)	23 (20%)

Survey 2 also posed an open-ended question asking the SOAR-trained and non-SOAR-trained groups how they studied the texts and wrote the essay. Table 9 displays self-reported strategy use by group (the middle two columns). For the control group, the most commonly used strategy was selecting information using underlining or note taking. Next most common was associating. About one-third reported looking for similarities and differences in the selected information or directly in source texts. Only five participants reported making a table to organize information. The SOAR group, on the other hand, used SOAR strategies to complete the post-training synthesis essay. Forty-one participants reported using the full SOAR strategy system. Ten participants used select, organize, and associate components. Six participants used select and

organize components to complete the task. The groups differed significantly on their reported strategy use ($p < .0001$).

In order to perform a fidelity check on self-reported strategy use in Survey 2, we examined participant-generated study materials during post-training writing and counted incidences of observed strategy use. The groups differed significantly on observed strategy use ($p < .0001$). Participants from both groups selected information from source texts, but significantly more SOAR participants used organizing, associating, and regulating strategies than control group participants, as shown in the right two columns of Table 9.

When comparing self-reported strategy use with observed strategy use, we notice that for selecting and organizing strategies, self-reports generally corresponded with strategy use for both groups, except that 100% of control participants selected information by either underlining or note taking, but only 40% of them reported using such strategies when surveyed. For associating and regulating strategies, although the number of participants reporting and using strategies were somewhat at odds, both indices showed that SOAR participants used more of these strategies than control participants.

Table 9. Comparisons of Participants' Reported Strategy Use in Survey 2 and Observed Strategy Use from Baseline Writing Study Materials

Strategy Use	Number of Participants (%)			
	Survey 2		Post-training writing study materials	
	Control	SOAR	Control	SOAR
Selecting	23 (40%)	57 (100%)	57 (100%)	57 (100%)
Organizing	5 (7%)	57 (100%)	4 (7%)	51 (90%)
Associating	19 (32%)	51 (90%)	2 (4%)	15 (26%)
Regulating	0 (0%)	41 (72%)	3 (5%)	27 (47%)

SOAR participants were also asked in Survey 2 to identify the most and least useful SOAR component for preparing for the post-training synthesis writing task. Forty-eight SOAR participants (84%) identified organize as most useful because creating a matrix helped them organize selected information and identify relationships. They also commented that the matrix helped them select main points and plan the essay. Twenty-five participants (45%) identified regulate as the least useful SOAR component. Some explained that they commonly used a planning outline and proofread essays on their own already, so they did not find regulation training new or helpful. Other participants reported that they did not have time or need to create a planning outline, especially when the matrix already provided a structure for writing the essay. Sixteen participants (29%) identified associate as the least useful SOAR component. Most of them explained that the matrix was enough for them to spot similarities and differences so they did not need to write out associations. Two others expressed that they did not understand the

associate component from the training materials and wanted more explanation and practice on this component.

2.2.3 Discussion

Brief SOAR training was partially effective for synthesis writing. With respect to written essays, SOAR training improved information selection and essay organization, but not intertextual connections. With respect to the training itself, SOAR training was generally effective in that every SOAR participant used at least the select and organize components in post-training essay writing. SOAR's other two components, associate and regulate, might require more time and practice to acquire fully.

Table 10 summarizes Experiment 2 findings with respect to its three data sources (i.e., essay scores, study materials, and survey reports) for both writing tasks. Essay scores reflect the quality of written products, and study materials and survey reports reveal processes students used during synthesis writing. At baseline, control and SOAR participants did not differ with regard to their writing processes and written products. At post-training, some group differences emerged. First, regarding organization, most SOAR participants created a matrix to organize information, whereas few control participants did so. This strategy difference likely produced different essay structures: about half of SOAR participants, compared with 16% of control participants, organized essays categorically. Second, regarding association, more SOAR participants reported and used associations than control participants. Increased association use, however, did not increase intertextual connections in essays. Students might need more time, explanation, or practice to master the association strategy and increase intertextual connections in essay writing. Third, regarding regulation, more SOAR participants reported and used regulation strategies than control participants. No essay measure, however, directly assessed regulation, making it unclear whether or how regulating strategies improve synthesis writing.

Although participants' reported strategy use in surveys and observed strategy use in study materials each revealed that SOAR participants used more SOAR strategies than control participants at post-writing, reported and observed strategy use were somewhat at odds, especially for association and regulation. More participants reported using association and regulation strategies than evidenced by observed strategy use. There are two possible explanations for such discrepancies. First, some participants reported in the survey that the matrix displayed associations so clearly that they did not need to write down associations. Therefore, these participants associated ideas (as they reported in the survey), but their mental associations were not observable in study materials. Second, some participants perhaps overestimated their strategy use, as is common with self-reports (e.g., Russo, Johnson, & Stephens, 1989; Veenman, Prins, & Verheij, 2003). In either case, future studies should include more accurate online processing data such as think-aloud data and keystroke logging (Tillema, van den Bergh, Rijlaarsdam, & Sanders, 2011).

Overall, SOAR training was robust for improving essay organization, as evidenced in all three data sources. SOAR training also increased association and regulation strategy use, but did not impact writing based on the present measures.

