

The Impact of Study and Learning Strategies On Post-Secondary Student Academic Achievement: A Mixed-Methods Systematic Review

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ABSTRACT

Background:

Within academic development, it is important for students to use effective study strategies to facilitate learning. Techniques used for long-term information retention include note taking strategies, time management, methods of self-testing and active recall. These strategies are explored to help students learn more effectively to attain their academic goals.

Methods:

A mixed-methods systematic review of peer-review articles and grey literature was conducted with a predetermined criteria for a convergent integrated synthesis approach. PsychInfo (Ovid), Web of Science, and ProQuest databases were searched with guidance of a PICO-P logic grid and search strategy using keywords of student, study strategies, and achievement alongside filters. Initial studies were screened and reconciled by two independent authors with the use of a piloted screening tool. Using the Mixed Methods Assessment Tool (MMAT), included studies were assessed for quality. Two authors independently performed data extraction. Heterogeneity in study designs, outcomes, and measurements precluded meta and statistical analyses; thus, a qualitative analysis of studies was provided.

Results:

Four major themes contributing to academic performance were identified among the appraised articles. These themes were self-testing, scheduling/time management, concept maps, and learning styles. Self-testing, scheduling, and concept maps were positively correlated with increased academic performance, while no correlation was found with learning styles and academic performance.

Conclusion:

Included studies provided evidence for significant differences in study strategies implemented by high and low achieving students, such as areas of motivation for learning, efficiency, active recall, retrieval practices, and concept maps. Understanding the effectiveness of certain study strategies is critical for students and educational facilitators to maximize learning.

KEY WORDS

(study strat* AND student*) OR (study strat* AND achievement)

INTRODUCTION

The transition to post-secondary studies is a challenging journey for many students, particularly within academia. Educational conventions and schedule changes require most college students to determine study strategies on an individual-basis through trial and error. A study asked 177 undergraduate students to rank the strategies implemented when studying (1). Many methods of learning, including self-studying, active, and retrieval-related methods (e.g., flashcards, past tests) were commonly listed, where 83.6% of students enlisted rereading notes as the most common learning strategy. However, rereading notes is evidenced as a passive and inefficient study strategy, thereby indicating a gap within student knowledge regarding awareness on effective study strategies. Within studying, passive engagement serves ineffectively as newly learned information may only be encoded in short-term memory. Students may be able to recall limited amounts of information for an upcoming evaluation, but will find application-based questions to be significantly more challenging due to lack of strong foundational comprehension of materials. Thus, rereading, highlighting, or underlining study material serve as overall less effective and passive study strategies commonly adopted by low-achieving students (2). Contrastingly, self-testing is a method of retrieval practice used to build long-term retention of newly learned material (3). Although some students reported using the self-test method, most justified the choice as a strategy to test their knowledge of the material and gauge the amount of time needed to further engage with content. These strategies fluctuate frequently amongst students, which reflects the uncertainty that many students have when it comes to effective study habits.

Effective study strategies (including efficient note-taking, time management, and active recall methods) are an important key to academic success. Study strategies involve choosing study materials best suited for the student's unique way of learning. Study materials are learning tools that assist students in further synthesizing and reorganizing content such as flashcards, note-taking and concept map templates (4). Note-taking strategies involve learning how to extract important information from a lecture or textbook reading, and can play a significant role in the study process and the foundation for practicing good study strategies. For project management and study task prioritization, creating a to-do list allows for effective planning and scheduling. A study investigated the advantages to employing higher working memory, the capacity to prioritize and remember important information (5). The researchers used recall tasks to design experiments testing participants' recall accuracy. With descriptive statistics, a relationship was determined between working memory and recall, as well as between working memory and selectivity. These were measured and scored as the proportion of obtained points

and maximum points against the possibility of gaining chance points. Statistical significance was determined with all 4 experiments scoring over 88% in reliability. Thereby, these relationships indicate importance in setting attainable long-term and short-term goals to stay productive.

Active recall and spaced learning are effective strategies to retain information for longer periods of time, such as using flashcards or teaching unfamiliar concepts to others. The forgetting curve, founded by psychologist Hermann Ebbinghaus, displayed negative correlation between information retention and time (6). Spaced repetition encompasses re-exposure to information, which further solidifies memories (7–9). Thereby, spaced learning disrupts the forgetting curve, to allow for new information to be encoded in long-term memory. With increased intervals of revisiting material, more time can be provided between each successive session.

Another issue that can reduce efficient information retention is multitasking. A study examined the impacts of multitasking on academic performance and learning outcomes. When students attended to two sources of information, these students showed poorer learning outcomes ($p = 0.023$) with limited accuracy in memory retention. However, when asked to only focus on one source of information, working memory capacity was improved ($p = 0.080$) and students were also more confident in learning effectiveness. Thus, multitasking has shown a decrease in the amount of information recalled when evaluated, compared to those who focused on a single task (10). Within multitasking, task switching occurs when attentional resources are shifted to complete another task set (11,12). When constantly switching between tasks, the brain requires additional time to refocus due to the increased demand for working memory processing, which may easily disrupt productive workflow (12). Therefore, it is highly recommended that one focuses on one task to be completed at a time and avoid task-switching. The Pomodoro technique is gaining popularity among students for help with time management.

A study on 623 college students in an introductory biology course in 2019 came to the conclusion that college students used four strategies on average when studying, with half of the strategies identifying as active recall methods. Students who used more active study strategies for longer periods of overall study time were seen to have more positive reflection in their marks. Although students began studying six days before for an exam on average, the amount of days spent preparing in advance did not correlate with increased performance. College students also reported being distracted 20% of the time during study sessions. Amount of time spent studying, types of strategies used and minimizing distractions are all significant factors that contribute to a students' overall academic performance, which must be further analyzed (13). In relation to specific study strategies, researchers determined common study methods to include completion of past exam questions (100% of students), rereading material (92.3% of students), explaining concepts to peers (7.7% of students), and using flashcards (7.7% of students) (14). Study strategies are highly variable and many factors must be taken into account, including the unique learning styles of students.

The aforementioned study strategies focus on developing a deeper understanding of material and content. Mastering these study techniques will support goal orientation, with a clear objective and intentions in mind. Effective application of study strategies will support student familiarity of newly learned concepts and ideas, particularly for application in different problem-solving scenarios. Among 931 undergraduate students in an introductory biology course, high academic achievers were found to implement more self-testing strategies, less likely to study last minute, and more likely to plan a study schedule in advance (15). A good learning attitude, self-motivation and proficiency in adapting better learning and study strategies are correlated with higher academic achievement (16). These students are also aware of long-term goals, such as pursuing a dream career, and strengthening effective learning strategies is critical for success as lifelong learners.

This systematic review aims to answer the following questions: What are the most effective study and learning strategies that result in higher academic achievement? Through conducting detailed studies and consulting experts in the field, this systematic review will contribute towards a deeper understanding of specific effective study strategies. Specifically, present literature will be examined to determine potential avenues to increase academic achievement by building on study habits and learning strategies.

METHODS

To determine the effectiveness of study and learning strategies on student achievement, a systematic review was conducted for peer-reviewed and grey literature from January to May 2021, using search strategies including keywords, truncations, and booleans. The current review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The protocol of this systematic review was registered with PROSPERO (record ID: CRD42021234245). PROSPERO is an international database of prospectively registered systematic reviews in health and social care.

Study design and setting

This systematic review aims to assess effective study strategies to be integrated towards virtual interventions, particularly within the development of the Felicity App. The Felicity App is a virtual application targeting young adults aged 15 to 40 years old. Felicity aims to support productivity enhancement through psychological interventions in various aspects, including positive reinforcements for educational/work productive behaviours. App features will also include productivity tools such as to-do lists, calendars, and reminder notifications. Positive reinforcement tools include psychological interventions like mental health exercises (such as self-affirmations, mindfulness, and other techniques), time management tips (delivered through notifications and avatar narratives), and positive reinforcement rewards for productive behaviours (through point-systems and potential leaderboards). The Felicity App aspires to guide

students into becoming independent, self-regulated learners by encouraging students to choose appropriate strategies, set goals, reflect on performance and modify accordingly.

This systematic review investigated the effectiveness of learning strategies to determine the pertinence of selected literature to improve student academic performance and productivity. A virtual application setting was chosen as the medium to deliver the functions available in the Felicity App due to its accessibility, convenience, and wide usage amongst the target age group of individuals between the ages of 25 and 40. The mixed-method study design was employed to analyze both qualitative and quantitative psychological behaviour research data related to study or learning strategies.

Inclusion/Exclusion Criteria

The inclusion/exclusion criteria was predetermined, where included studies consisted of undergraduate or professional school students aged 18–40 years old with no pre-existing physical/mental conditions. Eligible studies measured academic achievement as Grade Point Average or test performance of students while comparing those using study or learning strategies against non-users. Only primary studies and grey literature were included, where systematic reviews, literature reviews, and opinion texts were excluded as secondary literature. Reference lists of included articles were hand searched and screened for potential inclusion. Studies were excluded if test outcomes did not compare before and after the implementation of study or learning strategies or if outcomes did not compare differences in strategies between high- and low-achieving students. Studies were also excluded if the sample consisted of a single gender or if the study setting was an under-developed country.

Search strategy

A logic grid was constructed to guide the search strategy aligned with the PICO – P (population): undergraduate or professional school students; I (intervention): study or learning strategies; C (comparison): compared to subjects that do not use any study or learning strategies; O (outcome): increased academic performance (GPA, test score).

A diverse selection of literature, which included grey, was reviewed based on a predetermined inclusion/exclusion criteria. The databases searched were PsychInfo (Ovid), Web of Science, and ProQuest for the period of January 1990 to December 2021 using keywords and subject headings related to learning strategies and college student academic performance. The key terms used in building the search strategy for the Databases were student, study strategies, and achievement (see Appendix 1 for the complete search strategy and Appendix 2 for the grey literature search strategy). The key terms were combined using Boolean operators to search the electronic Databases. In addition, filters were applied to each database to optimize relevance for study inclusion. For PsychInfo, results were filtered by subjects of academic achievement, college students and learning. For Web of Science, results were filtered under the subject of psychology,

and results found within ProQuest were filtered under the subjects of college students and academic achievement.

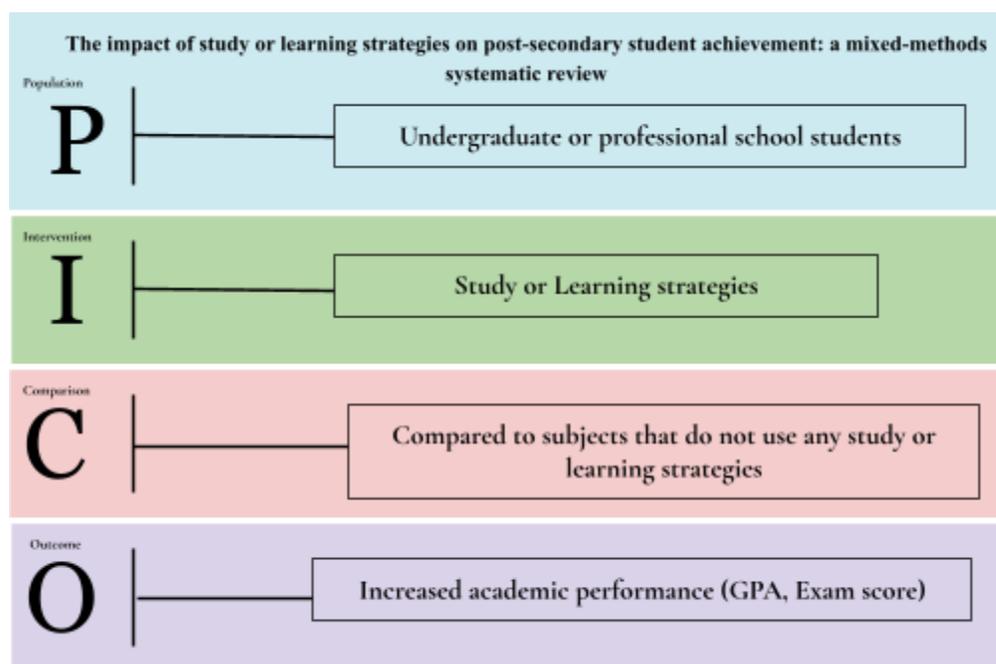


Figure 1. Research question in PICO format.

Data collection and abstraction

Collection of data was first done by gathering database search results and removing any duplicate literature pieces using Endnote (version X8.2). Endnote is a commercial reference management software package used to manage bibliographies and references.

An abstract screening tool, consisting of 9 questions, was created using inclusion and exclusion criteria to ensure only relevant data would be collected. A pilot test of the abstract screening tool was done with 25 articles using our search strategy found in a database different from the ones used in the study. Initial pilot testing resulted in an accuracy score of 40%. Three independent authors reconciled discrepancies and modified the screening tool to consolidate objectivity and accuracy of the tool. Re-testing of the screening tool resulted in an accuracy score of 77%. Two review authors applied the modified screening tool to the final list of peer-reviewed and non-peer-reviewed articles and analyzed specific sections of the literature, including purpose, methods, results, and potential future applications or improvements. Upon its integration with the collected data, two review authors independently used the tool to analyze titles and abstracts, with a third review author present to resolve any disagreements. Articles that were considered relevant remained for another round of screening, in which the same two authors independently performed a full-text analysis to include and exclude articles according to the eligibility criteria.

