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USING LEARNER LOGS TO ENHANCE METACOGNITION IN TWO TEACHER EDUCATION COURSES

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Abstract

This paper shares reflections from an empirical study on the experience of using Pintrich et al.'s (1991) Motivated Strategies for Learning Questionnaire (MSLQ) and learner logs to strengthen metacognition and self-regulated learning in students enrolled in two education courses: a) an educational foundations course, which focuses on critical and contemporary issues in education, and b) a mathematics course for elementary education majors, which studies geometry. Student reactions as well as the qualitative benefits and drawbacks of these tools are also shared. In addition, important pointers are highlighted in the following areas: designing pre-class work, providing feedback on the MSLQ, and using the MSLQ results to generate learner log prompts.

Keywords

Motivation, Learning Strategies, Learner Logs, Cornell Notes, Motivated Strategies for Learning Questionnaire

Introduction and Literature Review

In the 21st century, the role of teacher and learner continues to shift as the nation becomes more and more technologically advanced. Along with these innovations come more technological jobs, which require workers to be equipped with 21st century skills. These skills include creativity, collaboration, critical thinking, and problem solving. Therefore, there has never been a better time than now for the nation's graduates to become authentic problem solvers. As problem solvers, learners become more cognizant of, and responsible for, their own learning experiences. This type of learner continuously engages in metacognition and develops autonomously. Research on flipped learning highlights its potential in providing students with opportunities to engage in self-regulated learning experiences (Talbert, 2017). The idea behind flipped learning experiences requires students to prepare outside of class prior to engaging during in-class activities. This requirement is the beginning stage of engaging students in self-regulated learning. Flipped classrooms are known to lead to gains in student engagement and student performance as they facilitate self-teaching, self-assessment, and self-regulation (Talbert, 2017). As shared above, flipped learning experiences are designed to introduce students to the learning materials before class, allowing class time to be devoted to deepening understanding of concepts through collaboration with peers. In-class activities are devoted to deep discussion of concepts and problem-solving activities, which are facilitated by the instructor.

According to Nilson (2013), students take little ownership of their own learning and attribute much of it to what is happening to them (through their professors). Students are not professional learners, and often lack the necessary knowledge (strategic knowledge, knowledge regarding cognitive tasks, and self-knowledge) and skills (self-discipline, effort, and time management) to be self-regulated learners (Nilson, 2013). However, by facilitating a flipped learning environment, educators begin to shift student perspectives of themselves and how they learn, i.e., developing self-regulated learners. Self-regulated learning is cyclical—the student plans for a task, monitors his or her performance, and then reflects on the outcome (Nilson, 2002). Reflection is used to make modifications and prepare for the next task. While students are responsible for monitoring and reflecting on their performance, setting goals, and using results of previous performance to guide future performance, educators play a key role in coaching them along the way (Zimmerman, 2002). It is obvious that students need self-awareness of their own learning and

self-regulation to reap the full benefits of a flipped classroom, since students are expected to be more responsible for learning content outside of the classroom.

As a way to capture student reflections, Weimer (2013) developed "learning logs", which she describes as a reflective writing strategy that helps students develop learning skills and self-awareness of their learning. They have been used in STEM disciplines (Maharaj and Banta, 2000), professional courses (Grimm, 2015), and non-STEM disciplines (Babcock, 2007) to promote knowledge acquisition and self-awareness of learning. Nilson (2013) highlighted the benefits to students when they reflect on their own learning, a notion that captures the framework of this study.

Theoretical Framework

The connected ideals of self-regulated learning, guided self-reflection, and flipped learning provided the frame for this study. To enhance student engagement and maintain a focus on learning, the researchers collaborated in flipping their spring 2018 courses. Each flipped course was designed to measure self-regulated learning practices and guided self-reflection. Self-regulated learning practices were measured using the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, et al. 1991). Guided self-reflection was measured using learner logs that were designed for students to reflect on their learning experience within the flipped classroom. The concept of learner logs is an adaptation of Weimer's (2013) learning logs to shift the focus on the learner. The purpose of this study was to use learner logs as a metacognitive activity to help students in the flipped classroom become more aware of how they learn, acquire self-regulated learning skills, and be more responsible for their own learning. The researchers hypothesize that if students regularly write reflective learner logs and receive periodic feedback from faculty, then they will become more aware of how they learn, and this will enhance their metacognitive skills and lead to their becoming more effective learners.

