2018

Learning Strategies Employed by College Aged Students with Disabilities: The Link Between Metacognition, Motivation, and Working Memory

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A Thesis submitted to the Department of Psychology

in partial fulfillment of the requirements for the degree of

Master of Science in Psychological Science

UNIVERSITY OF NORTH FLORIDA

COLLEGE OF ARTS AND SCIENCES

September 2018

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Abstract

The aim of this study is two-fold. First, we want to understand the levels of metacognitive awareness of learning strategies in undergraduates with learning disabilities. Previous research states that recall is the most effective method of studying, but most students prefer to reread their notes or textbook which is ineffective. Second, we want to explore the link between Working Memory and metacognitive awareness of learning strategies in undergraduates with learning disabilities. The learning strategies that college students with and without disabilities is examined, we found that students in both groups preferred the usage of the same strategies equally. The most preferred strategy was rereading notes/textbook, and least preferred was studying in groups. Interestingly, we found no differences between the groups with regards to their: motivation, metacognition, and working memory. Initially, it was found that the group of students with disabilities greatly differed in visual-spatial working memory, however, once we controlled for those who were visually-impaired or had attention deficit hyperactivity disorder (ADHD), the results became non-significant. Gender differences in learning strategies was examined and we found that males preferred the usage of completing practice problems and the usage of mnemonic devices, whereas females preferred highlighting their notes or textbook.

keywords: metacognition, motivation, working memory, learning strategies, studying strategies

Learning Strategies Employed by College Aged Students with Disabilities: The Link Between Metacognition, Motivation, and Working Memory

Previous research on students' learning strategies primarily focuses on how they incorporate their prior knowledge and skills and how they adjust their learning strategies. Weinstein and Mayer (1986) define learning strategies as behavior and cognition that students execute while learning, to better influence the efficiency and amount of information they acquire. Previous research (McKeachie, 1987) has identified two distinct branches of this broad learning strategy definition; micro-processes, such as cognition and memory, are more inherent and can't usually be directly manipulated, while macro-processes, which will be the focus of this study, involve the student's methods of taking in and processing information (e.g. textbook, teacher, note-taking etc.). McKeachie points out that these "macrolevel" learning strategies involve both students' use of them, as well as students' knowledge about them. He further categorizes these strategies into cognitive, metacognitive, and resource management strategies. In this research, the focus is on the cognitive and metacognitive strategies that students in higher education with learning disabilities can use.

Learning Strategies

There is a myriad of different learning strategies that a student can utilize. Previous research has narrowed down learning strategies into two different categories. First, there are cognitive learning strategies that are involved in the encoding and retrieval of knowledge (McKeachie, 1987). These include such strategies as using flash cards, self-quizzing, and reading notes. The other category is in the metacognitive realm. Learning strategies associated with metacognition are time management, progress monitoring, and goal setting (Reed, 2013, pg. 105-109).

Prior research has established that the most effective learning strategies involve recall. Previous research by Karpicke, Butler, & Roediger (2009), has shown that when students have been tested on material, they remember more information in the future than if they had simply repeatedly studied it. They title this phenomenon the *testing effect.* There are some learning strategies that prescribe to this testing effect, including, quizzes, practice tests, and the use of flash cards. While a litany of previous research has shown that test-recall is the most effective learning strategy, a vast majority of surveyed students in the study by Karpicke, et al., (2009), utilized the repeated-reading method, which research has shown to be ineffective and inefficient in helping students in their academic endeavors. There has also been some prior research that shows that men and women differ on certain learning strategies, such as men prefer studying in groups, while women do not (Ruffing, Wach, Spinath, Bruken, & Karbach, 2015). There is also a link between “deeper” metacognitive learning strategies employed by students that have a history of reading impairment and students who do not. Students with no history of reading impairment tended to use deeper metacognitive learning strategies than those who did have a history of reading impairment (Chevalier, Parrila, Ritchie, & Deacon, 2017).

Metacognition

As defined by Reed (2013, pg. 104), metacognition is the choosing of strategies for processing information. Metacognition is an array of mental activity that involves thinking about cognition, which ranges from more discrete acts in which individuals recognize specific thoughts to more manufactured acts in which an array of thoughts, feelings, intentions, and connections between events are integrated into larger complex representations (Vohs, et al., 2016). Metacognition is an important aspect of a person’s ability to learn as research in the fields of science and mathematics (Lai, Zhu, Chen & Li, 2015; Thomas & Anderson, 2014). Previous research by Thomas and McRobbie (2001) has shown that developing and enhancing a student's metacognition can improve their learning processes and learning outcomes. While their research was focused in scientific learning realm, it can be proposed that these increases in learning outcomes can be generalized to various fields of academics. Through their research conducted in 1994, Schraw and Dennison found that there were two subcategories of metacognition, knowledge of cognition and regulation of cognition.

