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The Impact of Self-Regulated Learning on Academic Performance in High School Students

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ABSTRACT

Many studies have found a strong correlation between academic performance and self-regulated learning (SRL). However, few studies have been conducted on high school students, fewer still examined specific SRL strategies instead of general themes or categories, and almost no studies considered the role that digital technology might play in SRL. This study uses data collected through an anonymous mixed-methods survey given to students at a rural high school. This survey collected information on both SRL strategies students use, and their GPA, used as a measure of academic performance. A portion on the survey focused on how students use digital technology, both for potential distraction and for SRL. Data on SRL strategies and digital technology use was sorted into categories by question, averaged, and then correlated with GPA to determine how certain strategies impacted academic performance, and how digital tool use or digital distraction impacted academic performance. This study found that most SRL strategies that correlated with academic success fell under two key modes: form-based studying and self-adaptive studying. In addition, while digital tool use did not correlate strongly with SRL, it correlated negatively with digital distraction. With this understanding, this study finds that there are distinct types of SRL implementation. Educators should consider this, adapting to student preferences when assisting with SRL implementation. Future research should also investigate the relative impact certain SRL skills or subcategories have over others.

Introduction

Despite all the advances of modern pedagogy, America's education system has not reached its full potential. The Program for International Student Assessment measures the academic performance of 15-year-old students across 79 countries. The 2018 assessment found that American students had the 9th highest reading scores, the 31st highest mathematics scores, and the 12th highest science scores (Schleicher, 2020). In order to improve academic outcomes, educators have increasingly turned to new ideas in learning theory (Boekaerts & Minnaert, 1999). Experimental validation shows that certain theoretical models hold promising pathways for improving academic achievement.

Building on this research into learning styles, Zimmerman (1986) introduced the concept of self-regulated learning (SRL). In SRL, students direct themselves by choosing the tools and strategies that are most effective in helping them to learn and complete tasks. SRL also includes the student's thoughts, feelings, and actions when completing tasks. SRL is not practiced by a specific type of learner. Instead, it refers to the methods and tactics each student uses to complete their work.

Further research into SRL refined this general definition and created several theoretical models. Significant studies (Britton and Tesser, (1991), Duckworth et al., (2011), Li et al., (2018)) have evaluated the relationship between SRL and academic performance and found that practicing SRL was strongly correlated with high academic performance. Due to these empirical indications, other studies such as Panadero (2017) have recommended training educators to teach SRL skills. Improved SRL skills will help students find ways to

complete their work and improve their performance, making research into SRL key to improve educational outcomes. However, few studies have focused on United States high school students or evaluated how digital technology impacts the SRL strategies students use. This study seeks to rectify this by investigating the correlation between the use of SRL strategies and the academic performance of students in a rural county in Southern Maryland. This study also examines the use of digital technology in SRL.

Literature Review

The first major model of self-regulated learning was proposed in Zimmerman (1989). According to this model, termed the Triadic Analysis of Self-Regulated Learning, SRL is influenced by the self, their behavior, and their environment. The self is the individual's goals and objectives. As the individual tries to achieve them, they become aware of their own actions and efforts, and begin to take action to regulate them. This leads to the behavior aspect, or the learner's observations and self-reflections. Individuals determine how they are performing and evaluate their degree of success. Students use this to search for the most effective ways of achieving their goals. Finally, the environment factor refers to the physical setting of the learning environment, and the effects of those environments on learning. Students regulate their learning by modifying their learning environments to best support them, such as arranging their desks to best help them study or adding more lighting to a dimly-lit room. Aspects of each factor provide feedback to the others, which in turn influences their function. For example, someone's behavior of exercising regularly will influence the type of clothes they wear and what equipment they keep in their room, changing their environment. It will also influence the self by helping to achieve their goal of becoming more physically fit (Zimmerman, 1989).

