Embedding Self-Regulated Learning Strategies in an Online Homework Platform in a Blended Math Course: An Action Research Study

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The purpose of this action research study was to evaluate the impact of using self-regulated learning (SRL) strategies embedded within an online homework platform, MyMathLab, on students' SRL and mathematics self-efficacy skills whilst taking a college-level blended Algebra course at a 2-year college in the southeastern United States. The results revealed no significant effect of the intervention on the students' SRL and mathematics self-efficacy skills. However, the students expressed that MyMathLab tools and embedded SRL strategies positively impacted their goal setting, time management, help-seeking, self-efficacy and self-reflection skills. Although the students had mainly positive perceptions of MyMathLab, some students expressed negative perceptions.

Introduction

Blended and online learning environments have become increasingly popular among students and teachers due to recent technological advances (Eggers et al., 2021). It is experiencing a marked increase in popularity in the wake of the novel coronavirus (Amarathunga, 2025). One reason for the increasing trend towards blended and online learning environments is that students can use learning aids at any time and from any location (Ratniyom et al., 2016). Although recent studies have reported on the positive impact of blended learning on student motivation, test grades, learning satisfaction (Jiang et al., 2024), self-efficacy and class engagement (Chyr et al., 2017), increased rates of student dropout as well as course failing has been seen in blended learning environments when compared to courses taught in the traditional classroom (Alkış & Temizel, 2018).

Blended learning environments require students to utilize their skills in motivation, goal setting, evaluating their self-efficacy and satisfaction, and effective use of help-seeking aids (Alkış & Temizel, 2018; Broadbent & Fuller-Tyszkiewicz, 2018; Chyr et al., 2017; Kintu et al., 2017). These are just some of the skills that a self-regulated learner uses to become “a master of their own learning processes” (Zimmerman, 2008, p. 166). The skills of a self-regulated learner have been correlated to their homeworking behavior (Ramdass & Zimmerman, 2011). Most homework is completed independently at home, either under supervision or not. While independently completing homework, students practice self-regulation by motivating themselves, avoiding distractions, using homework completion strategies, managing time, setting goals, evaluating their own performance, and postponing gratification (Ramdass & Zimmerman, 2011). In brief, homework helps students develop better self-regulation skills (Ramdass & Zimmerman, 2011), and students’ self-efficacy is enhanced when they utilize homework support services (Kitsantas et al., 2011). In recent years, some higher education institutions have adopted online homework platforms (OHWPs) (Magalhães et al., 2020). Lunsford and Pendergrass (2016) defined an OHWP as a computer-based system that allocates homework assignments to students and also provides immediate feedback based on their responses. OHWPs provide instant, interactive feedback that can enhance student learning (Peng, 2009). Also, clear and detailed feedback can help to encourage students’ self-efficacy, which can positively impact their motivation (Abrami et al., 2011). Another study recommended that combining a certain type of homework with SRL strategies can positively impact students’ self-regulation skills (Lee, 2016).

Although blended learning has numerous advantages over face-to-face instruction, it places greater responsibility on students to manage their own learning. To be successful in a blended learning environment, students must possess and use a range of self-regulated learning strategies (Sharma et al., 2007). Unfortunately, this means that “blended learning environments often do not adequately meet the needs of students who still lack sufficient SRL skills” (Eggers et al., 2021, p. 176). Therefore, students should be provided with adequate support so as to develop appropriate SRL skills within blended learning environments (Eggers et al., 2021). In this sense, the current study embedded SRL strategies within MyMathLab, an OHWP integrated within a college-level blended mathematics course. Then, we evaluated the impact of using SRL strategies embedded in the OHWP on students’ SRL and mathematics self-efficacy whilst taking an intensive college-level algebra course at a regional college campus in the southeastern United States. As such, the study explored the following research questions:

1. How and to what extent does the MyMathLab OHWP impact upon students’ SRL skills?
2. How and to what extent does the MyMathLab OHWP impact upon students’ mathematics self-efficacy?
3. What are students’ perceptions of how the MyMathLab OHWP impacted their SRL skills?

Literature Review

Blended Learning

Blended learning is an educational approach in which an educator combines traditional face-to-face instruction with online, digital learning to create a more flexible and engaging learning environment (Boda & Weiser, 2018; Kintu et al., 2017;

Koukounas, 2016; O'Byrne & Pytash, 2015). Chyr et al. (2017) proposed a definition that 30-37% of a blended course is delivered in the traditional face-to-face context. Watson et al. (2011) reported that blended learning can range from as low as 1% to 90% digital instruction. However, O'Byrne and Pytash (2015) stressed that there is no single, perfect blend of digital instruction and traditional teaching that defines blended learning.

