REVIEW ARTICLE

A Scoping Review of Health Sciences Students' Self-Regulated Learning in Online and Blended Study Environments: Strategies, Processes, and Outcomes

Rozelle Francesca K. Bentulan, MAEd,[1] Maria Concepcion C. Cabatan, PhD,[1]
Ralph Kevin M. Genoguin, MSPH and Joseph Reuben G. Manansala, RSLP[1]

[1]*University of the Philippines Manila*

ABSTRACT

Background. Self-regulated learning (SRL) is considered an important factor for success in online and hybrid learning contexts. No comprehensive synthesis of studies on SRL among various health science fields in these learning environments is currently available.

Objectives. This study summarized literature on SRL in online and hybrid health professions education contexts and, additionally, identified specific SRL strategies used, processes utilized to promote SRL, and outcomes associated with SRL.

Methods. The scoping review protocol entailed literature searching, screening and selection, data extraction, frequency and thematic analyses, and data presentation.

Results. Fifty-four (54) peer-reviewed articles published between 2015 and 2025 were included in the review. Studies came from six different regions, with the biggest number coming from Asia (25). Studies were mostly observational (24) and qualitative (11), focusing on blended learning modalities (29). Forty-two (42) articles involved undergraduate students from mostly fields of nursing (24) and medicine (16). Students used a variety of strategies encompassing the forethought, performance, and self-reflection phases of SRL, employing task strategies most frequently. SRL was cultivated using teaching-learning strategies, different learning delivery modalities, technology, and special interventions. SRL was associated with enhanced student performance, engagement, perception of online learning, and other non-cognitive skills for learning.

Conclusion. Literature on SRL among health sciences students in online and blended learning has increased in the past years, especially after the pandemic-driven shift to distance learning. A scarcity of high-level evidence has been found. Deliberate SRL development efforts are beneficial to help facilitate better acceptance of online learning and improve chances for student success.

Keywords: self-regulated learning, health science education, online learning, blended learning

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Corresponding author: Rozelle Francesca K. Bentulan, MAEd
College of Allied Medical Professions
University of the Philippines Manila
Pedro Gil St., Ermita, Manila 1000, Philippines
Email: rkbentulan@up.edu.ph
ORCiD: https://orcid.org/0009-0001-0090-1736

INTRODUCTION

Universities migrated from in-classroom to online learning due to the COVID-19 pandemic.[1-4] By early 2021, when vaccinations were rolled out, schools in some countries (e.g., United States) shifted to blended or hybrid learning modes.[5] Teaching and learning in full online and

hybrid learning modes utilized various information and communication technology tools.[2,6,7] Challenges to online and hybrid learning include factors related to the situation and environment (examples include distractors within the students' immediate environment such as noise, chores, and household members, limited space for studying, and the need to balance work and family roles and responsibilities in addition to academic requirements), factors related to the individual (such as stress, anxiety, and lack of motivation, physical health and mental health problems, and difficulty maintaining attention to learning materials), and factors related to technology (such as poor internet connectivity, lack of devices, and technical difficulties with audio and video).[1,8-10] Ways to meet the increased challenges of online and hybrid learning have become pivotal targets of higher education institutions.[11]

While positive and successful online learning experiences may be attributed to many factors, one of the most critical is self-regulated learning (SRL).[12,13] SRL is engagement in metacognitive, motivational, and behavioral processes using specific strategies to meet learning and performance goals.[14] Student academic success in an online environment is directly proportional to their active participation in and ability to manage and cope with learning.[12,15] For example, self-regulated learners engage in help-seeking processes and utilize strategies such as asking for help for information and advice from peers and faculty.[11] Students who have limited self-regulation may find online learning difficult.[3] Self-regulation particularly becomes vital as students take on more responsibility in the rather autonomous world of distance learning.[16] SRL processes and strategies thus need to be provided in the online environment for students to achieve optimal learning and academic performance.[17]

SRL Processes and Strategies in Online Learning Contexts

SRL involves processes and strategies that support learning efforts in an open learning environment.[18] Hill and Hannafin identified four scaffolds to support and guide one's learning.[19] The four scaffolds include the conceptual scaffold for prioritizing and considering information, the metacognitive scaffold to gauge learning and establish how to think during learning, the procedural scaffold for utilizing resources, and the strategic scaffold to provide alternatives for task completion.

Various disciplines (e.g., computer science, engineering, biology, chemistry) have studied SRL in both classroom and online learning environments using different theoretical perspectives. An initial scope showed a few studies describing SRL in health science programs. Most of these studies discussed SRL in traditional in-classroom settings. Zheng and Zhang reported that self-regulation strategies such as peer-learning and help-seeking improved learning outcomes for medical students in a flipped classroom setting.[20] These studies show that SRL strategies such as proactive information-seeking, rehearsing, elaborating, and summarizing, as well as changing the environmental context in studying, are vital for medical students' long-term memory and recall.[15] Nursing students who practice SRL tend to focus more on mastering professional nursing knowledge than basic classroom knowledge and are more open to communicating with peers, which are deemed important in the practice of safe and collaborative patient care.[21] SRL among medical students in the clinical environment was described to help harness clinical skills and support mental health.[22]

To our knowledge, there has been no comprehensive synthesis and integration of studies of SRL in online and hybrid learning environments covering various health professions fields, specifically beyond nursing and medicine. In light of continuing online and hybrid learning contexts and the recent demand to offer support for students, it is timely, strategic, and valuable to conduct a synthesis of the literature to gain a better and deeper understanding of SRL processes and strategies and how these are used in online and hybrid teaching-learning contexts. A rigorous review and synthesis will offer understanding to help educators tailor and scaffold supports that are pivotal in fostering positive learning experiences and outcomes for health science students in online and hybrid learning contexts. The findings of this scoping review may be used to develop a program of SRL strategies for educators and students. Additionally, the findings of this study will provide better direction to researchers in the fields of health professions education and online learning.

To address the lack of synthesis of literature for varied health professions, we identified, summarized, and described existing literature discussing the use of SRL in online and hybrid learning environments among health science students. This review also aimed to identify and summarize the findings of relevant studies and discuss implications on education, particularly in the context of online and hybrid learning for health science students. Moreover, this review will name aspects of SRL that have not been addressed in previous research and will serve as directions for future studies.

In this review, definitions of relevant concepts are explained in Table 1.

OBJECTIVE

The objective of this scoping review was to identify, map, and synthesize the available literature on SRL among health science students in online and hybrid learning environments. Specifically, the review sought to describe the self-regulated learning strategies employed by health science students, characterize the educational processes, instructional approaches, and learning contexts that facilitate self-regulated learning in online and hybrid settings, and summarize the academic and non-academic outcomes associated with SRL in online and hybrid learning environments.

Table 1. Definitions of Concepts

Concept	Definition
Health professions	Degrees and professions related to the study of human health such as medicine, nursing, physical therapy, occupational therapy, speech pathology, audiology, pharmacy, dentistry, etc.[23] In this study, this term is used interchangeably with 'health sciences.'
Self-regulation strategies	Methods or tactics that a person employs to positively impact learning, including cognitive/learning, metacognitive, motivational, and behavioral/resource management strategies.[16,24] For the purpose of this study, SR strategies will also include self-regulation processes or "self-initiated cognitions and emotions that can affect learning and performance."[14]
Outcomes	*Academic outcomes* are changes or developments in knowledge, skills, or attitudes relevant to school performance and learning. *Non-academic outcomes* include changes or developments that are unrelated to school performance or learning, such as satisfaction levels and other non-cognitive processes and behaviors.
Distance education/ learning	Learning that involves an instructor and a learner whose teaching-learning interactions occur at separate places (not face-to-face). Varied forms of instructional strategies are utilized either synchronously or asynchronously.[25]
Online learning	Learning is occurring and facilitated online or over the internet.[25,26] Other terms used interchangeably with this are 'e-learning' and 'web-based learning.'
Hybrid learning	Learning is facilitated using both online and face-to-face methods. Online teaching-learning interactions may happen synchronously or asynchronously.[26] In this study, this term is used interchangeably with 'blended learning.'

METHODS

Study Design

The frameworks of Arksey and O'Malley, Levac et al., and Peters et al. were utilized for the study.[27-29] Scoping study methodologies are appropriate to use for mapping existing literature for an area of research, identifying the level of evidence, and gaps in knowledge. Although the five-step process of Arksey and O'Malley was adopted, modifications from Levac et al. and Peters et al. were incorporated in some of the steps.[27-29]

Ethics Approval

This study was granted exemption from ethical review by the University of the Philippines Manila Research Ethics Board since the study involved neither human participants nor identifiable human tissue, biological samples, or data.

Search Strategy

A literature search was conducted to identify relevant studies using the electronic databases PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), ProQuest, ScienceDirect, JSTOR, and Directory of Open Access Journals (DOAJ). These databases were chosen because they are known sources of literature from health, health professions, and social sciences. In addition, the researchers have access to these databases. Only articles published from 2015 onward were included to ensure that contextually relevant data featuring contemporary digital learning settings are included in this review.

Table 2. Search Terms and Variants

Key term	Variant
Self-regulated learning	"SRL", "self-regulation", "self-regulation strategies", and "self-regulation processes"
Hybrid learning environment	"online", "blended", "remote", "distance", "virtual", "internet-based", "e-learning"
Health science students	"dentistry students", "physiotherapy students", "occupational therapy students", "speech pathology students", "medical students", "nursing students", "pharmacy students", "allied health students", "health professions students"

The search terms that were used are "self-regulated learning" and were combined with key terms "hybrid learning environments", "health science students" and their variants (Table 2).

Because each database varies according to specificity and search procedures, keywords were modified. Novel variants of the keywords were also added as the literature search progressed and new information came to light. The Medical Subject Headings (MeSH) were also examined for related terms.

The research team held regular meetings before and during the search process. At the beginning, all members of the team discussed the search terms, process, recording, and use of a reference management software (e.g., Zotero). Other meetings focused on monitoring and reporting. Members of the research team were assigned to specific databases to search. The entire team reviewed and discussed search results. Disagreements or issues about the search process were decided by consensual agreement.

The three-step method of searching was utilized.[29] An initial search of two databases (PubMed and CINAHL) was done to analyze keywords and index terms used to describe the article. The second step was to search all identified databases using the identified keywords and index terms. Duplicate articles were removed. The third step was to search for additional articles by manually examining the reference lists of included articles. The PRISMA decision flowchart was used to record the study selection process.[30]

The sources and search results were organized using the reference management software Zotero (Corporation for Digital Scholarship; Roy Rosenzweig Center for History & New Media, George Mason University). The studies that passed title screening were imported into a shared collection in Zotero. The researchers used the sort feature in

the application to arrange the articles in alphabetical order by author, followed by a manual inspection for duplicate studies extracted from different databases using online spreadsheets.

Evidence Screening and Selection

Three rounds of eligibility screening were conducted. The first was title screening, then abstract screening. Members of the research team independently reviewed and rated articles. Each member of the team was assigned a random list of titles and abstracts to screen. Meetings were held regularly to resolve any ambiguity related to study selection.

The third screening reviewed the full text of the articles against the inclusion and exclusion criteria. Studies had to meet all these criteria to be included in this review:

(1) published in a refereed journal from 2015 onward,
(2) written in English,
(3) discussed SRL strategies and outcomes in online and hybrid learning environments,
(4) participants included health science students (e.g., dentistry students, allied health students, medical students, nursing students, pharmacy students, and other health-related courses).

Articles were excluded if they were:

(1) dissertations, conference proceedings, editorials, textbooks, and opinion articles,
(2) written in other languages with no English translation,
(3) published before 2015,
(4) studies focused on instrument development and validation,
(5) studies with participants from secondary level education and below,
(6) studies with participants not in an online or blended learning environment.

The researchers used an article checklist for standardization and inter-rater agreement in study selection. The article checklist (Appendix A) was used for both the title and abstract screening and full-text study selection. To ensure credibility, two members of the research team screened each study, and one member was asked to review if there were any disagreements. Among the issues resolved were discrepancies in the interpretation and classification of related concepts (e.g., self-directed learning), particularly in determining whether they aligned or were synonymous with self-regulated learning (SRL). Disagreements were also resolved in cases where key information necessary for screening was unclear or not explicitly reported in the articles.

For title and abstract screening, all answers on the article checklist were either "yes" or "not sure" for the article to be eligible for full-text screening. Afterward, all conditions stated in the checklist must be satisfied for the study to pass full-text screening.

Table 3. Chart Matrix

Title
Authors
Year of publication
Country where the study was done
Field of study/ program level
Study purpose/ objectives
Study design
Participants
Key findings

Data Charting Process

A chart matrix was utilized for the data extraction process (Table 3). The extracted data consist of authors, year of publication, location of the study, discipline or field of study, program level (undergraduate, graduate), study purpose/objectives, study design, and key findings in terms of SRL strategy/ies, processes, and outcomes.

Five (5) randomly selected articles were first charted by the team. This was done to ensure that the charting process was standardized among all members of the research team. Validation of this process, including issues in charting, was discussed. The entire team was assigned to chart the rest of the articles. The research team exchanged charts to ensure accuracy of data extraction.