Table 10. Summary of Experiment 2 Data Sources and Group Comparisons

	Baseline			Post-training		
	Essay scores	Study materials	Survey	Essay scores	Study materials	Survey
Selection	S = C	S = C	S = C	S = C	S = C	S = C
Organization	S = C	S = C	S = C	S > C	S > C	S > C
Connection	S = C	S = C	S = C	S = C	S > C	S > C
Regulation	NA	S = C	S = C	NA	S > C	S > C

Note. S = SOAR group; C = Control group

3. General Discussion

Synthesis writing is a common requirement in college classes because it reflects many key goals for college student writing development, such as reading across texts for relationships and patterns and using strategies to compose new texts that integrate text information (Council of Writing Program Administrators, National Council of Teachers of English, & National Writing Project, 2011; WPA Outcomes Statement for First-Year Composition, 2014). College students are often required to compose synthesis essays that compare multiple topics (Addison & McGee, 2010; Cumming et al., 2016; Massengill, 2015; Torraco, 2016); unfortunately, their essays are generally not well written (Addison & McGee, 2010; Dovey, 2010; Solé et al., 2013). Instead of composing essays that compare multiple text topics across common categories, students routinely compose flawed essays that involve patchwriting—composing an essay based mainly on one topic and adding a few details from other topics (Barks & Watts, 2001), tag-all writing—including ideas from all topics but in a disjointed fashion (Britt et al., 1999), or separate representation writing—summarizing each topic in turn but failing to draw relationships among topics (Britt et al., 1999).

Synthesis writing difficulty is not surprising because this type of writing is a multi-layered, complex process that requires students to balance their changing roles as source reader, note taker, text writer, and text reviser (Mateos & Solé, 2009; McGinley, 1992). When presented with such a challenging task, students need strategies that help them carry out these myriad roles. Particularly, students need strategies that help with synthesis writing's key processes: selecting (identifying important ideas from source texts), organizing (arranging selected ideas in a graphic organizer from which intertextual relationships are easily observed), and connecting (recognizing and reporting intertextual relationships). This study investigated one such potential strategy system—SOAR (Kiewra, 2005, 2009), using two experiments. Experiment 1 served as

an efficacy study to test the full potential of providing students with optimal SOAR supplements for synthesis writing. After the optimal SOAR supplements showed potential to improve synthesis writing, Experiment 2 served as a training study, wherein students were trained to generate their own SOAR materials for synthesis writing.

Generally speaking, SOAR proved an effective strategy system for synthesis writing in the present study. Both providing SOAR supplements (Experiment 1) and training students to create their own SOAR materials (Experiment 2) helped SOAR-aided students write better synthesis essays than non-SOAR-aided students, as measured by information selection and essay organization. Providing SOAR supplements also improved intertextual connections in Experiment 1. SOAR likely improved selection because SOAR's matrix extracted important ideas from source texts and set it apart from less important information. When important information was extracted in a matrix, students had access to all important information at once so they need not repeatedly search for information from different source texts as they wrote. This computationally efficient processing advantage (Kauffman & Kiewra, 2010; Larkin & Simon, 1987) likely produced more complete essays and freed more cognitive resources for generative activities such as organizing and connecting ideas when writing.

SOAR likely improved organization because the matrix signaled the inherent structure of the selected information across multiple texts (Kauffman & Kiewra, 2010; Kiewra, 2012). An effective synthesis essay organizes information categorically so information from multiple topics can be compared (Kiewra & Mayer, 1995). However, when information is scattered throughout different texts or simply organized in linear form, it is difficult to see its inherent structure. A matrix, on the other hand, is a two-dimensional visual organizer that lists topics (such as types of creativity) across the top, common categories (such as definition, goal, and time demands) down the leftmost column, and intersecting topic and category information within matrix cells. This structure allows users to look across a category and easily see how multiple topics compare along that category (Kiewra, 2012; Kiewra & Mayer, 1995). Such was the case in the present study as students using a matrix were more likely to organize information in essays categorically compared to students writing without a matrix.

SOAR likely improved intertextual connections in Experiment 1 because the provided matrix localized relevant information in close proximity, making it easy for students to compare relevant information across topics and to identify intertextual connections (Kauffman & Kiewra, 2010). Furthermore, provided association prompts in Experiment 1 might have boosted intertextual connections by directing students' attention to specific matrix cells from which intertextual connections could be built. Previous synthesis writing studies also showed that relationship prompts helped students integrate information from multiple source texts (De La Paz & Felton, 2010; Zhao, 2016).

SOAR's regulate component might have also contributed to improved synthesis writing. Because we did not have a direct essay measure assessing students' self-regulation, we discuss possible self-regulation indicators with caution. In Experiment 1,

the provided self-regulation checklist might have helped students regulate writing by cueing students to examine whether they included all necessary text ideas (information selection), organized information categorically (essay organization), and compared information across texts (intertextual connections). In Experiment 2, SOAR training resulted in participants using more effective strategies (including regulating strategies) and producing better materials for post-training writing, which might, in part, reflect improved self-regulation. SOAR training's regulate component included creating an outline and using a self-checklist. At post-training writing, more SOAR participants generated outlines than control participants. The writing outlines might have reminded students to organize essays categorically and to include intertextual connections. Previous writing research found that task-specific checklists improved writers' self-regulation (Bromley, 2011; Hodgson & Bohning, 1997).

Although Experiments 1 and 2 found similar results regarding SOAR's impact on information selection and essay organization, the two experiments had somewhat contradictory results regarding intertextual connections. Experiment 1 found that SOAR boosted intertextual connections, whereas Experiment 2 did not find such improvement. Differing intertextual connections results might suggest a difference between students using provided SOAR materials (Experiment 1) versus students generating their own SOAR materials (Experiment 2). Generating SOAR materials might have limited students' cognitive resources due to extraneous processing (e.g., creating a matrix), thereby limiting germane processing needed for building associations (Stull & Mayer, 2007). In Experiment 1, SOAR materials were provided, and students did not need to create their own, which reduced extraneous cognitive processing and allowed SOAR-aided students to use germane processing for connecting ideas from multiple texts (Stull & Mayer, 2007; Sweller, 1994).