Blended learning offers many benefits, such as providing access to course content (Johnson & Graham, 2015), increasing students' learning and motivation (Jiang et al., 2024), providing learning flexibility, enhancing student and faculty satisfaction (Johnson & Graham, 2015), and improving self-efficacy and class engagement (Chyr et al., 2017). However, students in blended learning environments are required to possess and apply a certain level of SRL skills (Bonk & Graham, 2005).

Self-Regulated Learning

SRL is when a learner uses and self-evaluates their own ability, motivation, and beliefs to perform the tasks required for learning a given concept (Hoops et al., 2016; Rogers et al., 2020; Taranto & Buchanan, 2020). A learner must use a variety of skills to be successful as a self-regulated learner; these skills are collectively referred to as SRL skills. Some of the skills that students use are environmental structuring, goal setting or being goal-oriented, time management, help-seeking, self-efficacy, self-reflection, and task strategies (Barnard et al., 2009; Barnard-Brak et al., 2010).

Zimmerman's Model of Self-Regulation is based on Bandura's social cognitive theory and has been widely acknowledged in the field of education (Zimmerman, 1989; Zimmerman & Campillo, 2003). Zimmerman's Model is cyclical and divided into three phases: forethought, performance, and self-reflection. During the forethought phase, students analyze their task and self-motivation beliefs (Kooken et al., 2021; Panadero & Alonso-Tapia, 2014), identify a plan, and determine the learning strategies and tools needed to attain their goals (Panadero & Alonso-Tapia, 2014). Students also examine their self-efficacy and determine whether the task is valuable for attaining their personal goals and interests (Panadero & Alonso-Tapia, 2014; Zimmerman & Campillo, 2003). During the performance phase, students are self-observant regarding how they notate, why they are attempting to complete a task, and what the expected outcomes are from completing the task (Panadero & Alonso-Tapia, 2014; van Alten et al., 2020). When a student receives metacognitive feedback, they are more likely to be better self-regulated learners (Labuhn et al., 2010; Panadero & Alonso-Tapia, 2014). Students also monitor and diagnose their time management (Lai & Hwang, 2016), environmental settings, self-manage their motivational strategies, and seek help where needed (Panadero & Alonso-Tapia, 2014; Zimmerman & Campillo, 2003).

Lastly, the self-reflection phase includes self-judgment and self-reaction to the tasks completed when learning a concept (Zimmerman, 2008; Zimmerman & Campillo, 2003). Students' self-judgment relies upon the goals they set, how they most recently performed and mastered a concept when compared to their past level of performance and mastery, and how the students compare with their class peers (Kizilcec et al., 2017; Littlejohn et al., 2016; van Alten et al., 2020). In other words, students need attainable and measurable goals when attempting tasks and learning concepts (Kizilcec et al., 2017). Students' self-reactions depend on their satisfaction level, how they adapt their performance to attain their goals, and their learning of the concepts being taught (Zimmerman, 2008; Zimmerman & Campillo, 2003). Therefore, if students feel satisfied with completing a task, their self-efficacy will likely improve, and they will become increasingly motivated to learn concepts based on the tasks they have completed (Kitsantas et al., 2011; Ramdass & Zimmerman, 2011).

Mathematics Self-Efficacy

Mathematics self-efficacy is defined as a student's belief in their ability to perform mathematical tasks (Zetriuslita et al., 2020). Another way to define mathematics self-efficacy is a student's ability to master and explain mathematical concepts, to accept encouragement from others regarding their achievement on mathematical tasks, and to positively control their mood and actions whilst performing mathematical tasks (Lau et al., 2018; Usher & Pajares, 2009). Students with a high level of mathematics self-efficacy are generally more successful or achieve higher test scores in mathematics classes (Kitsantas et

al., 2011; Peters, 2013). Also, a student's mathematics self-efficacy can be positively correlated to both their online homework achievement and to their metacognitive and environmental control strategies (Sun et al., 2018).

Supporting SRL in the Mathematics Classroom

It has been reported that students are typically unable to establish SRL processes and often struggle to master complex topics (Azevedo et al., 2012). Therefore, in recent years, educators and researchers have investigated strategies that promote students' SRL in the mathematics classroom. One such strategy has been to design a class activity requiring students to reflect on and explain their learning process and the quality of their work (Rosário et al., 2019). This impacts upon the students' metacognitive and self-reflection skills. Another way to enhance students' metacognitive skills is to include in-class activities in which stronger SRL students can demonstrate to their peers how to manage their time effectively and make the best use of learning strategies (Lai & Hwang, 2016).