Hand-searches were then performed independently to fill in any gaps in the literature from the initial search strategy. The same two review authors independently applied the screening tool and performed the same two-step process to eliminate irrelevant literature. Screening of all relevant literature was completed on February 14th, 2021. A final list of screened articles were further processed during data extraction, where MMAT quality appraisal methods were implemented.

Assessment of study quality, certainty of evidence, and limitations

The Mixed Methods Assessment Tool (MMAT) was used to assess the quality of the articles from a final list of 98 articles obtained after full text screening, including grey literature and hand searched articles. This process was performed independently by two authors from February 17th to February 21st, 2021. The MMAT is an appraisal tool used to assess the methodological quality of articles organized into five categories: qualitative research, randomized controlled trials, non-randomized studies, quantitative descriptive studies and mixed methods studies. Each category had five criteria to rate, and all articles were kept despite their overall rating. Articles that were removed included duplicates and retracted articles. Reconciliation between the two authors followed with disagreements settled with a third author. A list of 67 quality appraised articles with respective MMAT scores were produced.

It was crucial to ensure that similar external conditions were shared among all papers, including the state of the country (developing or developed countries), and how they may compare to the target state, as some may have different standards in comparison to general developed countries. This characteristic was not included in the quality assessment, but to ensure the papers fit that criteria, an analysis on the state of every article's origin country was done during the first screening protocol. In terms of the structure of MMAT assessments, there have been various discrepancies in previous reliability tests regarding "non-randomized" (classified as set 3) and "qualitative" (classified as set 1) sections (17). Due to the more complex analysis provided in these types of papers, these discrepancies may be due to varying perspectives by those completing the quality assessment. In order to secure objective and accurate evaluations, this uncertainty was resolved during reconciliation, where quality assessment members discussed any inconsistencies and agreed on a final assessment that best reflected the article.

Data extraction

Data was extracted by two authors independently, and took place from March 7th to March 12th, 2021. A table was created and data was extracted based on the categories: First author and title of included study, country, study design, duration, participant information, type of data, summary of the main outcomes, and quality/design score obtained from the process mentioned in the prior section. Authors reconciled disagreements from March 13th to March 14th, 2021.

After full text screening, 186 articles were included. After quality appraisal conducted independently, 67 articles remained after duplicates were deleted. 54 articles remained after quality appraisal reconciliation.

Table 1. *Study characteristics*

Study Criteria	Sub-categories	Number of Studies belonging to each Sub-category
Study design	Qualitative research	6
	Randomized controlled trials	4
	Non-randomized studies	8
	Quantitative descriptive studies	36
	Mixed methods studies	0
Study population (participants)	Undergraduate students	35
	Graduate/professional school students (medical, dental, pharmacy, nursing etc.)	11
	Unspecified/no participants	8
Study setting (country)	United States	36
	China	5
	The Netherlands, Ireland	2
	India, Turkey, Norway, Qatar, United Arab Emirates, Finland, Taiwan, Belgium	1
Year published	1990 - 1999	4
	2000 - 2009	12
	2010 - 2019	37
	2020 - 2021	1
Type of data in study (many studies had overlaps in type of data used)	Questionnaire-based studies	42
	Intervention-based studies	11
	Observation-based studies	10
	Paper-based studies	5

	Meta-analysis studies	2
Study quality: MMAT design score	5 rating	20
	4 rating	28
	3 rating	6
	2 rating	0
	1 rating	0

RESULTS

Search results and screening

The search and identification of potential records were conducted by JO and MV from January 2021 to February 2021 (Fig. 2 PRISMA flow diagram). The database and hand-search identified 585 records, of which 38 were duplicates. JO and MV screened articles at the title and abstract level. Both screeners considered one hundred and eight-six full-text articles for inclusion, but only fifty-three records met the inclusion criteria (Fig 2. PRISMA flow diagram). One hundred and thirty-three studies were excluded because participants consisted of students from secondary or primary schools, academic performance was not measured, the study was not written in english, or the sample size was below 50 (see Appendix 3 for a list of excluded studies).

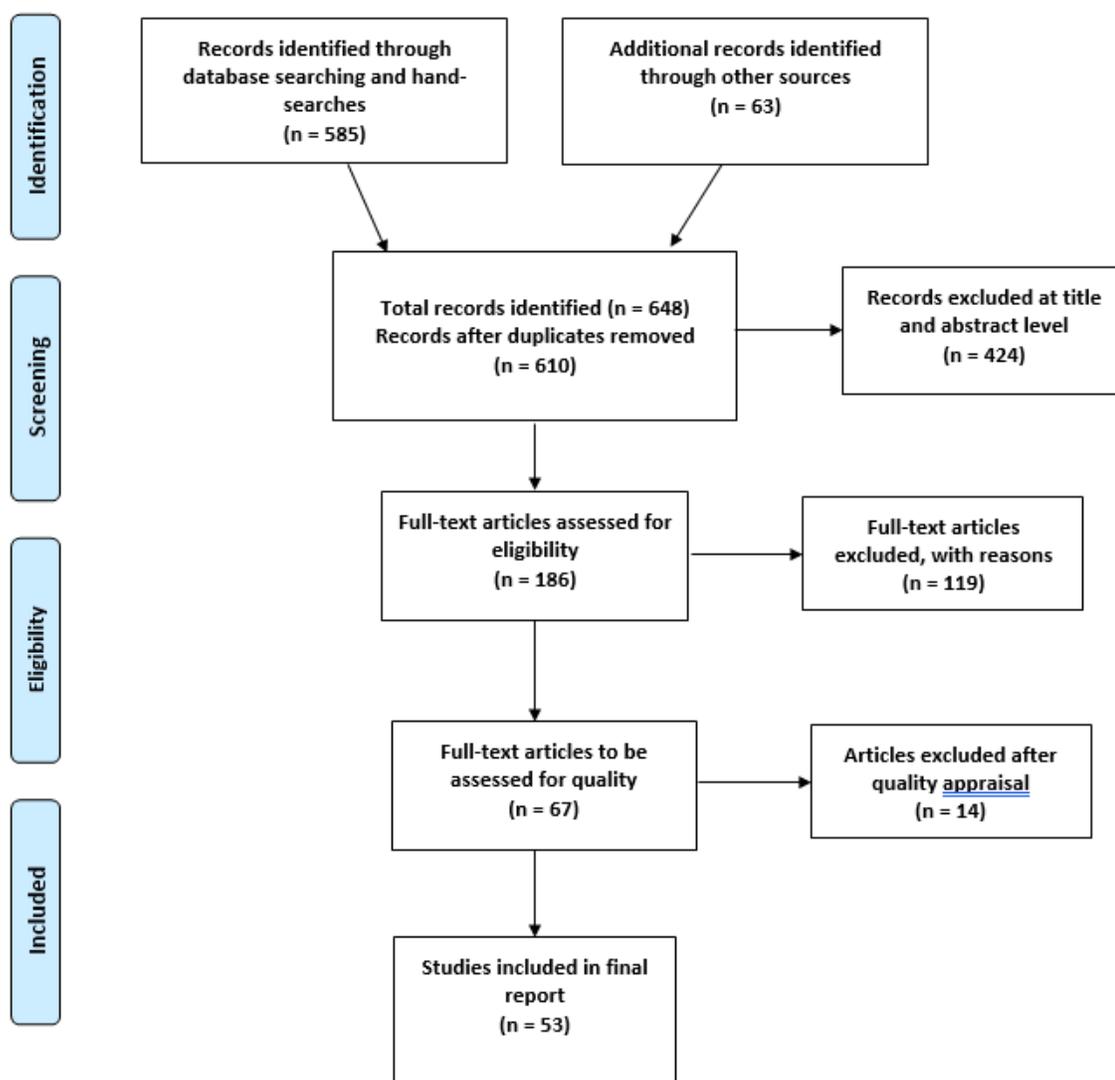


Figure 2. PRISMA (preferred reporting items for systematic reviews and meta-analyses) flow diagram.

Study Characteristics

Of the fifty-three papers included in this review, six were qualitative, four were randomized control trials, eight were non-randomized trials, and thirty-six were quantitative descriptive studies. Forty-two articles were questionnaire-based studies, eleven were intervention-based studies, ten were observational studies, five were paper-based studies, and two were meta-analyses. Twenty articles were given a 5 star quality rating, twenty-eight were rated 4 stars, and 6 were rated 3 stars. In terms of study settings, thirty-six articles were published in the United States, five published in China, two in the Netherlands and Ireland each, and one was published in India, Turkey, Norway, Qatar, United Arab Emirates, Finland, Taiwan, and Belgium

each. Thirty-five articles focused on studying undergraduate student populations, eleven articles based on graduate or professional school students (i.e., medical, dental, pharmacy, nursing, etc.), and 8 articles had unspecified or no participants. In terms of year published, four articles were published from 1990 to 1999, twelve articles were published from 2000 - 2009, thirty-seven articles were published from 2010 to 2019, and one article was published most recently from 2020 to 2021. See study characteristics in Appendix 4.

Main Findings

Due to the variability of the studies and result measurement resulting in study heterogeneity, the findings from the studies were extracted and synthesized qualitatively to compare outcomes. Four themes from the literature were identified. These themes included self-testing, scheduling, concept maps, and learning styles. It was found that these themes were nuanced and interrelated. *Self-testing* refers to a specific category of study strategies involving evaluation of one's knowledge and understanding of course material through retrieval or recognition practice. Sixteen articles demonstrated a significant positive correlation between self-testing and academic performance.

Scheduling/Time management refers to the creation of a schedule with concrete dates and times to review course material and study. Ten articles demonstrated a positive correlation between scheduling strategies and academic performance.

Concept maps refer to the visual organization and representation of knowledge that depicts suggested relationships between ideas. Three articles explored the validity of concept map usage for self-assessment of course material.

Learning styles refer to the preferential way in which a learner absorbs, processes, comprehends, and retains information. Seven articles discussed the correlation between VARK learning styles and academic performance.

DISCUSSION

This systematic review provides a comprehensive examination of the current literature regarding the topics of learning strategies aimed towards improving student academic performance. The results from this systematic review suggest that the outcomes for students are mixed and did not always result in increased performance. Generally, the implementation of study and learning strategies was associated with increases in test scores and Grade Point Average (GPA), but variation in the significance and level of improvement in performance was evident with different strategies and assessment methods. It was found that self-testing, scheduling, concept maps, and learning styles were the four major themes discussed in the literature. Self-testing, scheduling, and concept maps were positively correlated with increased academic performance, while no correlation was found with learning styles and academic performance. Each of the four themes will be discussed below.

Self-Testing

The following studies revealed self-testing as one of the best predictors of strong academic performance. Through the use of the Learning and Study Strategies Inventory (LASSI), self-testing was measured as one of the cognitive abilities and comprehension monitoring strategies used by students to assess their ability to review course material (19). A strong, positive correlation between self-testing and a high Grade Point Average (GPA) is apparent across all studies, where students who implemented effective self-testing strategies obtained greater achievement (20). Specifically, students with higher academic achievement scored higher on the self-testing subscale of LASSI, whereas students with lower academic achievement scored lower (21,22).

Although self-testing can be used as a metacognitive tool to evaluate progress and as a learning strategy to boost performance, high-achieving students reported using self-testing metacognitively more frequently (23). This finding suggests that self-testing is most effective when it is used to monitor how well the information has been learned as opposed to how familiar a certain concept is. This explains why the use of flashcards (one of the most popular self-testing methods) and similar retrieval-type strategies were found to be not significantly related to GPA (24). As flashcards may operate on the basis of passive-learning where students may not fully understand the presented factual information, this ineffective approach may be omitted and replaced with self-testing by introducing short concept-check practice questions to encourage deeper mental processing (25). This method will allow users to not only actively process the recently-learned information, but also reflect on their thinking patterns and face knowledge gaps which might have otherwise been ignored through the use of flashcards (26).

Scheduling/Time Management

A number of the included studies ($n = 10$) elicited students to implement a study schedule and dedicate specific parts of the day to studying (2,15,28,24,40). The results from the included papers suggest a strong positive correlation between scheduling strategies and academic performance (20,29,30,43,44). Significant differences between low and high achieving students revealed an increased use of study schedules and stronger time management skills for higher achieving students. While lower achievers were characterized by a focus on impending deadlines and studying late at night, higher achievers were characterized by planned study schedules and spaced practice. Moreover, one article implemented a study strategy course where students were taught how to create study schedules (45). Results from these studies indicated an increase in GPA, which is linked to better understanding and achievement of the course material, after taking the course (28,45). This suggests that students were capable of learning and adopting specific strategies which could then translate to increased academic performance.

Concept Maps

A concept map is an uncommon strategy when studying and was more often used for self-assessment of knowledge ($n = 3$). A positive correlation was found between concept map usage and academic performance, suggesting concept maps may be an effective and viable study strategy (31,32). Concept maps allow students to generate a visual representation of information and generate relationships between connected ideas (33–35). Typical reviewing strategies such as highlighting and re-reading notes showed no significant relationship (28) with concept map outcomes, suggesting a deeper level of understanding is required in order for concept maps to be effective at assessing learning. Strategies that involve deeper processing of information (36) such as self-testing followed by the creation of a study map may result in more stronger consolidation of information. Moreover, because of the visual nature of this strategy, concept maps may show increased benefits for visual learners when compared to auditory, read/write, or kinesthetic learners (37,38).