According to research by Flavell (1979) knowledge of cognition consists of three components: person, strategy, and task. The person component consists of an individual's awareness of how others process their cognition, and how an individual processes their own cognition. The strategy component consists of the ability of an individual to know which cognitive strategies they should employ whenever facing a task, as well as when, where, and why each cognitive strategy should be used. The task component is comprised of an individual's knowledge on the best way to amend his/her own cognition if new information is presented to an individual during a task. Amzil and Stine-Morrow (2013) use the terms declarative, procedural, and conditional knowledge to correspond upon Flavell's three components. Declarative knowledge corresponds to stateable knowledge about one's processing, and general thinking abilities, as well as learning strategies that one uses best. For example, an individual will know that he/she perform better on exams if he/she are in a cooler room as compared to a warmer room, and that the individual knows how he/she performs on essay exams than multiple choice. Procedural knowledge compares to strategy, where an individual knows how to use strategies and procedures to maximize learning. Finally, conditional learning corresponds to task, an individual knows when a learning strategy should be used and why that specific learning strategy should be used.

Regulation of cognition refers to the active tracking of cognitive processes as they occur, as well as the use of regulatory heuristics to facilitate cognitive performance (Amzil & Stine-Morrow, 2013). Previous research (Schraw & Dennison, 1994; Amzil & Stine-Morrow, 2013; Baker, 1989) has shown evidence that regulation of cognition involves five primary tasks; planning, information management, debugging, evaluation, and monitoring. These five tasks can be categorized into either monitoring of cognition or control of cognition. Monitoring of cognition is an individual's self-awareness of comprehension and task performance, as well as the ability to engage in self-testing while learning new material. Control of cognition involves the decisions that we make, either consciously or sub-consciously, based on monitoring incoming information.

The importance of an individual's metacognitive abilities when it comes to learning and doing well academically cannot be understated. A study by Everson and Tobias (1998) established a direct relation between a student's metacognitive skills and academic success. They developed the knowledge monitoring ability (KMA) for measuring knowledge monitoring accuracy. The KMA recorded a college student's estimation of his/her own vocabulary knowledge and then compared the estimation with actual student performance. KMA scores were compared with the student's GPA in courses where word knowledge was used. KMA scores and GPA were found to have a significant positive correlation. This research has great educational implications, as a student's metacognitive awareness can be used to predict their academic success. If we are able to successfully predict a students' academic success, then we will be able to target those who may struggle and give them the tools to be more successful. Swanson (1990) demonstrated that if an individual had high metacognitive abilities but low aptitude, their metacognitive abilities would make up for the low aptitude. What we can extrapolate from Swanson's finding is that, no matter the aptitude of an individual, he/she can improve their academic performance by improving their metacognitive knowledge. This has important implications for the educational realm as being able to teach metacognitive skills to students can help them reach their full academic potential, even if one has low aptitude.

Although someone's metacognitive abilities play a crucial role in learning, research has shown that self-regulation, which comprises of both an individual's metacognitive skills (planning, monitoring, and evaluation) and their motivation (beliefs, goals, and dispositions) interact to determine learning outcomes (Zepeda, Richey, Ronevich & Nokes-Malach, 2015). Through their research, they were able to determine that metacognitive instruction given to middle school aged children, led to increased metacognitive skills but also led to higher motivation and better performance on a test and a self-guided learning activity. Du Boulay et al., (2010) explain the relationship and bidirectionality of metacognition and motivation quite well. Imagine if a student is given a test, if the student performs well on the test, his/her belief in his/her mastery of the material will increase, which in turn increases the effectiveness of the learning strategies that his/her used while studying for said test. This will increase the student's self-efficacy and motivation to study for the next test, which should conclude with the student doing well on the following test.

Motivation

While having knowledge of cognition and knowing of deeper-processing learning strategies is not enough to promote a student's academic achievement, a student must be motivated to use such strategies as well as regulating his/her cognition and effort (Pintrich & DeGroot, 1990). There are three components to the theoretical framework for conceptualizing a student's motivation, which is called *general-expectancy value model* (Fishbein & Ajzen, 1975).