Other ways to improve SRL in the mathematics classroom or blended learning environment is the use of strategy observation tools (Bell & Pape, 2014), checklist instruments or self-monitoring forms (McClain, 2015), self-metacognitive questionnaires (Kramarski & Gutman, 2006), or student learning logs (Lai & Hwang, 2016). These tools aid students in self-reflection and self-evaluation of different components of their SRL skills.

Besides in-class SRL strategies, many researchers have attempted to design computer-based learning systems to both promote and support students' SRL (e.g., Duffy & Azevedo, 2015; Lai & Hwang, 2016; Zheng et al., 2018). For example, Lai and Hwang (2016) developed an SRL system that included self-monitoring, teacher management, and an out-of-class system and database to support the flipped classroom approach. They found that a self-regulated flipped mathematics class can improve elementary-level students' learning outcomes and self-efficacy, and that they perform better in goal setting, help-seeking, task planning, time management, and study time strategies.

In another study, Cho and Heron (2015) suggested using a social media platform in self-paced online mathematics to enhance collaborative interaction among students and to support them in self-regulating their motivational and emotional skills, as well as the learning strategies they apply. Collaborative interaction, both face-to-face or online, can lead to collective discourse, which has been shown to improve students' abilities to discuss, justify, and evaluate their mathematical processes (Bell & Pape, 2014; Marshman & Brown, 2015). This implies, therefore, that collective discourse can help to improve students' self-evaluation skills.

Online Homework and OHWP

As a key element of the learning process, the concept of homework has been studied over the years and has been found to help students perform better in their classes. With the use of technology both in and out of class, online homework has increased. Online homework helps increase students' perceptions of mathematical concepts and the mathematics courses they take (Locklear, 2012) and can also increase student involvement during in-class discussions (Locklear, 2012). OHWPs can be offered by textbook publishers (Callahan, 2016; Lunsford & Pendergrass, 2016), as shareware (Balta et al., 2018), or as open-source (Heenehan & Khorami, 2016). Online homework has been shown to improve students' mathematics self-efficacy (Sun et al., 2018). However, there is mixed evidence on whether online homework improves students' self-regulation skills (Lee, 2016; Ramdass & Zimmerman, 2011).

OHWP offers many advantages for both instructors and students. One major advantage is that OHWPs provide immediate feedback to students as they complete their assignments (Balta et al., 2018; Callahan, 2016; Heenehan & Khorami, 2016; Locklear, 2012; Lunsford & Pendergrass, 2016; Perdian, 2013; Shanahan, 2018). This feedback is either in the form of a grade (Duzhin & Gustafsson, 2018; Labuhn et al., 2010; Lunsford & Pendergrass, 2016), providing hints or steps on how to correctly solve the problem (Duzhin & Gustafsson, 2018; Labuhn et al., 2010; Lunsford & Pendergrass, 2016), or regarding the accuracy of the answers submitted by the student (Hegeman, 2015; Hodges et al., 2015). Instructors also receive feedback from

OHWPs with regard to their students' grades, the time spent by their students on each assignment, data regarding their students' access to the system and what assignments they have completed, and what concepts their students either comprehend or have yet to master (Balta et al., 2018; Lunsford & Pendergrass, 2016; Perdian, 2013).

OHWPs allow students to complete their assignments at any time and from anywhere (Albelbisi & Yusop, 2018). This is considered especially helpful for students studying within a hybrid or blended learning class, as they can complete their assignments or learn the required course material outside of the traditional face-to-face classroom (Watson et al., 2011). OHWPs allow students to attempt an assignment multiple times, enabling them to practice more and better learn the concepts taught as part of the assignment (Engelke et al., 2016; Locklear, 2012). Finally, online homework assigned via OHWPs has been shown to help scaffold student learning (Mínguez-Pardo et al., 2024; Ramdass, 2012; Thompson et al., 2016).

When students are consistently held to a high level of accountability to complete their online homework, their self-efficacy, effort regulation, learning strategies, and achievement can be positively influenced (Koukounas, 2016). Similarly, a positive correlation has been established between students completing their homework online and their self-regulation (Lee, 2016; Ramdass & Zimmermann, 2011). This means that as students complete their homework online, they are also improving their ability to self-regulate, and thereby their SRL skills.

Method

Research Design

The current study utilized an action research approach, a systematic inquiry process conducted by educators and school administrators to gather information about how educators teach, how administrators lead their school, and how students learn (Mertler, 2017). The current study used a convergent parallel mixed-methods design, in which quantitative and qualitative data were collected and analyzed separately, then compared and interpreted together (Creswell, 2014). In this study, we embedded SRL strategies within MyMathLab, an OHWP integrated within a college-level blended mathematics course in which the students have low self-regulation skills. We also evaluated the impact of this intervention on students' SRL and mathematics self-efficacy.