Learning Styles

In current literature outlining the influence of learning style preferences on academic performance, the VARK (Visual, Aural, Read/write and Kinesthetic) model is most utilized among other proposed types of learning style inventories. According to VARK, visual learners are those who prefer diagrammatic representations such as images and graphs, aural learners rely on auditory tools for information processing, learners who prefer to read/write often take notes and refer to written material, and kinesthetic learners learn through practice and experience (39). Although the concept of learning styles has been solidified through the VARK model, multiple studies provide evidence against the effectiveness of VARK learning styles on academic performance. As many of these studies assessed anatomy and physiology students, the collective findings support that the utilization of the VARK model in an academic setting has a limited contribution to assessment marks in these courses (41,42). Moreover, the slight variance in test scores was not attributable to learning style preferences, and no learning style conferred an overall advantage (41,42).

Given the well-established ineffectiveness of learning styles on academic performance across literature, implementing features which allow users to assess their learning styles through the *Felicity* Application should be avoided. Ensuring that *Felicity* focuses on providing resources pertaining to other successful study strategies instead would enable the users to improve their academic performance in a meaningful way.

LIMITATIONS

This systematic review integrated qualitative studies from peer-reviewed and grey literature within a range of literature. The holistic collection of data provides well-rounded perspectives of current data, but additional research should be pursued to assess quality and validity in greater depths. Furthermore, the data within this systematic review is limited by the searched databases and demographic restrictions. Data was not extracted from developing countries nor from

demographics outside of the age limit. Studies written in languages outside of English were excluded and may limit the scope of the data pool. Single-site studies are found in the included studies and may limit generalizability due to insufficient support towards findings. Results obtained from retrospective studies may not apply to a general population or draw concrete also hard to generalize and draw concrete conclusions due to the nature of the retrospective design. The limitations may have also been compounded with the use of multiple reporting systems that were used to collect these data. Though these limits are pre-determined to optimize relevance with the research aims in mind, further statistical analysis is required as a qualitative synthesis of findings was used with the diverse study designs and subsequent heterogeneity in study results.

In terms of quality appraisal, MMAT is comprehensive when appraising the quality of general types of study methodologies and designs. However, it does not provide specific criteria and may leave some important information left to the discretion of quality assessors. This lack of structure provides the advantage of being applied to a wide variety of articles, and authors must pre-determine assumptions to tailor the tool towards their own set of articles. A common criteria across most MMAT categories was the representativeness of the sample in relation to the target population, but an “acceptable” percentage breakdown of genders was not specified. As a result, quality assessment members found that most psychology-based articles had significantly more female than male participants, and pre-determined an acceptable gender percentage cut off point of 33% male and 67% female subjects or a smaller difference. The titles of the articles were also considered in deciding the representative level of the sample, with more specific titles being favoured over vague titles. Specific titles include specifying details of the subject undergraduate student population, country and institution where the study was conducted, and field of study. Due to the heterogeneity and mixture of quality, additional research and quantitative analysis may be required to further support findings.

It is also important to note that because most studies calculated grade point average (GPA) as a measure of academic performance, yet this may not be the best indicator of a student’s true academic abilities. There are many students who are able to retain and apply the knowledge that they have learned, but they are not able to effectively translate their knowledge well in a testing environment. Possible reasons that may be affecting a student's abilities to succeed in a testing environment could include anxiety and increased stress. These factors may cause students to overthink or misinterpret questions, which affects their overall performance on a test. Today, many courses offer other forms of assessments, such as take-home assignments, group projects, presentations and reflections. These types of assessments offer students more flexibility and the ability to reduce their stress levels, while still being able to demonstrate their knowledge using other methods of measuring academic performance.

During the systematic review process, there were more cross-sectional studies and fewer longitudinal studies. Based on the studies that were found in our literature search, long-term effects of learning strategies cannot be elucidated. Future directions should examine the effectiveness of these learning strategies on studying, managing stress and anxiety levels, and whether students feel more confident in their academic performance over time as they implement these learning strategies.

CONCLUSIONS

Findings within present literature have determined potential virtual interventions pertaining to learning strategies and student academic performance, including motivation for learning, efficiency, retrieval practices, and self-concept. Within included studies, a distinction has been drawn between high and low academic achievers based on differences in study strategies. For instance, high academic achievers tend to implement more active recall and deep-learning processes compared to low academic achievers. Recognizing and understanding the effectiveness of certain study strategies are critical for both students and professional teaching staff to maximize content learned and application to real world situations.

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JX devised and supervised the project and secured funding acquisition. JO, TT, YK, AW, MV, and HH wrote the manuscript. JO created figures. TT, YK, and JO computed numerical data and created tables. JO and MV performed the article screening. AW, TT and YK performed hand searches. TT and YK carried out the quality assessment. All authors refined and approved the manuscript.

Appendix 1 - Database Searches

Database	Search	Results
PsychInfo (1967 – 2020) by Ovid	(study strat* AND student*) OR (study strat* AND achievement)	109
Web of Science	(study strat* AND student*) OR (study strat* AND achievement)	188
ProQuest	(study strat* AND student*) OR (study strat* AND achievement)	184

Appendix 2 - Grey Literature Searches

Database	Search	Results
OpenGrey, Harvard Graduate School of Education	(study strat* AND student*) OR (study strat* AND achievement)	63

Appendix 3 - List of Excluded Studies**Excluded articles from database abstract screen**

Author(s)	Title
A. B. Abdelkarim, Naim Hamadain, Elgenaid Tucci, Michelle Ford, Timothy Sullivan, Donna	US dental students' and faculty members' attitudes about technology, instructional strategies, student diversity, and school duration: A comparative study
A. B. Qureshi, Syed Akhtar Hussain Pirvani, Madiha Dawani, Narendar	Understanding and practice of evidence based search strategy among postgraduate dental students: A preliminary study
A. Blewitt	Math and science academy literacy instruction: Student study strategies, self-perception as readers, and reading achievement
A. D. Arthur	Differences between EDPSY 100 and non-EDPSY 100 students on study skills as measured by the learning and study strategies inventory (LASSI)

A. E. Enns, Gloria D. Montgomery, Cynthia Gonzalez, Vivian M.	Perceived stress, coping strategies, and emotional intelligence: A cross-sectional study of university students in helping disciplines
A. G. Caspi, P. Privman, M.	Viewing comprehension: Students' learning preferences and strategies when studying from video
A. Halbach	Finding Out About Students' Learning Strategies by Looking at Their Diaries: A Case Study
A. J. H. Holm, Hannah Rhodes, Matthew G.	Study strategies and "study drugs": Investigating the relationship between college students' study behaviors and prescription stimulant misuse
A. J. S. Onwuegbuzie, C. R.	Relations between hope and graduate students' coping strategies for studying and examination-taking
A. K. Geçer	A study on information search and commitment strategies on web environment and internet usage self-efficacy beliefs of university students
A. L. Heikkilä, Kirsti Nieminen, Juha Niemivirta, Markku	Relations between teacher students' approaches to learning, cognitive and attributional strategies, well-being, and study success
A. L. Loranger	The study strategies of successful and unsuccessful high school students
A. M. Ager, M.	Psychometric properties of the coping strategy indicator (CSI) in a study of coping behaviour amongst Malawian students
A. M. Francis-Cracknell, Shari Kent, Fiona Edwards, Emma Iles, Ross	Several strategies for clinical partners and universities are perceived to enhance physiotherapy student engagement in non-metropolitan clinical placements: a mixed-methods study
A. M. Rogiers, Emmelien Van Keer, Hilde	What they say is what they do? Comparing task-specific self-reports, think-aloud protocols, and study traces for measuring secondary school students' text-learning strategies
A. M. S.-R. Navea-Martin, Jose	Study on the use of self-motivational strategies in university students
A. M.-U. Schwed, Janice	Brain-friendly study strategies, Grades 2-8: How teachers can help students learn
A. P. Brugnolli, Serena Viviani, Debora Saiani, Luisa	Nursing students' perceptions of tutorial strategies during clinical learning instruction: A descriptive study
A. P. Reaser, Frances Petscher, Yaacov Proctor, Briley	The learning and study strategies of college students with ADHD
A. R. D. Daros, Katharine E. Meyer, M. Joseph Chow, Philip I. Barnes, Laura E. Teachman, Bethany A.	Impact of social anxiety and social context on college students' emotion regulation strategy use: An experience sampling study
A. Raimes	Language proficiency, writing ability, and composing strategies: A study of ESL college student writers
B. B. S. Silver, Everett V., Jr.	A study strategies self-efficacy instrument for use with community college

Greene, Barbara A.	students
B. K. S. Matin, Shahin	Comment on "coping strategy mediates the relationship between body image evaluation and mental health: A study with Chinese college students with disabilities"
B. R. B. Schirmer, J. Lockman, A. S.	What verbal protocols reveal about the reading strategies of deaf students: A replication study
B. S. B. Olaussen, Ivar	Identifying latent variables measured by the Learning and Study Strategies Inventory (LASSI) in Norwegian college students
B. W. Tuckman	The "Strategies-for-Achievement" Approach for Teaching Study Skills
C. A. B. Orsini, Vivian I. Tricio, Jorge A.	Motivational profiles and their relationships with basic psychological needs, academic performance, study strategies, self-esteem, and vitality in dental students in Chile
C. B. Darnon, Fabrizio	Achievement goals, study strategies, and intrinsic motivation: presentation of a research field and validation of the French version of Elliot and McGregor's (2001) scale
C. Badenier	Reliability and validity of the Learning and Study Strategies Inventory (LASSI) in a sample of students from the metropolitan region in Chile
C. C.-F. Wei-Po, Yen Tai-Ling, Liu	Predicting effects of psychological inflexibility/experiential avoidance and stress coping strategies for internet addiction, significant depression, and suicidality in college students: A prospective study
C. D. B. Meneghetti, Rossana Cornoldi, Cesare	Strategic knowledge and consistency in students with good and poor study skills
C. F. Russo	A comparative study of creativity and cognitive problem-solving strategies of high-IQ and average students
C. I. A. Ioannou, Eckart	Approaches to and treatment strategies for playing-related pain problems among Czech instrumental music students
C. I. Andrei, Varga Patricia Valentina, Zetes	Comparative study between study tracks: math and sciences or humanities, regarding academic motivation and learning strategies in the 9th grade students
C. M. K. Kokkinos, Apostolos Markos, Angelos	The relationship between learning and study strategies and big five personality traits among junior university student teachers
D. A. Kahn	Predicting math achievement using the SMALSI as a measure of motivation and learning and study strategy use
D. C. Kim Josefina Hubertina, Gino Kester, Liesbeth Kirschner, Paul Arthur	Do secondary school students make use of effective study strategies when they study on their own?
D. C. T. Beidel, S. M. Taylor-Ferreira, J. C.	Teaching study skills and test-taking strategies to elementary school students - The testbusters program

D. D. Shukla, Aj Pattaradanai	Student's perceived level and teachers' teaching strategies of higher order thinking skills: A study on higher educational institutions in thailand
D. K. Harless	A comparison of gender differences in the relationship among learning styles, achieving styles and study strategies of college students
D. L. E. Butler, Cory L. Poole, Shannon	Promoting strategic writing by postsecondary students with learning disabilities: A report of three case studies
D. S.-L. Rodger, Adele	Students' perceptions of debating as a learning strategy: A qualitative study
D. Z. Zhao, Huaqian Wu, Yingli Zhou, Qianfu	A study of the impact of internet-based instruction integrated innovation education on university student entrepreneurial team collaboration and strategic innovation
E. D. Boujut, Annika Grousselle, Amelie Cappe, Emilie	Comparative study of teachers in regular schools and teachers in specialized schools in france, working with students with an autism spectrum disorder: Stress, social support, coping strategies and burnout
E. D. Kissi, Kwaku Ahadzie Debrah, Caleb Adjei-Kumi, Theophilus	Underlying strategies for improving entrepreneurial skills development of technical and vocational students in developing countries: using Ghana as a case study
E. d. S. Boruchovitch, Acácia Aparecida Angeli	Psychometric studies of the Learning Strategies Scale for university students
E. E. W. Hall, Resa E. Hall, Katherine S.	Weight loss strategies used by first year college students: An exploratory study
E. G. E. Carayannis, Dan Hanson, Mike	A cross-cultural learning strategy for entrepreneurship education: Outline of key concepts and lessons learned from a comparative study of entrepreneurship students in France and the US
E. H. Bush, Karen Zickefoose, Samantha Simanek, Gina Holmberg, Michelle Henderson, Ambyr	Learning and study strategies of students with traumatic brain injury: A mixed method study
E. H. Henderson, H. Grant, A. Berlin, A.	Conflict and coping strategies: a qualitative study of student attitudes to significant event analysis
E. T. P. Goetz, Douglas J.	The role of students' perceptions of study strategy and personal attributes in strategy use
E. Y. Sendurur, Zahide	Students' web search strategies with different task types: An eye-tracking study
F. C. Lv, Hongxin	A study of metacognitive-strategies-based writing instruction for vocational college students
F. J. Sinkavich	Metamemory, attributional style, and study strategies: Predicting classroom performance in graduate students
F. R. R. Croft, P. Larueatuonah, S. Baechle, C. Gemmill, J.	Pilot investigation of validation of the modified learning and study strategies inventory (LASSI) for hearing-impaired preparatory students at Gallaudet