The first component is that of self-efficacy. Self-efficacy is essentially the belief that a child (or individual) has in that his/her have the ability to complete a task, and they are responsible for his/her performance. Previous research has shown that students who believe that they are able to complete a task and believe that they are able to engage in metacognition, use deeper-processing metacognitive strategies, and are more likely to persist and complete a task than students who do not believe they can perform well on a task (Paris & Oka, 1986). Self-efficacy beliefs have better predictive value of learning and achievement outcomes in a multitude of various cognitive domains, such as; mathematics and language, compared to the other two components of self-regulation (test anxiety and task value). While there is research that shows almost no gender difference in self-efficacy (Lin, 2016), there does appear to be somewhat of a difference in reported levels of self-efficacy in a motivational aspect when it comes to age, as younger students tend to report a higher level of self-efficacy as compared to older students, however older students self-reported lower levels of text-anxiety than younger students (Metallidou & Vlachou, 2007). Metallidou and Vlachou (2007), also provided support of self-efficacy being the most significant predictor of performance, cognitive and regulatory strategy use. Self-efficacy is also known for playing a continuous, adaptive role in the learning process, as it continuously adapts to influence an individual's motivation, goal orientation, academic performance, and changes to response to circumstances (Dull, Schleifer & McMillan, 2015).

The second component of a student's motivation is Intrinsic versus Extrinsic (also known as Task value). This component deals with the student's beliefs about the importance of the tasks, interest of the tasks, and his/her goals for the tasks. Essentially, this component asks a student "Why are you doing this task?" and his/her answers to this question is what's important. There is research to support the idea that students who are motivated by goals of mastery, challenge, and learning, and believe that the task is interesting and important will engage in more metacognitive activity, deeper metacognitive learning strategies and processing, and more effective effort management (Pintrich & De Groot, 1990). Not only does ascribing a high value in a task have positive benefits for the individual's inner-self but they are viewed as being a better student. In a study conducted by Metallidou and Vlachou (2010), they found that children who ascribed a higher value of beliefs in mathematics, were evaluated by their teachers as being more metacognitively, motivationally, and cognitively competent learners, as compared to the low task value students in their class. As with previous research, students with high task value had significantly higher performance, more frequently expressed more self-regulated learning behaviors, and had better metacognitive knowledge of strategies in the domain of mathematics, as compared to those with low task value.

The third and final component is an emotional component that is simplified as test anxiety. While test anxiety has been linked to perceptions of competence, a student's metacognition, effort management, and cognitive strategy use, research has shown conflicting information. Naveh-Benjamin, McKeachie, Lin, & Holinger (1981) found that high anxious students seemed to be effortful and persistent as much as their low anxious counterparts. High anxious students showed to be more ineffective and inefficient learners than low anxious students. However, there is research that shows that high anxious students are not persistent or effortful. Also, research on test anxiety seems to be linked more to the other two areas of self-regulation, rather than having a simple relationship to self-regulation. An example of how test anxiety and self-efficacy have a shared relationship is as follows; a student who believes he/she have the confidence, tools, and motivation to take on a statistics exam, he/she would have high task value, high self-efficacy, and low test anxiety. However, after receiving bad exam grades (subjective based on each individual) his/her self-efficacy will decline, as they will start to believe that they were overestimating how confident they were in their abilities, in turn, their test anxiety will most likely increase. It should be noted that even if a student's self-efficacy declines, and his/her test anxiety increases, his/her task value should still remain at close to the same level as before the student received the bad exam scores.

Working Memory

Lastly, an important executive cognitive function that plays an important role in motivation, learning, and metacognition is working memory. Working memory is defined as a cognitive structure that remembers, manages, maintains, processes, and stores information, with its role specified to the short-term (Colmar, Davis & Sheldon, 2016). The most accepted model of working memory is comprised of four components: the phonological loop (verbal), the visual-spatial sketchpad, the episodic buffer, and finally, the central executive (Van de Weijer-Bergsma, Kroesbergen & Van Luit, 2015). The phonological loop involves the storage and rehearsal of auditory and phonological information. This component is most commonly referred to as verbal working memory. The visual-spatial sketchpad involves the temporary storage and rehearsal of visual-spatial information; the visual-spatial sketchpad is most typically just referred to as visuo-spatial working memory. The episodic buffer acts as a temporary storage system that is responsible for the integration of information from multiple sources. The final component is the central executive, which is a domain general attentional control system that is involved in multiple processes, including, the selection and execution of strategies, retrieval of information from long-term memory, monitoring of input, the coordination of the other components of the working memory system, and simultaneously storing and processing of information (Weijer-Bergsma et al., 2015). It should be noted that the duration and capacity for the information that one's working memory capacity can hold are limited, as one can only typically process two to four chunks of novel information for only a few seconds (Kuldas, Hashim, Ismail, & Bakar, 2015).