Study Setting

The current study took place during the first five weeks of a college-level Algebra class offered to students with low mathematics placement test scores. The course was offered as part of a 2-year program at a regional campus in the Southeastern United States by the first author of the current study. This course was chosen because students taking it typically have some of the lowest SRL and mathematics self-efficacy skills. The students attended in-class lectures and completed daily homework and structured journals using an OHWP called MyMathLab. The class met four days a week for 75 minutes each time.

Intervention

To support students' self-regulated learning and self-efficacy, we embedded SRL strategies within MyMathLab, an OHWP integrated into a college-level blended mathematics course. MyMathLab was chosen to monitor and implement the SRL strategies since it enables students to contact their instructor for assistance where needed (Locklear, 2012), and offers students access to pre-prepared resources (Hegeman, 2015; Lunsford & Pendergrass, 2016) as well as an assignment question bank created by mathematics educators (Hauk et al., 2015; Engelke et al., 2016). Also, MyMathLab offers students specific features to master key concepts and improve their homework grades (Pearson, n.d.). Table 1 summarizes the MyMathLab features used to promote SRL skills.

Table 1

Summary of MyMathLab Tools Promoting SRL Skills

SRL Skill	MyMathLab Tools and Strategies
Goal Setting	• Students would set goals to complete assignments (up to three attempts). • Students would set goals to complete homework assignment prior to next class. • Students would set goals to earn highest grade possible (up to three attempts). • Structured journals help students to evaluate their goals weekly.
Time Management	• Homework assigned daily, and due prior to next class. • Homepage and assignment calendar shows which assignments are due, and when.
Help Seeking	• Students can access different homework help tools (View an Example, Animation, Video, Contact the Professor, and eTextbook) whilst completing their homework.
Mathematics Self-Efficacy	• Gradebook shows students their current class grade and assignment grades. • Help tools available to aid students complete their homework assignments. • Students can rework problems when they are initially incorrect. • Students receive positive, instant, and informative feedback when they answer questions (either correctly or incorrectly). • Study Plan provides students with extra problems for additional practice.
Self-Reflection	• Students would evaluate and judge their position in the class based on their class grade and assignment grades. • Structured journals assigned weekly allow students to self-evaluate their weekly learning process and accomplishments.

Daily homework created using MyMathLab's quiz function was assigned one hour prior to each class, and was due before the next class (i.e., within 24 hours). The homework included five problems, and each student was given three attempts to earn the highest grade possible within the assigned time limit. Whilst completing their daily homework assignments, students had access to a variety of resources and tools provided either by their course instructor or through MyMathLab (see Table 2).

Table 2

Summary of MyMathLab Tools and Resources

MyMathLab Resources and Tools	Description
Course Homepage	Includes the following: • Course calendar. • Which assignments are due next?

	• Course grade. • Link to Study Plan. • Link to Assignment Page. • Link to eTextbook. • Link to Multimedia Library. • Link to Course Tools.
Course Gradebook	Provides the following: • Student's overall grade. • Separate grade for each assignment. • Overall grade breakdown by assignment category.
Course Calendar	• View assignments due each week or for the whole semester. • Weekly view: see when each assignment is given and due. Clicking on dates provides details of each specific assignment. • Semester view: see when all assignments are due.
Assignment Page	• Select which assignment category to view and see which chapter each assignment is in. • Categories: homework, quizzes, tests. • Select to view all assignments or a specific number of assignments.
eTextbook	• Select which chapter and section to access. • Access a specific page, or search for keywords, bookmark pages, and highlight text. • Once a section is chosen, eTextbook also links to the Study Plan and pre-recorded videos. • eTextbook is also accessible from homework help tools tab.
Study Plan	• Provides students with additional practice problems based on concepts taught in each book section. • Practice problems are similar to those in the eTextbook and problem bank used to create homework, quizzes, and tests.
Multimedia Player	• Select which MyMathLab pre-recorded videos, PowerPoint, animations, and interactive figures to access for specific sections of the eTextbook.
Course Tools	• Access to documents uploaded by the course instructor. • Documents are placed in folders organized and created by the course instructor. • Documents can be downloaded and saved.
View Example	• Provides detailed example of how to solve a problem similar to the currently assigned homework.