While the Tridactic Analysis model was highly influential, it failed to explain the ways in which those practicing SRL thought, planned, and evaluated themselves. This led to the development of Pintrich's SRL Model. Introduced in Pintrich (2000), designed to help clarify individual cognitive functioning in SRL. In this model, SRL is composed of four phases: forethought, planning, and activation; monitoring; control; and reaction and reflection. These phases are cyclical, meaning that learners repeat these steps continuously until a task is completed. Each phase is expressed through four areas of regulation: cognition (judgements of learning and skills), motivation, behavior (individuals' attempts to control their own behavior), and context (attempts to control and regulate their learning context). The first phase focuses on establishing goals. The second involves breaking goals into tasks, assessing motivation, and monitoring work progress. The third centers around adjusting strategies to increase performance. Finally, the fourth involves evaluating progress towards the goal and the effectiveness of the individual's choices and thought processes (Pintrich, 2000). The Pintrich SRL Model has also received significant attention through the Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich in Pintrich et al. (1993). A literature review recently found that the questionnaire was the most widely used instrument in SRL measurement (Roth et al., 2016). Like the Pintrich model, the MSLQ has four core categories. These categories are metacognition (how students analyze their own learning process), planning (how students prepare for assignments), execution (how students complete assignments), and reflection (how students review their work and strategies used). The planning section contains the organization and deadline-setting categories, and the execution section contains the task-management and elaboration subcategories. This paper uses the model defined by the MSLQ due to its popularity as a survey tool and its ability to classify behaviors more specifically through subcategories.

As SRL models developed, researchers sought to better determine the relationships between SRL and academic performance. One of the first to do so was Britton and Tesser (1991). This study was based on a time-management framework, but included elements similar to those of Pintrich's SRL model. However, unlike Pintrich (2000), this study made a distinction between short-term execution and long-term execution. In the study, researchers gave college students at the University of Georgia a questionnaire to evaluate their task management and general self-regulation. Results in these categories were compared to their GPA. They found that higher self-regulation was generally correlated with increased academic performance, and lower self-regulation

with decreased academic performance (Britton & Tesser, 1991). This general pattern was corroborated by Duckworth et al. (2011), which used an experimental study to evaluate the effectiveness of a specific SRL behavior set. In this study, a group of high school students completed a short reflection asking them to set goals and plan how they would complete a PSAT practice book, while students in the control group did not. When students returned their books after three months, students in the intervention group completed more problems than those in the control group. This indicates that goal-setting and planning translated into an increased performance, suggesting a more complete practice of SRL would also correlate with increased academic performance.

Most studies have focused on college students, with few studies on secondary school populations. Li et al. (2018) conducted a literature review on SRL in elementary and secondary school students in China. Results indicated a consistent relationship between SRL strategies and academic performance. In particular, the study found that SRL behaviors related to organization and reflection had the most significant impact on academic performance. Joo et al. (2000) also found that strong SRL skills in high school students in South Korea correlated with high academic performance. Students were surveyed on their SRL skills and given lessons on computer use and technology. Results indicated that SRL correlated with both individual test scores and final grades, indicating that SRL impacts both learning success and cumulative performance. These studies have established correlations between SRL and academic success in college and foreign high school students.

Gaps in the Research

Comparatively few SRL-related studies have investigated high school students. Most that have, such as Li et al. (2018) and Joo et al. (2004) were conducted on students in foreign countries. The cultural and academic situation in the United States is significantly different from other countries, in both academic structure and style and in cultural expectations, as indicated by Li et al. (2018). Studies conducted in the United States, such as Duckworth et al. (2011), have not investigated all aspects of SRL or its relationship with digital technology. Studies like Mei (2016) have examined the impact of individual technologies on academic performance, while others have studied SRL in the context of distance learning (Neroni, 2019). However, no study conducted in the United States on high school students has examined the impacts of individual digital tools and technologies on the execution of SRL strategies. Moreover, all of these studies took place in a pre-pandemic world, where online educational technologies were used much less than they are today. The rise of educational technology means discovering relationships between digital tool use, SRL strategies, and academic outcomes is more important than ever to help students' academic performance.

Methodology

This study used a mixed-methods survey to determine how particular SRL strategies practiced by students impact their academic performance. This study puts particular emphasis on how the use of digital technology influences the implementation and effectiveness of SRL strategies, including the impact of digital distraction.

To investigate the impacts of SRL strategies, this study must collect reliable measures of academic performance. Quantitative data are consistent and easily comparable, suiting the purposes of this study (Leedy & Ormrod, 2019). Grade point average serves as the quantifiable measure of academic performance.