There is research to support the notion that an individual's working memory is a significant predictor of their academic performance (Alloway & Alloway, 2010). It appears that for students that have at least average working memory, they are more likely to have higher need for cognition, which in turn benefits intelligence (Hill, Foster, Sofko, Elliot & Shelton, 2016). Need for cognition is similar to the intrinsic vs. extrinsic, or task value component of self-regulation. Need for cognition is an individual's difference that describes one's intrinsic motivation to engage in effortful cognitive processes, as well as getting enjoyment from engaging in these processes (Hill et al., 2016). It is interesting to note that the positive effects of need for cognition only translated to those individuals with an average working memory. Motivation has also been shown to actually increase visuospatial working memory when an individual's motivation is high and possibly more intrinsic focused (Sanada, Ikeda, Kimura & Hasegawa, 2013). There has also been research that shows that while some individuals with disabilities such as attention deficit hyperactivity disorder (ADHD), can have negative impacts on some aspects of working memory (visuospatial working memory in ADHD's case), their motivation is not negatively impacted (Dovis, Van der Oord, Huizenga, Wiers & Prins, 2014). It could possibly be extrapolated from this research that other disabilities, while having a negative impact on one or both aspects of verbal memory, could not show a negative effect on one's motivation.

However, when it comes to an interaction between one's working memory and metacognition, there appears to be little research on this exact topic to date. While information that is present in working memory is thought to be represented consciously, and metacognition works unconsciously, there is debate about whether or not they interact at all (Samaha, Barrett, Sheldon, LaRocque & Postle, 2016). Some recent research has expressed that working memory needs metacognitive awareness in order to function (Dutta, Shah, Silvanto & Soto, 2014). However, research is showing that even though it is predicted that working memory performance would improve with higher encoding confidence, thus establishing a link between metacognition awareness and working memory. Working memory performance does not improve with higher visual discrimination confidence (Samaha et al., 2016).

Present Study

This current study is important because students who have any disabilities that hinder their learning capabilities are facing increased expectations to make adequate progress through the general education curriculum, as they are to complete grade-level material on time (Kaldenberg, Watt & Therrien, 2015). There is also a lack of research on how, or whether those with disabilities that inhibit metacognition have different motivations for learning, such as intrinsic motivation. However, prior research (Lichtinger & Kaplan, 2015) has shown that motivation and self-regulation play an important part in the academic success of a student. A recent report by the National Center for Special Education research (Newman et al., 2011) reported that only 34% of students with disabilities graduate with a bachelor's degree within eight years. It could be expected that many of these students drop out of college because their disabilities hinder their academic success. The same report also showed that more and more students with disabilities are entering the college ranks.

The aim of this study is two-fold. First, we want to investigate any differences in the learning strategies that college aged students with disabilities employ, as compared to the general university population. Secondly, we want to investigate whether there are any differences in the working memory, motivation, and metacognition of college aged students with disabilities. Our first aim leads to our first hypothesis, that students with disabilities will demonstrate the usage of more inefficient and ineffective learning strategies than the general university student. Our second aim leads us to the second hypothesis that students with disabilities will consistently score lower on all sub-scales of: motivation, working memory, and metacognition. Our third hypothesis is that students with disabilities will choose to restudy the material in our learning strategies scenario as compared to the general student, who will be more likely to use a recall method to study. Finally, our fourth hypothesis is that men and women will show differences in what types of learning strategies that they employ.

Methods

Participants

Participants were undergraduate students at the University of North Florida (UNF) (N=391), who were either registered with the university's Disability Resource Center (DRC), or as self-identified as having a disability. However, after eliminating those that had incomplete sets of data or those whom had a working memory score (either visual or verbal) 3 standard deviations greater or less than the mean of all working memory scores, we were left with 125 participants. We then divided participants into two groups; Students with Disabilities (SWD) and Student without Disabilities (SWOD). Those in the SWD group (N=61) are students who either were registered with the university's Disability Resource Center (DRC), or those self-identified as having a disability (autism-spectrum disorder, visually-impaired, attention deficit-hyperactivity disorder, deaf/hard of hearing, blind/low vision, physical disability, Other health/disease such as; migraines, Crohn's, diabetes, cancer, etc, other psychological, emotional, and/or behavioral impairment, specific learning disability, speech/language impairment, traumatic brain injury, or other). Those who were not registered with the DRC, or self-identified as having a disability were part of the SWOD group (N=64).

Demographics: In our study, most of our participants were female (81.6%), were between the ages of 20-25 (63.25), and Caucasian (76%). In terms of disabilities that we looked at, we had participants with the following; Attention-Deficit Hyperactivity Disorder (19.2%), Autism Spectrum Disorder (.8%), Deaf or Hard of Hearing (.8%), Blind or Low-Vision (1.6%), physical disability (.8%), other health problems such as migraines, diabetes, cancer, etc (10.4%), psychological, behavioral, or emotional impairment (12.8%), Specific Learning Disability (2.4%), speech or language impairment (2.4%), traumatic brain injury (.8%), and finally we included an "other" category which consisted of 7.2% of the population.