The whole initial process of screening, selection, ancestry searching, and data extraction was completed from October 2021 to September 2022. A follow-up search was done in January 2026 to include more recently published articles (until 2025). Data analysis was finally concluded in February 2026.

Data Analysis and Presentation

The results of the search and selection process were summarized using the PRISMA flow chart.[30] The findings of the review were summarized using frequency and thematic analyses. The characteristics of the studies were summarized and discussed through a frequency analysis. This presented the number of studies per year, country, health profession under study, program level of participants, type of study design, and SRL processes and strategies involved.

To answer the research questions, the research team generated themes guided by the thematic analysis process prescribed by Braun and Clarke.[31] Specifically, the investigators went through the following phases: (1) familiarizing with data extracted; (2) generating initial codes and categories; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes; and (6) producing the report. Initial categories were grouped by meaning according to the research questions. These were further reduced to themes relevant to answering the research questions. Themes were divided into 3 main categories: SRL strategies used by students in the online/hybrid environment, processes and contexts used to

promote SRL in the online and hybrid environment, and academic and non-academic outcomes associated with SRL.

Tables and figures were used to present the results. Themes were presented in narrative format. Implications for education, practice, and research were drawn from the results. Gaps in knowledge related to SRL in online and hybrid learning were identified. Recommendations for practical applications of SRL strategies in health professions education were included. A discussion of the strengths and limitations of the scoping review was also presented.

RESULTS

The search results are presented in Figure 1, in the form of a PRISMA diagram.[30] A total of 11,025 records were generated from the initial database search, and an additional 107 articles were identified during the follow-up search to include more recent articles. This totals 11,132 articles reviewed. After removing duplicates (n = 4907) and adding articles retrieved from ancestral search (n = 90), a total of 6315 articles were screened. After full-text screening, 54 articles were included in the final synthesis. The characteristics of all studies included in the review are summarized in Appendix B.

Frequency or Characteristics of Sources of Evidence

This section summarizes the characteristics of the articles included in this review in terms of quantity, design and instruments used, program level, health science course, and mode of learning.

Quantity of Research

The studies included in this review were published between 2015 and 2025, with 37 published from 2020 to 2025 and 17 between 2015 and 2019. Studies were conducted in six different regions, with Asia accounting for the majority of these numbers (*n* = 25), followed by North America (*n* = 11), Europe (*n* = 8), and Australia (n = 6). Conversely, only two studies each were conducted in South America and Africa.

Research Design and Instruments

Research designs varied, with a greater number employing observational (n = 24) and qualitative (n = 11) designs. Few studies utilized an experimental design (n = 8) and mixed design (n = 8), while only three (3) synthesis studies were included in the review. Quantitative, qualitative, and mixed-methods methods were used to study SRL strategies. Quantitative methods used the Motivated Strategies for Learning Questionnaire (MSLQ), a modified version of the MSLQ, the Online Self-regulated Learning Questionnaire, Motivation Regulation Scale, Learning Strategies Scale (EEA), Self-regulation Behaviour Scheme, Self-regulated Learning Skills Scale (SRLSS), Students' Self-Regulated Learning Scale, and the Qualitative methods used interviews, focus group discussions, data from personalized learning plans and an in-class learning activity, and data from discussion forum posts.

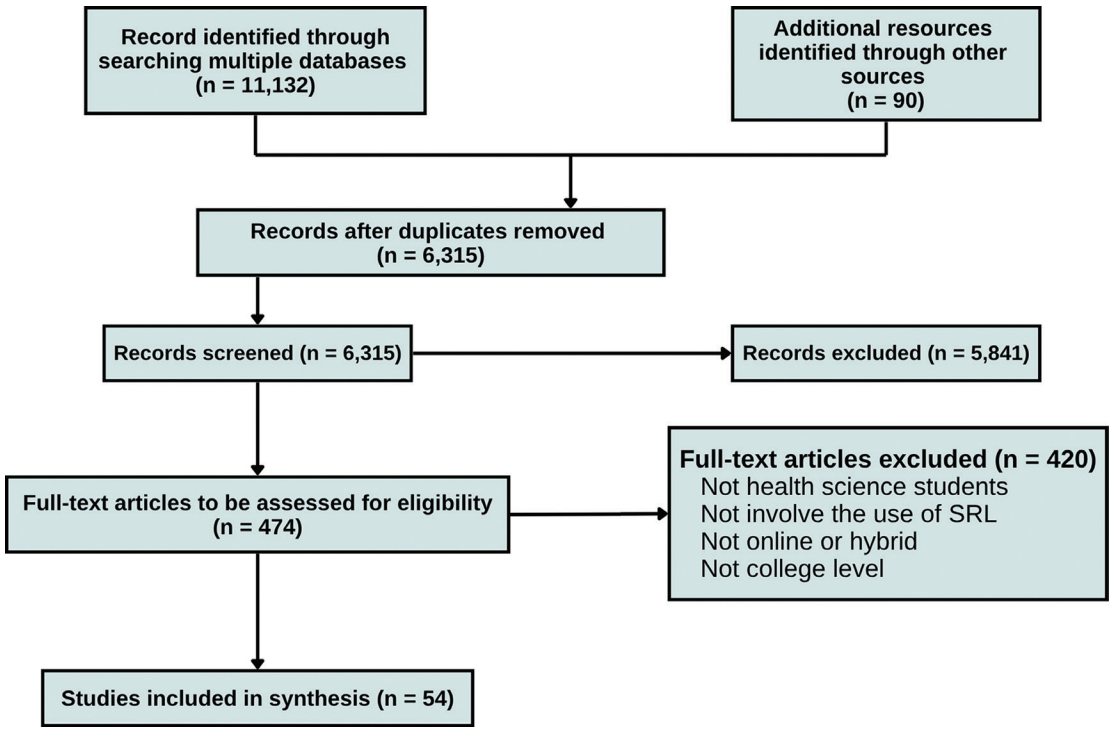

Figure 1. PRISMA Flowchart.

Program Level

Forty-two (42) studies involved undergraduate students, while ten (10) studies involved graduate students. Of the 54 studies, one involved both undergraduate and graduate students, and another did not indicate the program level of participants

Health Science Courses

The majority of the studies included nursing (n = 24) or Doctor of Medicine (n=16) students in their respective research. Mixed courses were found in five (5) studies, while pharmacy was found in four (4) studies, and dentistry was found in two (2) studies. Physical therapy, occupational therapy, and biomedicine students were involved in one (1) study each.

Mode of Learning

The majority of the studies studied SRL in a blended learning environment (n = 29). Twenty-one (21) studies, on the other hand, examined SRL in a fully online learning environment. Only four (4) studies included both online and hybrid modes of learning.

SRL Strategies, Processes, and Outcomes

This section presents the themes generated to answer this study's review questions. An in-depth discussion of (1) SRL strategies used by students, (2) processes and contexts used to promote SRL, and (3) outcomes associated with SRL in the context of health science students in online and hybrid learning environments. Appendix C presents the review's theme matrix, summarizing the studies considered under each generated theme.

Theme 1: SRL Strategies Used by Students in the Online/Hybrid Environment

Twenty (20) studies report SRL strategies used by health sciences students. Specified strategies are detailed below according to Zimmerman's phases of SRL.[14]

Subtheme 1.1: Forethought Phase – Task Analysis and Self-Motivation Beliefs (n = 16). Task analysis was reported in ten studies.[32-41] Categories of task analysis include goal setting and strategic planning. No other information for any specific goal-setting activity was enumerated. Examples of specific strategic planning activities are preparing, orientation, and connecting.

Self-motivation beliefs were reported in seven studies.[20, 32,42-46] Categories of self-motivation beliefs include self-efficacy, task interest/value, goal orientation, and outcome expectation. Examples of specific activities for each category are: Efficacy management for self-efficacy; task value and interest enhancement for task interest/value; and intrinsic goal orientation, extrinsic goal orientation, and goal-oriented self-talk for goal orientation. No specific activity related to outcome expectation was found.

Subtheme 1.2: Performance Phase – Self-Control and Self-Observation (n = 20). Self-control was reported in 20 studies.[20,32-50] Categories of self-control include task strategies, self-instruction, time management, environmental structuring, help-seeking, self-consequences, imagery, persistence, and interest incentives. Examples of specific activities for each category are: Organizing, effort regulation, and distributed practice for task strategies; talking through problems for self-instruction; planning time ahead for time management; use of new technology and minimizing distractions for environmental structuring; asking professors and other students and asking questions over social media for help-seeking; and self-consequating for self-consequences. No specific activity related to imagery and interest incentives was found.

Self-observation was reported in nine studies.[20,32,33,36,38,43,47,48,50] Categories of self-observation include metacognitive monitoring and self-recording. Examples of specific activities for metacognitive monitoring include learning how to learn, knowing what works, monitoring, and metacognition. No specific activity related to self-recording was found.

Subtheme 1.3: Self-Reflection Phase – Self-Judgment and Self-Reaction (n = 12). Self-judgment was reported in 12 studies.[33-41,44,48,50] Categories of self-judgment include self-evaluation and causal attribution. Examples of specific activities for self-evaluation include reflecting, self-assessment, metacognitive processing after learning, and evaluating use of time. No specific activity related to causal attribution was found.

Self-reaction was reported in two studies.[34,41] Categories of self-reflection include adaptive/defensive decisions and self-satisfaction. Examples of specific activities for adaptive/defensive decisions include modification and adjustment. No specific activity related to self-satisfaction was found.

Theme 2: Processes and Contexts Used to Promote SRL in the Online and Hybrid Environment

Forty (40) articles out of the 54 examined SRL processes and contexts. Four sub-themes describe processes and contexts: (1) teaching-learning; (2) learning delivery modalities; (3) technology-based; (4) special courses. Teaching-learning refers to activities incorporated in pedagogical approaches in specific courses. Learning delivery modalities refer to contexts such as flipped classroom, blended learning, online learning (e.g., Massive Open Online Courses [MOOC]). Technology-based activities refer to those that utilize systems involving computers and learning management systems. Special courses are those that were deliberately developed or created to promote SRL.

Subtheme 2.1: Teaching-Learning Strategies (n = 9). Synchronous discussions with the teacher and provision of learning materials promoted SRL in blended learning.[34,43,51] Pharmacy students optimized active learning strategies

during face-to-face engagements because they had already viewed recordings.[43] Virtual patients and other web-based learning resources in a clinical clerkship program were reported to be of value.[51] Giving students freedom or flexibility to determine the use of time and space for learning through virtual patient learning activities enabled students to engage in SRL strategies.[51] Guidance and continuous feedback and assessment from teachers, together with the use of web-based learning materials and one-on-one online meetings, encouraged collaborative work and improved study habits among medical students.[33,34,42,51] Minimum feedback was recommended to allow for self-regulated learning through self-assessment and problem solving.[50] Say et al. argued that over-feedback may only address surface-level learning.[50] Co-constructed simulation promoted SRL through peer and independent learning among occupational therapy students.[52] Similar to the aforementioned studies, MacKenzie et al. maintained that teacher-initiated guidance through the entire process of developing and delivering a case simulation, including a debriefing, promoted SRL.[52] Undergraduate physiology students with higher self-regulation (time management and effort regulation) engaged more in generating and answering questions as part of an online formative assessment. Moreover, Poot et al. suggest dedicating time for students to perform the task, as this is viewed to benefit students with poor self-regulation and time management skills.[53]

Subtheme 2.2: Learning Delivery Modalities (n = 25). Based on the literature, it appears that SRL is salient in courses delivered through virtual classrooms, flipped classrooms, blended learning, and massive open online courses (MOOC). Seven papers studied courses delivered through flipped classrooms and the use of digital tools.[20,38,41,44,54,55] Kim, Kim, and Chae used a flipped classroom composed of pre-learning, readiness assessment, mini-lecture, group activities, and formative assessment on community health nursing students and found that academic self-regulation, co-regulation, and class participation improved even if there was no significant improvement in academic performance.[55] Self-regulated learning and motivation were also observed among nursing students who attended a hybrid practicum course.[56] They concluded that flipped classrooms can transform students' approach to learning. A scoping review by Ballouk et al. confirmed the finding that study habits, motivation, and autonomy improved for medical students in blended learning.[33] McKiernan et al. utilized a flipped classroom for Doctor of Pharmacy students and identified the study behaviors that promote success.[38] Some of the behaviors identified appeared to be SRL (although not labeled as such). These were preparation for class and testing, seeking help, and building on strengths. Metacognition played a vital role in high-performing students who were competent in selecting and modifying their study behaviors.[38] Zheng et al. developed a competency-based curriculum integrating basic science and clinical experience in a flipped classroom for first- and second-year medical students.[41] Overall, students used more SRL strategies in the planning and reflection stages and less frequently in the learning and monitoring stages. Students who viewed themselves as high achievers used more strategies in the monitoring stage. Zheng et al. recommended that students be given explicit instructions to monitor their own learning.[41] A flipped classroom approach was used to teach medical statistics.[57] SRL improved for the "flipped class," and they found that SRL was not significantly different from the traditional class.[57] Zheng and Zhang reported that peer learning and help-seeking positively affected the academic performance of medical students in flipped classrooms.[20] Lim et al. found that peer learning positively influenced the use of SRL among students in online learning.[58] Students in flipped classrooms had apprehensions about expectations, independent work, schedules, and time allocation. Learner readiness is an important consideration in using flipped classrooms and digital tools.[54]

Kassab et al. found that resource management regulation strategies, time and study environment, and effort regulation directly influenced examination scores of medical students in a blended learning experience.[59] Nursing students in blended learning had highly developed motivation regulation that indicated strong study engagement and high academic performance.[60] Holik and Davidson suggest more assistance (faculty and peer face time) for students in the early college years, specifically in accessing and managing resources and expanding their self-regulation skills.[35] Furthermore, motivation regulation changes according to specific learning contexts.[60] Mäenpää et al. identified specific motivation strategies that are helpful: environmental structuring, self-consequating, goal-oriented self-talk, efficacy management, emotion regulation, regulation of value, and interest enhancement.[46] Individual and situational factors were found to enhance and to sustain the use of appropriate SR strategies.[46]

Students transitioning from traditional face-to-face to fully online and blended learning had to learn self-regulation, specifically, managing their learning (including time and space) by prioritizing learning (selecting critical topics and activities).[33,42,61] In their transition, students also learned the process of shifting, adapting, and adjusting according to daily life demands (study, work, and personal life).[61] Self-discipline, time management, and commitment to learning were vital elements in successful transition to online learning. Dental students taking a MOOC in Implant Dentistry with self-regulation followed the prescribed pathway in navigating the MOOC.[62] Also, the self-regulated learners accessed and revisited the MOOC content and assessment more frequently.