SOAR participants in Experiment 1 also received association prompts that might have directed them to look for intertextual connections from specific matrix cells, whereas SOAR participants in Experiment 2 did not receive such an aid. Instead, SOAR participants in Experiment 2 were trained to create associations from their self-generated matrix. As revealed in participant-generated study materials, 51 SOAR-trained participants (90%) successfully generated a matrix, but only 15 SOAR-trained participants (26%) wrote associations in notes to prepare for post-training writing. This discrepancy could be explained by SOAR participants' Survey 2 responses. Many reported that the associate step was unnecessary to include in notes because they could easily spot relationships in the matrix and, therefore, did not need to write associations in notes. However, students might not have been as effective at identifying associations as they believed themselves to be. Without the aid of association prompts, like those provided in Experiment 1, Experiment 2 students using SOAR might not have noticed some subtle relationships in the matrix. Even if students were able to spot associations in the matrix without writing them down, students had to hold them in working memory while also selecting information from notes, structuring and organizing their essay, and monitoring other activities such as spelling, grammar, etc. Given the limits of

working memory (Baddeley, 2007), students might have forgotten some associations they intended to include. Incorporating associations into essays might have been more difficult and cognitively taxing than students realized. Furthermore, the quality and quantity of associations depend on a matrix's completeness. Participant-generated matrices (Experiment 2), on average, contained less complete information than the researcher-provided matrix (Experiment 1), thereby resulting in fewer intertextual connections.

In summary, providing ideal SOAR supplements improved synthesis writing with respect to information selection, essay organization, and intertextual connections. Even though students in Experiment 1 were not trained to use SOAR for writing, SOAR materials were easy to use and effective for writing. In Experiment 2, brief SOAR training proved effective for information selection and essay organization but not intertextual connections. Perhaps SOAR's effectiveness might increase if students are given more time to practice SOAR and to create more complete SOAR materials, resembling Experiment 1 researcher-provided SOAR materials, prior to writing. Furthermore, it is worth noting that SOAR training was not geared toward writing (except the regulate component). Students were taught to select, organize, and associate information but were never instructed in how to apply these strategies directly to synthesis writing. This might explain why 90% of SOAR-trained participants created a matrix, but only half of them organized their essays categorically. Students might need specific instruction on how to use a matrix to organize essay information. Similarly, SOAR training taught students how to make associations but did not demonstrate how to incorporate these associations into essays. This omission might explain why many SOAR-trained writers organized information by category but then failed to connect information categorically in their essays. Perhaps SOAR's synthesis writing effectiveness can increase when students are taught explicitly how to apply SOAR directly to synthesis writing and actually practice writing during SOAR training. Some previous synthesis writing strategy training studies used multiple-session training that spanned several days or weeks, provided opportunities for students to practice trained strategies for essay writing, and found writing improvement (e.g., Kirkpatrick & Klein, 2009; Martínez et al., 2015; Reynolds & Perin, 2009).

In terms of writing theories, findings support and advance existing writing models. With respect to Flower and Hayes' (1981) cognitive writing model, SOAR was effective for improving synthesis writing because it facilitated writing's planning process. Synthesis writing is especially cognitively taxing during planning because it adds an extra step—multiple-text comprehension—beyond most writing tasks. This additional planning step requires writers to select, organize, and connect information from multiple texts. Therefore, SOAR aided planning by helping writers select, organize, and connect information from multiple texts.

With respect to Bereiter and Scardamalia's (1987) model, SOAR likely promoted knowledge transforming. Present findings showed that students left to their own devices (not aided by SOAR) were knowledge-telling writers: they selected information from

texts and simply reported selected information. Students aided by SOAR, on the other hand, resembled knowledge-transforming writers: they selected information from texts, integrated information by organizing and connecting it across texts, and then wrote essays capturing their integrated text understanding. However, without having administered a knowledge test, we cannot confirm that SOAR aided knowledge transformation.

4. Limitations and Implications

Several limitations might narrow the generalizability of results. First, Experiment 1 sample size was relatively small. Small sample size can result in low statistical power, which might hinder statistically significant results detection. Although statistically significant group differences were found in Experiment 1, future studies should replicate the experiment with a larger sample size to validate findings. In addition, there were more female than male students in both experiments. This was not done by design; it was a demographic representation of the recruitment pool. It is nonetheless a limitation, even though males and females were equally represented across SOAR and non-SOAR groups in both experiments. Previous research suggests a possible gender difference for writing favoring females over males (e.g., Reynolds, Scheiber, Hajovsky, Schwartz, & Kaufman, 2015). Future research should strive to obtain a sample that is equally represented by males and females to see whether SOAR supplements and SOAR training are equally effective for both genders.

Second, with respect to dependent measures, the present study lacked accurate online processing data such as think-aloud data and keystroke logging (Tillema et al., 2011). Instead, the present study used offline self-report data and validated reported strategy use by analyzing participant-generated study materials. These offline measures, though, were insufficient to document students' writing procedure (e.g., whether students engaged various processes in a linear or recursive fashion) or time spent on each process. Future research should incorporate accurate online writing process measures and determine their relationships with writing products (see Tillema et al., 2011). Furthermore, the present study did not include a knowledge acquisition measure to evaluate whether students learned about the topics they wrote about. Future research should include such knowledge acquisition measures to determine how the combination of SOAR and synthesis writing might benefit knowledge acquisition and transformation (see Martínez et al., 2015). In addition, prior knowledge of writing topics was assessed using a single self-report item. The self-report measure did not directly assess prior knowledge but only participants' estimations. Future studies should use more direct assessments such as a free recall test that asks participants to write down what they know about the topic (Dochy, Segers, & Buehl, 1999).