Materials

Two working memory tests, one verbal and one visuo-spatial, were utilized via online program to measure the working memory of the participants. Those tests were the Backward Digit Recall and the Mr. X subtests of the Automated Working Memory Assessment (Alloway, 2007). Backward Digit Recall was used to test the verbal working memory of a participant, while the Mr. X subtest was used to test the visual-spatial working memory of a participant. (Cronbach's α of .86, and .84 respectively).

Learning Strategies. A pre-determined list of popular learning strategies based on previous research (Karpicke et al., 2009) is utilized for students to rank. There were 10 items including; memorization, highlighting in notes/textbook, practicing recall, making outlines/

review sheets, use of mnemonic devices, studying with a group of students, rewriting notes, using flashcards, doing practice problems, and rewriting notes. Students ranked them in order of which strategies they use most often to least often.

Learning Strategy Scenario. Participants were presented with a scenario that asked them to imagine they have an upcoming exam that they are studying for and after they have read the chapter, what option would they most likely choose to do: 1. Go back and restudy the entire chapter or parts of it, 2. Try to use a recall method of studying material from the chapter (without possibility of restudying the material), and 3. Use a different type of study strategy.

Metacognition. The materials consisted of twenty-one self-report questions chosen from the Metacognitive Awareness Inventory (MAI) created by Schraw and Dennison (Schraw and Dennison, 1994). The original MAI consisted of 52 questions, each belonging to one of two subgroup categories: knowledge of cognition or regulation of cognition. Twenty questions were selected for this study in order to expedite the survey for participants. Each question was reviewed and determined to be applicable or inapplicable for the participants. Inapplicable questions were not considered for the study. Questions for the study were then selected based on loading factors calculated by Schraw and Dennison. The ten highest loaded and participant applicable questions were chosen from each subgroup category. These twenty questions were then formatted to a first grade reading level to ensure comprehension of all participants. (Cronbach's α of .87, and .88 respectively).

Motivation. The Motivated Strategies for Learning Questionnaire (MSLQ) is an 81 item self-report survey rated on a 7-point Likert scale. The items are separated into two main sections: Motivational scales with 31 items and six subscales and Learning Strategy scales with 50 items and 9 subscales. The purpose of the questionnaire is to assess both student motivation with course materials and the student's learning strategies. For the purposes of our study, we focus on three constructs due to the correlational value to final course grades. The constructs used are Intrinsic (Task Value), Beliefs of Self-Efficacy, and Metacognition Self-Regulation Strategies. In selecting the items to be included in our study, we used the correlation value to Final Course Grade found in Pintrich et al's 1991 study. Items with a correlation of 0.40 or higher were selected. (Cronbach's α of .71-.91).

Procedure

Volunteers were recruited over a 3-month period. The study was advertised on the university DCR website, as well as through the UNF SONA online system. Individuals who chose to participate clicked on a link hosted by a third-party survey website, Qualtrics, and completed a survey utilizing multiple test materials.

Results

Hypothesis 1: Students with disabilities will demonstrate the usage of more inefficient and ineffective learning strategies than the general university student.

It appears there is no difference in the learning strategies that SWD and SWOD use (graph 1). Both SWD and SWOD used the strategy of rereading notes and/or their textbook most often (M=3.344, SD=.271 and M= 3.203, SD=.265 respectively). Both groups also used the strategy of studying with other peers the least, SWD (M= 8.197, SD= .254), SWOD (M= 7.953, SD= .248).

Hypothesis 2: Students with disabilities will consistently score lower on all sub-scales of: motivation, working memory, and metacognition. In order to compare the group performances on working memory, a MANOVA was conducted on the standard scores. The overall group term associated with Hotelling's T-test is reported in all instances (Table 1). The MANOVA performed on the verbal and visual working memory tests indicated a significant group difference: F=3.420, p=.036; η2p=.053. Post-hoc tests (Bonferroni adjusted, p<.05) indicated that in the viso-spatial working memory test, the participants in the SWD scored significantly lower than the SWOD (M= 100.115, SD= 2.622, M= 109.328, SD= 2.560, respectively). However, there were no significant group differences in the verbal working memory test.

After further review of previous research (Dovis et al., 2014), we separated participants that were either visually-impaired or had ADHD into their own group (Students with VI/ADHD) (n=26) and Students with disabilities (n=35). A MANOVA was conducted in order to compare the group performances on working memory. The MANOVA was conducted on the standard scores. The overall group term associated with Hotelling's T-test is reported in all instances (see Table 2), with post-hoc comparisons set at an alpha level of .05. The MANOVA performed on the verbal and visual working memory tests indicated no significant group differences between the Students with disabilities: F=1.768, p=.180; η2p=.057.