Pharmacy students in a fully online environment during the COVID-19 pandemic needed support, use of time management, and goal orientation.[44] Roslan and Halim identified characteristics of learners, educators,

and institutions that enable success in online learning environments.[40] For learners, a conducive learning space at home, access to devices, connectivity, and self-regulation were noted to be essential to online learning. Educators' visible presence, adoption of active learning approaches, authentic learning, and user-friendly platforms that allow students to seek help, and asynchronous teaching were characterized as enablers to online learning. Access to relevant internet resources and additional support for disadvantaged students were identified as institutional enablers.

In contrast, Kim, Kim, and Lee reported that there was no statistical significance in self-regulation for senior nursing students when they shifted to a fully online context.[63] They recommend assessment of readiness for online learning along with careful planning and design of courses to be delivered in online learning environments.[63] Kamali and Bagheri-Nesami associated e-learning acceptance with online self-regulated learning.[37]

Subtheme 2.3: Technology-Driven (n = 9). It is widely claimed that the utilization of technology requires SRL for success in academic performance.

Functions of learning management systems (LMS), such as access to course materials and portals for submission of assignments were described as tools to promote SRL.[34,43,59] Edelbring and Wahlström used a web-based platform for medical students to work on virtual patient cases on their own time.[51] Although it promoted learning of diagnosis and biomedical knowledge, the authors recommend that teacher-directed guidance is necessary to optimize learning. Nursing students engaged in information and communications technology (ICT) through an LMS in a virtual education context were found to have a strong correlation between the use of ICT and SRL skills.[64] Medical students' SRL behaviors and medical reasoning co-occurred, especially in difficult patient cases using BioWorld, an intelligent tutoring system.[36] An online self-regulated enquiry-based learning (EBL) led to a positive online learning experience for nursing students.[48]

Social media platforms such as Facebook, within a flipped classroom context used to teach ocular trauma, enhanced cognitive engagement of undergraduate medical students.[65] Nursing students used e-portfolios for self-reflection and goal setting.[66] A group of nursing students studying mental health and psychiatric disorders that used Web Quest (a tool used to develop creativity, reflection and higher-order thinking skills) was found to have higher levels of SRL, compared to a group that used team-based learning.[67]

Subtheme 2.4: Special Courses and Interventions (n = 9). Special courses planned and deliberately developed to promote SRL were also reported. Examples of these are the E-learning Patient Safety (ELPAS) course, e-learning modules, Free Course Student Doctor (FCSD) and introduction of SRL to nursing students using task-based text work through a learning platform.[68-72] ELPAS medical students had intermediate to high levels of SRL.[68] Perceived relevance and usability of the system are significant markers for e-learning acceptance.[68] Asadzandi et al. and Briscoe and Brown developed self-regulated e-learning modules for nursing students.[66,69] The modules focused on the various phases of SRL (e.g., self-assessment of prior learning, personal and environmental factors, amount of quality study time needed for success in school, SRL strategies). Matsuyama et al. developed a seven-month elective course where students design their learning supported by mentors.[71] Medical students who participated in this learner-centered course promoted SRL in terms of self-image, self-reflection, and seeking more learning strategies.[71] To promote SRL for students in a master's degree program in nursing education, Wesselborg provided learning resources on the fundamentals of SRL. In addition, students were asked to perform tasks that were labeled as "self-directed elaboration and consolidation" (p.2). Students' feedback showed that conscious use of SRL helped in planning their learning process.[72] A dermatology morphologic module was developed to examine accuracy and learning efficiency between two groups (self-regulated and algorithm-regulated) of first-year medical students.[73] After a pre-test, practice module, and post-test, the self-regulated group spent less time in the module that reflected better learning efficiency.[73] Only a fair increase in taking action for motivation and knowledge, planning and setting goals, using strategy and evaluation, and learning addiction were reported for nursing students who underwent an online communications course.[70]

Theme 3: Academic and Non-Academic Outcomes Associated with SRL

Twenty-eight (28) articles featured outcomes associated with SRL. Specifically, this theme includes various factors that have been found related to SRL or its components, strategies, and/or processes. Four subthemes emerged from the analysis, namely, (1) academic performance and skills, (2) engagement in learning, (3) perception of learning experience, and (4) non-cognitive skills for learning.

Subtheme 3.1: Academic Performance and Skills (n = 19). A number of studies reported a relationship between SRL and the performance of health science students in online or blended learning contexts. SRL and specific strategies such as peer learning and help-seeking contribute to student achievement and promote academic competency.[12,20,39] Conversely, a lack of SRL may lead to difficulties in comprehension and poor learning outcomes in class.[41] Academic performance, measured using grades or grade point averages, has been positively associated with SRL capabilities in general, and the use of specific SRL strategies such as goal setting, self-evaluation, elaboration, organization, metacognition, time management, effort regulation, extrinsic goal orientation, control of learning belief, and rehearsal.[33,40,43,47,74,75] A combination of qualitative and quantitative studies likewise

found that higher-performing students report or display better SRL practices such as selecting and modifying their own study behaviors, metacognition, and motivation regulation.[38,60,76] Furthermore, Huang et al. found that higher performers employ deeper SRL strategies in more complex tasks and higher-order reasoning processes.[36] A few studies, however, had findings that do not support these ideas. Abouzeid et al. found no correlation between SRL and academic achievement, while Zheng & Zhang found that the SRL strategy of rehearsal had a negative impact on learning outcomes.[20,77]

The study of Asadzandi and colleagues reported that SRL enhances general academically important abilities like metacognitive skills.[66] Specific and more specialized skill development benefits were also reported in other studies. Mackenzie et al. found that SRL helped enhance skill development, clinical reasoning, and insight for therapeutic interactions.[52] Additionally, Cho and Jang found SRL to be positively associated with moral sensitivity, which is important in ethical decision-making among nurses.[56] SRL-based learning also promotes efficiency (less time needed) in learning specialized skills in dermatologic morphology training, according to Traboulsi et al.[73]

Subtheme 3.2: Engagement in Learning (n = 8). A few studies also touched on the relationship between SRL and student engagement in learning. Specifically, several studies have linked SRL with enhanced learning engagement.[45,78,79] Examining profiles of nursing students, Mäenpää and colleagues found that those with higher motivation regulation were more engaged in their studies as well.[45] Specifically, they experienced better vigor, dedication, and absorption in relation to their academics. Bradley et al. and Whittaker likewise found that students with higher SRL tend to be more engaged in online learning activities as they spend more time on their learning materials and complete more or a heavier load of coursework.[12,75] SRL has also been linked with improved study habits, specifically in looking for and selecting resources for learning.[33] Furthermore, SRL has been shown to be positively correlated with learning flow. Among the factors examined (including motivation, self-efficacy, and lecture type), SRL ability had the strongest influence on the degree of learning flow of nursing students.[80] However, a study by Abouzeid et al. reported no correlation between SRL and participation in online discussions, a specific component of student engagement in online learning.[77]

Subtheme 3.3: Perception of Online Learning Experience (n = 4). Several authors have established the relationship between SRL and a student's perception of learning experiences, particularly in online learning contexts. SRL levels were shown to be significantly correlated with the perceived quality of the online learning experience and the online courses themselves.[68,77] The higher the students' SRL levels are, the more positive their e-learning experience is.[68,77] Additionally, SRL has been linked with an enhanced perception of the benefits of online activities among learners. Students with higher degrees of SRL showed more appreciation for the value of virtual and web-based activities.[51] These studies support the idea that SRL is an important variable that positively impacts online learning acceptance and experience.[37,51,68]

Subtheme 3.4: Non-cognitive skills for learning (n = 5). SRL has been associated with a few non-cognitive skills important for the learning of health science students. The skill of reflection is among one of them. Gaupp et al. found that SRL is significantly correlated with reflective thinking among medical students.[68] Additionally, Morsy et al. reported that SRL is positively associated with online self-efficacy.[81] SRL has also been linked with reduced experience of cynicism as a risk factor for burnout and atychiphobia or fear of failure.[45,81] Two non-cognitive factors were, on the other hand, determined to affect self-regulation positively. Arianfar and Seyf found that both academic self-efficacy and future orientation directly affect academic self-regulation in a group of post-graduate medical students.[82]

DISCUSSION

This study aimed to summarize available literature on SRL in online and hybrid health professions education contexts. Current literature on SRL among health science students in online and blended learning contexts has increased in the past years, especially from the years 2020-2025. In the process, the researchers also looked into specific SRL strategies used, processes and contexts utilized to promote SRL, and the various academic and non-academic outcomes associated with SRL. Based on the reviewed studies, health science students used a variety of strategies encompassing the forethought, performance, and self-reflection phases of SRL, employing task strategies most frequently. SRL was cultivated and developed using teaching-learning strategies, different learning delivery modalities, technology, and special SRL interventions or courses. SRL was found to be associated with enhanced academic performance, student engagement, perception of online learning, and other non-cognitive skills for learning.

Current State of Research

There has been a noticeable increase in literature related to SRL of health science students in the online context in recent years. The sudden shift to online learning from 2020 onwards due to the COVID-19 pandemic may have encouraged researchers to explore the learning strategies used by students in this setup.[1,4] This scoping review synthesized the studies on SRL and online learning published from 2015 -2025.

This review discovered that Asia contributed the most research to the field. This may be attributed to increased

participation of Asian countries in exploring distance education. Fellowship programs (e.g., AAOU Inter-University Staff Exchange Fellowship Programme), course development initiatives by 5 open universities (OU5), research collaboration, and academic conferences (e.g., Asian Association of Open Universities Annual Conference) may suggest a more active community in the field of online learning in Asia.[83] Korea, which contributed the most research to this field in Asia, also attributed the increase in popularity of e-learning to the rapid development of the country's information and communication technology industry alongside the high literacy rate in the country.[84]

This review found that research on SRL in the online learning environment focused more on undergraduate students as compared to postgraduate students. A few factors may explain the greater need for and focus on undergraduate research in this area. According to a study by Fadl et al. Sudanese undergraduate students have a different perspective and motivation when it comes to online learning.[85] Their only exposure to similar environments may be from Facebook and the like. They also present with a less positive perception as compared to postgraduate students, thus requiring students to be more self-regulated in the classroom. Furthermore, a lot more undergraduate courses shifted to online learning during the pandemic.