Third, logistical time constraints associated with the recruitment pool limited SOAR training time and perhaps the potential of SOAR training. Experiment 2 provided a single and brief SOAR training period. Although training time and materials were nearly

identical to the successful SOAR training that boosted achievement (Daher & Kiewra, 2016), more extensive training in future studies seems fitting given the complex nature of synthesis writing. Furthermore, SOAR training did not explicitly show students how to use self-generated SOAR materials for writing. Although this was done to ensure that the SOAR group did not receive any additional writing help than the control group, future studies might investigate direct writing applications to SOAR training by setting up a control group that practices a less effective synthesis writing strategy such as summarization. In addition, SOAR training used a pre-programmed, auto-advanced PowerPoint presentation to display SOAR instruction and practice opportunities. Some students reported that they did not fully understand some SOAR components (e.g., associate), whereas others did not experience this difficulty. These comments suggest individual learning differences that might be overcome by employing self-paced SOAR training.

Last, there was no delay between training and post-writing in Experiment 2, which might have introduced a fatigue effect detrimental to students' post-training writing performance. This no-delay design was largely due to logistical time constraints. One alternative would be testing the long-term effects of SOAR training by including a delayed writing task. Another option might be conducting an experiment in an authentic classroom using authentic writing tasks throughout a semester.

This study offers practical implications for students, teachers, instructional designers, and writing centers. First, practitioners should view the control group's results as an indication that commonly used synthesis writing strategies, such as underlining and linear note taking, do not produce effective synthesis essays that organize information by common categories cutting across multiple source texts and then connect and integrate that information as they write. Second, based on SOAR group findings, writers should be helped to use SOAR strategies for synthesis writing: select and organize notes in a graphic organizer, associate information by categories across topics, and regulate writing using a checklist containing task completion criteria. This can be accomplished as educators either provide SOAR supplements or teach students how to use SOAR to create their own materials to aid synthesis writing. Similarly, instructional designers who develop online writing courses or writing modules could incorporate SOAR materials or training. Finally, writing centers might also provide SOAR materials and SOAR training to improve student writing as they assist students in planning and completing writing assignments. The bottom line is that students need writing help, and SOAR is an effective and usable means for helping students write synthesis style essays.

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References

Addison, J., & McGee, S. J. (2010). Writing in high school/writing in college: Research trends and future directions. *College Composition and Communication*, *62*(1), 147–179.

Anmarkrud, Ø., Bråten, I., & Strømsø, H. I. (2014). Multiple-documents literacy: Strategic processing, source awareness, and argumentation when reading multiple conflicting documents. *Learning and Individual Differences*, *30*, 64–76. https://doi.org/10.1016/j.lindif.2013.01.007

Atkinson, R. K., Levin, J. R., Kiewra, K. A., Meyers, T., Kim, S.-I., Atkinson, L. A., … Hwang, Y. (1999). Matrix and mnemonic text-processing adjuncts: Comparing and combining their components. *Journal of Educational Psychology*, *91*(2), 342. https://doi.org/10.1037/0022-0663.91.2.342

Baddeley, A. (2007). *Working memory, thought, and action*. OUP Oxford. https://doi.org/10.1093/acprof:oso/9780198528012.001.0001

Baker, L., & Lombardi, B. R. (1985). Students' lecture notes and their relation to test performance. *Teaching of Psychology*, *12*(1), 28–32. https://doi.org/10.1207/s15328023top1201_9

Barks, D., & Watts, P. (2001). Textual borrowing strategies for graduate-level ESL writers. *Linking Literacies: Perspectives on L2 Reading-Writing Connections*, 246–267.

Barzilai, S., Tzadok, E., & Eshet-Alkalai, Y. (2015). Sourcing while reading divergent expert accounts: Pathways from views of knowing to written argumentation. *Instructional Science*, *43*(6), 737–766. https://doi.org/10.1007/s11251-015-9359-4

Bednall, T. C., & Kehoe, E. J. (2011). Effects of self-regulatory instructional aids on self-directed study. *Instructional Science*, *39*(2), 205–226. https://doi.org/10.1007/s11251-009-9125-6

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition* (Vol. xxi). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Britt, M. A., Perfetti, C. A., Sandak, R., & Rouet, J.-F. (1999). Content integration and source separation in learning from multiple texts. In S. R. Goldman, A. C. Graesser, & P. van den Broek (Eds.), *Narrative comprehension, causality, and coherence: Essays in honor of Tom Trabasso* (pp. 209–233). Mahwah, NJ, US: Lawrence Erlbaum Associates.

Bromley, K. (2011). Best practices in teaching writing. In L. M. Morrow & L. B. Gambrell (Eds.), *Best practices in literacy instruction* (4th ed., pp. 295–318). New York, NY, US: The Guilford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Council of Writing Program Administrators, National Council of Teachers of English, & National Writing Project. (2011). Framework for success postsecondary writing. Retrieved from http://wpacouncil.org/files/framework-for-success-postsecondary-writing.pdf

Cumming, A., Lai, C., & Cho, H. (2016). Students' writing from sources for academic purposes: A synthesis of recent research. *Journal of English for Academic Purposes*, *23*, 47–58. https://doi.org/10.1016/j.jeap.2016.06.002

Daher, T. A., & Kiewra, K. A. (2016). An investigation of SOAR study strategies for learning from multiple online resources. *Contemporary Educational Psychology*, *46*, 10–21. https://doi.org/10.1016/j.cedpsych.2015.12.004

Dansereau, D. F., & Holley, C. D. (1982). Development and evaluation of a text mapping strategy. In A. Flammer & W. Kintsch (Eds.), *Advances in Psychology* (Vol. 8, pp. 536–554). https://doi.org/10.1016/S0166-4115(08)62718-1