Many notable studies in this field have relied on surveys to reliably gauge the SRL performance of large groups of students, from Joo et al. (2000) to Britton and Tesser (1991) to nearly all the studies included in the meta-analysis by Li et al. (2019). This study can also make use of robust, extensively-tested survey methods such as Pintrich's MSLQ (Panadero, 2017; García-Ross et al., 2004). Quantitative data from a survey allows a correlational analysis to find the relationship between SRL strategies and academic performance.

However, quantitative responses only provide general information about SRL performance. In order to fully understand how students implement SRL strategies, this study uses qualitative free response questions. These allow for a deeper examination of individual SRL practices. This is necessary to identify specific techniques and their implementation context. By combining this qualitative measure with other quantitative analyses such as Spearman's rank-order correlation, mixed-methods research gives the best insight into how students practice SRL strategies and how SRL strategies influence academic performance.

Implementation

This study was conducted at a public high school in a rural county in Southern Maryland. The high school is the largest high school in the county, offering a variety of subjects including Honors and Advanced Placement (AP) courses. The high school calculates grade-point average (GPA) on a standard 4-point scale, with a letter grades in a class corresponding with grade-point values as follows: A(90-100%)=4.0, B(80-89%)=3.0, C(70-79%)=2.0, D(60-69%)=1.0, F(0-59%)=0.0. AP courses receive additional weight, with letter grades in an AP class corresponding with grade point values as follows: A(90-100%)=5.0, B(80-89%)=4.0, C(70-79%)=3.0, D(60-69%)=1.0, F(0-59%)-0.0. These point values are averaged for the total courses taken in a semester to produce a weighted GPA.

Participants were selected for this study based on their enrollment in this high school. Recruitment materials advertising the study were distributed to teachers in each of the core subject areas taught at the school (English, Mathematics, Science, Social Studies, Foreign Language, and Fine/Practical Arts). With teacher and administrator approval, these recruitment materials were displayed in these teachers' classrooms. The researcher also passed out recruitment materials in hallways and during lunch. Participants were required to return an informed consent form signed by their parents to the researcher or the AP Research teacher. With a completed informed consent form, students would receive a link to an online survey. Responses were collected through Google Forms, where surveys were linked to informed consent forms to prevent the use of data without informed consent. Students could choose not to answer any question in the survey. All responses were kept confidential and destroyed upon the conclusion of the study.

Survey Questions

The survey consisted of three types of questions: multiple choice, GPA, and open ended. For the 44 multiple choice questions, participants would rate their agreement to the presented statements on a seven-point Likert scale. An answer choice of one expressed strong disagreement and an answer choice of seven expressed strong agreement. The statements were adapted from the MSLQ (Pintrich et al., 1993). In addition, questions in two technology-focused areas were also included to determine how digital technology influenced students' SRL strategies. These two categories were the use of digital tools, with each question corresponding to a core category of SRL, and digital distraction. In all these categories, values on Likert scales represented the degree to which participants practiced behaviors and skills associated with the question's category. High scores in most questions corresponded to higher levels of practice and skill in the question's category, except for questions 16, 39, and 42, where high scores on questions indicated a lower level of practice and skills in the corresponding category. These questions are marked as (REVERSE) in Table 1, which shows the questions with their category and subcategory. Answer responses were stored individually and averaged by category and subcategory for data processing.

Table 1. Likert scale questions and categories

Question Number	Question	Category	Subcategory
1	When I become confused about something I'm reading for this class, I go back and try to figure it out.	Metacognitive	N/A
2	If topics in class are difficult to understand, I change the way I read the material.	Metacognitive	N/A
3	Before I study a new unit or subject thoroughly, I often skim through the textbook or unit outline to see how it is organized.	Metacognitive	N/A
4	I ask myself questions to make sure I understand the material I have been studying in my classes.	Metacognitive	N/A
5	When studying for my classes, I try to determine which concepts I don't understand well.	Metacognitive	N/A
6	When I read from my textbook or other assigned readings, I outline the material to help me organize my thoughts.	Planning	Organization
7	When I study, I go through the readings and my class notes and try to find the most important ideas.	Planning	Organization
8	I make simple charts, diagrams, or tables to help me organize material for my classes.	Planning	Organization
9	When I study, I go over my class notes and make an outline of important concepts.	Planning	Organization
10	I usually keep my work area clear of everything other than what I am currently working on.	Planning	Organization
11	I write out assignment due dates in a non-digital planner or calendar when I receive them.	Planning	Deadline setting
12	I plan out when I will complete assignments, and I follow my plan.	Planning	Deadline setting
13	When I plan my day, I take into both my academic work and other personal responsibilities and activities.	Planning	Deadline setting
14	I have a clear idea of what I want to accomplish during the next week.	Planning	Deadline setting
15	When my schedule changes, I rearrange when I will complete my schoolwork.	Planning	Deadline setting