The majority of the studies collected in this review implemented an observational research design. This may be correlated with a significant number of studies that were published during the COVID-19 pandemic. Observational studies are ideal in a pandemic given their speed of implementation and lower cost. Aside from this, observational studies may have also been conducted because a more in-depth research design (i.e., requiring more skills and resources) might be more difficult to implement during these times. Given these, researchers must be aware of the possible limitations and considerations for observational designs.[86,87]

Interestingly, the majority of the studies gathered by this review implemented a hybrid or blended learning environment. This may be due to the advantage of this learning mode in integrating the benefits of both the online and face-to-face learning environment.[88] Especially with the nature of health science courses (e.g., physical skills, live procedures, and direct patient contact), students prefer a more flexible learning environment. Both Atwa et al. and Torda & Shulruf reported that intended learning outcomes by medical courses may not be achieved in a fully online learning environment.[89,90] Students and faculty agree that there are skills (e.g., communication skills for face-to-face interaction), procedures (e.g., suturing techniques), and examinations (e.g., direct feedback) that must be administered and demonstrated in person. The experiences and challenges (i.e., examinations and technical issues) of online learning may have led to the preference of students for face-to-face or a blended learning mode.[89]

SRL Strategies Used by Health Science Students in Online and Blended Learning

This study determined what SRL strategies health sciences students used in online and blended environments. The students used various strategies that encompass all phases of SRL, the majority of which were considered task strategies in the performance phase. However, the results of some studies were aggregated for various disciplines; thus, it could not be inferred exactly which strategies or how frequently such strategies were used by health science students alone.[32,47] Nevertheless, the strategies found in this study are more diverse compared to the strategies found by Broadbent and Poon among college and university students in similar learning environments.[91]

While existing questionnaires enumerated in this study measure SRL strategies in all phases, not all categories or strategies are included (e.g., no item related to outcome expectation, interest incentives, or causal attribution, etc.). It may be the case that learners are using these strategies but are simply not captured by survey tools chosen by the authors. In fact, there are other questionnaires that, when used, could have added even more information regarding SRL among health science students. For instance, the Scale of Self-Regulation in Learning includes keeping records and self-monitoring (self-recording) as well as attributions for failure (causal attribution).[92] This questionnaire has actually been used in higher education but not much among health sciences students. In addition, the Self-Regulated Learning at Work Questionnaire includes items on self-satisfaction or affect, and while this instrument has been adapted for medicine and for nursing, these questionnaires are not as widely used as the more popular ones (e.g., MSLQ, OSLQ, etc.).[93-95]

Further research on this area can include the utilization of instruments that capture a broad range of SRL strategies. One recently developed instrument, the Self-Regulation for Learning Online, claims to do so.[96] In addition, a comparative analysis of all available SRL questionnaires may support the initiative to develop an even newer tool. Future studies should also explore SRL strategies among students in under-examined health sciences disciplines, such as occupational therapy and speech-language pathology, to better understand how SRL manifests within their specific learning environments.

Processes and Contexts to Promote SRL

Findings from the included studies provide evidence that SRL processes are deliberately integrated into various pedagogic approaches and processes (T-L, learning delivery modes, technology, and special SRL courses) in health science programs. Findings reveal that successful pedagogical principles and tools (active learning, peer learning, virtual patients, synchronous classes) delivered in multiple modes (blended, flipped, online) promote or encourage the use of SRL.[43,51,58] Although multiple variations of online learning

promote flexibility for students, studies show that teacher visibility (guidance/presence/feedback) produces added benefits to support SRL.[34,38,51,54,55,59,60] These findings are consistent with the systematic review of Wong et al., wherein SRL support approaches (e.g., prompts, feedback) influenced learning performance and use of SRL strategies.[17] Teacher visibility, prompts, feedback, and virtual tools may also be viewed as scaffolds to guide learning and task completion in online and blended learning environments.[19]

The online learning context and its variants (e.g., flipped classroom) have powered the use of technology, in particular, learning management systems and social media platforms.[34,43,59,65] This is consistent with the study of Onodipe et al., wherein they described how an LMS boosted SRL among students in a flipped classroom.[97] These studies described how SRL helped optimize these technologies to support learning. However, Wong et al. cited a study that found that these supports were only effective when actively used.[17,21]

Success in online learning is predicated on learners' characteristics.[40,46] McKiernan et al. also reported that transformation of learners may be attributed to learner characteristics.[38] This finding may be parallel to the human factors that Wong et al. articulated.[17] Wong et al. discussed how learner factors (cognitive ability, self-efficacy, achievement levels, gender) leverage differently in terms of approaches to support SRL and SRL strategies.[17] This study suggests that students with the "right" human factors will be more likely to utilize SRL, hence perform better academically, also reported by Kassab et al.[59] Learner readiness for online learning may also be regarded as a human factor.[54,63] Other related human factors such as self-discipline, time management, and commitment to learning were pinpointed by Lan et al. as elements that have a role in the successful transition to online learning.[62]

Numerous studies highlighted the development of targeted interventions for students' SRL.[35,37,48,49,56,68-73,79,81] For example, Matsuyama et al., Traboulsi, and Wesselborg evaluated the courses in terms of SRL.[71-73] Other studies explored SRL using qualitative approaches.[36,42,50] A meta-analysis to examine the effectiveness of SRL training programs found that these improved academic performance, cognitive and resource management strategies, motivation, and self-efficacy.[98] Similar to other studies, training effects were mediated by the design of the training program and learner characteristics.[98]

Academic and Non-Academic Outcomes Associated with SRL

The importance of SRL in online learning contexts has been repeatedly emphasized.[12,13,91] This study revealed specific academic and nonacademic factors that existing research has associated with SRL, potentially further clarifying elements in online student success that SRL impacts. While conflicting findings exist, the majority of related studies showed the link between SRL and positive student outcomes among health science students in online and hybrid learning environments. This includes better academic performance, improved student achievement and competence, enhanced skill development, and heightened student engagement. These positive outcomes were related to SRL as a whole and to a long list of specific SRL strategies, including metacognition, time management, effort and motivation regulation, control of learning beliefs and strategies, goal setting, self-evaluation, peer learning, and help-seeking, among others. A number of these strategies, specifically metacognition, time management, effort regulation, and peer learning, have likewise been identified in Broadbent and Poon's systematic review as among the most significant correlates of academic achievement among students in online higher education settings.[91]

Resonating with Broadbent and Poon's findings, the current study suggests that SRL has numerous benefits related to academic achievement in the context of online or hybrid learning, particularly in the health sciences fields.[91] In fact, several non-cognitive skills vital to a health professional were also linked with SRL. These traits, namely reflective thinking, reduced cynicism and atychiphobia, self-efficacy, and future-orientation, will contribute to their competence as students and future professionals. Reflective practice, for instance, has been repeatedly named as a critical trait for successful learning and practice in the health professions field. Students use reflection in performing academic and clinical tasks, and the practice of reflection has been linked to deeper learning approaches and meaning-making. Among professionals, reflection improves clinical practice as it is an essential component in understanding complex cases and learning from experiences.[99] Self-efficacy is likewise considered quite important as it "underpins all aspects of health professional education and practice," with several studies reporting its benefits on student performance and professional practice behaviors.[100]

Looking at all the factors discussed above, it seems SRL training may be valuable in improving health science student outcomes in online learning contexts. Another notable finding is that SRL seems to have an impact on how students perceive their online learning experience. Students with higher SRL appreciate their e-learning experience more and view online learning in a more positive light. These findings may then suggest that SRL training could not only lead to better student success and engagement but also to easier acceptance and better appreciation of the online learning platform.

Gaps and Limitations

This study reveals a scarcity of experimental studies that could help establish strong cause-and-effect relationships in the context of SRL and online learning. Studies exploring the long-term impacts of SRL on learners and health professionals are also lacking. The researchers also noted

that qualitative studies providing a deeper understanding of the construct and its mechanism are quite insufficient at the moment. For example, there is a need to understand why some students are highly self-regulated, and others are not.

Studies investigating SRL in online and blended learning utilize a variety of theories and instruments in measuring the construct. This made the alignment of results and interpretation of findings across studies challenging. There were questionnaires and frameworks, however, that were more frequently used, while other available instruments appear to be underutilized.

This study specifically used the lens of Zimmerman in interpreting some of its findings. While other frameworks were encountered and considered during article review and screening, the theory of Zimmerman was deemed most appropriate to guide the organization of concepts to answer the research questions. Findings of studies using other frameworks were somewhat reframed and analyzed in consideration of Zimmerman's model.

This scoping review only considered articles published in six databases. Relevant articles available in other databases may have been excluded in this review. Findings from gray literature and from studies published in languages other than English were also not included. Finally, articles in this review did not go through critical appraisal prior to analysis.

The researchers also did not attempt to determine if there were differences in SRL between and among health disciplines and if there are differences in SRL across cultures.

CONCLUSION

In recent years, particularly following the pandemic-induced shift to distance education, there has been a growing body of literature on SRL among health science students in online and blended learning environments. However, high-level evidence remains limited. This scoping review provides literature evidence that SRL is an important construct to understand, especially because online and hybrid environments have become mainstream in health professions education. This research indicates the merit of deliberate and tailored SRL training and development prior to or in conjunction with online learning. This could potentially help in facilitating better acceptance of the online learning context and improve chances for success in health science learning and practice.

Because most health sciences have a clinical component, it may also be worthwhile to explore the nature and type of SRL required of students in pre-clinical and clinical years. Another research direction is to examine SRL processes across different healthcare educational settings from a cultural lens. From a methodological perspective, experimental studies need to be done to establish causal relationships. Mixed methods research may also be of value to provide deeper and balanced insights into health science students' and educators' experiences of SRL.

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APPENDICES

Appendix A. Article Checklist

Title and Author of the Study:				
	Yes	No	Not sure	Remarks
Was the study published in a peer-reviewed journal?				
Was the study written in English? a. If not, is an English version available?				
Was the publication year 2015 or later?				
Did the study discuss SRL strategies or self-regulation? a. Were the strategies employed by the students? b. Were the strategies incorporated in the course or curriculum?				
Was the study targeted towards learning in fully online or hybrid environments?				(If yes, indicate here if online or hybrid)
Were the study participants health science students?				

Appendix B. Summary of Study Characteristics

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Abouzeid, E.; O'Rourke, R.; El-Wazir, Y.; Hassan, N.; Ra'oof, R. A.; Roberts, T.[77] 2021 Egypt	Interactions between learner's beliefs, behaviour and environment in online learning: Path analysis	**Participants** • 128 students in the Health Professions Education program **Program level** • Postgraduate	**Study purpose/objectives** • Explore the interaction between self-regulated learning, the conception of learning, online discussion, and the e- learning experience in an online environment, and how this interaction may affect academic achievement **Study design** • Observational: cross-sectional	**Course or curriculum** • Medicine **Learning setup** • Fully online	**Strategy or process** • Environment structuring • Goal setting • Time management • Help seeking • Task strategies • Self-evaluation **Assessed using Online Self-Regulated Learning Questionnaire (OSLQ)* **Outcomes** • Academic ○ Statistically significant relation with: ○ Quality of e-Learning experience ○ Conception of learning ○ No correlation with: ○ Online discussion ○ Academic achievement
Alatawi, K. ; Brand, G. ; Hampton, K. ; Fooladi, E. ; Kaushik, S.[42] 2025 (Australia)	Master of Nursing Students' (MNS) Experiences With Online Learning During COVID-19 Pandemic: A Qualitative Study in an Australian University	**Participants** • 12 domestic or international master's degree nursing students **Program level** • Postgraduate	**Study purpose/objectives** • Describe the collective experiences of MNS on online learning during the COVID-19 pandemic. **Study design** • Descriptive, qualitative design guided by phenomenology	**Course or curriculum** • Nursing **Learning setup** • Online	**Strategy or process** • Adapting to online learning (one out of 5 themes) • In online learning, participants become more self-regulated in their learning, such as enhanced self -motivation, time management, and organizational skills • Students adapted to online learning by becoming more self-regulated, improved digital literacy skills, and appreciation of the flexibility and accessibility offered through online learning.
Anthonysamy, L.; Hew, S.; and Koo, A.C.[32] 2020 Malaysia	Self-regulated learning strategies and non-academic outcomes in higher education blended learning environments: A one decade review	**Participants** • Undergraduate students in digital learning within a blended learning environment; **Program level** • Undergraduate	**Study purpose/objectives** • The aim of this review is twofold: Firstly, to identify what are the self-regulated learning strategies used in digital learning within a blended learning context in higher education and to delve deeper into the literature to explore any research gap(s). Secondly, to understand how self-regulated learning strategies (SRLS) can be utilized effectively in digital learning in order to achieve non-academic outcomes in higher education institutions. **Study design** • Synthesis: Systematic review following PRISMA guidelines	**Course or curriculum** • Nursing **Learning setup** • Blended learning	**Strategy or process** • Rehearsal • Elaboration • Organization • Critical Thinking • Planning and Monitoring • Regulating • Time and study environment • Effort regulation • Peer learning • Help Seeking • Self-efficacy • Task value • Goal orientation
Arianfar, A.; Seyf, M. H.[82] 2020 Iran	A Causal Relationship Model of Self-regulated learning and future orientation: The Mediating Role of academic Self-Efficacy and task Value among Masters of Medical education (virtual) in Shahid Beheshti University of Medical Sciences	**Participants** • 205 master's students in medical education (virtual) of Shahid Beheshti University of Medical Sciences (academic year 2018-2019) **Program level** • Postgraduate	**Study purpose/objectives** • Explain the learning self-regulation of medical students in Shahid Beheshti University of Medical Sciences in Tehran ○ Investigate and clarify the relationships between motivational variables and cognitive variables ○ Investigate the mediating and predictive role of variables ○ Determine the extent of direct and indirect effects of these variables on each other using path analysis **Study design** • Observational: Descriptive, correlational study	**Course or curriculum** • Medicine **Learning setup** • Fully online	**Strategy or process** • Task value • Self-regulation • Self-efficacy, education • Future (career) orientation **Assessed using 4 questionnaires (Bouffard Self-Regulatory Questionnaire, Pintrich Assignment Value Questionnaire, Standard Academic Self-Efficacy Questionnaire, Future Life Path Questionnaire)* **Outcomes** • Significance of the direct effect coefficients according to the conceptual model (academic): ○ significant for direct effect of future orientation on academic self-efficacy, homework value, and academic self-regulation ○ significant for direct effect of academic self-efficacy on academic self-regulation and homework value ○ significant for the direct effect of homework value on academic self-regulation • Significance of the indirect effect coefficients according to the conceptual model (academic): ○ significant for indirect effect of future orientation on academic self-regulation ○ significant for indirect effect of academic self-efficacy-education on self-regulation-education