De La Paz, S., & Felton, M. K. (2010). Reading and writing from multiple source documents in history: Effects of strategy instruction with low to average high school writers. *Contemporary Educational Psychology*, *35*(3), 174–192. https://doi.org/10.1016/j.cedpsych.2010.03.001

Dochy, F., Segers, M., & Buehl, M. M. (1999). The relation between assessment practices and outcomes of studies: The case of research on prior knowledge. *Review of Educational Research*, *69*(2), 145–186. https://doi.org/10.3102/00346543069002145

Dornisch, M., Sperling, R. A., & Zeruth, J. A. (2011). The effects of levels of elaboration on learners' strategic processing of text. *Instructional Science*, *39*(1), 1–26. https://doi.org/10.1007/s11251-009-9111-z

Dovey, T. (2010). Facilitating writing from sources: A focus on both process and product. *Journal of English for Academic Purposes*, *9*(1), 45–60. https://doi.org/10.1016/j.jeap.2009.11.005

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication*, *32*(4), 365–387. https://doi.org/10.2307/356600

Frase, L. T., & Schwartz, B. J. (1975). Effect of question production and answering on prose recall. *Journal of Educational Psychology*, *67*(5), 628–635. https://doi.org/10.1037/0022-0663.67.5.628

Garner, R. (1987). Strategies for reading and studying expository text. *Educational Psychologist*, *22*(3–4), 299–312. https://doi.org/10.1080/00461520.1987.9653054

Gil, L., Vidal-Abarca, E., & Martínez, T. (2008). Efficacy of note-taking to integrate information from multiple documents. *Infancia y Aprendizaje*, *31*(2), 259–272. https://doi.org/10.1174/021037008784132905

Goldsmith, H. H., Buss, A. H., Plomin, R., Rothbart, M. K., Thomas, A., Chess, S., … McCall, R. B. (1987). Roundtable: What is temperament? Four approaches. *Child Development*, *58*(2), 505–529. https://doi.org/10.2307/1130527

Hammann, L., & Stevens, R. (2003). Instructional approaches to improving students' writing of compare-contrast essays: An experimental study. *Journal of Literacy Research*, *35*(2), 731–756. https://doi.org/10.1207/s15548430jlr3502_3

Hodgson, A. R., & Bohning, G. (1997). A five-step guide for developing a writing checklist. *Journal of Adolescent & Adult Literacy*, *41*(2), 138–141.

Jairam, D., & Kiewra, K. A. (2009). An investigation of the SOAR study method. *Journal of Advanced Academics*, *20*(4), 602–629. https://doi.org/10.1177/1932202X0902000403

Jairam, D., & Kiewra, K. A. (2010). Helping students soar to success on computers: An investigation of the SOAR study method for computer-based learning. *Journal of Educational Psychology*, *102*(3), 601–614. https://doi.org/10.1037/a0019137

Jairam, D., Kiewra, K. A., Rogers-Kasson, S., Patterson-Hazley, M., & Marxhausen, K. (2014). SOAR versus SQ3R: a test of two study systems. *Instructional Science*, *42*(3), 409–420. https://doi.org/10.1007/s11251-013-9295-0

Karpicke, J. D. (2012). Retrieval-based learning: Active retrieval promotes meaningful learning. *Current Directions in Psychological Science*, *21*(3), 157–163. https://doi.org/10.1177/0963721412443552

Kauffman, D. F., & Kiewra, K. A. (2010). What makes a matrix so effective? An empirical test of the relative benefits of signaling, extraction, and localization. *Instructional Science*, *38*(6), 679–705. https://doi.org/10.1007/s11251-009-9095-8

Kiewra, K. A. (1985). Investigating notetaking and review: A depth of processing alternative. *Educational Psychologist*, *20*, 23–32. https://doi.org/10.1207/s15326985ep2001_4

Kiewra, K. A. (1987). Notetaking and review: The research and its implications. *Instructional Science*, *16*(3), 233–249. https://doi.org/10.1007/BF00120252

Kiewra, K. A. (2005). *Learn how to study and SOAR to success*. Upper Saddle River, New Jersey: Pearson/Prentice Hall.

Kiewra, K. A. (2009). *Teaching how to learn: The teacher's guide to student success*. Thousand Oaks, California: Corwin Press.

Kiewra, K. A. (2012). Using graphic organizers to improve teaching and learning. The IDEA Center. Retrieved from http://www.theideacenter.org

Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., & Roskelley, D. (1991). Note-taking functions and techniques. *Journal of Educational Psychology*, *83*(2), 240–245. https://doi.org/10.1037/0022-0663.83.2.240

Kiewra, K. A., & Mayer, R. E. (1995). Matrices or outlines as writing tools: Their effect on writing structure. Presented at the American Educational Research Association, San Francisco, CA.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review*, *95*(2), 163–182. https://doi.org/10.1037/0033-295X.95.2.163

Kirkpatrick, L. C., & Klein, P. D. (2009). Planning text structure as a way to improve students' writing from sources in the compare–contrast genre. *Learning and Instruction*, *19*(4), 309–321. https://doi.org/10.1016/j.learninstruc.2008.06.001

Kobayashi, K. (2009). Comprehension of relations among controversial texts: effects of external strategy use. *Instructional Science*, *37*(4), 311–324. https://doi.org/10.1007/sl 1251-007-9041-6

Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, *11*(1), 65–100. https://doi.org/10.1111/j.1551-6708.1987.tb00863.x

Lenski, S. D., & Johns, J. L. (1997). Patterns of reading-to-write. *Reading Research and Instruction*, *37*(1), 15–38. https://doi.org/10.1080/19388079709558252

MacArthur, C. A., Philippakos, Z. A., & Ianetta, M. (2015). Self-regulated strategy instruction in college developmental writing. *Journal of Educational Psychology*, *107*(3), 855–867. https://doi.org/10.1037/edu0000011