	university
F. Shaghghi	Comparing the study methods of Iranian and American high school students from the perspective of cognitive and metacognitive strategies
F.-F. L. Zhao, Xiao-Ling He, Wei Gu, Yan-Hong Li, Dong-Wen	The study of perceived stress, coping strategy and self-efficacy of Chinese undergraduate nursing students in clinical practice
G. B. Kim, Jiyoung	A study into students' use of digital english learning strategies in tertiary education
G. M. M. Boulton-lewis, Ference Lewis, David C. Wilss, Lynn A.	A longitudinal study of learning for a group of indigenous Australian university students: Dissonant conceptions and strategies
G. Zhao	A cross-cultural study on the conflict management strategies between chinese and american college students
H. A.-S. Laine, Vera Haukkala, Ari Hankonen, Nelli	Acceptability of strategies to reduce student sitting: A mixed-methods study with college teachers
H. B. S. Sheu, W. E.	An exploratory study of help-seeking attitudes and coping strategies among college students by race and gender
H. B. Weber, Dominik Hillmert, Steffen	Information-seeking behaviour and academic success in higher education: Which search strategies matter for grade differences among university students and how does this relevance differ by field of study?
H. M. A.-M. Al-Kadri, Mohamed S. Al-Takroni, Habib Roberts, Chris van der Vleuten, Cees P. M.	Self-assessment and students' study strategies in a community of clinical practice: A qualitative study
H. M. A.-m. Al-Kadri, Mohamed S. Roberts, Chris Van der vleuten, Cees P.	Exploring assessment factors contributing to students' study strategies: Literature review
H. P. Yang, Xiaoping Zheng, Bo Wang, Linxian Wang, Yadong Du, Shuai Lu, Xinyi	A strategy study on risk communication of pandemic influenza: A mental model study of college students in Beijing
H. Sueki	Preferences for suicide prevention strategies among university students in Japan: a cross-sectional study using full-profile conjoint analysis
H.-B. S. Sheu, William E.	An exploratory study of help-seeking attitudes and coping strategies among college students by race and gender
I. Jackson	Development of a strategic framework for addressing the needs of students with disabilities in Sydney catholic schools (case study)
I. R. Alqarni	Saudi english major freshmen students' vocabulary learning strategies: an exploratory study
J. A. Subramanian, V. R.	Improving the quality of educational strategies in postgraduate dental

Morgaine, K. C. Thomson, W. M.	education using student and graduate feedback: findings from a qualitative study in New Zealand
J. B. Rankin, Val	brain-friendly study strategies, Grades 2-8: How teachers can help students learn
J. B. Rankin, Val	Creative teaching method as a learning strategy for student midwives: A qualitative study
J. Bolden	Associations among attention problems, learning strategies, and hazardous drinking behavior in a college student sample: A pilot study
J. C. King Ebrahimiyan	The effect of study skills instruction on the study strategies and attitudes of college students with learning disabilities
J. C. M. Turner, C. Meyer, D. K. Gheen, M. Anderman, E. M. Kang, Y. Patrick, H.	The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study
J. E. J. Ormrod, Lynn	Study strategies for learning spelling: Correlations with achievement and developmental changes
J. H. Kuo, Chris Miller, Michael T.	Encouraging college student success: The instructional challenges, response strategies, and study skills of contemporary undergraduates
J. J. Malmberg, Hanna Jarvela, Sanna	Tracing elementary school students' study tactic use in study by examining a strategic and self-regulated learning
J. J. P. B. Le Grange, Karel F. H.	The behavioural self-regulation strategies of Indian South African university students: An exploratory study
J. Jarvis	'Study in Estonia': the strategic implications of hosting international students on Estonia's tourism economy
J. K. P. Corkett, Rauno Hein, Serge F.	Learning and study strategies of university students who report a significant history of reading difficulties
J. L. Han, Qingsheng	A correlation study among achievement motivation, goal-setting and L2 learning strategy in EFL context
J. L. Vacek, Judy	Teaching concepts to nursing students using model case studies, the venn diagram, and questioning strategies
J. L.-K. Chwaszcz, Bernadeta Wiechetek, Michal Niewiadomska, Iwona Palacz-Chrisidis, Agnieszka	Personality traits, strategies for coping with stress and the level of internet addiction: A study of Polish secondary-school students
J. M. H. Williams, Kal Marcavage, Emily	Experimental study of assertion training as a drug prevention strategy for use with college students
J. M. M. Monteil, N.	Effects of context and performance feedback on social comparison strategies among low-achievement students: experimental studies
J. N. C. Erin, Anne L. Wolffe,	Learning and study strategies of secondary school students with visual

Karen	impairments
J. P. C. Szlachta	Peer instruction of first-year nurse anesthetist students: A pilot study of a strategy to use limited faculty resources and promote learning
J. P. Cioffi, N. Arundell, F.	A pilot study to investigate the effect of a simulation strategy on the clinical decision making of midwifery students
J. Park	The effects of perceived environmental factors and adolescents' motivation on achievement mediated through study strategy in the United States and Korea. (family value orientation, ego orientation, high school students)
J. R. Roca, Mercedes Canet, Olga	Learning outcomes of "The Oncology Patient" study among nursing students: A comparison of teaching strategies
J. R. S. Kirby, Robert Allingham, Beth H. Parrila, Rauno La Fave, Chantal B.	Learning strategies and study approaches of postsecondary students with dyslexia
J. S. Nijhuis, Mien Gijsselaers, Wim	The interplay of perceptions of the learning environment, personality and learning strategies: a study amongst International Business Studies students
J. S. Oh, Lorraine	Nursing students' preferences of strategies surrounding cinenurducation in a first year child growth and development courses: A mixed methods study
J. S. S. Krajcik, Patricia E. Lunetta, Vincent N.	A research strategy for the dynamic study of students' concepts and problem solving strategies using science software
J. Swafford	Comprehension strategies research and college developmental studies students
J. Szlachta	Peer instruction of first-year nurse anesthetist students: A pilot study of a strategy to use limited faculty resources and promote learning
J.-Y. W. Pan, Daniel Fu Keung	Acculturative stressors and acculturative strategies as predictors of negative affect among Chinese international students in Australia and Hong Kong: A cross-cultural comparative study
K. Bippert	Text engagement & reading strategy use: A case study of four early adolescent students
K. F. L. Hew, Chung Kwan	Comparing video styles and study strategies during video-recorded lectures: Effects on secondary school mathematics students' preference and learning
K. J. H. C. Dirx, Gino Kester, Liesbeth Kirschner, Paul Arthur	Do secondary school students make use of effective study strategies when they study on their own?
K. J. P. M. S. B. Suda, Gillian C. PharmD Franks, Andrea S. PharmD	Faculty and student perceptions of effective study strategies and materials
K. K. Howard, Brian	Study tours: Strategies for serving business students
K. L. Hong-Nam, Alexandra G.	A comparative study of language learning strategy use in an EFL context: monolingual Korean and bilingual Korean-Chinese university students

K. L. Lueg, Rainer	Why do students choose English as a medium of instruction? A Bourdieusian perspective on the study strategies of non-native English speakers
K. M. Scully, Miguel	Peer influence strategies in collectively consumed products (events and festivals): An exploratory study among university students
K. M. T. O. Collins, A. J.	Study coping and examination-taking coping strategies: the role of learning modalities among female graduate students
K. N. Salmela-Aro, Jari-Erik	Achievement and social strategies during university studies and career characteristics 10 year later
K. R. Morehead, Matthew G. DeLozier, Sarah	Instructor and student knowledge of study strategies
K. S. Castleberry	Rationale and research concerning pre reading study strategies with secondary and college students
K. T. Salmela-Aro, Asko Nurmi, Jari-Erik	Achievement strategies during university studies predict early career burnout and engagement
K. W. Kovach, L. R.	Learning and study strategies, and performance anxiety in postsecondary students with learning disabilities: A preliminary study
K. W. Sutthinaraphan, Punchalee	A study of english communication strategy use of undergraduate students majoring in science
L. B. MacCullagh, Agnes Badcock, Nicholas A.	University students with dyslexia: A qualitative exploratory study of learning practices, challenges and strategies
L. B. MacCullagh, Agnes Badcock, Nicholas A.	University students with dyslexia: A qualitative exploratory study of learning practices, challenges and strategies
L. B. S. Bliss, Janice R.	The effects of institutional culture on study strategies of hispanic students as measured by the inventario de comportamiento de estudio, the spanish version of the study behavior inventory
L. C. Howell	The effect of learning styles, preferred intelligence, and study strategies on a student's preference for condensed or distributed instruction
L. Cheng	A study of Chinese engineering students' communication strategies in a mobile-assisted professional development course
L. G. Johnson, S. Harris, K. R.	The effects of goal setting and self-instruction on learning a reading comprehension strategy: A study of students with learning disabilities
L. Hirsto	Certainty of career choice at the beginning of university studies - general strategies and attributions in achievement situations, and career motives
L. I. Wilhelmi, Freya Steinhäuser, Jost	What leads to the subjective perception of a 'rural area'? A qualitative study with undergraduate students and postgraduate trainees in Germany to tailor strategies against physician's shortage
L. J. M.-P. Labrague, Denise M. Papathanasiou, Ioanna V. Edet,	Stress and coping strategies among nursing students: an international study

Olaide B. Tsaras, Konstantinos Leocadio, Michael C. Colet, Paolo Kleisiaris, Christos F. Fradelos, Evangelos C. Rosales, Rheajane A. Vera Santos-Lucas, Katherine Velacaria, Pearl Irish T.	
L. K. G. Fryer, Paul Walker, Richard	Reciprocal modelling of Japanese university students' regulation strategies and motivational deficits for studying
L. K.-Q. Anderson-Inman, Carolyn Horney, Mark A.	Computer-based study strategies for students with learning disabilities: Individual differences associated with adoption level
L. L. Huang, Wansheng Xu, Fuming Liu, Hairong Yu, Liang	Emotional responses and coping strategies in nurses and nursing students during Covid-19 outbreak: A comparative study
L. L. Newman	Test anxiety, study strategies, and exam performance in first year chiropractic students
L. M.-M. Jimenez-Taracido, Ana I.	Do students apply the learning strategies they report? Study of reading comprehension monitoring in scientific texts
L. R. M. Royanto	The effect of an intervention program based on scaffolding to improve metacognitive strategies in reading: a study of year 3 elementary school students in Jakarta
L. S. Westin, Annelie J. Berglund, Mia	Students' experiences of learning in relation to didactic strategies during the first year of a nursing programme: a qualitative study
L. S. Wolf, Andrea Warner Ross, Ratchneewan	Predictors of stress and coping strategies of US accelerated vs. generic baccalaureate nursing students: an embedded mixed methods study
L. Z. Zou, Ye	A study of english vocabulary learning strategies used by ethnic minority students in leshan normal university, Sichuan, China
M. A. D. Abulela, Earnest C., Jr.	Measurement invariance of the Learning and Study Strategies Inventory-second edition (LASSI-II) across gender and discipline in Egyptian college students
M. A. D. Casado, Mary I.	Effect of educational strategies on anxiety in the second language classroom: An exploratory comparative study between U.S. and Spanish first-semester university students
M. B. Koopman, Anouke Beijgaard, Douwe	Students' goal orientations and learning strategies in a powerful learning environment: A case study
M. B. Tower, Eddie Watson, Bernadette Heffernan, Catherine Tronoff, Glenyss	Using social media as a strategy to address 'sophomore slump' in second year nursing students: A qualitative study
M. C. W. C. Yip, Olive L. L.	Relation of study strategies to the academic performance of Hong Kong university students
M. C. Yip	Differences in learning and study strategies between high and low achieving

	university students: A Hong Kong study
M. C. Yip	Differences between high and low academic achieving university students in learning and study strategies: A further investigation
M. D. Samadi, Mehdi	A case study of the predicting power of cognitive, metacognitive and motivational strategies in girl students' achievements
M. E. Brewster	The effect of achievement motivation on fifth-grade students' choice of study strategies
M. E. G. Gredler, L. S.	Students' perceptions of their self-regulatory and other-directed study strategies: A factor analysis
M. F. Rauch, Ceil	Motivating students to use newly learned study strategies
M. Fitriana	Students' reading strategies in comprehending academic reading: a case study in an Indonesian private college
M. G. Gredler, L.	Students' perceptions of their self-regulatory and other-directed study strategies: A factor analysis
M. G. L. Ge, J.	Study on relationships between English learning strategies and academic achievement of middle school students
M. J. R. Khan, Seemab	Moderating role of learning strategies between meta-cognitive awareness and study habits among university students
M. K. O. Tallent-Runnels, Arturo Lotven, Ann C. Walsh, Sharon K. et al.,	A comparison of learning and study strategies of gifted and average-ability junior high students
M. L. Wijnen, Sofie M. M. Smeets, Guus Kroeze, Maarten van der Molen, Henk	Comparing problem-based learning students to students in a lecture-based curriculum: learning strategies and the relation with self-study time
M. M. K. Mitchell, C. M.	Coping strategies used by occupational-therapy students during fieldwork: an exploratory study
M. R. C. Ramos, Clare Reicher, Stephen Haslam, S. Alexander	A longitudinal study of the effects of discrimination on the acculturation strategies of international students
M. S. Emsaki, Shahla	Comparative study of terminating conversation strategies used by graduate TEFL students and graduate native English speaking students
M. S. Samuelstuen	Psychometric properties and item-keying direction effects for the Learning and Study Strategies Inventory-High School Version with Norwegian students
M. T. Prosser, Keith	Student evaluations of teaching and courses: student study strategies as a criterion of validity
M. Tsuei	The study of peer-assisted learning strategy system for elementary students
M. Z. M. Z. Yusoff, Nor Azan Mat	Exploring suitable emotion-focused strategies in helping students to regulate their emotional state in a tutoring system: Malaysian case study