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Asadzandi, S.; Mojtahedzadeh, R.; Mohammadi, A.[66] 2022 (Iran)	What are the Factors that Enhance Metacognitive Skills in Nursing Students? A Systematic Review	**Participants** • Studies that involved Nursing students **Program level** • Not stated	**Study purpose/objectives** • Determine the factors that enhance metacognitive skills of nursing students **Study design** • Systematic review	**Course or curriculum** • Nursing **Learning setup** • Mix (classroom, blended learning, and e-learning)	**Strategy or process** • Self-regulated e-learning modules • E-portfolio **Outcomes** • Enhanced metacognitive skills
Bagheri-Nesami, M.; Ahmady, S.; Kohan, N.[64] 2021 Iran	Relationship between information and communications technology engagement with online self-regulated learning in nursing students of Mazandaran University of Medical Sciences	**Participants** • 272 undergraduate nursing students in Mazandaran University of Medical Sciences in three nursing schools of Sari, Amol, and Behshahr. **Program level** • Undergraduate	**Study purpose/objectives** • "To determine the relationship between online self-regulation, ICT engagement, age, gender, previous semester grade average, and total grade average of nursing students in the electronic environment" **Study design** • Observational: Correlational	**Course or curriculum** • Nursing **Learning setup** • Fully online	**Strategy or process** • Positive self-concept in ICT • Self-confidence in ICT • Online exposure • Social exposure • Computers, tablets, and mobile phones interest • Spending time in ICT • Negative ICT self-concept • Environmental structuring • Goal setting • Task strategies • Time management • Help seeking • Self-evaluation **Assessed using OSLQ, ICT engagement questionnaire* **Outcomes** • Statistically significant (academic): ○ relationship between ICT engagement and online self-regulated ○ relationship of online self-regulation with previous semester grade average and total grade average ○ age had a significant inverse correlation with the previous semester grade average and total grade average ○ relationship between ICT engagement and the gender of nursing students ○ relationship between ICT engagement and nursing students' semester with ANOVA test • Not statistically significant (academic): ○ relationship between online self-regulation and the gender of nursing students ○ relationship between online self-regulation and nursing students' semester with ANOVA test
Balakrishnan, A.; Nair, S.; Kunhikatta, V.; Rashid, M.; Unnikrishnan, M. K.; Jagannatha, P. S.; Chandran, V. P.; Khera, K.; Thunga, G.[43] 2021 India	Effectiveness of blended learning in pharmacy education: An experimental study using clinical research modules	**Participants** • 241 Doctor of Pharmacy students (final year) **Program level** • Postgraduate	**Study purpose/objectives** • "to evaluate the effectiveness of blended learning (BL) on knowledge score of final year Pharm D (Doctor of Pharmacy) students employing a 9 hour learning module" • "to compare the use of motivation and learning strategies between BL, web-based e-learning (WEL) and didactic teaching (DT)" **Study design** • Experimental; prospective cluster randomized trial	**Course or curriculum** • Pharmacy **Learning setup** • Blended learning	**Strategy or process** • Compared motivation and learning in Didactic teaching (DT), Web-based e- learning (WEL), and Blended Learning (BL) • WEL ○ Students listened e-learning module through website Clinilearn ○ After each video, a summary of the chapter is provided ○ Case study discussion ○ Additional case studies ○ Simulated forms for practice ○ Important links and files ○ Assignments ○ Discussion forum to clarify doubts • BL ○ Listening to e- learning modules (except additional case studies & simulated forms) ○ Face-to-face instruction by experts to reinforce the concept through case studies ○ Practical session using various forms used in clinical trial activities ○ Active discussion **Outcomes** • **Usage of SRL strategies** ○ BL group ■ use of SRL strategies was higher in the BL group than in DT and WEL, except for intrinsic goal orientation, task value, control of learning belief, and help seeking ■ BL showed statistically significant highest score in all scales of cognitive strategies (rehearsal, elaboration, organization, and critical thinking) than DT and WEL ■ significant weak positive correlation with extrinsic goal orientation, control of learning belief, and rehearsal ○ WEL group ■ WEL students scored less in all scales of motivational and learning strategies compared to BL ■ peer learning and help seeking score was less in the WEL group ○ DT group ■ DT students employed all motivational and learning strategies more often than WEL students except in extrinsic goal orientation, self-efficacy, and test anxiety ■ Help seeking was highest in DT ○ Others: ■ no statistically significant difference "between groups": in test anxiety, time management, and effort regulation between DT and BL in usage of intrinsic goal orientation, task value, and control of learning belief for peer learning ■ for students of DT and WEL: no significant correlation between final score and MSLQ strategies

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Ballouk, R.; Mansour, V.; Dalziel, B.; McDonald, J.; Hegazi, I.[33] 2022 (Australia)	Medical students' self-regulation of learning in a blended learning environment: a systematic scoping review	**Participants** • Studies that involved medical students **Program level** • Post-graduate	**Study purpose/objectives** • Explore medical students' learning behaviors, adaptations, and implementation of learning strategies in a blended learning environment using self-regulated learning theory **Study design** • Scoping Review	**Course or curriculum** • Medicine **Learning setup** • Blended Learning	**Strategy or process** • Scaffolding of instructional guidance • Self-regulated learning • Cognitive apprenticeship (learning a skill with educator's help) **Outcomes** • Support for self-regulated learning • Academic performance • Improvement of study habits through resource selection
Bingen, H. M., Steindal, S. A., Krumsvik, R., Tveit, B.[54] 2019 Norway	Nursing students studying physiology within a flipped classroom, self-regulation and off-campus activities	**Participants** • 23 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • "to gain knowledge of how nursing students describe learning and studying physiology off-campus" • "to propose a teaching design, which supports the students' studies between the on-campus meetings" • "To explore nursing students' use of self-regulated learning strategies, the following research question was formulated" **Study design** • Qualitative: Design - based	**Course or curriculum** • Nursing **Learning setup** • Flipped classroom	**Strategy or process** • Flipped classroom ○ students can view lectures online while at home and do exercises on campus when their teacher is available **Outcomes** • **Main points of the study** ○ Traditional students - a new teaching approach ■ Attempts to self-regulate often required extra time and effort, which they did not always feel were available ○ Attempts to self-regulate ■ Some sought social assistance off-campus by participating in their study group. ■ Some used multiple repetition as a means to remember things and develop an overview ■ Most students took notes and used them for reviewing, but some felt it was difficult to rely on them to capture the essence of the subject ■ Self-oriented feedback loop - Some students adapted to the flipped classroom in order to enhance their learning--they changed strategies when they realized that they could not use the same strategies they had used to study science in high school
Bradley, R.L.; Browne, B.L.; Kelley, H.M.[12] 2017 United States	Examining the influence of self-efficacy and self-regulation in online learning	**Participants** • 266 participants from a small university in South Georgia; 213 females and 52 males with an age range of 18 - 43 years; 115 psychology, 88 education, 39 SP, 3 nursing, 2 biology, 3 business, 2 exercise science, 4 criminal justice, 1 English, 8 did not specify major (classified as others) **Program level** • Undergraduate	**Study purpose/objectives** • "Examine self-efficacy and SR skills and their influence on achievement in an online learning environment" **Study design** • Observational	**Course or curriculum** • Mixed: psychology, education, speech pathology, nursing, biology, business, exercise science, criminal justice, English, others (not specified) **Learning setup** • Fully online	**Strategy or process** • Self-regulation as measured by the Motivated Strategies for Learning Questionnaire (MSLQ) **Outcomes** • By improving their self-efficacy beliefs, students will begin to use more of the self-regulatory strategies that are vital to success in an online course, thereby improving their overall performance.
Briscoe, G.; Brown, L.[69] 2019 United States	Self-Regulated E-Learning Modules for Prenursing Success	**Participants** • 3 cohorts consisting of 163 pre-nursing students **Program level** • Undergraduate	**Study purpose/objectives** • "To describe the framework of self-regulated learning, the learning modules, student feedback, and implications for nurse educators" **Study design** • Observational: Descriptive	**Course or curriculum** • Pre-nursing students **Learning setup** • Fully online	**Strategy or process** • Presentation of 5 self-regulated learning e-learning modules that allowed the students to reflect on prior learning, academic factors, personal and environmental factors, cognition, and metacognition, self-assessment, organization and time management, reading and note-taking, successful study skills, test-taking strategies

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Broadbent, J.[47] 2017 Australia	Comparing online and blended learner's self-regulated learning strategies and academic performance	**Participants** • 606 undergraduate students attending a University in Melbourne, Australia **Program level** • Undergraduate	**Study purpose/objectives** • The aims of the current study were threefold: (1) to assess differences in perceived frequency of use of self-regulated learning strategies in two different learning modes (blended learning vs. online learning); (2) to examine the relationships between SRL strategies and subject grade for both groups; and (3) to explore whether contributions of the SRL strategies for subject grade differed across the two groups. **Study design** • Observational: Descriptive statistics correlational	**Course or curriculum** • Mixed **Learning setup** • Fully online • Blended learning	**Strategy or process** • Cognitive ○ Rehearsal ○ Elaboration ○ Organization ○ Critical thinking • Resource management ○ Time management ○ Effort regulation ○ Peer learning ○ Help seeking • Metacognitive strategies ○ Metacognition **Assessed using the Motivated Strategies for Learning Questionnaire (MSLQ)* **Outcomes** • The results showed that online learning students reported using all SRL strategies more often than blended learning students, except for the strategies of peer learning and help-seeking, which were employed significantly more often by blended learning students • For online learners, only time management and effort regulation strategies use were found to positively influence grades. • Greater use of peer learning and help-seeking strategies was exhibited in blended learning students
Can, Ş; Durgun, H; Dalcalı, B.K.[70] 2022 (Turkey)	Effect of online communication skills training on effective communication and self-efficacy and self-regulated learning skills of nursing students: A randomized controlled study	**Participants** • 61 first year nursing students **Program level** • Undergraduate	**Study purpose/objectives** • Determine the effects of online communication skills training on effective communication, self-efficacy, and self-regulated learning skills **Study design** • Pre-post-test randomized controlled experimental study	**Course or curriculum** • Nursing **Learning setup** • Online	**Strategy or process** • Online communication skills training **Outcomes** • Online communication skills training did not significantly increase SRL
Chen, Y.; Wei, W.; Yang, Y.; Chen, T.; Wu, M.[78] 2025 (China)	A latent profile analysis of self-regulation associated with engagement in online learning among nursing students	**Participants** • 676 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • Identify different online SRL profiles among nursing students and explore differences in demographic variables and online learning engagement **Study design** • Cross-sectional survey	**Course or curriculum** • Nursing **Learning setup** • Online	**Outcomes** • Students with moderate to high SRL in an online setting had higher learning engagement.
Cho, S.; Jang, S.J.[56] 2022 (South Korea)	Nursing students' motivational and self-regulated learning during the COVID-19 pandemic: A cross-sectional study	**Participants** • 195 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • Identify the predictors of nursing students' motivational and self-regulated learning in clinical nursing practicum during the COVID-19 pandemic **Study design** • Cross-sectional study	**Course or curriculum** • Nursing **Learning setup** • Hybrid and Online practicum	**Strategy or process** • Hybrid or fully online practicum **Outcomes** • Higher motivational and self-directed learning for those who attended a hybrid practicum and for those with higher moral sensitivity
Chong, D.Y.K.; Tam, B.; Suk, Y.Y.; and Wong, A.Y.L.[34] 2020 Hong Kong	Learning to prescribe and instruct exercise in physiotherapy education through authentic continuous assessment and rubrics	**Participants** • 122 Year 2 physiotherapy students in the first semester (online questionnaire, n = 117; FGD, n = 5) **Program level** • Undergraduate	**Study purpose/objectives** • "To explore students' perceived learning benefits and their learning processes in this authentic continuous assessment." • "To investigate the usage patterns of various LMS activities and their relationships with the learning outcome (i.e., assessment scores)." **Study design** • Mixed method	**Course or curriculum** • Physiotherapy (Year 2) **Learning setup** • Blended learning	**Strategy or process** • The "intervention" authentic continuous assessment is an assessment component within the course, Exercise Science. Done by pairs for the exercise activities, students were tasked with submitting weekly logs and communication videos, as well as participating in discussion forums through the LMS. Lecturers graded various assessment tasks and provided feedback to students at three time points (at the beginning, mid-point, and on completion) using rubrics available on the LMS from the first day of class. In addition, the rubrics were explained to students in the first class, and they were reminded to refer to them throughout the assessment period. A peer assessment rubric on communication skills was also included.