Massengill, S. A. (2015). *High school writing experiences, writing self-efficacy, and composing from multiple sources: A mixed methods study*. North Carolina State University. Retrieved from http://gradworks.umi.com/37/10/3710654.html

Mateos, M., Martín, E., Villalón, R., & Luna, M. (2008). Reading and writing to learn in secondary education: Online processing activity and written products in summarizing and synthesizing tasks. *Reading and Writing*, *21*(7), 675–697. https://doi.org/10.1007/s11145-007-9086-6

Mateos, M., & Solé, I. (2009). Synthesising information from various texts: A study of procedures and products at different educational levels. *European Journal of Psychology of Education*, *24*(4), 435–451. https://doi.org/10.1007/BF03178760

Martínez, I., Mateos, M., Martín, E., & Rijlaarsdam, G. (2015). Learning history by composing synthesis texts: Effects of an instructional programme on learning, reading and writing processes, and text quality. *Journal of Writing Research*, *7*(2), 275–302. https://doi.org/10.17239/jowr-2015.07.02.03

McGinley, W. (1992). The role of reading and writing while composing from sources. *Reading Research Quarterly*, *27*(3), 227–248. https://doi.org/10.2307/747793

Moran, R., & Billen, M. (2014). The reading and writing connection: Merging two reciprocal content areas. *Georgia Educational Researcher*, *11*(1), Article 8. https://doi.org/10.20429/ger.2014.110108

Neuwirth, C. M., & Kaufer, D. S. (1989). The role of external representation in the writing process: implications for the design of hypertext-based writing tools. In *Proceedings of the second annual ACM conference on Hypertext* (pp. 319–341). ACM. Retrieved from http://dl.acm.org/citation.cfm?id=74250

Newell, G. E. (2006). Writing to learn. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 235–247). New York, NY, US: Guilford Press.

Novak, J. D. (1990). Concept mapping: A useful tool for science education. *Journal of Research in Science Teaching*, *27*(10), 937–949. https://doi.org/10.1002/tea.3660271003

O'Hara, K. P., Taylor, A., Newman, W., & Sellen, A. J. (2002). Understanding the materiality of writing from multiple sources. *International Journal of Human-Computer Studies*, *56*(3), 269–305. https://doi.org/10.1006/ijhc.2001.0525

Ozgungor, S., & Guthrie, J. T. (2004). Interactions among elaborative interrogation, knowledge, and interest in the process of constructing knowledge from text. *Journal of Educational Psychology*, *96*(3), 437–443. https://doi.org/10.1037/0022-0663.96.3.437

Peverly, S. T., Brobst, K. E., Graham, M., & Shaw, R. (2003). College adults are not good at self-regulation: A study on the relationship of self-regulation, note taking, and test taking. *Journal of Educational Psychology*, *95*(2), 335–346. https://doi.org/10.1037/0022-0663.95.2.335

Pressley, M., McDaniel, M. A., Turnure, J. E., Wood, E., & Ahmad, M. (1987). Generation and precision of elaboration: Effects on intentional and incidental learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *13*(2), 291–300. https://doi.org/10.1037//0278-7393.13.2.291

Reynolds, G. A., & Perin, D. (2009). A comparison of text structure and self-regulated writing strategies for composing from sources by middle school students. *Reading Psychology*, *30*(3), 265–300. https://doi.org/10.1080/02702710802411547

Reynolds, M. R., Scheiber, C., Hajovsky, D. B., Schwartz, B., & Kaufman, A. S. (2015). Gender differences in academic achievement: Is writing an exception to the gender similarities hypothesis? *Journal of Genetic Psychology: Research and Theory on Human Development, 176*, 211-234. https://doi.org/10.1080/00221325.2015.1036833

Risemberg, R. (1993). *Self regulated strategies of organizing and information-seeking when writing expository text from sources* (Ph.D.). City University of New York, United States -- New York. Retrieved from http://0-search.proquest.com.library.unl.edu/pqdt/docview/304023645/abstract/E4979B080C424E20PQ/1

Roediger, H. L., & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. *Trends in Cognitive Sciences*, *15*(1), 20–27. https://doi.org/10.1016/j.tics.2010.09.003

Russo, J. E., Johnson, E. J., & Stephens, D. L. (1989). The validity of verbal protocols. *Memory & Cognition, 17*(6), 759-769. https://doi.org/10.3758/BF03202637

Schunk, D. H., & Swartz, C. W. (1993). Goals and progress feedback: Effects on self-efficacy and writing achievement. *Contemporary Educational Psychology*, *18*(3), 337–354. https://doi.org/10.1006/ceps.1993.1024

Segev-Miller, R. (2007). Cognitive processes in discourse synthesis: the case of intertextual processing strategies. In M. Torrance, L. Van Waes, & D. Galbraith (Eds.), *Writing and cognition: Research and applications* (Vol. 20, pp. 231–250). Amsterdam: Elsevier.

Solé, I., Miras, M., Castells, N., Espino, S., & Minguela, M. (2013). Integrating information an analysis of the processes involved and the products generated in a written synthesis task. *Written Communication*, *30*(1), 63–90. https://doi.org/10.1177/0741088312466532

Spivey, N. N. (1991). The shaping of meaning: Options in writing the comparison. *Research in the Teaching of English*, *25*, 390–418.

Spivey, N. N. (1997). *Reading, writing and the making of meaning: The constructivist metaphor*. San Diego, CA: Academic Press.