Question Number	Question	Category	Subcategory
16	I wait until the last minute to complete my assignments. (REVERSE)	Planning	Deadline setting
17	When I study, I pull together information from different sources, such as lectures, readings, and discussions.	Execution	Elaboration
18	I try to relate ideas in one class to those in other classes when possible.	Execution	Elaboration
19	When reading for my classes, I try to relate the material to what I already know.	Execution	Elaboration
20	When I study, I write brief summaries of the main ideas from a class's readings and the concepts from the class's lectures or assignments	Execution	Elaboration
21	I try to understand the material in my classes by making connections between the readings and the concepts from the lectures.	Execution	Elaboration
22	When I have several things to do, I do a little bit of work on each one.	Execution	Task management
23	When I am completing an assignment, I don't get distracted by socializing or leisure activities.	Execution	Task management
24	I set goals for the entire quarter.	Execution	Task management
25	I focus on one assignment at a time.	Execution	Task management
26	I complete large assignments by breaking them down into smaller parts, and working on those parts individually.	Execution	Task management
27	When I don't get the academic performance that I want, instead of studying more, I study in a different way.	Reflection	N/A
28	After taking a test, I try to understand what topics I was weaker in and where I need to improve.	Reflection	N/A
29	I try to understand how I made mistakes in my assignments.	Reflection	N/A

Question Number	Question	Category	Subcategory
30	I try different methods of studying to maximize my performance.	Reflection	N/A
31	After completing a major assignment, I reflect on my performance and what I could have done differently.	Reflection	N/A
32	I often use software to remind me of when to do work and to make sure I don't forget my assignments.	Digital Tools	Deadline setting/ Organization
33	I often use a digital calendar to manage my assignments and tasks.	Digital Tools	Organization
34	I often take notes digitally.	Digital Tools	Elaboration
35	I often use mind-mapping software to organize my notes, brainstorm, or map my thoughts.	Digital Tools	Elaboration
36	I often use to-do list software to help prioritize my school tasks.	Digital Tools	Task management
37	I often use digital flashcards or other review software to study for my tests.	Digital Tools	Reflection
38	I often browse non-academic websites while I work.	Digital Distraction	N/A
39	I spend more than 15 minutes on an academic task without switching to another app or program. (REVERSE)	Digital Distraction	N/A
40	I often have music or videos playing while I am studying.	Digital Distraction	N/A
41	I often check social media while I am studying.	Digital Distraction	N/A
42	I often use software to help me stay focused and decrease my distraction. (REVERSE)	Digital Distraction	N/A

When creating this survey, some questions from the MSLQ were refined to focus on the high school educational environment instead of college. The researcher followed the process described in García-Ross et al. (2004), which adapted a time-management survey by Britton and Tesser (1991) to a high school population. This involved simplifying language, focusing questions on more holistic school life rather than behaviors practiced for a single class, and more clearly separating in-class and out-of-class behaviors in the statements.

In addition to these statements, participants also self-reported their GPA as a measure of academic performance. This is a common practice in studies on SRL and time management, as GPA is considered a reasonable indicator of general academic performance (Britton and Tesser, 1991; Farooq et al., 2011). However, relying on self-reported data does pose some issues: students may feel uncomfortable revealing their GPA to someone else, or may feel self-conscious and exaggerate or understate their GPA when self-reporting. To combat this, the survey materials emphasize survey responses are confidential. However, research into self-reporting GPA in high-school students indicates that students are mostly truthful. Cassady (2000) and Schwartz and Beaver (2015) conclude that students are mostly truthful when reporting their GPA, while Shaw and Mattern (2009) concludes that students only slightly exaggerate their GPA, statistically within half a letter-grade. Thus, while inaccurate self-reporting is still a possibility, there is no compelling reason to distrust self-reported GPA.