N. I. Abouammoh, Farhana AlFaris, Eiad	Stress coping strategies among medical students and trainees in Saudi Arabia: a qualitative study
N. J. e. a. Entwistle	Student failure: disintegrated patterns of study strategies and perceptions of the learning environment
N. L. Hung Van, Wongsu Saengsuwan, Jiamjit Thinkhamrop, Bandit Wright, Pamela	The relationships between the use of self-regulated learning strategies and depression among medical students: An accelerated prospective cohort study
N. L. O. Howells, Holly K.	Diary study of sexual risk taking, alcohol use, and strategies for reducing negative affect in female college students
N. L. Xu, Yingyi	Coping strategy mediates the relationship between body image evaluation and mental health: A study with Chinese college students with disabilities
N. M. Ballenberger, Dirk Zalpour, Christoff	Musculoskeletal health complaints and corresponding risk factors among music students study process, analysis strategies, and interim results from a prospective cohort study
N. M. M. Ghoneim	The listening comprehension strategies used by college students to cope with the aural problems in EFL classes: an analytical study
N. M. M. Rao, B. E. Sachs, J.	Motivational beliefs, study strategies, and mathematics attainment in high- and low-achieving Chinese secondary school students
N. T. Imran, Khaula Fatima Pervez, Muhammad Ijaz Jawaid, Masood Haider, Imran Ijaz	Medical students' stress, psychological morbidity, and coping strategies: a cross-sectional study from Pakistan
N. V. C. Volkova, V. A.	Career aspirations of undergraduates studying at some strategic occupational programs
N. V. Sanaie, Parvaneh Sedighi, Ladan Sadeghi, Bit	Comparing the effect of lecture and jigsaw teaching strategies on the nursing students' self-regulated learning and academic motivation: a quasi-experimental study
P. A. M. Alexander, P. Guan, Joseph	The learning and study strategies of highly able female students in Singapore
P. A. M. Alexander, P. Karen Woods, Bradford S. Duhon, Karen E. Parker, Dawn	College instruction and concomitant changes in students' knowledge, interest, and strategy use: a study of domain learning
P. A. S. O. Moreira, Joao Tiago Dias, Paulo Vaz, Filipa Machado Torres-Oliveira, Isabel	The students' perceptions of School Success Promoting Strategies Inventory (SPSI): development and validity evidence based studies
P. A. Solano, Andrea Caprino, Matilde Conigliaro, Claudia Giacomini, Gabriele Serafini, Gianluca Amore, Mario	The personal experience of severe suicidal behaviour leads to negative attitudes towards self- and other's suicidal thoughts and behaviours: A study of temperaments, coping strategies, and attitudes towards suicide among medical students
P. Adhikary	English language learning strategies adopted by bachelor level students (A

	case study of Nepal)
P. C. N. Rosario, Jose Valle, Antonio Gonzalez-Pianda, Julio Lourenco, Abilio	Grade level, study time, and grade retention and their effects on motivation, self-regulated learning strategies, and mathematics achievement: a structural equation model
P. M. D. Schulz, Carmel L. Burdett-Jones, Denise Gamble, Natalie S. Kosiak, Machellee M. Neal, Joclyn M. Baker, Gail E.	Evaluation of strategies designed to enhance student engagement and success of indigenous midwifery students in an away-from-base bachelor of midwifery program in australia: A qualitative research study
P. N. Forbus, John J. Mehta, Sanjay S.	A study of non-traditional and traditional students in terms of their time management behaviours, stress factors, and coping strategies
P. Syawal, Nasrullah, A. S. Ali Wira, Rahman	Good EFL learner's strategy In enhancing english mastery: a case study at indonesian college students
P. W. Whannell, Robert Allen, Bill	Investigating the influence of teacher strategies on academic self-efficacy and study behaviour of students in a tertiary bridging program
Q. S. Bukhsh, Abid Nisa, Muzammil	A study of learning stress and stress management strategies of the students of postgraduate level: a case study of islamia university of Bahawalpur, Pakistan
Q. Wang	Lexical inferencing strategies for dealing with unknown words in reading: a contrastive study between filipino graduate students and chinese graduate students
R. d. S. Ekuni, Bruno Miguel Nogueira Agarwal, Pooja K. Pompeia, Sabine	A conceptual replication of survey research on study strategies in a diverse, non-WEIRD student population
R. D. Zazkis, Ed Dautermann, Jennie	Coordinating visual and analytic strategies: a study of students' understanding of the group D_4
R. H. DeMarco, L. Lynch, M.	Nursing students' experiences with and strategic approaches to case-based instruction: a replication and comparison study between two disciplines
R. I. A.-M. Rabadi, Batoul	An empirical study on vocabulary learning strategies by jordanian FFL university students
R. J. Andreassen, Magne S. Braten, Ivar	Investigating self-regulated study strategies among postsecondary students with and without dyslexia: a diary method study
R. J. Andreassen, Magne S. Bråten, Ivar	Investigating self-regulated study strategies among postsecondary students with and without dyslexia: a diary method study
R. K. Sahragard, Yaser Abbasian, Reza	Field of study, learning styles, and language learning strategies of university students: are there any relations?
R. L. A. Uгла, Mohamad Jafre Zainol	A study of apology strategies used by Iraqi EFL university students
R. L. Petersen, Ellen Guarino, A. J.	The relationship between college students' executive functioning and study strategies

R. L. Steele, W. Caperchione, C. Anastasi, J.	An exploratory study of the concerns of mature access to nursing students and the coping strategies used to manage these adverse experiences
R. M. Herrero, Adriana Cormo, Giulia Etchemendy, Ernestina Banos, Rosa Garcia-Palacios, Azucena Ebert, David D. Franke, Marvin Berger, Thomas Schaub, Michael P. Goerlich, Dennis Jacobi, Corinna Botella, Cristina	An internet based intervention for improving resilience and coping strategies in university students: study protocol for a randomized controlled trial
R. T. H. Roessler, Mary L. Rumrill, Phillip D.	Strategies for improving career services for postsecondary students with disabilities: results of a focus group study of key stakeholders
S. B. H. Nolen, Thomas M.	Personal and environmental influences on students' beliefs about effective study strategies
S. B. H. Nolen, Thomas M.	A construct validation of measures of students' study strategy beliefs and perceptions of teacher goals
S. C. J. Ender, F. A. Novels, A. N. Moss, R. A. Wray, H.	College work study as an affirmative-action strategy promoting student involvement
S. F. E. S. Rovers, Renee E. van Merrienboer, Jeroen J. G. Savelberg, Hans H. C. M. de Bruin, Anique B. H.	How and why do students use learning strategies? A mixed methods study on learning strategies and desirable difficulties with effective strategy users
S. G. Nielsen	Strategies and self-efficacy beliefs in instrumental and vocal individual practice: a study of students in higher music education
S. J. Stoyhoff	English language proficiency and study strategies as determinants of academic success for international students in U.S. universities
S. L. R. Simon-Dack, P. Dennis Marcum, Geoff D.	Study habits, motives, and strategies of college students with symptoms of ADHD
S. M. Bryant	The effects of visualization and verbalization as study strategies on middle school students' retention of defined concepts learned from expository text
S. M. F. Bacon, Michael D.	A study of the attitudes, motives, and strategies of university foreign language students and their disposition to authentic oral and written input
S. N. S. Mojarad, Somayeh AhmadiGatab, Teymor	Studying the effects of teaching cognitive and metacognitive strategies on self-efficacy and goal-selecting of orphan girl students
S. S. Hung-Bin, William E.	An exploratory study of help-seeking attitudes and coping strategies among college students by race and gender
S. S. Sutiyatno	A survey study: the correlation between metacognitive strategies and reading achievement
T. L. Uwatoko, Yan Sakata, Masatsugu Kobayashi, Daisuke	Healthy campus trial: a multiphase optimization strategy (MOST) fully factorial trial to optimize the smartphone cognitive behavioral therapy (CBT)

Sakagami, Yu Takemoto, Kazumi Collins, Linda M. Watkins, Ed Hollons, Steven D. Wason, James Noma, Hisashi Horikoshi, Masaru Kawamura, Takashi Iwami, Taku Furukawa, Toshi A.	app for mental health promotion among university students: study protocol for a randomized controlled trial
T. M. P. Chevalier, Rauno Ritchie, Krista C. Deacon, S. Hélène	The role of metacognitive reading strategies, metacognitive study and learning strategies, and behavioral study and learning strategies in predicting academic success in students with and without a history of reading difficulties
T. Mushoriwa	The study strategy: performance function among students in three teachers' colleges in Masvingo and Harare, Zimbabwe
T. S. Whetstone	Getting stripes: educational achievement and study strategies used by sergeant promotional candidates
U. V. M. Chinwe, Ikezu Uju Joy	Causes, effects and strategies for eradicating cultism among students in tertiary institutions in nigeria: a case study of nnamdi azikiwe university awka anambra state, nigeria
V. G. S. Spencer, T. E. Mastropieri, M. A.	Content area learning in middle school social studies classrooms and students with emotional or behavioral disorders: A comparison of strategies
V. M. Adams	Comparing paper-based and electronic outlining as a study strategy for mainstreamed students with learning disabilities
V. M. McInerney, Dennis M. Marsh, Herbert W.	Effects of metacognitive strategy training within a cooperative group learning context on computer achievement and anxiety: An aptitude-treatment interaction study
W. D. DeJong, Beth Schneider, Shari Kessel	Pregaming: An exploratory study of strategic drinking by college students in Pennsylvania
W. F. Geiser	Effects of learning-style awareness and responsive study strategies on achievement in, incidence of study of, and attitude toward mathematics of suburban eighth-grade
W. V. D. B. Tops, An Noens, Ilse Baeyens, Dieter	A multi-method assessment of study strategies in higher education students with an autism spectrum disorder
W.-P. Y. Chou, Cheng-Fang Liu, Tai-Ling	Predicting effects of psychological inflexibility/experiential avoidance and stress coping strategies for internet addiction, significant depression, and suicidality in college students: a prospective study
X. D. Z. Xu, Q. L. Chen, X. Y.	The experimental study of thinking strategy training about the effect on the ability of students in senior high school solving chemical calculation problems
X. Liu	The relationship between the depth of vocabulary knowledge and chinese MA students' use of vocabulary learning strategy and L2 contact in a study-abroad context
X. M. Zhu, Jianqing	A study on employability of contemporary chinese university students and improvement strategies

X. X. Chen, Gengsheng	A survey study of chinese college engineering students' use of metacognitive strategies in english writing
X. Z. Chen, D. J.	A study of the relationships among stressors in school work, coping strategies and psychological health in secondary school students
Y. C. Alshahrani, Lynette Rasmussen, Philippa	Undergraduate nursing students' strategies for coping with their first clinical placement: descriptive survey study
Y. Cai	A study on compliment response strategies by chinese college students
Y. W. Lee, Evelin	Teachers' intended classroom management strategies for students with ADHD: a cross-cultural study between South Korea and Germany
Y. W. Lee, Evelin	Teachers' accuracy in identifying ADHD status and their intended classroom management strategies for students with and without ADHD: a vignette study in South-Korea and Germany
Y.-C. J. Hsieh	The cross-cultural study on the effect of the use of student-generated visualization as a study strategy for middle school science concept learning
Y.-M. T. Lim, Cai-Lian Lee, Teck-Heang	Perceived stress, coping strategy and general health: a study on accounting students in malaysia
Z. Gan	Asian learners re-examined: an empirical study of language learning attitudes, strategies and motivation among mainland chinese and hong kong students
Z. L. Cao, Yuewu	A study on metacognitive strategy use in listening comprehension by vocational college students
Z. L. Rao, Fulan	Effect of academic major on students' use of language learning strategies: a diary study in a chinese context
Z. Zhou	The empirical study into the relation of the meta-cognitive strategy use and english achievement of college students

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<u>Author</u>	<u>Title</u>
A. A. Al-Emadi	The relationships among achievement, goal orientation, and study strategies
A. F. L. Hoffmann, Ruben Fernandez Liporace, Maria Mercedes	Psychometric analysis of the Learning and Study Strategies Inventory in college students
A. J. M. Elliot, H. A. Gable, S.	Achievement goals, study strategies, and exam performance: A mediational analysis
A. L. Freiberg Hoffmann, Ruben Fernandez Liporace, Maria Mercedes	Psychometric Analysis of the Learning and Study Strategies Inventory in College Students
A. M. Belshaw, Adam Phillips, Hannah Kay Rodrigues, Hannah	Comment on: creating assessments as an active learning strategy: what are students' perceptions? A mixed methods study