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Edelbring, S.; and Wahlstrom, R.[51] 2016 Sweden	Dynamics of study strategies and teacher regulation in virtual patient learning activities: a cross-sectional survey	**Participants** • 150 medical students participating in a clerkship preparatory course during Spring 2009 **Program level** • Undergraduate	**Study purpose/objectives** • "To enhance understanding of the relationships between students' self-regulated learning strategies and teacher regulation in the context of computerized VP activities" **Study design** • Observational: Cross-sectional research (cross-sectional survey)	**Course or curriculum** • Medicine, clerkship (preparatory course) **Learning setup** • Blended learning	**Strategy or process** • Exploratory web-based activities such as virtual patients (VPs)Virtual patients or VPs ○ The Web-SP virtual patient platform • Students worked in a self-directed manner with four VP cases presenting symptoms that were aligned with course topics and intended learning outcomes. The Web-SP virtual patient platform was used for delivering the VP cases online. Time was allocated for self-study of VPs during the course, but a specific time or place was not assigned for this purpose. **Outcomes** • The interplay is expressed foremost in associations between the perceived benefit of virtual patient use and the study strategies of self-regulated learning and external regulation of learning. Overall, self-regulation was expressed moderately together with the perceived benefit of virtual patient use.
Gaupp, R.; Fabry, G.; Körner, M.[68] 2018 Germany	Self-regulated learning and critical reflection in an e-learning on patient safety for third-year medical students	**Participants** • 193 medical students (third year) **Program level** • Undergraduate	**Study purpose/objectives** • "To explore the influence of critical thinking, self-regulated learning, and system usability on the acceptance of e-learning for patient safety." **Study design** • Observational: Quantitative: cross-sectional	**Course or curriculum** • Medicine (Year 3) **Learning setup** • Fully online	**Strategy or process** • Learning with ELPAS focused on SRL: ○ Users could decide individually on learning time, learning speed, and which content they used to study; ○ Students worked in small group discussions with peers and tutors; ○ Students answered online quizzes for self-assessment; ○ Students completed five assignments (two multiple-choice tests, three fostered reflection); ○ Students had to engage in SRL to master the basic knowledge, which they had to apply to case studies **Outcomes** • Students with high levels of reflection or critical reflection reported higher SRL behaviors • Students with high SRL rated the course better than those with low SRL • Pronounced association between critical reflection and self-regulated learning (medium-to-large effect size) • Influence of SRL in e-learning course quality outcomes was less pronounced but statistically significant (suggesting SRL capabilities are important for succeeding in e-learning environments) • Design of the e-learning system facilitated SRL and metacognitive strategies by providing immediate feedback (monitoring strategies), linking relevant literature (resource strategies), and allowing discussion with peers (cooperation strategies) • System usability was the most pronounced factor & showed strong correlations with SRL (suggesting that improving usability of an e-learning course will satisfy and support learning of students)
Holik, M.T.; Davidson, P.[35] 2023 (United States)	Students' Ability to Self-Regulate in a First-Year Experience Health Science Course	**Participants** • 657 health science students **Program level** • Undergraduate	**Study purpose/objectives** • Describe perceptions of engagement in online and blended learning environments, and ability to self-regulate in a first year experience (FYE) course. **Study design** • Educational design	**Course or curriculum** • Health science **Learning setup** • Online and blended learning	**Strategy or process** • Goal setting • Study environment • Task strategies • Time management • Help seeking • Self-evaluation **Outcomes** • Online group reported higher agreement with the strategies (mentioned above) than the blended group
Huang, X.; Li, S.; Wang, T.; Pan, Z.; Lajoie, S.P.[36] 2023 (Canada)	Exploring the co-occurrence of students' learning behaviours and reasoning processes in an intelligent tutoring system: An epistemic network analysis	**Participants** • 31 Medical students **Program level** • Post-graduate	**Study purpose/objectives** • Investigate how self-regulated learning and medical reasoning occurred concurrently in medical students while completing a diagnostic task in an intelligent tutoring system **Study design** • Quantitative using Epistemic Network Analysis	**Course or curriculum** • Medical students **Learning setup** • Intelligent tutor system	**Strategy or process** • Diagnostic task consisting of easy and difficult cases **Outcomes** • SRL and reasoning processing were more frequently used in the difficult task in the following: orientation, planning, monitoring, evaluation, and self-reflection.
Jahromi, Z.; Mosalanejad, L.; Rezaee, R.[67] 2016 Iran	The effect of web quest and team-based learning on students' self-regulation	**Participants** • 77 Nursing students from Jahrom University of Medical Sciences in Iran taking mental health and psychiatric disorder courses **Program level** • Undergraduate	**Study purpose/objectives** • "To examine the effects of cooperative learning methods using Web Quest and team-based learning (TBL) on students' self-direction, self-regulation, and academic achievement" **Study design** • Experimental and comparative study	**Course or curriculum** • Nursing **Learning setup** • Blended learning	**Strategy or process** • WebQuest approach as a teaching strategy ○ Increased students' self-regulation ■ increased students' higher thinking and self-direction ■ participated actively in discussions and completed tasks very quickly ■ increased responsibility in learning ○ Sees an increase in the students' self-regulation median range • The WebQuest group showed higher levels of self-control, self-management, and self-regulation after educational intervention • Although synergy achieved in integrated learning has greater effects than self-regulation.

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Kamali, M.; Bagheri-Nesami, M.[37] 2022 (Iran)	The association between online self-regulated learning and E-learning acceptance among medical sciences students during the COVID-19 pandemic	**Participants** • 234 medical sciences students **Program level** • Postgraduate	**Study purpose/objectives** • Determine the relationship between online and self-regulated learning and E-learning acceptance **Study design** • Descriptive analytical	**Course or curriculum** • Medical Sciences **Learning setup** • Online	**Strategy or process** • Online learning **Outcomes** • Significant relationship between online self-regulated learning and E-learning acceptance. • Above average level of online self-regulated learning
Kassab, S.; Al-Shafei, A.; Salem, A.; and Otoom, S.[59] 2015 Bahrain	Relationships between the quality of blended learning experience, self-regulated learning, and academic achievement of medical students: a path analysis	**Participants** • 171 medical students **Program level** • Undergraduate	**Study purpose/objectives** • Examine the relationship between the different aspects of students' course experience, self-regulated learning, and academic achievement of medical students in a blended learning curriculum. **Study design** • Observational: Multiple Regression Statistical Analysis	**Course or curriculum** • Medicine, Junior cycle (3 semesters from year 2 to year 3/6-year program) **Learning setup** • Blended learning	**Strategy or process** • Hybrid/Blended Learning ○ face-to-face teaching complemented by a Virtual Learning Environment (VLE)- Moodle • One of the main findings in this study is the effect of teaching quality and appropriate workload on students' motivational aspect of self-regulation, specifically the expectancy and value components
Kim, Y., Kim, N., Lee, S.H.[63]. 2021 South Korea	Effects of Online Learning on Nursing Students in South Korea during COVID-19	**Participants** • 164 senior nursing students **Program level** • Undergraduate	**Study purpose/objectives** • "To examine the learning effects of online education to determine the differences in the degrees of (a) knowledge, (b) self-regulation, (c) learning flow after an educational intervention" **Study design** • Experimental: Quasi-Experimental	**Course or curriculum** • Nursing (senior year) **Learning setup** • Fully online	**Strategy or process** • Online learning environment • The self-regulation score after the intervention was higher than that before the online learning, but it did not improve significantly • Assumed that the self-regulation score above the median before and after the test and the significant increase in learning flow may have facilitated the accomplishment of the learning task

Kim, Y., Kim, N., Chae, M.[55]
 	
2021
 	
South Korea
	Effects of flipped learning on nursing students: A mixed methods study	**Participants**
		• 62 junior-year students enrolled in a compulsory course titled Community Health Nursing I (experimental group: 32, control group: 30)
		
		Program level
		• Undergraduate
			Study purpose/objectives
			• "Aimed to verify the effects of flipped learning on class participation, academic self-regulation, coregulation, and academic performance, and to offer suggestions regarding educational strategies related to flipped learning"
			
			Study design
			• Experimental: Quasi-Experimental
				Course or curriculum
				• Nursing (junior year)
				
				Learning setup
				• Flipped classroom
					Strategy or process
					• Flipped learning
					  ○ Pre-class (watching videos online)
					  ○ Readiness assurance
					  ○ Mini-lecture
					  ○ Group activities
					  ○ Formative assessment
					• After flipped learning, the means of all three variables – class participation, academic self-regulation, and co-regulation – were higher in the experimental group than in the control group.
					• The participants expressed positive and negative FL experiences, and these experiences provided additional information about significant effects of class participation, academic self-regulation, and co-regulation, and the insignificant effect on academic performance of FL

Kor, P.P.K.; Liu, J.Y.W. ; Kwan, R.Y.C.[48] 2022 (Hong Kong, China)	Exploring nursing students' learning experiences and attitudes toward older persons in a gerontological nursing course using self-regulated online enquiry-based learning during the COVID-19 pandemic: A mixed-methods study.	**Participants** • 155 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • Explore experience in an online self-regulated enquiry-based learning (EBL), evaluate impact on their self-regulated learning experience, learning satisfaction, self-confidence in learning and attitudes toward older people **Study design** • Sequential explanatory mixed methods study	**Course or curriculum** • Nursing **Learning setup** • Online	**Strategy or process** • Online self-regulated EBL **Outcomes** • High level of metacognitive skills, persistence in online education • Moderate level of time management skills and environmental structuring • Acceptable level of help-seeking skills

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Lan, M.; Hou, X.; Qi, X.; Mattheos, N.[62] 2019 China	Self-regulated learning strategies in the world's first MOOC in implant dentistry	**Participants** • 7608 individuals enrolled • Two groups of learners emerged: Attentive (n=1433) Auditors (n= 3581) **Program level** • Mixed	**Study purpose/objectives** • "To investigate learners' behaviors and correlate patterns of Self-Regulated Learning (SRL) with performance and achievement during a Massive Open Online Course (MOOC) in Implant Dentistry." • "Specifically, to investigate patterns of SRL behaviors through data mining and investigate correlations of such patterns with the learner's activity and performance" **Study design** • Qualitative: Pedagogic research	**Course or curriculum** • Dentistry (ranging from undergraduate students, fresh graduates, and junior clinicians to senior and experienced practitioners) **Learning setup** • Fully online	**Strategy or process** • Use of Massive Open Online Course which was developed from Zimmerman's SRL model ○ a peer solution is used to kickstart a guided reflection, aiming to help students identify strengths and weaknesses in their own thinking and define new learning objectives ○ learning content derived from 52 distinct competencies (11 major and 41 supporting) ○ the course was organized into 5 modules, each with a number of lessons, and each lesson consisted of resources (i.e., lectures, clinical procedure videos, discussion boards, and a graded assignment) **Outcomes** • Academic ○ A significantly higher engagement, achievement, and completion rates among Attentive than Auditors. ○ Increased grades for learners who consistently use MOOC, which is affected by the demographic and professional background of learners and motivation in attending MOOC.
Lim, C.; Ab Jalil, H.; Ma'rof, A.; and Saad, W.[58] 2020 Malaysia	Self-Regulated Learning As A Mediator In The Relationship Between Peer Learning And Online Learning Satisfaction: A Study Of A Private University In Malaysia	**Participants** • 94 students = Business and Law • 118 students = Social Sciences and Leisure Management • 40 students = Health and Medical Sciences • 114 students = Innovation and Technology **Program level** • Undergraduate	**Study purpose/objectives** • Determine the causal relationships among students' self-regulated learning (SRL) abilities, peer learning, and online learning satisfaction in a blended learning environment. **Study design** • Observational: Quantitative; Correlational Research Design	**Course or curriculum** • Mixed (Business & law, Social sciences & leisure management, Health & medical sciences, Innovation & technology) **Learning setup** • Blended learning	**Strategy or process** • All the blended courses selected for this study met the following characteristics: ○ students were undergraduates ○ the courses were the top 3 most active blended learning courses in their respective schools for the March 2019 semester, as measured by student participation rates ○ each course had various learning objects or activities for each blended learning component ○ the instructors used the university's LMS portal as their platform for blended learning delivery • Improvement in student satisfaction after the implementation of peer learning intervention was due to SRL strategies employed by students.
Lima, A.C.B.; Santos, D.C.M.D.[49] 2023 Brazil	Learning strategies of undergraduate nursing students during the COVID-19 pandemic	**Participants** • 112 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • To analyze the learning strategies used by undergraduate nursing students from a public higher education institution in remote teaching during the COVID-19 pandemic **Study design** • Observational: Cross-sectional	**Course or curriculum** • Nursing **Learning setup** • Fully online	**Strategy or process** • Undergraduate nursing students frequently used self-regulatory and cognitive learning strategies during remote learning
Liu, L.; Caliph, S.; Simpson, C.; Khoo, R.; Neviles, G.; Muthumuni, S.; and Lyons, K.[44] 2021 Australia	Pharmacy Student Challenges and Strategies towards Initial COVID-19 Curriculum Changes	**Participants** • 774 first, second, third, and fourth year pharmacy students studying a Bachelor of Pharmacy (Honors) and/ or Master of Pharmacy at Monash University in Melbourne, Australia **Program level** • Undergraduate	**Study purpose/objectives** • To gain a comprehensive understanding of pharmacy students' benefits, challenges, and strategies during the first few months of the COVID-19 pandemic. By examining the fallout from the immediate transition from face-to-face learning to distance virtual learning, this study contributes to a better understanding of healthcare students' adaptability and well-being throughout the pandemic. **Study design** • Qualitative: Descriptive	**Course or curriculum** • Pharmacy (Year 1 to Year 4) **Learning setup** • Fully online	**Strategy or process** • Learning Strategies: distributed practice (scheduling to spread learning activities evenly over time), use of new technology (e.g., Google Calendar), own strategies • Time Management: planning ahead, other tactics • Motivational strategies: goal-oriented self-talk; peer support