After averaging every respondent's scores in each category of SRL using the MSLQ categories of metacognition, planning, execution, and reflection, these averages were ranked along with respondent's GPA scores to perform Spearman's rank-order correlation. This process was repeated for each subtopic of SRL, for each question, and for digital distraction and digital tool use. Correlations were also performed between digital tools and digital distraction. The researcher used a table of critical values for Spearman's correlation from the University of York (n.d) to determine what results indicate correlations. Critical values were determined by the survey's sample size. Critical values for p-values of 0.10, 0.05, and 0.025 were used. Any correlations exceeding the critical values were determined to be statistically significant. Results were listed with the highest applicable p-value.

Four free-response questions were also included to provide a more focused understanding of how students implement SRL strategies. Like the Likert-scale responses, these questions focused on different areas of SRL. Two focused on how students plan and conceive of assignments. The other two others focused on the strategies students use while completing assignments and the work environment they create to complete their assignments. These are shown in Table 2. These insights were naturally of a more personal nature, so they were analyzed thematically. However, they give a far more detailed view of how students implement these strategies daily, approaching the detail obtained through interviews or discussions while still maintaining a large sample size.

Table 2. Free-response questions

Question Number	Question
FR1	How do you organize your work for larger assignments?
FR2	Describe your normal study environment.
FR3	How do you divide your time during a study period?
FR4	Are there any specific apps or programs that you use to help you manage your time? What are they?

Results

There were 25 total respondents to the survey. However, one response did not contain GPA data and was therefore excluded from quantitative analysis, as SRL correlation with academic performance could not be estab-

lished with this response. Likewise, another respondent did not answer any of the included free-response questions, and as a result their response was not included in qualitative analysis. As a result, both the quantitative and qualitative analyses had a sample size of 24.

Quantitative

The results of the correlation analysis are shown in Table 3, with the highest applicable p-value used for each correlation.

Table 3. Significant correlations (Spearman's correlation matrix)

Correlation Category	GPA	Digital Tools
Organization	0.273*	—
Elaboration	0.282*	0.409***
Reflection	0.330*	0.330*
Question 6	0.390**	—
Question 14	0.419***	—
Question 17	0.444***	—
Question 21	0.390*	—
Question 30	0.315*	—
Question 34	0.311*	—
Question 38	-0.326*	—
Question 41	-0.375*	—
Digital Distraction	-0.410***	-0.375**

*p ≤ .10, **p ≤ .05, ***p ≤ .025

While most individual questions had no correlation with GPA, some questions (6, 14, 17, 21, 30, 34, 38, and 41) showed statistically significant correlations as shown in Table 3. Of particular note are questions 6, 14, and 17. These values correlate when using a significance value of 0.025 for questions 14 and 17 and and 0.05 for question 6. Lastly, two statements about digital distraction correlated negatively with GPA: questions 38 and 41.

Digital distraction had a strong negative correlation with GPA, with a p-value of 0.025, while digital tool use did not have a significant correlation with GPA. Each respondent's scores for digital tools questions were also correlated with their average score in the corresponding categories of the MSLQ. This produced two statistically significant results: a positive correlation between the reflection digital tool question and average reflection score, and a positive correlation between the elaboration digital tool question and average elaboration score. These correlations are shown in Table 3. In particular, the correlation between the elaboration question and average elaboration scores holds for a significance value of 0.025, indicating a strong relationship between the two values.

Qualitative

The analysis of respondent's answers to free-response questions produced several notable themes. Patterns or behaviors that occurred at least twice among responses were generated into codes, which were grouped under five themes. These themes are shown with their grouped codes in Table 4.

Table 4. Themes and Codes of Thematic Analysis

Theme	Codes
Self-Focused Adaptive Studying	Metacognitively-determined breaking Metacognitive analysis of work Categorical work strategy
Form-Based Studying	Bodily-needs-based work Completionist work strategy Proactive time-setting
Supportive Technology Use	Time-based breaking Online educational resources Website-based planning and support software
Concentrative Technology Use	Induced ambience
Physically-Organized Working	Computer alert systems Physical work presentation Environment construction and management Physical planning tools