Russell, Andrew	
A. M. Meshbane, John D.	Effectiveness of a mnemonic study strategy for retention of geographic names and locations by college students
A. M. Persky	A four year longitudinal study of student learning strategies
A. R. Lorenzo	Comparative study on the performance of bachelor of secondary education (BSE) students in educational technology using blended learning strategy and traditional face-to-face instruction
B. R. Dawson	Textbook reading strategies used by "study strategies for college success" students in content courses during the following semesters
B. W. D. Bergey, S. Hélène Parrila, Rauno K.	Metacognitive reading and study strategies and academic achievement of university students with and without a history of reading difficulties
B. W. P. Bergey, Rauno K. Laroche, Annie Deacon, S.	Effects of peer-led training on academic self-efficacy, study strategies, and academic performance for first-year university students with and without reading difficulties
C. A. Baldwin	Achievement goals and exam performance: An exploration of the role of study strategies and anticipatory test anxiety
C. A. M. Christensen, D. R. Isaacs, P. J.	Cognitive strategies and study habits - An analysis of the measurement of tertiary students learning
C. D. Zepeda	Self-regulated learning in a college course: Examining student metacognitive study strategies, grit, self-efficacy, and performance
C. Gutierrez-Braojos	Future time orientation and learning conceptions: effects on metacognitive strategies, self-efficacy beliefs, study effort and academic achievement
C. J. Z. Fong, Linda Reichwein Ozel, Zeynep Ebrar Yetkiner Phelps, Julie M.	Between and within ethnic differences in strategic learning: a study of developmental mathematics students
C. Li	Study on the relationship among strategies in language learning, achievement motivation and academic scores of students in normal university
C. Magno	Assessing students' study strategies and achievement goals
C. Metzgen	College-student learning and study strategies: A cross-cultural study between Switzerland and the United States
D. F. Sacks	The effects of the direct instruction of study strategies on first year college students' strategy use
D. J. Eberling	A comparison of the effectiveness of study strategies instruction with community college students
D. J. O. Dickinson, D. Q. Dunn, J. S.	Distributed study, cognitive study strategies and aptitude on student learning
D. Jairam	Helping students soar to success on their computer: A mixed methods

	approach to investigate and test an integrated study strategy system for online prose
D. Watkins	Academic achievement and the congruence of study motivation and strategy
F. d. M. Van Overwalle, Machteld	The effects of attribution-based intervention and study strategy training on academic achievement in college freshmen
F. J. P. G.-P. Estrada, Francisco Javier Conde-Vélez, Sara	Learning styles in university students: Types of strategies, materials, supports, evaluation and performance. case study
F. Phillips	A research note on accounting students' epistemological beliefs, study strategies, and unstructured problem-solving performance
G. A. Hale	Students predictions of prose forgetting and the effects of study strategies
G. Erdamar	An investigation of student teachers' study strategies with respect to certain variables
G. Jean-Louis	Skill, will, and self-regulation: Assessing the learning and study strategies of university summer bridge program students
H. D. Mason	Learning and study strategies among first-year students at a south african university: A mixed methods study
H. I. B. Stromso, I. Samuelstuen, M. S.	Students' strategic use of multiple sources during expository text reading: A longitudinal think-aloud study
H. K. Jabbari, M. K. Heydari, M.	The comparatively study of student in the eye of locus of control, motivational beliefs, and self regulated learning strategies
H. M. A.-M. Al Kadri, Mohamed S. Elzubair, Margaret Magzoub, Mohi Eldien AlMutairi, Abdulrahman Roberts, Christopher van der Vleuten, Cees	Exploring factors affecting undergraduate medical students' study strategies in the clinical years: A qualitative study
H. N. Alkhateeb, Ramzi	Assessment of learning and study strategies of university students in Qatar using an arabic translation of the Learning and Study Strategies Inventory
H. P. Phan	Amalgamation of future time orientation, epistemological beliefs, achievement goals and study strategies: Empirical evidence established
I. O. Braten, B. S.	The learning and study strategies of Norwegian first-year college students
J. A. S. Lawrence, Ram P.	A study of teaching and testing strategies for a required statistics course for undergraduate business students
J. B. Biggs	Motivation to learn and students study strategies
J. B. L. Kurtz, Michael A. Holman, Elizabeth E. Grob, Karri L. Monrad, Seetha U.	Creating assessments as an active learning strategy: what are students' perceptions? A mixed methods study

J. Biggs	A comparison of student motivation and study strategies in CAE and university populations
J. C. Moore	Cognitive, learning and study strategy predictors of student-athlete academic success and academic progress rates
J. D. B. Karpicke, Andrew C. Roediger, Henry L., III	Metacognitive strategies in student learning: Do students practise retrieval when they study on their own?
J. M. Oliver	The relationship between learning/study strategies and gains in algebra i competency among developmental mathematics students
J. N. Laakkonen, Anne	Relationships between learning strategies, stress, and study success among first-year veterinary students during an educational transition phase
J. O. Mäkinen, Erkki	University students' situational reaction tendencies: reflections on general study orientations, learning strategies, and study success
J. R. B. King, Shirley Lipsky, Sally	Students' self-questioning and summarizing as reading study strategies
J. S. Martinezguerrero, J. J.	Learning strategies - predictive analysis of study habits on college students academic performance
J. S. Sriram	Enabling students to learn: design, implementation and assessment of a supplemental study strategies course for an introductory undergraduate biology course
J. V. Ferla, Martin Schuyten, Gilberte	Relationships between student cognitions and their effects on study strategies
K. R. Francom	Achievement motivation and study strategies of graduate students: testing boundary conditions of theoretical constructs
K. T. R. Rugsaken, Jacqueline A. Jones, James A.	Using the learning and study strategies inventory scores as additional predictors of student academic performance
L. A. B. Flowers, Brian K. Moore, James L., III	Concurrent validity of the Learning and Study Strategies Inventory (LASSI): A study of African American pre college students
L. B. Hodo	The effects of study skills instruction on achievement and usage of selected study strategies in Algebra II classes
L. M. Chen, Jianqing	Empirical Study on Incentive Education Strategies for College Students in Social Transition Period
L. M. S. Ramjan, Lyn Salamonson, Yenna Morris, Maureen M. Armstrong, Lyn Sanchez, Paula Flannery, Liz	Identifying strategies to assist final semester nursing students to develop numeracy skills: A mixed methods study
L. P. Franciosi	Problem-solving appraisal, self-reported study strategies, and academic performance of first-year college students
M. A. Dahlgren	Portraits of PBL: Course objectives and students' study strategies in computer

	engineering, psychology and physiotherapy
M. E. Ross	The effects of student expectations about the cognitive complexity of test items on study strategies and on memorization and cognitively complex test item performance
M. K. McAndrew, Rajit S. Pierre, Gaelle C.	Do dental students use optimal study strategies?
M. L. N. Simpson, Sherrie L.	Textbook annotation: an effective and efficient study strategy for college students
M. L. Smith	A quantitative analysis of critical thinking abilities, learning and study strategies, and academic achievement in associate degree nursing students
M. M. M. Cavamura Endo, Fabiano Koich Kienen, Nadia	The learning and study strategies of Norwegian first-year college students
M. Nebres	Training in summarizing notes: Effects of teaching students a self-regulation study strategy in science learning
M. P. V.-G. Deming, Maria Idleman, Lynda S.	The reliability and validity of Learning and Study Strategies Inventory (LASSI) with college developmental students
M. R.-G. Ruiz-López, Marta Villanueva, Purificación-González Márquez-Cava, Montserrat García-Mateos, Mónica Ruiz-Ruiz, Beatriz Herrera-Sánchez, Esteban	The use of reflective journaling as a learning strategy during the clinical rotations of students from the faculty of health sciences: An action-research study
M. V. S. Pinxten, Carolien Peeters, Christine De Laet, Tinne Langie, Greet	At-risk at the gate: Prediction of study success of first-year science and engineering students in an open-admission university in Flanders-any incremental validity of study strategies?
O. J. Ehindero	A discriminant function analysis of study strategies, logical reasoning ability and achievement across major teacher undergraduate curricula
O. O. Z. Adesope, Mingming Nesbit, John C.	Achievement goal orientations and self-reported study strategies as predictors of online studying activities
S. B. H. Nolen, T. M.	Personal and environmental influences on students beliefs about effective study strategies
S. H. M. Moon, Sun Jung Yoon, Hyun Bae Park, Jun-Bean Kim, Ju Whi Park, Wan Beom	Deliberate practice as an effective remediation strategy for underperforming medical students focused on clinical skills: a prospective longitudinal study
S. K. Grimes	Targeting academic programs to student diversity utilizing learning styles and learning-study strategies
T. G. Jakubowski	Social-cognitive factors associated with the academic self-regulation of undergraduate college students in a learning and study strategies course

U. W. Isik, Janneke Croiset, Gerda Kusrkar, Rashmi A.	The role of study strategy in motivation and academic performance of ethnic minority and majority students: A structural equation model
U. W. Schiefele, K. P. Winteler, A.	Amount of learning and elaboration strategies as mediators of the relation between study interest and achievement
Y. E. Salamonson, Bronwyn Koch, Jane Wilson, Ian Davidson, Patricia M.	Learning strategies of first year nursing and medical students: A comparative study

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<u>Author</u>	<u>Title</u>
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Jacob B, Peasah SK	An Elective Course for Student Pharmacists on Pharmaceutical Industry Practice
AACN	AACN practice guidelines for neuropsychological assessment and consultation. Clinical Neuropsychology
Advokat C, Lane SM, Luo C	College students with and without ADHD: Comparison of self-report of medication usage, study habits, and academic achievement
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A. J., & McGregor, H. A.	A 2×2 achievement goal framework
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Cannon, R. and Newble, D.	Handbook for teachers in universities and colleges: A guide to improving teaching methods
Cantwell, R. H., & Moore, P. J.	The development of measures of individual differences in self-regulatory control and their relationship to academic performance
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Yip, M. C. W.	Relationship of study strategies and academic performance of higher education: A cross-cultural comparison

Appendix 4

First author and title of included study	Country	Study design, duration, and participants	Type of Data	Outcome	Quality: Design/score
<i>Balasubramaniam et al, 2016; A Study of Learning Style Preferences among First Year Undergraduate Medical Students Using VARK Model</i>	India	Quantitative descriptive design; One-time questionnaire (VARK) filling-out period (exact time not specified) given to first year undergraduate students (n=152, only 144 completed successfully)	Questionnaires (n=144)	48% of participants preferred unimodality, and 52% preferred multimodality. Within the unimodal learning sample, 35% used kinaesthetic techniques and 34% used auditory techniques. Within the multimodal learning sample, kinesthetic, aural, and visual techniques made up the majority of learning styles. It was found that most students preferred the multimodal learning approach, which suggests that the implementation of multimedia may effectively accommodate their learning styles.	4/*****
<i>Baykan et al, 2007; Learning styles of first-year medical students attending Erciyes University in Kayseri, Turkey</i>	Turkey	Quantitative descriptive design; Questionnaire (VARK) given to fill out at the beginning of the semester (exact time not specified); Administered to first-year medical students (n=162, only 155 completed successfully)	Questionnaires (n=155)	After administering VARK it was found that the 36.1% of the sample preferred unimodality, and 63.9% preferred multimodality. Additionally, 23.3% used kinesthetic techniques, 7/7% used auditory techniques, 3.2% used visual techniques, and 1.9% used read-write techniques in their learning strategies. 30.3% of participants had bimodal approaches, 20.7% had trimodal approaches, and 12.9% had quad-modal approaches. No significant differences in learning style preferences were observed between males and females, and no significant relationship was observed between student GPAs and their learning preferences.	4/*****
<i>Credé et al, 2008; Study Habits, Skills, and Attitudes: The Third Pillar Supporting Collegiate Academic Performance</i>	USA	Qualitative design; Meta-analysis (exact time not specified) of studies (n=72,431) concerning 10 study skill constructs;	Studies (n=72,431)	Learning strategy/skill inventories don't often depend on highschool admission test scores, but they do have a slight relation to personality constructs. It was found that motivation and study skills have the highest correlation with student gpa and course success. Inventories that are most predictive of performance are regarding study habits and attitude. Anxiety rooted in academics also seemed to be a negative predictor of student performance.	1/*****
<i>Diseth, 2011; Self-efficacy, goal orientations and learning strategies as mediators between preceding and subsequent academic</i>	Norway	Quantitative descriptive design; Inventories were given out (15 min. to complete) to undergraduate psychology students (n=211, only 177 completed correctly)	Questionnaires (n=177) Inventory before exam, highschool GPA, examination grade,	It was found that a strong relationship exists between the learning strategies of self-efficacy/goal orientations and deep/surface learning. Additionally, preceding academic achievement was found to predict self-efficacy and future achievement.	4/****