Videos	• Pre-recorded MyMathLab videos provide detailed examples of how to solve problems similar to currently assigned homework.
Animation	• Tool that provides both a video and interactive examples that students can manipulate (as an example similar to currently assigned homework).
Ask the Instructor	• Enables students to email questions or concerns direct to the course instructor whilst doing their homework.
Instructor Tip	• Enables the course instructor to provide hints to help students complete the assigned homework.

The weekly structured journals used in the current study's intervention are based on the work of Zimmerman and Martinez-Pons (1988). The participants answered three guided questions that focused on self-reflection about their goals for that week, their confidence in applying current concepts to future concepts, their frequency of use of available homework help tools or MyMathLab resources, and their goals for the following week. The students completed structured journals and submitted them via the MyMathLab's test function.

Participants

The study participants were 17 students enrolled in the class; however, only 13 (seven female, six male) were included in the data analysis, as four students did not consent to the use of their data. The demographic information of the study's participants is presented in Table 3. Nine participants also volunteered for the focus group interview.

Table 3

Participant Demographics

Pseudonym	Age (years)	Ethnicity	Gender	Grade	Major
Alex	18	Caucasian	Male	Freshman	Business
Jake	18	Caucasian	Male	Freshman	Computer Science
Jill	19	African-American	Female	Sophomore	Elementary Education
Rose	18	Caucasian	Female	Freshman	Nursing
Shanna	22	Caucasian	Female	Sophomore	Biological Science
Jasmine	18	Caucasian	Female	Freshman	Nursing
Joseph	18	Caucasian	Male	Freshman	Business Administration

Jane	16	Caucasian	Female	Dual credit	Unspecified
Jessica	18	African-American	Female	Freshman	Science
Chris	18	Caucasian	Male	Freshman	Business
Josh	18	Caucasian	Male	Freshman	Environmental Science/Studies
Abby	17	Caucasian	Female	Dual credit	Unspecified
Zach	18	Caucasian	Male	Freshman	Business Marketing

Instruments

Data were collected using the Sources of Mathematics Self-Efficacy Scale (SMSES) (Usher & Pajares, 2009), the Online SRL Questionnaire (OSRLQ) (Barnard et al., 2009; Barnard-Brak et al., 2010), structured journals, and through focus group interviews.

The SMSES consists of 24 items, through which participants rate their mastery of experience, vicarious experience, social persuasion, and physiological state on a 6-point Likert-type scale ranging from 1 = definitely false to 6 = definitely true. The OSRLQ also consists of 24 items and is used for participants to rate their environmental structuring, goal setting, time management, help-seeking, task strategies, and self-evaluation skills using a 5-point Likert-type scale, ranging from 1 = strongly disagree to 5 = strongly agree. These two questionnaires were applied twice, as 1 week prior to and 1 week following the intervention.

The focus group interviews were used to gather the students' experiences and perceptions of how MyMathLab impacted their mathematics self-efficacy and SRL skills. Four interviews were conducted, each with two or three students in each group, with a total of nine participants throughout the study. In the structured journals, which were completed weekly, the students reflected on their confidence with the material taught each week, the tools they used, and their goal-setting skills. Each student submitted five journals during the study.

Data Analysis

To examine the impact of the intervention on participants' SRL skills and math self-efficacy, separate Wilcoxon Signed-Rank Tests were used, following a Shapiro-Wilk Test that indicated the distribution of the differences in the dependent variables was not normal. To eliminate the Type I error, a Bonferroni correction level of .00083 for OSRLQ and .0125 for MSES was used.

The study's qualitative data were analyzed inductively to generate emergent codes, categories, and themes (Cresswell, 2014) using Delve, a qualitative data analysis software (see https://delvetool.com/). We adopted the constant comparative approach and used in vivo, simultaneous and pattern coding so as to make meaning from the data and to determine its patterns and themes (Saldaña, 2016). Peer debriefing, rich and thick description, member checking, and triangulation were used to ensure the study's rigor and trustworthiness.

Findings

How and to what extent does the MyMathLab OHWP impact upon students' SRL skills?

According to the Wilcoxon Signed Ranks Tests, using the embedded SRL strategies in MyMathLab did not statistically impact the students' SRL skills, as can be seen from Table 4. Examination of the median scores showed that the participant students' SRL skills increased slightly, except for Help-Seeking and Self-Evaluation.