We then proceeded to conduct a MANOVA to compare the group performances on working memory between the SWD group, without the visually impaired or ADHD students, and the SWOD group. The MANOVA was conducted on the standard scores. The overall group term associated with Hotelling's T-test is reported in all instances (see Table 3), with post-hoc comparisons set at an alpha level of .05. The MANOVA performed on the verbal and visual working memory tests indicated no significant group differences between the SWD groups: F=.783, p=.460; η2p=.016.

In order to compare the group performances on the motivated strategies for learning questionnaire (MSLQ), a MANOVA was conducted on the standard scores of the subscales (Intrinsic Value, Belief of Self-Efficacy, and Metacognition Self-Regulation Strategies). The overall group term associated with Hotelling's T-test is reported in all instances (see Table 4), with post-hoc comparisons set at an alpha level of .05 (Table 2). The MANOVA performed on the subscales indicated no significant group differences: F=1.027, p=.383; η2p=.025.

In order to compare the group performances on the Metacognitive Awareness Inventory (MAI), a MANOVA was conducted on the standard scores of the subscales (Knowledge of Cognition and Regulation of Cognition). The overall group term associated with Hotelling's T-test is reported in all instances, with post-hoc comparisons set at an alpha level of .05 (Table 5). The MANOVA performed on the subscales indicated no significant group differences: F=.729, p=.485; η2p=.012.

Hypothesis 3: Students with disabilities will choose to restudy the material in our learning strategies scenario as compared to the general student, who will be more likely to use a recall method to study. A chi-square test of goodness-of-fit was performed (see Table 6) to determine whether the three options in the learning strategies scenario were equally preferred. Preference for the three options was equally distributed among the participants, X2 (2, N = 125) = 4.512, p=.105.

Hypothesis 4: Men and women will show differences in what types of learning strategies that they employ. An independent-samples t-test was conducted to compare preferred learning strategies and sex differences (male and female) (see Table 7). There was a significant difference in the scores for doing practice problems; males (M=4.95, SD=2.55) and females (M=7.12, SD=2.38), t(123)=-4.03, p<.01. There was also a significant different in the scores for using mnemonic devices; males -(M=4.65, SD=2.69) and females (M=6.11, SD=2.68), t(123)=-2.366, p=.02. Lastly, there was a significant different in the scores for highlighting in notes/textbook; males (M=5.25, SD=2.75) and females (M=3.80, SD=2.78), t(123)= 2.278, p=.024.

Discussion

Hypothesis 1 and 3

With regards to our first hypothesis, it appeared that students in both the Students without disabilities up as well as the Students with disabilities group used the same study methods. It also appears that our third hypothesis was not supported, as participants in both the Students with disabilities and Students without disabilities groups equally chose between the three scenarios. A possible reason why we are seeing this result could be the installation of SLS (strategies for success in college, career, and life, and foundations of college success, etc.) classes in the Florida university system. In the Florida university system, it is possible, that at some colleges and universities that students who come into college with either a disability or a student who takes a college placement exam and test into a remedial math or reading class will be required to take at least one SLS class, usually in their first semester. It should also be noted that students who are not diagnosed with a disability or test into a remedial class are still eligible to take SLS classes, as they are classes that are available to everyone. While we did not ask the participants in our sample if they have taken an SLS class, at least one SLS class is required for all incoming freshman at the university of North Florida.

There is an aspect of “teaching students how to study effectively” in these SLS classes, further examination of the syllabi for these classes is needed to know what study methods are being taught to students in these classes, however, it is possible that students are being taught the usefulness of these “deeper” learning strategies that involve recall and how to effectively employ them. If students with disabilities are being required to take these SLS classes, and if effective study strategies are being taught, this would be a plausible explanation for our results. Further studies should investigate whether participants in their sample have taken at least one SLS class in their academic career, regardless if they have an identified disability or tested into a remedial class to see if these classes are indeed having a positive impact on students. It would also be pertinent for following studies to include at least one academic outcome variable, such as a student's grade point average (GPA). The inclusion of looking at both an individual's GPA as well as if they have had taken any prior SLS classes could help provide support on whether these SLS classes are having an effect on one's academic outcomes as well as their learning strategies.

Hypothesis 4

We tested for gender effects on learning strategies and found that males greatly preferred doing practice problems and using mnemonic devices as compared to women, while women preferred highlighting in their textbooks. There has been prior research that shows that men and women tend to differ in terms of learning strategies that they use (Ruffing et al.,2015). It was found that males took advantage of their peers when studying (studying in groups for example) than women did. In our study, we found that studying in groups/with peers was the least preferred learning strategy for both men and women, but women preferred this method more so than men. Additionally, our findings yields an interesting difference in that both SWD and SWOD groups greatly ill-favored the use of studying in group. This finding also contradicts various research findings that female students prefer to work in groups on academic tasks, as well as tending to score higher on various social traits such as extraversion, agreeableness, and conscientiousness (Joo, 2017). Males were also found to use critical evaluation strategies for studying, while females were found to use all other study strategies more so than males.