<i>achievement.</i>			ASSIST inventory		
<i>Dobson et al, 2014; Self-testing promotes superior retention of anatomy and physiology information</i>	USA	Randomized controlled trials design; Phase 1 and phase 2 were conducted over the course of more than a week with undergraduates from an Anatomy and Physiology I course (n=147, with only 125 being included)	Examinations (n=5), observations (more than a week), questionnaires	The reading, testing, and rereading strategy (R-T-R) was found to significantly increase students' ability to retain information after a week of its implementation. Additionally, the implementation of self-testing instructions seemed to aid students in preparing for course examinations.	2/****
<i>Dobson, 2009; Learning style preferences and course performance in an undergraduate physiology class</i>	USA	Quantitative descriptive design; Questionnaire (VARK) given out (exact time not specified) to undergraduate students in Applied Human Physiology courses (n=1,037, with only 901 being included)	Questionnaires (n=901)	It was found that there are significantly different learning style preferences between male and females. 46% of females preferred visual learning, 27% preferred read/write methods, and 4% preferred kinesthetic. However, 49% males seemed to prefer visual learning, 29% preferred read/write methods, 17% preferred aural, and 5% preferred kinesthetic. Additionally, it was found that there was a significant relationship regarding sensory modality and student course scores.	4/****
<i>Drago et al, 2004; Vark preferred learning styles and online education</i>	USA	Quantitative descriptive design; Review of VARK preferred learning style and online education (exact time not specified); VARK administered to students from 11 MBA management courses at the end of each semester (n=527, with only 326 completed successfully)	Questionnaires (n=326), Studies	It was found that students completing school online were more likely to have more well-developed visual and read-write learning strategies. Those that preferred read-write methods and other students who had well-developed skills across all 4 learning styles were found to be more likely to evaluate the effectiveness of a course lower in comparison to other students. Students that preferred aural/read-write methods were individuals who did not have well-developed skills in other learning styles. These students were found to be more likely to evaluate course effectiveness higher.	4/****
<i>Elliot et al, 1999; Achievement goals, study strategies, and exam performance: A mediational analysis.</i>	USA	Quantitative descriptive design; 2 studies conducted analyzing achievement goals over a total of 343 undergraduates enrolled in an introductory level psychology course (only	Questionnaires (n=343)	It was found that mastery goals positively predict persistence, deep processing, and effort in students. With performance-approach goals, it seemed that they acted as positive predictors for surface processing, persistence, exam performance, and effort as well. Performance-avoidance goals also positively predicted surface processing, along with disorganization. Yet it seemed to additionally act as a negative predictor for deep processing and exam performance. Overall, it was shown that persistence and effort moderated the relationship between performance-approach goals and exam performance, with disorganization moderating exam performance and performance-avoidance goals instead.	4/****

<i>Farkas et al, 2015; Learning style versus time spent studying and career choice: Which is associated with success in a combined undergraduate anatomy and physiology course?</i>	USA	Quantitative descriptive design;	Questionnaires (n=492)	It was found that the amount of study time was not significantly correlated with the style of learning or student career plans. Career choices and study time seemed to be correlated with higher student achievement.	4/*****
<i>Duncan et al, 1996; Assessing students' motivation and learning strategies in the classroom context: The Motivated Strategies for Learning Questionnaire.</i>	USA	Qualitative design; Reviews of studies regarding motivation and cognitive components in a classroom context; (participants aren't really specified, it talks about studies in a more general sense)	Studies, Questionnaires (used in those studies)	The Motivated Strategies for Learning Questionnaire is deemed to be fairly reliable, with response accuracy depending on the characteristics of particular questions (ex. Length, phrasing). It was found that the learning strategies scales included in this questionnaire positively correlated with student performance in terms of course grades. This study demonstrated that the MSLQ is a valid approach to analyzing student motivation and study strategies within schooling.	1/*****
<i>Hartwig et al, 2012; Study strategies of college students: are self-testing and scheduling related to achievement?</i>	USA	Quantitative descriptive design; Administered questionnaires (exact time not specified) to undergraduate students in KSU participant pool (n=324)	Questionnaires (n=324)	Self-testing, rereading, and scheduling of study time were all important factors regarding GPA, with positive associations with the first 2 strategies. It was found that high-achieving students were less likely to participate in late-night studying in comparison to low-achieving students, who also seemed to be driven by deadlines. Additionally, the accumulation of study was found to be associated with the use of fewer study strategies.	4/****
<i>Yip, 2012; Learning strategies and self-efficacy as predictors of academic performance: a preliminary study</i>	China	Quantitative descriptive design; Administered revised LASSI-C questionnaire (20 min) to undergraduate students (n=215, only 200 completed successfully)	Questionnaires (n=200)	It was found that, by comparing high-achieving and low-achieving students, major differences can be observed. In particular, self-efficacy acted as a good indicator between both student groups in a university setting.	4/****
<i>Zhou et al, 2016; The relationship between study strategies and academic performance</i>	USA	Quantitative descriptive design; LASSI and SDLRS questionnaires were administered (over a session, exact time not specified) to medical students before their first and second years (n=168)	Questionnaires (n=168)	The results obtained through SDLRS and LASSI implementations differ in terms of their predictive value. While LASSI subscales of concentration, motivation, time management, and test strategies seem to correlate with student academic performance, it seems that SDLRS does not have any direct relation to the subject.	4/****

<i>Khalil et al, 2017; The Relationship Between Learning and Study Strategies Inventory (LASSI) and Academic Performance in Medical Schools</i>	USA	Quantitative descriptive design; LASSI questionnaire was administered during orientation (exact time not specified) to medical students starting first and second year (n=128)	Questionnaires (n=128)	Students that had more experience within medical school provided more accurate assessments of learning strategies in comparison to those starting medical school. It was found that 3 subscales - anxiety, selecting main ideas, and test strategies - all had a correlation with student achievement during internal and external testing.	4/*****
<i>Khalil et al, 2019; The Use of Learning and Study Strategies Inventory (LASSI) to Investigate Differences Between Low vs High Academically Performing Medical Students</i>	USA	Quantitative descriptive study, 180 medical students from three classes	Questionnaires (n=180)	By comparing high-achieving and low-achieving students, it was seen that only 3 LASSI subscales provided significant differences between the 2, being anxiety, motivation, and test strategies. These scales correlated with both groups during internal and external tests.	4/*****
<i>Vrugt et al, 2008; Metacognition, achievement goals, study strategies and academic achievement: Pathways to achievement.</i>	Netherlands	Quantitative descriptive design; The MSLQ questionnaire was administered 1 week before an exam (exact time not specified) to first-year undergraduate psychology students enrolled in the Introduction to Psychology course (n=952)	Questionnaires (n=952)	The metacognitive pathway in self-regulated learning incorporated positive mastery goals relationships, while also incorporating negative performance-avoidance goals relationships within metacognition. On the contrary, the strategy pathways incorporated only the positive effects of mastery and performance-approach goals within metacognition and deep cognition. Overall, metacognition had a positive effect on all 4 strategies of effective self-regulated learning. Performance-goals also presented positive effects through surface cognitive and resource management strategies.	4/****
<i>Alkhateeb et al, 2014; Assessment of learning and study strategies of university students in Qatar using an Arabic translation of the Learning and Study Strategies Inventory</i>	Qatar	Quantitative descriptive design; LASSI questionnaire was administered (exact time not specified) to undergraduate university students (n=413)	Questionnaires (n=413)	Of the 10 scales, only 9 were found to be significantly correlated with student GPAs, providing a statistically significant basis that presents differences between low-achieving and high-achieving students. It was found that anxiety and test strategies predicted academic success in reference to student GPAs.	4/****
<i>O'Mahony et al, 2016; Association between learning style preferences and anatomy assessment outcomes in graduate-entry Fand undergraduate medical students</i>	Ireland	Quantitative descriptive design; VARK and LSQ questionnaires were administered (exact time not specified) to first and second years in the DEM medical program and first years in the GEM program (n=327)	Questionnaires (n=327)	A weak correlation between anatomy assessment performance and multiple LSQ style preferences were observed. The "Activist" style seemed to have a negative correlation with anatomy scores in second year students, while the "Theorist" seemed to have a weak correlation with anatomy scores in second year students. Students who achieved high scores on the VARK "Aural" modality, however, were found to have improved anatomy scores.	4/*****

<p><i>McAndrew et al, 2016; Dental Student Study Strategies: Are Self-Testing and Scheduling Related to Academic Performance?</i></p>	<p>USA</p>	<p>Quantitative descriptive design; 16-item survey administered after preclinical laboratory sessions (exact time not specified) to second year dental students (n=358, only 94 completed successfully)</p>	<p>Questionnaires (n=94)</p>	<p>Self-testing and rereading study strategies seemed to be the techniques used by the majority of the sample population. It was found that self-testing (frequently with flashcards) was more likely to be adopted by high-achieving students, who commonly spaced out their studying over multiple sessions. Highlighting or underlining techniques seemed to be adopted by low-achieving students, who commonly crammed their study sessions. Stronger performance was associated with longer periods of study or practice, and lower performance was associated with shorter periods of study or practice. While a majority of students claimed to believe that studying would be more productive in the morning, 84% reported studying during later hours (evenings, late night).</p>	<p>4/****</p>
<p><i>Hoskins et al, 2017; Effectiveness of a Low-Cost, Graduate Student-Led Intervention on Study Habits and Performance in Introductory Biology</i></p>	<p>USA</p>	<p>Non-randomized design; Recruitment of participants occurred 7 weeks into the semester (voluntary), targeting undergraduate students enrolled in an introductory biology course</p>	<p>Observing, questionnaires</p>	<p>It was found that there was a weak association between changes in study habits and the quality of work with changes in performance during lecture exams. However, this relationship seemed to only be significant during the Fall semester. The course structure implemented in this study is shown to be effective and inexpensive.</p>	<p>3/****</p>
<p><i>Albaili, 1997; Differences Among Low-, Average- and High-achieving College Students on Learning and Study Strategies</i></p>	<p>United Arab Emirates</p>	<p>Quantitative descriptive design; LASSI questionnaire was administered (exact time not specified) to undergraduate students (n=168). GPA was used as an index of college academic achievement.</p>	<p>Questionnaire (n=168)</p>	<p>In terms of questionnaires, it was found that those that scored lower were low-achieving students, with higher scores being associated with average or high-achieving students. No significant differences were seen between the average or high-achieving student groups in terms of scoring. This study showed that Motivation was considered an important characteristic that separated low-achieving students from high-achieving students.</p>	<p>4/****</p>

<p><i>Willman et al, 2014; On study habits on an introductory course on programming</i></p>	<p>Finland</p>	<p>Non-randomized design; Literature review on online assessments and student activity patterns. Examining student short-term study habits on an online platform.</p>	<p>Observation</p>	<p>This study showed that students who finish their work early and do not work during weekends or at night tend to have higher grades. Those who earn lower grades differ in these behaviours, but have more enrichment in comparison to those that work at night. Additionally, tutorial periods that incorporate assignment introductions and assignment solving sessions increase the amount of assignments that are submitted. This structure may aid in preventing students that may otherwise fail the course due to completing assignments near their respective deadlines.</p>	<p>3/****</p>
<p><i>Karpicke et al, 2011; Retrieval practice produces more learning than elaborative studying with concept mapping</i></p>	<p>USA</p>	<p>Randomized controlled trials design; Tested retrieval practice</p>	<p>Observation</p>	<p>It was found that retrieval practice through retrieval-specific techniques enhanced learning in comparison to other elaborative study techniques. The findings show that retrieval practice is an effective approach when referring to conceptual learning in science.</p>	<p>2/****</p>
<p><i>Nonis et al, 2010; Performance of College Students: Impact of Study Time and Study Habits</i></p>	<p>USA</p>	<p>Quantitative descriptive design; Modified questionnaire was administered to undergraduate business students (n=201).</p>	<p>Questionnaires (n=201)</p>	<p>Both positive and negative relationships of study habits on student performance were observed. Particularly, it was found that 1 study habit would mediate the relationship between student performance and study time in a positive manner, but another would do so in a negative manner.</p>	<p>4/*****</p>
<p><i>Ye et al, 2016; Can they succeed? Exploring at-risk students' study habits in college general chemistry</i></p>	<p>USA</p>	<p>Non-randomized design; observed students in 12h increments (n=301)</p>	<p>Observation (12h periods)</p>	<p>A reduction in the difference between at-risk students and students not at risk can be done through high frequency studying. It was found that high frequency studying is not fairly related to quality of studying, yet both of these factors can play a role in the performance of an at-risk student. These findings can be used as a basis to create further avenues to improve student success.</p>	<p>3/****</p>