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Liu, Y.; Hu, H.; Wang, L.; Mao, Y.; Yang, K.; Ma, L.; Li, H.[79] 2023 China	Medical education environment perception and learning engagement in undergraduate nursing students: The mediating effect of self-regulated learning ability	**Participants** • 228 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • To investigate the interrelationships of medical education environment perception, learning engagement, and self-regulated learning ability among Chinese undergraduate nursing students **Study design** • Observational	**Course or curriculum** • Nursing **Learning setup** • Fully online	**Outcomes** • Education environment perception was positively correlated with all dimensions of learning engagement • SRL ability had a partial mediating effect on the relationship between medical education environment perception and learning engagement
MacKenzie, D.; Collins, K.; Guimond, M.; Hunter, A.; Jurcina, K.; McDonald, J.; Richards, N.; Sinclair, S.; Taylor, K.[52] 2018 Canada	Co-constructing Simulations with Learners: Roles, Responsibilities, and Impact	**Participants** • 8 Senior Occupational Therapy Master's students **Program level** • Postgraduate	**Study purpose/objectives** • To contribute new knowledge to the simulation literature by (a) providing design guidance for co-constructing health care simulations informed by best practice standards and (b) reporting the impact on student learning drawn from the qualitative program evaluation feedback following participation in the pilot co-constructed simulations. **Study design** • Qualitative: Thematic Qualitative Research	**Course or curriculum** • Occupational therapy **Learning setup** • Fully online	**Strategy or process** • Co-constructed design for the module allowed the instructors to guide and support SRL in all phases of the simulation development, delivery, and debrief. • The co-construction simulation series aimed to provide students with an opportunity to learn from and with each other, where the instructor served as a "guide on the side" • The approach allowed for directed SRL where responsibility shifted onto the student to take greater control over their own motivation and learning experiences **Outcomes** • Enhanced insight and clinical reasoning through observation and peer interaction • Enhanced skills development through collaboration and interaction with Instructor • Improved confidence in their SRL strategies as they progressed through the co-constructed simulation design
Mäenpää, K.; Järvenoja, H.; Peltonen, J. & Pyhältö, K.[60] 2019 Finland	Progress of nursing students' motivation regulation profiles and affiliations with engagement, burnout and academic performance	**Participants** • 98 nursing students; 34 in blended learning & 64 in traditional learning **Program level** • Undergraduate	**Study purpose/objectives** • To examine the development of nursing students' motivation regulation profiles, study engagement, and study burnout during two years in traditional and blended learning environments. Investigate these factors' associations with academic performance. **Study design** • Observational (cross-sectional and longitudinal)	**Course or curriculum** • Nursing **Learning setup** • Blended learning and traditional learning	**Strategy or process** • Blended learning program: One-week face-to-face classroom teaching monthly. Remaining time is spent studying on their own using tutors and technology-enhanced, web-based, online learning management systems. **Outcomes** • Self-consequating (a variable of motivation regulation) predicted GPA • Students with high-level motivation regulation skills displayed less cynicism and higher GPA than students with less-developed motivation regulation skills • No significant difference between the variables based on their learning environment.
Mäenpää, K.; Järvenoja, H.; Peltonen, J.; Pyhältö, K.[46] 2020 Finland	Nursing students' motivation regulation strategies in blended learning: A qualitative study	**Participants** • 12 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • To gain a more in-depth understanding of nursing students' motivation regulation (MR) strategies and factors contributing to their reported use along their 3-year study path in a blended learning environment. **Study design** • Qualitative	**Course or curriculum** • Nursing **Learning setup** • Blended learning	**Strategy or process** • Students employed seven MR strategies: environmental structuring, self-consequating, goal-oriented self-talk, efficacy management, emotion regulation, regulation of value, and interest enhancement • Individual (i.e., related to self-administered consequences such as self-efficacy beliefs and self-discipline) or situational (i.e., environmental structuring) factors often enhanced and sustained the use of MR strategies **Outcomes** • The findings suggest that participation in a BL program can facilitate nursing students' SRL and MR

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Mäenpää, K.; Pyhältö, K.; Järvenoja, H.; Peltonen, J.[45] 2018 Finland	Nursing students' motivation regulation and its relationship with engagement and burnout	**Participants** • 90 nursing students; 34 in blended learning & 56 in traditional learning **Program level** • Undergraduate	**Study purpose/objectives** • To examine individual variations in motivation regulation skills among nursing students and explore related factors. • Research questions: ○ 'What kinds of motivation regulation profiles can be detected among the first-year nursing students?' ○ 'How do these profiles relate to experienced study engagement and study burnout?' ○ 'Are there differences in motivation regulation profiles between students studying either in BL or in traditional learning environments?' **Study design** • Observational	**Course or curriculum** • Nursing **Learning setup** • Blended learning and traditional learning	**Strategy or process** • Participants showed high motivation regulation levels • Motivation regulation strategies based on the scale: ○ Regulation of value (most used) ○ Environmental structuring (most used) ○ Regulation of performance ○ Self-consequating ○ Regulation of mastery goals **Outcomes** • High motivation regulation was associated with increased levels of study engagement and reduced risk for developing burnout
Matsuyama, Y.; Nakaya, M.; Okazaki, H.; Lebowitz, A.J.; Leppink, J. & van der Vleuten, C.[71] 2019 Japan	Does changing from a teacher-centered to a learner-centered context promote self-regulated learning: A qualitative study in a Japanese undergraduate setting	**Participants** • 20 medical students; 13 under the FCSD program and 7 under the traditional teacher-centered curriculum **Program level** • Undergraduate	**Study purpose/objectives** • To explore whether shifting from a teacher-centered to a learner-centered context would improve SRL. • To explore how SRL develops during this transition. **Study design** • Qualitative	**Course or curriculum** • Medicine **Learning setup** • Blended (FCSD) and traditional teacher-centered learning	**Strategy or process** • Free Course Student Doctor (FCSD) - a learner-centered, self-directed elective course program wherein students make their own learning plans and are monitored remotely by their mentor as they study any subject at any institution **Outcomes** • Learner-centered learning could stimulate SRL. Students in the learner-centered program started constructing their future self-image, reflect on their current and future selves, and seek diverse learning strategies.
Matsuyama, Y.; Nakaya, M.; Leppink, J.; van der Vleuten, C.; Asada, Y.; Lebowitz, A.J.; Sasahara, T.; Yamamoto, Y.; Matsumura, M.; Gomi, A.; Ishikawa, S.; & Okazaki, H.[101] 2021 Japan	Limited effects from professional identity formation (PIF)-oriented intervention on self-regulated learning in a preclinical setting: A randomized-controlled study in Japan	**Participants** • 112 medical students **Program level** • Undergraduate	**Study purpose/objectives** • To examine whether a PIF-oriented intervention would enhance SRL among preclinical year students. **Study design** • Experimental (RCT)	**Course or curriculum** • Medicine **Learning setup** • Blended (PIF)	**Strategy or process** • Professional Identity Formation (PIF)-oriented intervention - used a Moodle-based platform that included online instructions videos and essay activities **Outcomes** • PIF intervention did not significantly improve SRL
McKiernan, K.C.; Colorafi, K.; Kim, A.P.; Stewart, A.S.; Remsberg, C.M.; Vu, M.; and Bray, B.S.[38] 2020 USA	Study behaviors associated with student pharmacists' academic success in an active classroom pharmacy curriculum	**Participants** • 13 high-performing Pharmacy students **Program level** • Undergraduate	**Study purpose/objectives** • To determine what specific behaviors high-performing students engage in in an active-learning pharmacy curriculum **Study design** • Qualitative	**Course or curriculum** • Pharmacy **Learning setup** • Blended	**Strategy or process** • SRL through metacognition (help-seeking, time management, willingness to vary learning strategies according to the demands of a particular course/assessment) • 5 themes (primary behaviors) that led to academic success ○ Preparing for class ○ Preparing for testing ○ Seeking help ○ Knowing myself ○ Building on strengths **Outcomes** • Academic success with the use of SRL and specific metacognitive strategies

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Morsy, A.A.I.; Atta, M.H.R.; Elsheikh, M.H.; Shehata, Y.M.[81] 2025 (Egypt)	Spotlighting the Atychiphobia among nursing Students: the role of online self-efficacy and self-regulated learning	**Participants** • 500 second year nursing students **Program level** • Undergraduate	**Study purpose/objectives** • To investigate the interrelationships among online self-efficacy (OSE), self-regulated learning, and atychiphobia (fear of failure) in the context of nursing education **Study design** • Observational: Correlational	**Course or curriculum** • Nursing **Learning setup** • Blended	**Outcomes** • SRL is positively correlated with OSE (moderate) • SRL is negatively correlated with atychiphobia (moderate) • Enhancing OSE strengthens the negative relationship between SRL and atychiphobia • Developing OSE and SRL can serve as protective factors against atychiphobia
Park, J & Seo, M.[80] 2022 Korea	Influencing factors on nursing students' learning flow during the COVID-19 pandemic: A mixed-method research	**Participants** • Nursing students; 245 for survey and 20 for FGD **Program level** • Undergraduate	**Study purpose/objectives** • Investigate the factors affecting nursing students' learning flow in COVID-19 pandemic situations through mixed-method research **Study design** • Mixed-methods	**Course or curriculum** • Nursing **Learning setup** • Blended	**Outcomes** • Learning flow was positively correlated with SRL
Park, K.; Moon, S.; Oh, J.[39] 2022 Korea	Predictors of academic achievement in distance learning for nursing students	**Participants** • 201 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • Identify the relationship between academic achievement and factors influencing distance learning among undergraduate nursing students. **Study design** • Observational (cross-sectional)	**Course or curriculum** • Nursing **Learning setup** • Fully online	**Strategy or process** • SRL strategies used based on scale: ○ Most used: environmental structuring, goal setting, time management ○ Least used: task strategies, help-seeking, self-evaluation **Outcomes** • Students with higher SRL competency presented higher academic achievement
Passos, K.; Bezerra, H.; Leonel, A.; Ramos-Perez, F.; Martelli-Júnior, H.; Machado, R.; Bonan, P.; Perez, D.[74] 2021 Brazil	Self-regulated learning perception of undergraduate dental students during the COVID-19 pandemic: A nationwide survey in Brazil	**Participants** • 779 dentistry students **Program level** • Undergraduate	**Study purpose/objectives** • To evaluate the perception of self-regulated learning of Brazilian undergraduate dental students during the COVID-19 pandemic **Study design** • Observational (cross-sectional)	**Course or curriculum** • Dentistry **Learning setup** • Blended	**Outcomes** • Academic performance in e-learning (self-report) was positively associated with SRL capacity
Peck, B.; Smith, A.; Terry, D.; and Porter, J.[61] 2021 Australia	Self-regulation for and of learning: Student insights for online success in a Bachelor of Nursing program in regional Australia	**Participants** • 15 nursing students **Program level** • Undergraduate	**Study purpose/objectives** • To provide insights into experiences of students engaged in transition from face-to-face learning to online learning **Study design** • Qualitative	**Course or curriculum** • Nursing **Learning setup** • Blended	**Strategy or process** • Inaugural blended online digital (BOLD) Bachelor of Nursing program - flexible delivery model; mostly online learning with one face-to-face learning block per semester for clinical skills • The transition required students to develop the skills of: ○ Self-regulation for learning ○ Self-regulation of learning
Poot, R; de Kleijn, R..; van Rijen, H.; van Tartwijk, J.[53] 2017 Netherlands	Students generate items for an online formative assessment: Is it motivating?	**Participants** • 109 biomedical students **Program level** • Undergraduate	**Study purpose/objectives** • Research questions: ○ To what extent is the practice of student-generated questions in an online environment motivating for all students? ○ What are the effects on student outcomes? **Study design** • Experimental	**Course or curriculum** • Biomedicine **Learning setup** • Blended	**Strategy or process** • Use of student-generated questions to facilitate learning in an online learning environment **Outcomes** • The program did not appear motivating to students • Developing and practicing student-generated questions (engagement) led to better academic achievement