As discussed previously, the typical student is not aware of the academic benefits of using studying strategies that use recall (Karpicke et al., 2009), and when informed that study strategies that involve recall have a greater effect on academic achievement, students still tend to use strategies such as rereading notes. However, most, if not all research in this realm has been done with college-aged students. It is quite plausible that students engage in less than optimal study strategies early in their academic career (elementary/primary school), should they use these less than optimal studying strategies and gain success, they may be instilled with false confidence in their abilities, and this false confidence would be hard to shake after so many years of using these strategies (Finn & Tauber, 2015). Per Finn and Tauber (2015), there seems to be a connection between metacognition and one's overconfidence in their usage of less than effective study strategies. Student's metacognitive skills and knowledge combine with their monitoring of learning can lead to illusions such as overconfidence in their abilities and study habits. Future studies should incorporate an academic outcome variable as mentioned above, such as grade point average (GPA), and ask participants to rate their confidence in their learning strategies, this would allow us to see if overconfidence in one's abilities could be hindering their usage of more effective strategies. An inclusion of an academic outcome variable could also help further support research that usage of recall learning strategies is associated with better learning outcomes.

It is also plausible that because Students without disabilities and Students with disabilities are typically being exposed to the same instructor, that that could influence both groups in using similar study strategies. It should come as no surprise that teachers/instructors have an impact on students and what strategies they employ. For example, in a recent study, it was found that about 80% of teachers discuss study strategies with their students (Morehead, Rhodes, & DeLozier, 2016). However, it was also found that only about 65% of teachers frequently endorsed study methods that had a recall component, and only 25% of teachers recommended the method of self-testing via the usage of flashcards. When students were asked whether their studying strategies, 64% of students reported that their studying habits and strategies were influenced by teachers/instructors. To see change in a student's study strategies, it may not be enough to help instruct them on more effective methods, or to inform them of the benefits of using learning strategies that have a recall component, one may need to work with teachers/instructors to ensure that they can promote the usage of effective learning strategies.

Hypothesis 2

The results did not support our second hypothesis that those in the SWD group would consistently and significantly score lower on the scales of: working memory, motivation, and metacognition. One possible explanation for why we saw these results is due to our distribution of disabilities that we had in our sample. The most selected disability that our sample size identified as having was attention-deficit hyperactivity disorder (ADHD) at almost 20%. As mentioned earlier, there is prior research that links ADHD to impairments in working memory (however, there should be no impairments to the other cognitive areas) (Dovis et al., 2014), and we saw a similar result in our study. While there was an initial significant difference between the SWD and SWOD groups with regards to visual-working memory, once we removed those that had a visual impairment or ADHD from the SWD group, the results between the two groups became non-significant. It is quite possible that because roughly 50% of participants in our sample have self-identified as having a disability that does not necessarily have a negative impact on the cognitive skills that we measured, these disabilities are not having as much of an impact as a sample with more cognitively impacted disabilities. It was unfortunate that in our study we had a narrow range of categories for disorder such as a general "other" as well as grouping emotional, behavioral, and psychological disorders into one category. Future studies should limit the broad categories and try to include more explicit diagnoses of disabilities.

Another plausible explanation for these results is that those in SWD group could have been largely self-identified as having a disability and they might have been overestimating the disability they self-identified as having, it is even possible that the individual thought they may have a disability, when it fact, none existed. There is research that supports the notion that those with physical disabilities tend to not self-identify, or self-disclose their disability if possible (Watson, 2002). It's quite possible that we are seeing a trend with regards to those that identify as having a disability, who may not have one, but because they may be struggling with academics feel as if they have a disability or at least identify with having one. It is also possible that students with a disability are overestimating the explicit effects of said disability and when measuring cognitive components, the effects of the disability is, in fact, negligible. Future studies should include and identify individuals that are either self-selecting as having a disability. With the added ability of being able to identify if an individual is either self-selecting as having a disability, or has been diagnosed with a disability, one could test to see if there is any discernable difference in their: working memory, motivation, or metacognition.