<i>Yip et al, 2007; Relationship of Study Strategies and Academic Performance in Different Learning Phases of Higher Education in Hong Kong</i>	China	Quantitative descriptive design; LASSI questionnaires (30min) were administered to undergraduate students	Questionnaires	Those with high academic achievement in Matriculation and those with low academic achievement in Matriculation have study habits that differ significantly. This particular case, however, was not seen at University. The effective strategies outlines in Matriculation therefore may not be applicable and work effectively in a university setting.	4/*****
<i>Bickerdike et al, 2016; Learning strategies, study habits and social networking activity of undergraduate medical students</i>	Ireland	Quantitative descriptive design; ALSI and demographic questionnaires were administered to medical students in year 2 and final year undergraduate-entry and graduate-entry medical students (n=376)	Questionnaires (n=376)	While surface learning should be discouraged, effort management and organised studying should continue to be put forward. This implementation can optimise academic performance in medical schools. Poor study habits seem to be correlated with the excessive use of social networking, and further contributes to reduced academic achievement.	3/*****
<i>Boswell, 2016; The Role Of Study Strategy Use, Meaning In Life, And Grit On The Academic Success Of University Students</i>	USA	Quantitative descriptive design;LASSI-2 was administered to 249 undergraduate students enrolled in psychology classes	Questionnaires (n=249)	Results show that the types of study strategies implemented by students accounted for 31% of the variance in GPA, and grit accounted for 4% of additional variance.	4/*****
<i>Broekkamp et al, 2007; Students' Adaptation of Study Strategies When Preparing for Classroom Tests</i>	Netherlands	Qualitative design; Review of multiple studies to develop a model to further stimulate research on strategy adaptation.	Studies	Students of various ages and grade levels can adapt their study strategies to accommodate different tasks to some extent, there are still big issues regarding the types of study strategies used and environmental impact in implementing these strategies. Authors suspect that the conditions of test preparation in the classroom do not support or promote the adaptability of study strategies.	1/*****
<i>Brown, 2017; An evidence-based analysis of learning practices: the need for pharmacy students to employ more effective study strategies</i>	USA	Qualitative design; Review of multiple studies to understand learning practices (focusing on pharmacy students)	Studies	Approaching material with study strategies consisting of superficial understanding and memorization techniques can be detrimental to professional growth. Faculty members should guide students in implementing more effective evidence-based study strategies.	1/*****

<i>Chen et al, 2015; The Relationship Among Academic Self-concept, Learning Strategies, and Academic Achievement: A Case Study of National Vocational College Students in Taiwan via SEM</i>	Taiwan	Quantitative descriptive design; Questionnaires were administered to national vocational college students (n=407)	Questionnaire (n=407)	Encouragement from high level educators has been shown to increase students' motivation to learn material, efficiency, and self concept. Academic self-concept has a positive effect on and may possibly predict academic achievement. Students showing high levels of self-concept also demonstrate having internal motivation to participate in learning.	4/****
<i>Costello, 2011; Achievement goals, interest, study strategies, and academic achievement</i>	USA	Quantitative descriptive design; Cluster analysis was used to examine study strategies of undergraduate students enrolled in introductory biology (n=119) and introductory psychology (n=57) courses	Questionnaire (n=176)	Students' mastery, performance-approach and performance-avoidance goals used to construct four achievement goal profiles.	4/****
<i>Cukras, 2010; The Investigation of Study Strategies that Maximize Learning for Underprepared Students</i>	USA	Non-randomized studies, 13 weeks, 19 Bronx Community College students	Bronx Community College's freshman-level textbook chapters, including open discussion and tests on topics	Certain strategies were found to improve learning compared to others. These results were found through teachers meeting with students on an individual basis and discussing test performance and strategies selected.	3/****
<i>Dill et al, 2014; The Use of the LASSI (The Learning and Study Strategies Inventory) to Predict and Evaluate the Study Habits and Academic Performance of Students in a Learning Assistance Program</i>	USA	Quantitative descriptive design; LASSI questionnaires (3h) were administered to students enrolled in four sections of a class called "Fundamentals of Achievement: Applications to College, Work, and Life) (n=145)	Questionnaires (n=145)	Over the course of the study, students' understanding and use of study strategies improved according to questionnaire results. Students identifying as having less anxiety were more likely to avoid suspension.	4/*****
<i>Dumlosky, 2013; Strengthening the Student Toolbox: Study Strategies to Boost Learning</i>	USA	Qualitative design; talks about all the different learning strategies (ex. Highlighting, testing, etc.)			1/*****

<i>Fleming, 2002; Improving Students' Exam Performance by Introducing Study Strategies and Goal Setting</i>	USA	Quantitative descriptive design; Questionnaires were administered to first-year students in 2 sections of introductory psychology (n=65)	Questionnaires (n=65)	Students in the control group overall scored lower on the first two and last exams, with insignificant differences for the third exam. First year students in the treatment group performed similarly to upper year students on all four exams, demonstrating comfort in new tools supplied for learning.	4/****
<i>Foote, 2010; Student-Generated Higher Order Questioning as a Study Strategy</i>	USA	Randomized controlled trials design; Created peer treatments to test student-generated higher order questioning as a study strategy. Implemented to students (n=120) in an introductory psychology course at a private university	Observation	There is no support indicating that one treatment option results in higher cognitive activity on the continuum with guided questions scoring requiring greater amount of mental effort and connections between concepts formed, compared to lower-order or fact-listing questions.	2/****
<i>Foutz, 2018; Collaborative Argumentation as a Learning Strategy to Improve Student Performance in Engineering Statics: A Pilot Study</i>	USA	Investigated if collaborative argumentation is a strategy that can improve student understanding. Implemented in a sophomore-level engineering course (n=60) with 75min lecture sessions twice a week, followed by a 50min problem solving session once a week	Observation (total of 15 weeks)	Argumentation improves student performance according to test scores, although students demonstrate doubt in the argumentative learning strategy. Students in both treatment groups had similar levels of confidence in their ability to complete the course.	3/***
<i>Gallagher, 2020; Using "Make & Take Quizzes" to Improve Exam Performance and Engage Students in Effective Study Strategies</i>	USA	Non-randomized design; Examined effectiveness of in-class quizzing strategy. Compared groups of students that completed (n=74) and did not complete (n=73) Make & Take Quizzes.	Testing	Students provided Make & Take Quizzes significantly outperformed students who did not receive the quizzes. Students' overall study strategies did not change, but there were slight changes in two study strategy categories of identifying main ideas of concepts and paraphrasing.	3/***
<i>Gatto, 2010; Learning and Study Strategies of Baccalaureate Nursing Students during First Semester Nursing Courses</i>	USA	Quantitative descriptive study, 133 students at two baccalaureate nursing programs in a southern state	Questionnaire (n=133)	Factors of age, number of transfer credits and learning and study strategies did not identify academically at-risk students. Having a higher GPA lowered the risk of being academically at-risk, while belonging to a minority or identifying as ESL increased the risk.	4/****

<p><i>Geller et al, 2017; Study strategies and beliefs about learning as a function of academic achievement and achievement goals</i></p>	<p>USA</p>	<p>Quantitative descriptive design; AGQ questionnaire was administered to undergraduate students enrolled in a introductory biology course (n=1039, with only 931 completed successfully)</p>	<p>Questionnaires (n=931)</p>	<p>High academic achievers were found to implement more self-testing strategies, less likely to study last minute, and more likely to plan a study schedule in advance. Achievement goals were strong predictors of specific study behaviours. Avoidance goals were correlated with increased last minute studying. Individual differences in student achievement and reasons for achievement can predict study strategies used.</p>	<p>4/****</p>
<p><i>Hagemeier et al, 2011; Student Pharmacists' Perceptions of Testing and Study Strategies</i></p>	<p>USA</p>	<p>Quantitative descriptive design; A survey was administered to first, second, and third year doctor of pharmacy students (n=425)</p>	<p>Survey</p>	<p>The main purpose of tests according to students was to assess the amount of material learned. A common technique used to study for exams was massed practice, while retrieval techniques were a lot less used.</p>	<p>4/*****</p>
<p><i>Husmann et al, 2019; Another Nail in the Coffin for Learning Styles? Disparities among Undergraduate Anatomy Students' Study Strategies, Class Performance, and Reported VARK Learning Styles</i></p>	<p>USA</p>	<p>Quantitative descriptive design; VARK questionnaires were administered to undergraduate students enrolled in a basic human anatomy course (n=426)</p>	<p>Questionnaires (n=426)</p>	<p>Most students did not report the same study strategies as the ones found in their VARK assessment. Student performance was not correlated with their score in the questionnaires. Other unrelated study strategies were found to have a positive correlation with their final grade.</p>	<p>4/****</p>
<p><i>Khalil et al, 2018; Learning and study strategies correlate with medical students' performance in anatomical sciences</i></p>	<p>USA</p>	<p>Quantitative descriptive design; LASSI questionnaires were administered to medical students of classes 2016, 2017, and 2018 (n=180)</p>	<p>Questionnaires (n=180)</p>	<p>There were significant correlations found between five out of the ten LASSI subscales: anxiety, information processing, motivation, selecting main idea and test strategies. Students lacking these skills were identified and communicated with, which resulted in improved academic achievement and test scores.</p>	<p>4/*****</p>

<p>Lopez et al, 2013; <i>Self-regulated learning study strategies and academic performance in undergraduate organic chemistry: An investigation examining ethnically diverse students</i></p>	USA	<p>Qualitative design; Investigated study strategies of ethnically diverse students by collecting study diaries, concept maps, problem sets, and final course grades.</p>	Observation	<p>Results show that the most common reviewing-type study strategies practiced by students were similar across all ethnic groups. These common strategies had little effect on students' problem solving, concept mapping, or course performance. Although students knew of the benefits of metacognitive and peer learning strategies, these strategies were not implemented.</p>	1/*****
<p>Nist et al, 2010; <i>Measuring the affective and cognitive growth of regularly admitted and Developmental Studies students using the Learning and Study Strategies Inventory (LASSI).</i></p>	USA	<p>Quantitative descriptive study, duration?, 71 regularly-admitted students volunteering to enroll in study strategies course at University of Arizona, 168 developmental studies students mandarily enrolling in study strategies course at University of Georgia</p>	LASSI tests administered throughout duration of the course (n=71+168)	<p>Authors found that there was both cognitive and affective growth experienced by regularly admitted and developmental students. All LASSI scales were not good predictors of success in course work.</p>	4/****
<p>Martins et al, 2019; <i>Intervention in Learning Strategies: Study with New University Students</i></p>	Brazil	<p>Quantitative non-randomized design; Psychoeducational intervention programs were analyzed in students (n=83) through questionnaires</p>	Questionnaire	<p>Qualitative differences in data was collected which allows the authors to reflect on the relationship between enrolling in higher education and the benefit of teaching self-regulated learning strategies within the first year of graduation.</p>	3/****
<p>Ross et al, 2006; <i>College Students' Study Strategies as a Function of Testing: An Investigation into Metacognitive Self-Regulation</i></p>	USA	<p>Quantitative descriptive design;</p>		<p>Students who anticipated exam questions that required deep-level processing used more deep-level strategies, while students anticipating exam questions requiring surface-level knowledge implemented more memory-related study strategies.</p>	4/****
<p>Sebesta et al, 2017; <i>How Should I Study for the Exam? Self-Regulated Learning Strategies and Achievement in Introductory Biology</i></p>	USA	<p>Quantitative descriptive design; Questionnaires were administered to students enrolled in an introductory biology course (n=414)</p>	Questionnaire (n=414)	<p>High academic achievers and students who experienced an improvement in exam grades used more specific cognitive strategies more. Low academic achievers reported not implementing the strategies they planned to use, or did not help significantly when used. The authors concluded that students entering introductory biology are unfamiliar with learning strategies and the best methods to implement them to maximize results.</p>	4/****

<i>Senko et al, 2013; Achievement goals, study strategies, and achievement: A test of the "learning agenda" framework</i>	USA	Quantitative descriptive design;		MAP goals produce more deep learning strategies to be implemented. In study 2, MAP and PAP goals were found to both be beneficial to academic achievement.	4/***
<i>Overwalle et al, 1990; The effects of attribution-based intervention and study strategy training on academic achievement in college freshmen.</i>	Belgium	Randomized controlled trials design; Investigating the effectiveness of remedial programmes on freshmen academic performance (n=43). 43 watched video-taped interviews with senior students relating the causes of their failures at the beginning of the first year, and how they had managed to improve their exam scores at the end of the year. 57 learned conventional rules of study strategy use and applied them during short practice trials.	Observation, questionnaire	Attribution video manipulation increased the percent of students who passed the final exam (18% for the first study and 20% for the second study) compared to the control group who did not receive exposure to this variable. The learning strategy course did not produce a significant effect on academic performance.	2/****
<i>Yip et al, 2002; Relation of Study Strategies to the Academic Performance of Hong Kong University Students</i>	China	Quantitative descriptive design;	Questionnaire (n=100)	High academic achievers and low academic achievers differed in scores for the motivation, scheduling, and selecting main ideas categories. The results found in this study may apply differently to students in Western vs. Asian universities due to the relationship to students' intrinsic disposition like motivation and concentration.	4/****
<i>Yip, 2009; Differences between high and low academic achieving university students in learning and study strategies: a further investigation</i>	China	Quantitative descriptive design;	Questionnaire (n=100)	High academic achievers ranked higher on all categories, including anxiety, attitude, motivation, concentration, self-testing, scheduling, study aids, information processing. There were similar results despite the mode of learning (conventional vs. distance-learning).	4/****
<i>Yip, 2007; Differences in Learning and Study Strategies between High and Low Achieving University Students: A Hong Kong study</i>	China	Quantitative descriptive design;	Questionnaire (n=180)	High academic achievers had different study strategies than low achievers, with females scoring higher than males. A good learning attitude, self-motivation and proficiency in adapting better learning and study strategies were correlated with higher academic achievement.	4/*****