Table 4

Results of Wilcoxon Signed-Ranks Tests for OSRLQ (N = 13)

Subscales	Pre-Median	Post-Median	Z-score	p
Goal Setting	3.20	3.60	-1.29	.20
Task Strategy	3.00	3.25	-1.34	.18
Environment Structure	3.75	3.75	-0.95	.34
Time Management	3.00	3.33	-0.76	.44
Help-Seeking	3.50	2.75	-1.26*	.21
Self-Evaluation	3.00	2.75	-1.5	.14

** Based on negative ranked tests.*

Ways to Impact Students' SRL Skills

Even though there are no significant improvement on the participants' SRL score, the students expressed that MyMathLab tools both positively and negatively impacted the following SRL skills: setting long-term goals, setting goals that limited which or how much they used certain homework-helping tools, setting goals to improve themselves, the types of self-evaluation they conducted, and what impacted their understanding of mathematical concepts, class success, and task completion.

The students stressed that using the structured journals and the daily homework helped them to set both short-term and long-term goals. The students also reportedly set goals to improve their task completion and grades, to seek help when needed, to increase their study time, and to manage their time better. The students also stressed the importance of using the structured journals in their goal setting, since the journals encouraged them to set weekly goals. In addition, the students emphasized that the assigned daily homework helped them with time management and with achieving their goals on time because "it's [daily homework] like every day is practice completing a task" (Jill). Furthermore, the students used their daily homework, Study Plan, journals, and the View Example tool to help them in setting their goals. For example, Josh mentioned that, "Like if I'm getting the problems right, I feel more confident and I try to set a goal higher to solve a harder problem."

The students stated positive self-reflections about the daily homework problems they were assigned, such as are exemplified in the following:

“I would say that the consistency of working five or six problems every day has kept my mind fresh on what we are supposed to be learning.” (Jack)

“The daily homework helped me because I’m able to go through each question at my own pace and when you can write on a clean surface.” (Audrey)

The participants stressed the positive impact of using MyMathLab’s homepage and calendar features, as well as their assigned daily homework, on their time management skills. They felt that the daily homework, Study Plan, MyMathLab videos and animations, Class Notes, old test keys, and View Example were the best tools for learning the required mathematical concepts and succeeding in the class. The following excerpts from the participant students exemplify their reasons:

“The reason I used these tools [View Example and Class Notes] and not others were because they most directly helped me with the daily homework I was trying to complete.” (Josh)

“I used these tools [View Example and Study Plan] because they most directly helped me with figuring out which formula to use to solve the word problems.” (Alex)

Lastly, the students mentioned that they most frequently used View Example, Ask the Instructor, and Class Notes; however, there was no clear definition of what they meant by “frequent.” They emphasized that the View Example tool helped them to complete their homework. Although they noted the importance of the various help tools in their learning, they set goals to limit how often or which resources or tools they used in the latter weeks of the course because they mainly did not want to become dependent on the use of these tools, primarily as they are not available during their formal course assessments. With regards to this, Jill commented, “I remember setting my goals one time to not rely on the course tools or examples. I wanted to try it [the problems] on my own first to see if I could do it.”

How and to what extent does the MyMathLab OHWP impact upon students’ mathematics self-efficacy?

The Wilcoxon Signed Ranks Test revealed that using the embedded SRL strategies in MyMathLab did not statistically affect students’ mathematics self-efficacy, as shown in Table 5. A review of the median scores showed an increase only in the Social Persuasion subscale.

Table 5

Results of Wilcoxon Signed-Ranks Tests for SMSES (N = 13)

Subscales	Pre-Median	Post-Median	Z-score	p
Mastery of Experience	3.67	3.33	-2.14	.03
Vicarious	4.00	4.00	-0.88	.38
Social Persuasion	3.67	4.00	-0.08*	.94
Physiological State	4.33	3.33	-2.28	.02

** based on negative ranked tests*

Ways to Impact Students' Mathematics Self-efficacy

Although no significant improvement in their self-efficacy scores was found, the students reported that the MyMathLab tools positively affected their confidence and increased their mathematics self-efficacy. The students mentioned that homework-helping tools (e.g., View Example and Ask the Instructor), daily homework, Gradebook, and Study Plan on the MyMathLab homepage positively improved their confidence and math self-efficacy. The Study Plan was the tool most mentioned by the students for improving their confidence in mathematics, as it helped them feel less confused by clearly walking them through different types of mathematical concepts. On this, Jacob commented, "I have begun to feel more confident after using my Study Plan and copying more examples from during the class."

The students stressed that, in general, all of the homework-help tools boosted their mathematics self-efficacy by providing steps, demonstrating solutions to similar problems, allowing them to check their progress, and were available for help whenever they felt the need. The students reported using the View Example tool most often to check their progress. The students reportedly enjoyed using the Ask the Instructor tool because they could get a clearer idea of the mistakes they were making, and the instructor responded almost instantaneously to their messages.