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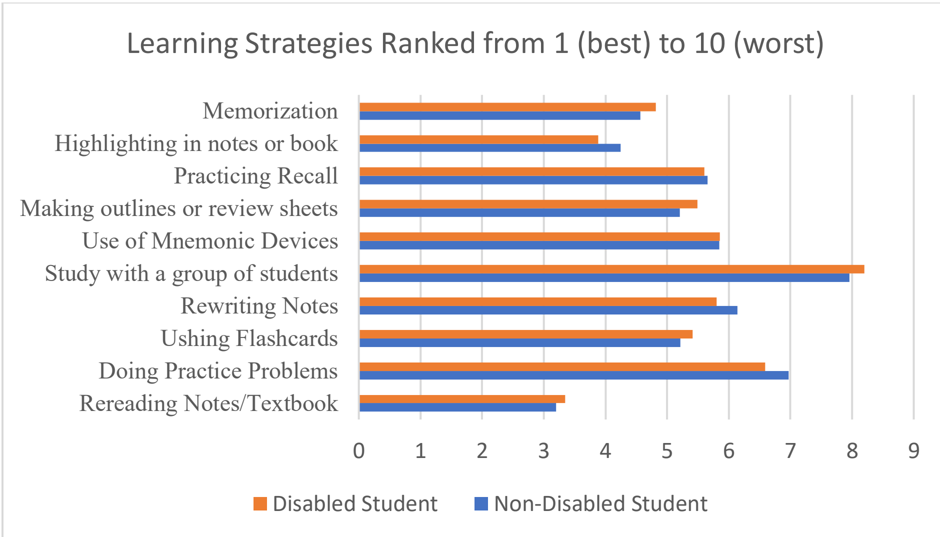

Figure 1. Learning strategies ranked from best to worst

Table 1

Descriptive Statistics of Working Memory

	SWOD	SWD
Variable	*M (SD)*	M *(SD)*
Verbal WM	107.72 (13.61)	107.13 (15.10)
Visual WM	109.33 (19.39)	100.11 (21.56)

Table 2

Descriptive Statistics of Working Memory: Participants with visual impairment and ADHD

	Students with disabilities		Students w/ ADHD or VI	
Variable	M (SD)	N	M (SD)	N
Verbal WM	107.37 (15.97)	35	106.81 (14.15)	26
Visual WM	104.34 (21.13)	35	94.42 (21.21)	26

Table 3

Descriptive Statistics of Working Memory with SWD group not including students that are Visually Impaired or have ADHD

	Students without disabilities		Students with disabilities	
Variable	*M (SD)*	*N*	*M (SD)*	*N*
Verbal WM	107.37 (15.97)	64	107.72 (13.61)	35
Visual WM	109.33 (21.13)	64	104.34 (21.13)	35

Table 4

Descriptive Statistics of Motivation Subscales

	Students with disabilities		Students without disabilities	
Variable	*M (SD)*	*N*	*M (SD)*	*N*
MSLQ Intrinsic	67.87 (4.65)	61	68.56 (3.47)	64
MSLQ Self-efficacy	122.31 (7.44)	61	124.22 (5.58)	64
MSLQ Self-regulation	151.66 (8.02)	61	153.70 (7.20)	64

Table 5

Descriptive Statistics of Metacognitive Subscales

Students with disabilities		Students without disabilities		
Variable	*M (SD)*	*N*	*M (SD)*	*N*
MAI Knowledge Cognition	237.16 (8.49)	61	238.31 (7.68)	64
MAI Regulation Cognition	227.61 (10.57)	61	226.92 (11.42)	64

Table 6

Crosstabulation of Students without disabilities and Students with disabilities for Learning Strategies Scenario

Group	Go back and restudy either the entire chapter or certain parts of the chapter.	Try to recall material from the chapter (without possibility of restudying the material).	Use some other study technique
Students with disabilities	39 (34.2)	11 (10.7)	22 (16.1)
Students without disabilities	31 (35.8)	11 (11.3)	11 (16.1)

Note. Numbers in parentheses indicate expected count.

Table 7

Significant Results of an Independent Samples T-Test comparing learning strategy preference and gender.

	Males		Females	
Variable	*M (SD)*	*N*	*M (SD)*	*N*
Practice Problems	4.95 (2.55)	23	7.12 (2.38)	102
Use of Mnemonic Devices	4.65 (2.65)	23	6.11 (2.68)	102
Highlighting in notes/textbook	5.25 (2.75)	23	3.80 (2.78)	102

Curriculum Vitae

Michael Rodriguez received his Bachelor of Science degree from the University of North Florida in 2013, before attending the University of North Florida in 2015 for his Master's degree in Psychological Science. While attending UNF for his Masters, he had the opportunity to work in Dr. Alloway's Working Memory and Education lab, as well as Dr. Angela Mann's Family Social Justice lab. He has presented research at professional conferences that include the Florida Association of School Psychologists, The National Association of School Psychologists, and the Association of Psychological Science.

Michael Rodriguez currently attends the University of Florida and is pursuing his Doctor of Philosophy in School Psychology.