Spivey, N. N., & King, J. R. (1989). Readers as writers composing from sources. *Reading Research Quarterly*, *24*(1), 7–26. https://doi.org/10.1598/RRQ.24.1.1

Stull, A. T., & Mayer, R. E. (2007). Learning by doing versus learning by viewing: Three experimental comparisons of learner-generated versus author-provided graphic organizers. *Journal of Educational Psychology*, *99*(4), 808–820. https://doi.org/10.1037/0022-0663.99.4.808

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction*, *4*(4), 295–312. https://doi.org/10.1016/0959-4752(94)90003-5

Tierney, R. J., & Shanahan, T. (1996). Research on the reading-writing relationship: Interactions, transactions, and outcomes. In R. P. Barr, D. Pearson, M. L. Kamil, & P. B. Mosenthal (Eds.), *Handbook of reading research* (2nd ed., Vol. 2, pp. 246–280). New York: Longman.

Tillema, M., van den Bergh, H., Rijlaarsdam, G., & Sanders, T. (2011). Relating self reports of writing behaviour and online task execution using a temporal model. *Metacognition and Learning*, *6*(3), 229–253. https://doi.org/10.1007/s11409-011-9072-x

Thiede, K. W., & Anderson, M. C. M. (2003). Summarizing can improve metacomprehension accuracy. *Contemporary Educational Psychology*, *28*(2), 129–160. https://doi.org/10.1016/S0361-476X(02)00011-5

Torraco, R. J. (2016). Writing integrative literature reviews: Using the past and present to explore the future. *Human Resource Development Review*, *15*(4), 404–428. https://doi.org/10.1177/1534484316671606

Tynjälä, P. (2001). Writing, learning and the development of expertise in higher education. In P. Tynjälä, L. Mason, & K. Lonka (Eds.), *Writing as a Learning Tool* (pp. 37–56). Netherlands: Springer. https://doi.org/10.1007/978-94-010-0740-5_4

Veenman, M. V. J., Prins, F. J., & Verheij, J. (2003). Learning styles: Self-reports versus thinking-aloud measures. *The British Journal of Educational Psychology, 73*, 357-372. https://doi.org/10.1348/000709903322275885

Wiley, J., & Voss, J. F. (1999). Constructing arguments from multiple sources: Tasks that promote understanding and not just memory for text. *Journal of Educational Psychology*, *91*(2), 301–311. https://doi.org/10.1037/0022-0663.91.2.301

WPA Outcomes Statement for First-Year Composition. (2014). Council of Writing Program Administrators. Retrieved from http://wpacouncil.org/files/WPA%20Outcomes%20Statement%20Adopted%20Revisions%5B1%5D_0.pdf

Woloshyn, V. E., Willoughby, T., Wood, E., & Pressley, M. (1990). Elaborative interrogation facilitates adult learning of factual paragraphs. *Journal of Educational Psychology*, *82*(3), 513–524. https://doi.org/10.1037/0022-0663.82.3.513

Zentner, M., & Bates, J. E. (2008). Child temperament: An integrative review of concepts, research programs, and measures. *International Journal of Developmental Science*, *2*(1–2), 7–37.

Zhao, R. (2016). *Effects of elaborative interrogation after reading belief-inconsistent arguments and need for cognition on argumentation and topic beliefs* (Doctoral Dissertation). University of Nebraska-Lincoln, Lincoln, Nebraska.

Appendix A: Sample Participant Essays Representing Topical, Categorical, and Mixed Organization

Topical Organization

It is believed to be that there are four different types of creativity. The first is expressive creativity. The second is adaptive creativity. The third is innovative creativity. Lastly, the fourth, which is emergent creativity.

The first form of creativity is expressive creativity. This is the ability to create a brilliant response in a spontaneous situation. An example of this is a soccer player doing extensive moves to beat a player in a game. It only takes a few seconds, but can take 8-12 years to gain this type of creativity. The goal of this is to create a "flash of brilliance" to showcase that is unheard of and remarkable. There are some key parts that are needed in order to reach this type of creativity. These include: consistency, automaticity, pattern recognition and prediction, and your timing to make your expressive response.

The second form is adaptive creativity. This is the ability to use past knowledge to accommodate to situations where problem solving is needed. The amount of time that is needed to display this type of creativity can be from a day up to a few weeks, but takes many years to have this type of creativity. The goal of this type of creativity is to improve the status quo. In order to improve the status quo, you will need to of mastered day to day problem solving strategies. If you have this type of creativity then you are able to analyze problems, plan solutions and execute them successfully. The key parts for this creativity are flexibility, pattern recognition, and being able to compare current and previous.

The third type of creativity is innovative creativity. This is the ability to change or alter a major process or product. It has no spontaneous response and can develop over your entire adult life span. The goal is to improve and make significant changes. To reach this goal you will use personal models, beliefs, and analogies to guide you. Being predictable, driven, and goal directed are key parts to having innovative creativity.

The last type of creativity is emergent creativity. This is the ability to change existing ideas, beliefs, or styles. This can take a lifetime to develop. An example of this type of creativity is Albert Einstein. He changed the existing views of physics and everyone knows that. The end goal in this is to set new trends. You will need to know the past and present ideas of whatever you are planning on changing in order to have this type of creativity to be able to make a difference. People that have this type of creativity need to be confident in themselves to be able to change the ideas, beliefs, or styles of previous information. These people tend to be great risk takers, trend setters, and have a Janusian way of thinking.

Each one of these types of creativity are amazing, but describe completely different people.