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Roslan, N. & Hamlin, A.[40] 2021 Malaysia	Enablers and barriers to online learning among medical students during COVID-19 pandemic: An explanatory mixed-method study	**Participants** • 178 medical students **Program level** • Undergraduate	**Study purpose/objectives** • To examine online learning (OL) readiness components, self-regulation, enablers and barriers to OL among medical students during the pandemic **Study design** • Mixed method	**Course or curriculum** • Medicine **Learning setup** • Fully online	**Strategy or process** • SR as an enabler of online learning • SRL strategies used based on scale: ○ Most used: goal setting, environmental structuring, self-evaluation ○ Least used: task strategies, time management, help-seeking **Outcomes** • Participants who had high CGPA had significantly higher goal setting and self-evaluation SRL scores
Say, R.; Visentin, D.; Saunders, A; Atherton, I.; Carr, A.; King, C.[50] 2024 Australia	Where less is more: Limited feedback in formative online multiple-choice tests improves student self-regulation	**Participants** • 937 (summative test scores), 802 (survey) and 45 (FGD) nursing students **Program level** • Undergraduate	**Study purpose/objectives** • To determine if score-only feedback promotes self-regulatory patterns of learning compared with knowledge of results plus elaborated feedback (KR + EF) when completing formative online multiple choice tests **Study design** • Mixed method	**Course or curriculum** • Nursing **Learning setup** • Blended	**Strategy or process** • Formative online MCTs • Score-only feedback versus knowledge of results plus elaborated feedback (KR + EF) in online MCTs **Outcomes** • Score-only feedback approach to formative online MCTs is more likely to promote SRL patterns than KR+EF • Students receiving score-only feedback in formative online MCTs were more likely to use metacognitive, cognitive, and behavioral strategies to resolve uncertainty ○ Associated with the need to self-evaluate, understand and engage more deeply ○ Associated with improved engagement in collaborative activities and information seeking • Score-only feedback was associated with higher summative tests scores
Traboulsi, D.; Hardin, J.; Parsons, L.; Waechter, J.[73] 2019 Canada	Does self-modulated learning vs. algorithm-regulated learning of dermatology morphology affect learning efficiency of medical students?	**Participants** • Medical students **Program level** • Undergraduate	**Study purpose/objectives** • To determine whether there were differences in diagnostic accuracy and learning efficiency between a self-regulated versus algorithm-regulated deliberate practice strategy. • To compare student experiences related to their learning **Study design** • Mixed-method	**Course or curriculum** • Medicine **Learning setup** • Blended	**Strategy or process** • Self-regulated versus algorithm-regulated dermatologic morphology training module ○ Both resulted in learning/skill improvement **Outcomes** • Self-regulated mode of learning appeared to impact learning efficiency positively
Utama, M.; Yuliawan, D.; Widyandana, Y.[65] 2020 Indonesia	Facebook® group usage to support flipped-classroom learning on ocular trauma	**Participants** • 45 medical students **Program level** • Undergraduate	**Study purpose/objectives** • To measure changes in the level of study motivation, self-directed learning readiness, and knowledge gain as variables of cognitive engagement of undergraduate medical students after joining a closed Facebook group to support ocular trauma flipped-classroom **Study design** • Experimental	**Course or curriculum** • Medicine **Learning setup** • Blended	**Strategy or process** • Incorporation of a Facebook group to moderate learning in a flipped classroom. In this group, study materials on ocular trauma that were developed based on Zimmerman's principles of SRL were given before, during, and after the flipped classroom session. **Outcomes** • All student cognitive engagement variables increased after incorporation of Facebook group to support flipped-classroom learning ○ Knowledge gain ○ Study motivation ○ Intrinsic goal orientation ○ Task value ○ Self-efficacy for learning & performance ○ Self-directed learning readiness ○ Self-management ○ Desire for learning ○ Self-control
Voils, S.A.; Childs-Kean, Lindsey, M.; and Thomas, A.[76] 2019 USA	Relationship between pharmacy students' use of self-regulated learning strategies and course outcomes	**Participants** • Postgraduate Doctor of Pharmacy students **Program level** • Graduate	**Study purpose/objectives** • "To determine the relationship between student-reported, self-regulated learning (SRL) with use of supplementary material, and overall performance in an advanced therapeutics course in a Doctor of Pharmacy program." **Study design** • Observational (correlation; regression analysis)	**Course or curriculum** • Doctor of Pharmacy **Learning setup** • Blended	**Outcomes** • A positive association was found between SR study behaviors and academic performance

Appendix B. Summary of Study Characteristics *(continued)*

Author, Year of publication, Country	Article Title	Participants, Program level	Study purpose/ objectives, Study design	Course or curriculum, Learning setup	Key findings Strategy or process Outcomes
Wang, X., Li, J., Wang, C.[57] 2020 China	The effectiveness of flipped classroom on learning outcomes of medical statistics in a Chinese medical school	**Participants** • 88 medical students; 44 in flipped class, 44 in traditional class **Program level** • Undergraduate	**Study purpose/objectives** • To compare the effectiveness of flipped class and traditional class on learning outcomes (including learning motivation, self-regulated learning, course satisfaction, and academic performance) of medical statistics in a Chinese medical school **Study design** • Observational	**Course or curriculum** • Medicine **Learning setup** • Blended	**Strategy or process** • Flipped classroom **Outcomes** • The flipped classroom seemed to enhance learning interest, SRL ability, and academic performance
Wesselborg, B.[72] 2020 Germany	Enhancing of self-regulated learning strategies for health care students to improve e-learning in the "Corona semester" as an interdisciplinary task	**Participants** • 49 students of master's degree in nursing education **Program level** • Graduate	**Study purpose/objectives** • To provide suggestions for the promotion of SRL among students of all health professions to foster digital learning competence **Study design** • Qualitative	**Course or curriculum** • Nursing Education **Learning setup** • Fully online	**Strategy or process** • Three-phase e-learning task-based text work project on SRL **Outcomes** • The SRL program provided support to the students during their e-learning experience. Participants planned their learning activities in a goal-oriented manner and used learning opportunities more systematically. • SRL as an important tool for coping with the learning process in digital environments.
Whittaker, A.[75] 2015 USA	Effects of Team-Based Learning on Self-Regulated Online Learning	**Participants** • 184 nursing students; 86 in team-based learning and 98 in traditional instructor-led learning **Program level** • Undergraduate	**Study purpose/objectives** • "To compare the effectiveness of team-based learning (TBL) with traditional instructor-led (IL) learning on self-regulated online learning outcomes in a blended undergraduate research and evidence-based practice course" **Study design** • Experimental (quasi-experimental)	**Course or curriculum** • Nursing; evidence-based practice course **Learning setup** • Blended	**Strategy or process** • Team-based learning intervention **Outcomes** • Students in the TBL group showed higher levels of SR in online learning activities and engaged in the online lessons more; they also scored higher in course exams.

Zheng, B. & Zhang, Y.[20]
 	
2020
 	
USA
	Self-regulated learning: the effect on medical student learning outcomes in a flipped classroom environment	**Participants**
		• 140 medical students
		
		Program level
		• Undergraduate
			Study purpose/objectives
			• This study focuses on exploring two research questions:
			  ○ Which SRL strategies affected student learning outcomes in a flipped classroom environment?
			  ○ How did students perceive the affordances and challenges of learning in the flipped classroom environment?
			
			Study design
			• Observational
				Course or curriculum
				• Medicine
				
				Learning setup
				• Blended
					Strategy or process
					• Flipped classroom environment
					• Peer learning and help-seeking were beneficial to student learning outcomes. On the other hand, rehearsal was negatively associated with student learning outcomes.
					
					Outcomes
					• Rehearsal as an SRL strategy had a negative association with student learning outcomes

Zheng, B., Ward, A., Stanulis, R.[41]
 	
2020
 	
USA
	Self-regulated learning in a competency-based and flipped learning environment: learning strategies across achievement levels and years	**Participants**
		• 26 medical students
		
		Program level
		• Undergraduate
			Study purpose/objectives
			• "The purpose of this study was to identify the SRL strategies medical students use in a flipped learning environment, and further examine whether students with different levels of self-perceived academic performance use SRL differently.
			
			Study design
			• Qualitative
				Course or curriculum
				• Medicine
				
				Learning setup
				• Blended
					Strategy or process
					• Competency-based and flipped learning environment
					• SRL strategies used:
					  ○ High usage (planning and reflection)
					  ■ reflecting
					  ■ adjustment
					  ■ task analysis
					  ■ connecting
					  ■ self-evaluation
					  ○ Low usage (monitoring phase)
					  ■ organizing
					  ■ summarizing
					  ■ applying
					
					Outcomes
					• Students who lack self-regulation strategies may fail to comprehend or connect ideas in their pre-class learning, which could lead to ineffective learning outcomes during in-class activities.

Appendix C. Theme Matrix

#	Themes	SR Strategies used by health science students				Processes used to promote SRL				Academic and Non-academic Outcomes associated with SRL			
		Zimmerman's model			Others	Teaching and Learning (T-L)	Learning delivery modality	Tech-nology-driven	Special courses/ interventions	Academic Performance	Engagement in learning	Perception of online learning experience	Non- cognitive skills for learning
	Authors/ Year	Fore-thought	Perfor-mance	Self-reflection									
1	Abouzeid et al. (2021)	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☐
2	Alatawi et al. (2025)	☑	☑	☐	☐	☑	☑	☐	☐	☐	☐	☐	☐
3	Anthonysamy et al. (2020)	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	Arianfar et al. (2020)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑
5	Asadzandi et al. (2022)	☐	☐	☐	☐	☑	☑	☑	☑	☐	☑	☐	☐
6	Bagheri-Nesami et al. (2021)	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
7	Balakrishnan et al. (2021)	☑	☑	☐	☐	☑	☐	☑	☐	☑	☐	☐	☐
8	Ballouk et al. (2022)	☑	☑	☑	☐	☑	☑	☐	☐	☑	☑	☐	☐
9	Bingen et al. (2019)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
10	Bradley et al. (2017)	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐
11	Briscoe et al. (2019)	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
12	Broadbent (2017)	☐	☑	☐	☑	☐	☐	☐	☐	☑	☐	☐	☐
13	Can et al. (2022)	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
14	Chen et al. (2025)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐
15	Cho et al. (2022)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐
16	Chong et al. (2020)	☑	☑	☑	☐	☑	☐	☑	☐	☐	☐	☐	☐
17	Edelbring & Wahlström (2016)	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☑	☐
18	Gaupp et al. (2018)	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑	☑
19	Holik et al. (2023)	☑	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐
20	Huang et al. (2023)	☑	☑	☑	☐	☐	☑	☐	☐	☐	☑	☐	☐
21	Jahromi et al. (2016)	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
22	Kamali et al. (2022)	☑	☑	☑	☐	☐	☑	☐	☐	☐	☐	☑	☐
23	Kassab et al. (2015)	☐	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐
24	Kim, Kim, & Lee (2021)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
25	Kim, Kim, & Chae (2021)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
26	Kor et al. (2022)	☑	☑	☑	☐	☐	☑	☑	☐	☐	☐	☐	☐
27	Lan et al. (2019)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
28	Lim et al. (2020)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
29	Lima et al. (2023)	☑	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐
30	Liu et al. (2021)	☑	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐
31	Liu, Hu, et al. (2023)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐

Appendix C. Theme Matrix *(continued)*

#	Themes	SR Strategies used by health science students				Processes used to promote SRL				Academic and Non-academic Outcomes associated with SRL			
		Zimmerman's model			Others	Teaching and Learning (T-L)	Learning delivery modality	Tech-nology-driven	Special courses/ interventions	Academic Performance	Engagement in learning	Perception of online learning experience	Non- cognitive skills for learning
	Authors/ Year	Fore-thought	Perfor-mance	Self-reflection									
32	MacKenzie et al. (2018)	☐	☐	☐	☐	☑	☑	☐	☐	☑	☐	☐	☐
33	Mäenpää et al. (2019)	☐	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐	☐
34	Mäenpää et al. (2020)	☑	☑	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐
35	Mäenpää et al. (2018)	☑	☑	☐	☑	☐	☐	☐	☐	☐	☑	☐	☑
36	Matsuyama et al. (2019)	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
37	Matsuyama et al. (2021)	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
38	McKiernan et al. (2020)	☑	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐
39	Morsy et al. (2025)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑
40	Park & Seo (2021)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐
41	Park et al. (2022)	☑	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐
42	Passos et al. (2021)	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐
43	Peck et al. (2021)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
44	Poot et al. (2017)	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐
45	Roslan & Hamlin (2021)	☑	☑	☑	☐	☐	☐	☐	☑	☑	☐	☐	☐
46	Say et al. (2024)	☐	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐
47	Traboulsi et al. (2019)	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐	☐
48	Utama et al. (2020)	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
49	Voils et al. (2019)	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐
50	Wang et al. (2020)	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
51	Wesselborg (2020)	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
52	Whittaker (2015)	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐
53	Zheng & Zhang (2020)	☑	☑	☐	☐	☐	☑	☐	☐	☑	☐	☐	☐
54	Zheng et al. (2020)	☑	☑	☑	☐	☐	☑	☐	☑	☑	☐	☐	☐