However, despite all these positives, the students felt that their mathematics self-efficacy and confidence were reduced when they did not use or were not provided with a specific tool, or even any homework-helping tool. Moreover, the students were not happy that some of the daily homework problems consisted of multiple steps, as can be seen in the following:

"I don't feel like it [daily homework] really negatively affects me. However, if it's a long homework assignment, then it negatively affects me." (Shanna)

"…but when the problems are even more complex and challenging, it discourages me because I have a harder time working the problem, and then I fear getting the answer wrong." (Michael)

What are students' perceptions of how the MyMathLab OHWP impacted their SRL skills?

Mixed Perceptions of MyMathLab

The participants reported both positive and negative perceptions whilst using MyMathLab during this intervention. In general, the students enjoyed working on their assigned homework at their own pace, found the help tools beneficial for their studies, benefited from MyMathLab's progress-tracking, and reportedly found it both easy to use and well organized. However, some of the participant students expressed negative perceptions of MyMathLab due to certain technical issues that they experienced as users, and also with regards to the format of the MyMathLab features:

"[I didn't like] not receiving a notification or reminder of when the homework was due." (Shanna)

"I tried to use a video one time, but found that the video didn't load." (Jane)

"I know one time it was like I did the View Example thing, and it showed a different way than how we solved it in class." (Jill)

Ways to Impact Students' Learning Strategies

The participants reported that MyMathLab tools, daily homework, and homework-helping tools aided them in learning the required mathematical concepts and completing their assigned tasks. The majority of the students stressed that the MyMathLab tools facilitated their learning by providing detailed explanations and examples that aligned with their learning needs.". However, a few of the students reportedly found these tools to be unhelpful to their learning experience. One of the students, Michael, mentioned in his daily journal that “I only used it [View Example] a few times since it was showing a different way to do the problems and I didn’t want to get confused.” Another participant, Jake, mentioned his appreciation of the rich resources provided in MyMathLab, saying that “it [MyMathLab] provides everything you need to be able to…understand the content.” The majority of students mentioned in their journal entries that the Study Plan helped them the most, as they perceived it worked best with their learning needs.

Suggestions to Improve MyMathLab

The students made recommendations to improve MyMathLab for future use. First, they did not consider the five problems per assignment sufficient for practicing or learning the mathematical concepts and recommended increasing the number of problems per assignment. Second, the students felt that the structured journal questions should be revised or supplemented with a variety of questions to “get the students to think differently about their goals, studying, time management, etc.” (Rose). Third, the students recommended adding more visual learning aids to MyMathLab. Lastly, they expressed the need for a dedicated mobile app, with one student (Joseph) mentioning that he “…tried to pull up MyMathLab on the phone, but the writing was too hard to read… Also, I can set notifications on my phone for the app.”

Discussion

The purpose of this action research study was to evaluate the impact of using SRL strategies embedded in the MyMathLab OHWP on students’ SRL and mathematics self-efficacy skills whilst taking a college-level Algebra course at a regional college campus in the United States. The quantitative results indicated no significant difference between the students’ pre- and post-SRL and mathematical self-efficacy scores. This is inconsistent with the findings of studies by Kramarski and Gutman (2006) and also Lai and Hwang (2016). Consistent with the findings of the current study, McClain (2015) found no significant differences in SRL scores between SRL and control groups when using an online self-monitoring record after completing each assignment. However, they found a significant difference in the second phase even though the treatment was moderate. This shows the importance of the intervention's length in achieving a positive impact. In the current study, the intervention lasted only 5 weeks, which may not have been long enough to detect a significant effect. Also, Bruso and Stefanik (2016) suggested administering the OSRLQ “multiple times throughout an academic year to identify trends in the use of self-regulated strategies” (p. 583). An alternative explanation for the lack of a significant impact may lie in the students’ higher ratings of SRL and mathematics self-efficacy prior to the intervention. Notably, slight increases in the students’ median post-scores were observed.

Lai and Hwang (2016) stressed that students’ self-regulation awareness can be enhanced when learning in a self-regulated learning environment, “regardless of whether they engage in higher or lower levels of self-regulation” (p. 138). The analysis of the focus group interviews and daily journals showed that MyMathLab both positively and negatively affected their goal setting, self-reflection, help-seeking, time management, and mathematics self-efficacy during the current study’s intervention.

Data retrieved from the students’ structured journals demonstrated that they were actively utilizing their SRL and mathematics self-efficacy skills during the intervention to improve their understanding of the course content and to achieve their overall goal of passing the course. This was first evident in the students evaluating their progress and resetting their goals to either strive to do better or work harder to keep improving during the more difficult learning topics.