First, two broad divisions of studying practices were found in this analysis. Many respondents emphasized the importance of adaptability and flexibility while studying. For example, many would prioritize assignments based on difficulty, and break when they felt distracted or tired. Respondents also worked on multiple homework assignments or studied for multiple classes at once. Some would decide the order of their study and the time and intensity they should use by evaluating their tasks. These behaviors were grouped under the concept of self-focused adaptive study, where the student determined studying habits by evaluating the individual scenarios of assignments while metacognitively evaluating their own focus and performance. This stood in stark contrast to another observed group of behaviors, called form-based studying. Reported behaviors under this category included a more completionist work strategy, working a single assignment until it was finished. Other behaviors included regulating work and breaks around set units of time and determining in advance when to start and finish work. The thematic analysis also produced several themes relating to technology. The first, supportive technology use, represented the active use of technology to aid in the completion of work, such as the use of online planners and organizers or online textbooks and other online learning resources. All these behaviors sought to use technology as a primary tool to aid in the completion of schoolwork. This stood in contrast with concentrative technology use, which encompassed more passive uses of technology, where respondents used technology as a secondary tool to aid in concentration. For example, respondents reported playing calming, meditative, and focusing music to help them study, and used phone or computer-based alerts to signal breaks in their work patterns. Lastly, respondents also reported a variety of behaviors classified under physically organized working. Some respondents would physically arrange and organize materials needed for work, color code or visually categorize assignments and school subjects and arrange study spaces to maximize quiet and comfort. Behaviors under this theme centered around using analog digital planning tools and organizing work environments to maximize efficiency.

Discussion

The data confirmed the correlation between SRL and academic performance and found relationships between specific aspects of SRL and academic performance. In addition, this study found that digital tool use was closely related to SRL.

Quantitative correlations showed a link between SRL and academic performance among the sample population. One of the four major SRL categories, reflection, produced a statistically significant correlation with academic performance. Organization (a subtopic of planning) and elaboration (a subtopic of execution) also correlated with academic performance. These findings match those in Li et al (2018), strengthening the link between these types of behaviors and academic performance. This suggests that organization, elaboration, and reflection have the greatest impact on high school academic performance. Further research is still needed to determine the causal relationship between these SRL categories and academic performance.

The relationships between individual questions and academic performance are more varied. The questions with the strongest correlation to GPA referred to reading from textbooks and outlining material (6), creating weekly plans (14), integrating different sources when studying (17), and writing summaries of the main ideas of class reading and concepts from class lectures (21). Some questions correlated with GPA even when the category it was part of did not. For example, question 14 (categorized under deadline setting) correlated with GPA, while its parent category and subcategory did not. These correlations suggest that certain SRL behaviors may be more related to academic performance than other behaviors. When scores on these questions are averaged with questions that have weaker correlations to produce a category-wide score, the resulting correlation value is weak. Further research is needed to explore whether specific SRL behaviors have more of an impact on academic performance than others.

While all aspects of SRL did not correlate with academic performance, three out of the four categories either directly correlated with academic performance or had correlating subcategories. Enough categories and subcategories correlate to uphold the overall correlation of the MSLQ model and academic performance and extend that correlation to US high school students.

Quantitative data also highlighted the significance of digital tool use when practicing SRL. Elaboration, referring to the process of extending and interrelating knowledge, and reflection, referring to self-analysis of performance and behavior, were strongly correlated with digital tool use. In addition to these results, digital tool use had a strong negative correlation with digital distraction. It seems likely that digital tools could aid in SRL. However, the use of digital tools would be expected to run the risk of some digital distraction. The data show that digital tool use has a strong negative correlation with digital distraction, defying these expectations. From the data, it seems that students can use digital tools without succumbing to the digital world's distraction, implementing SRL and achieving increased academic performance. Students that use digital tools may be less predisposed to digital distraction, or the use of digital tools may improve resistance to digital distraction. It could even be that SRL behaviors help students avoid digital distraction. However, this study cannot determine causality, necessitating further research. Regardless, these findings indicate that there are many opportunities to use digital tools as part of implementation of SRL.