Categorical Organization

There are many types of creativity. The first type is Expressive Creativity, which is the ability to generate an extremely rapid yet brilliant response in a spontaneous situation. Some examples would be a musician playing progressive jazz, or a college professor answering a student's question quickly and succinctly. Another type of creativity is Adaptive Creativity. This is the ability to use past knowledge to solve new problems. An example of this type of creativity would be a professor using similar past experiences to plan and organize a conference for the first time. The third type is Innovative Creativity, which is the ability to significantly change a major process or product or school of thought. A writer, artist or musician altering styles, a scientist altering a theory, and an inventor significantly improving their products would all be examples of Innovative Creativity. The last type is Emergent Creativity. Emergent Creativity is the ability to profoundly change existing ideas beliefs or styles. Einstein's theory of relativity and contribution to modern physics would be a great example of Emergent Creativity.

The times to develop these types of creativity increases from Expressive (8-12 years), to Adaptive (many years), to Innovative (entire adult life), and to Emergent Creativity (lifetime). The times to display these types of creativity follow a similar trend: It only takes a few seconds to display Expressive Creativity, a few days or weeks to display Adaptive Creativity, several years to display Innovative Creativity, and a whole life to display Emergent Creativity.

The goals in each creativity vary. Expressive Creativity has the goal to create a momentary flash of brilliance that is appropriate yet unusual, whereas Adaptive Creativity's goal is to slightly improve the status quo. A person with Innovative Creativity has the goal to improve a dissatisfaction which often results in a significant change. Emergent Creativity type of person will want to set new trends. In order to achieve their goals, Expressive and Adaptive creativity people have to practice for a long time before they can demonstrate their creativity. For Innovative and Emergent creativity people, they have to master the field, learn about the past and present knowledge, and be at the right time to bring about profound changes.

A person can tell which type of creativity they have by a few distinct characteristics. An Expressive Creative person will have the ability to maintain the flow of responses in a rapidly occurring sequence. An Adaptive Creative person will be able to plan effective solutions and execute the plans successfully in a short amount of time. Whereas a person who has Innovative Creativity will bring about distinct changes in society. A person with Emergent Creativity will have the desire to attack basic assumptions and confidence in their own ideas. These are the main distinctions between each type of creativity.

There are some myths about creativity. For Expressive Creativity, people often don't realize how much work and practice is behind the brilliant, seemingly spontaneous, response. The myth is that the person is naturally gifted with spontaneous responses. For Adaptive Creativity, many people don't appreciate this type of practical creativity, but simply think the problem is solved because the person is being flexible. For both Innovative and Emergent Creativity, the myth is that the person is born with innovative ideas. Many people fail to realize how much knowledge about the past and existing ideas these creative people have accumulated and examined before they propose something new.

Mixed Organization

Throughout one's adolescent years, strengths and weaknesses are developed. These are normally assessed by through extra-curricular activities, academics, and day-to-day occurrences. Personally, I have always considered my strengths to be perseverance, teamwork, judgment, humor, and creativity. While creativity is a commonly known characteristic, to many (myself included), the depth of the trait is usually overlooked. Creativity can be broken up into four types: expressive, adaptive, innovative, and emergent. While the following types of creativity are centered around the same concept, differences are still apparent.

Expressive creativity: the ability to generate a rapid, intellectual response in a spontaneous situation. Examples of this range from a comedian wittily reacting to a comment from an audience member, to a college professor answering a student's question in class. Along with laugh-out-loud funny comedians and all-knowing college professors, others that poses the ability to generate rapid flow of responses usually are consistent and automatic. While many believe that these creative responses and people are spontaneous, it is actually just a habitual calculated style that has been heavily practiced.

Like expressive creativity, many myths are associated with adaptive creativity – the ability to use past knowledge and strategies to accommodate to problem solving situations – the most prominent being, that flexibility is the key to problem solving. This misconception has been terminated through careful analysis. While people that are adaptively creative usually have the distinguished ability to analyze problems, plan solutions, and successfully execute them, it is due to overlearning. These overlearned effective problem solving strategies are usually mastered over a period of many years.

Innovative creativity differs from expressive creativity, as it focuses on a person's ability to significantly change or alter a major process, product, or school of thought. This type of creativity is very similar to emergent creativity – the ability to profoundly change existing ideas, thoughts, or styles – they have knowledge of the past and present, and are willing to redirect the future. Though are differentiated by goals. Innovative creativity generally stems from dissatisfaction which results in a desire to make a change. Whereas, emergent creativity stems from an intense goal to set trends.

The depth of creativity is commonly overlooked. Creativity can be broken up into four types: expressive, adaptive, innovative, and emergent. While the following types of creativity are centered around the same concept, differences are still apparent.

Appendix B: Experiment 2 Correlations between Essay Measures by Groups

Essay Measures	1	2	3
1. Selection	—	-.244**	-.057
2. Organization	-.414**	—	.589**
3. Connections	.005	.324**	—

Note. **$p < .01$. Correlations above the diagonal are for the SOAR group, and correlations below the diagonal are for the control group.

Appendix C: Full Analysis of Experiment 2 Organization Scores

Regarding essay organization, a three-way Chi-square test was conducted to determine whether essay organization was independent from time (baseline vs. post-training) and training (SOAR training vs. preferred strategy training). The Chi-square test revealed that essay organization was dependent on the two variables: time and training, χ^2 (1, N = 230) = 9.90, p = .007. At baseline writing, SOAR and non-SOAR groups did not differ in terms of essay organization, χ^2 (1, N = 116) = .877, p = .645. At post-training, there was a significant group difference, χ^2 (1, N = 114) = 15,689, p < .001. About 50% of SOAR writers, compared to only about 16% of non-SOAR writers, organized essays categorically.

Time	Essay Organization	SOAR	Control
Baseline	Topic	14 (24%)	10 (17%)
	Mixed	36 (62%)	40 (69%)
	Categorical	8 (14%)	8 (14%)
Post-training	Topic	16 (28%)	20 (34%)
	Mixed	13 (22%)	28 (49%)
	Categorical	28 (49%)	9 (16%)