The students also had access to MyMathLab’s course calendar and daily homework, which were there to help them set daily, attainable task-completion goals. As the students completed their daily homework, they were each permitted a maximum of 3

attempts to achieve the highest grade possible. Therefore, the students could set their own goals to earn a perfect score on their homework before all three attempts were used up. As Ramdas and Zimmerman (2011) emphasized, “During homework completion, students engage in self-regulation by motivating themselves, inhibiting distractions, using strategies to complete homework, managing time, setting goals, self-reflecting on their performance, and delaying gratification” (p. 195).

Help-seeking occurs during the performance phase of Zimmerman’s Model of Self-Regulation, with learners asking for help from peers, teachers, tutors, or other resources to understand a concept (Kizilcec et al., 2017). In the current study, the students used a wide range of support tools (e.g., Study Plan, eTextbook, View Example, Ask the Instructor, videos, and animations) during the intervention, but with mixed success. This finding aligns with earlier research in which not every participant found the MyMathLab tools, resources, and homework-helping tools helpful or useful, with no explanation given to support this (Holt et al., 2012; Law et al., 2012; Raines, 2016). One factor that may have negatively impacted the students’ help-seeking skills was that the help tool was not organized directly in line with the course (class) material, or where technical issues were encountered.

During the forethought phase of Zimmerman’s Model of Self-Regulation, students create and manage a plan to allocate their time to perform and complete their assigned tasks in order to learn the required course material (Broadbent & Poon, 2015; Handoko et al., 2019; Zimmerman, 2008). Participants in the current intervention reported that the daily homework, the MyMathLab homepage, and the calendar positively impacted their time management skills, corroborating previous studies examining either blended or online learning environments (Handoko et al., 2019).

The students in the current study reported mixed perceptions of how MyMathLab impacted their mastery of the material, which was also reported in Holt et al.’s (2012) study, with mixed reviews from students regarding their conceptual understanding whilst using MyMathLab. Two of the negative perceptions mentioned were not understanding the purpose of nontraditional symbols or letters and having low self-efficacy for new concepts due to perceived complexity.

The students' physiological state was both positively and negatively affected by the use of MyMathLab. Two factors that negatively impacted the students were the difficulty level of the assigned mathematical problems and MyMathLab technical glitches, which corroborate the study by Locklear (2012).

Implications for Practice

Several implications for embedding the SRL strategies into blended math courses can be drawn from the current study. First, the study can be said to contribute to the literature by providing an exemplar for the design and implementation of SRL strategies embedded within an OHWP for use in a college-level math course. This example will likely be relevant to other math instructors and researchers, as well as instructional designers. One key implication for both educators and instructional designers is choosing an appropriate platform for their course, as not every OHWP provides the same amenities and ease of access to its users (Balta et al., 2018; Callahan, 2016; Heenehan & Khorami, 2016; Hegeman, 2015; Locklear, 2012; Lunsford & Pendergrass, 2016). Moreover, to help students set long-term goals, educators should design the first structured journal to establish semester-wide goals and create a plan to meet them.

Limitations

The results of the current study should be interpreted in light of several limitations: a small sample size, a short intervention duration, and the assessment of SRL skills only through pre- and post-surveys. Also, the course instructor (the first author) conducted the interviews. This may have caused participants to report a more positive impact of the intervention.

Future Research

Future research should implement SRL strategies in courses over a longer implementation period, e.g., a full semester, and then administer the OSRLQ multiple times to evaluate trends in students' SRL skills. In addition, to mitigate reporting bias arising from the course instructor serving as the interviewer, future studies should employ a neutral interviewer who is not involved in course instruction, grading, or intervention delivery. This can help participants feel more comfortable expressing critical or negative feedback.

Conclusion

SRL skills are important in blended learning environments, as these settings require learners to take responsibility for their own learning. In this action research study, we examined the effects of embedding SRL strategies within the MyMathLab OHWP on college students' SRL and mathematics self-efficacy skills. Although quantitative analyses showed no significant changes in SRL or self-efficacy scores over the five-week intervention, the participant students expressed many ways during their focus group interviews and in their daily journals in which MyMathLab both positively and negatively impacted their SRL and mathematics self-efficacy skills. These SRL skills included goal setting, help-seeking, self-reflection, and time management as they navigated MyMathLab. Furthermore, students reported both supportive and challenging aspects of the MyMathLab. These findings provide valuable insight into how SRL strategies can be embedded into blended learning environments. With the increasing number of blended learning environments and the widespread use of OHWPs, instructors should intentionally embed SRL strategies to better support students' learning experiences.

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