Qualitative data also produced significant results. Thematic analysis produced new insights into the ways in which students implement SRL in the real world, separate from categorization of SRL-related activity from theoretical models. Themes from this data indicate several different types of SRL implementation behaviors, distilled into 5 categories. Several of these strategies, such as the two studying themes and the two technology themes, depict diametrically opposed methods of SRL implementation. Form-Based Studying and Concentrative Technology Use involve the student placing extreme control over the study environment to maximize focus on the task. Self-Focused Adaptive Studying and Supportive Technology Use take a different approach that allows attention to move off task and places greater emphasis on the student's own metacognition during task completion. However, successful students working in this mode set up their study environments to easily redirect their focus to productive work after break periods or other lapses of attention. This indicates a clear division in the ways students implement aspects of SRL. While the students' behaviors conformed to previous SRL categorization models, this study shines new light on the ways in which students specifically implement these general behaviors. There are at least two major modes of environment choice, self-management, and

technology use. Further study should examine the effectiveness of these implementation modes in academic achievement.

Limitations

This study also has some notable limitations. When translating questions from the MSLQ to be more suitable for a high-school environment, it is possible that certain translated questions did not accurately reflect the behaviors described in the MSLQ. If there were adaptation errors, there may be inaccurate results when participants completed the survey. Similarly, self-reported GPA may also have produced inaccurate results, as discussed in the Methodology section. Finally, this study was conducted among a relatively small sample of students at a single rural school. Moreover, many of these students were in grades 11 or 12 and were taking advanced or AP classes. Recruitment materials for the study were distributed mostly to teachers that taught upperclassmen. Some teachers who displayed advertising for this study mostly taught AP classes. Due to their workload and fast pacing, AP and advanced courses are usually more difficult than standard courses and may require an emphasis on different SRL skills to achieve academic success. In future studies on this subject, the sample size should be increased and distributed across multiple geographic regions. This sample should include students across all academic performance levels.

Conclusions

First, this study indicated that aspects of SRL do impact the academic performance of high school students. These aspects were spread across three of the four categories of SRL when using the MSLQ. This suggests that SRL is generally beneficial to the academic performance of high school students.

This study's finding that certain behaviors had a significant correlation with GPA has a significant impact on the field of SRL, as previous research has not identified specific SRL practices that correlate with academic performance. Educators should take note of these behaviors (namely, outlining notes and thoughts while reading textbooks, creating weekly plans and using them to have a clear understanding of what must be done in a week, integrating different sources when studying, and summarizing and synthesizing textbook notes and classroom lectures when studying) and find ways to integrate them into classroom instruction. For example, teachers could provide note sheets for students to fill out using their textbook or include sections of class where they interrelate material from their lectures and the class's textbook. Regardless of causality, the depth of this relationship indicates that SRL and academic performance are strongly linked. Therefore, educators may be able to increase academic performance by directly teaching SRL behaviors to augment classroom instruction.

In addition, digital tools are linked with the practice of aspects of SRL in these high school students. The use of these tools is negatively correlated with student distraction by digital technology. This suggests that with today's students, digital tools are a pathway to academic success, rather than a trapdoor to digital distraction. Based on these results, educators should encourage digital tools as a means for productivity. When designing these tools in the future, creators should take into consideration different styles of SRL implementation in students, allowing both minimalist designs amenable to concentrative technology use, and user-customizable designs to allow supportive technology use.

This study's thematic analysis seems to indicate five main patterns of how students implement self-regulated learning, with most following two modes: form-based and self-adaptive. Thematic classifications of SRL implementation also impacts the wider field of SRL, introducing details that help coach students into SRL implementation by adapting to their preferences. This new detail will allow for more discussions on how different implementation styles may impact SRL behaviors and categories. Educators should be aware of these variations in SRL implementation and adapt to student preferences when assisting with SRL implementation.

When designing study areas, for example, educators should provide tools that let both self-focused adaptive studying students and form-based studying students properly implement their respective styles. Moreover, these methods of study all seem to be valid; educators should keep this in mind when instructing students how to study, as some techniques may help some students but not others.

In addition, this study recommends several further studies to expand upon the conclusions and implications mentioned above. First, future research should seek to explain the negative correlation between digital distraction and digital tools. Additional research should also investigate the relative impact certain SRL skills or subcategories have over others. This study did not determine if certain implementation modes were associated with greater academic performance; future research should investigate if specific implementation modes of studying are more effective than others. The specific behaviors identified in this study, along with the greater understanding of implementation modes, can help educators to improve the instruction of SRL. This study can help educators prioritize SRL skills and support students in building an implementation that fits their needs. Self-Regulated Learning is a valuable tool in the arsenals of educators, and one that should be continually refined through research into all its forms and aspects.

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