Methods, Materials, and Procedures

Course Information

Two teacher education courses were included in this study: a) an educational foundations course and b) a mathematics course for elementary education majors (Geometry). The educational foundations course is one of three educational foundations courses that students must take prior to being accepted into the Educator Preparation Program. This course engaged students in observations, interactions, and analyses of critical and contemporary educational issues. Students investigated issues influencing the social and political contexts of educational settings in Georgia and the United States. They actively examined the teaching profession from multiple vantage points both within and outside the school. Against this backdrop, students also reflected on, and interpreted, the meaning of education and schooling in a diverse culture and examined the moral and ethical responsibilities of teaching in a democracy.

Geometry is one of three required mathematics courses for elementary and special education majors. This course engages pre-service teachers in content slightly beyond the mathematics that they will teach. In other words, the pre-service teachers gain a deeper understanding of geometry and measurement concepts taught from elementary grades through 8th grade. This experience allows them to engage in mathematical practices as well as develop and enhance their mathematics content knowledge.

In this study, both courses contained a control group and an experimental group. The control groups were taught largely traditionally, with the control group for the educational foundations course employing a limited amount of flipped learning. Traditional teaching means that instruction of concepts was delivered during in-class lecture, followed by related activities. For the experimental groups, course content was given using a flipped classroom format whereby students engaged in pre-class homework to self-teach and prepare for class, and in-class time was spent in active learning experiences such as problem-solving, computation, discussions, peer teaching, and group activities moderated by the instructor. Students in the experimental groups also engaged in writing a reflections of their experiences throughout the semester using guided learner logs.

More specifically, for the control group of the educational foundations course, Section B, was taught in the manner in which this course had traditionally been taught. Students were simply expected to comply with the established course schedule and complete related readings prior to each class meeting. For research projects, students were expected to seek out and utilize library and other available resources to facilitate course work. The class was heavily lecture-based with the instructor leading all discussions. No formal reflection activity was employed with this group. The experimental group, Section A, was flipped. Pre-class work required students to generate and submit Cornell notes prior to class/chapter discussions. Students were also put in groups of 3-4 and prepared to lead chapter discussions. This approach enabled students to come to class better prepared to engage meaningfully in discussions. The Critical Educational Issues Project was the major course assignment. For this project, students were paired to conduct research and do a class presentation on an educational issue. Pre-class work required students to access a research guide created specifically to aid students in conducting research for the class. In addition, students in this group submitted periodic reflections to "learner" log prompts. In all, students had to respond to 10 leaner log prompts throughout the semester (See Table 1).

In the experimental group, Section B, for the geometry course, students engaged in pre-class work, which included Cornell style notetaking, videos, and self-checks, outside of class to prepare for in-class tasks and activities. Pre-class work preparation was designed to equip students with necessary knowledge and skills to deepen their understandings during in-class tasks and activities. All 'homework exercises' were completed during class meetings within small groups. Additionally, the experimental group students reflected on their learning experiences throughout the semester via learner logs. The prompts for the learner logs are provided in Table 1. On the other hand, in the control group for the geometry course, students engaged in class meeting lectures of mathematics content, collaborated with their classmates during in-class tasks after lectures, and practiced at home by completing assigned homework exercises.

Participants

Educational Foundations Courses. The foundations course, Section A (experimental group) contained 18 students: 61% white, 11% black, 6% Asian, 6% other, and 16% preferring not to disclose their ethnicity. There were 3 males, 13 females, and 2 students who did not provide their gender. Of the 18 students, 17 of them provided additional information within the survey related to age and employment. The average age of these students was 24 with 82% of them being employed outside of the institution. The students also self-declared their year and/or classification status and specified their majors. In the experimental group (Section A), there were one senior, four juniors, two sophomores, one freshman, as well as five students who did not disclose this information. This same group contained four elementary education majors, one education major, one special education major, one biology with teacher certification major, one psychology major, as well as five students who did not share this information.

The control group (Section B) contained 13 students: 23% white, 15% black, 15% Asian, 31% other, and 16% preferring not to disclose their ethnicity. There were one male, seven females, and five students who did not provide their gender. Of the 13 students, eight of them provided additional information within the survey related to age and employment. The average age of these students was 25 with 75% of them being employed outside of the institution. The students also self-declared their year and/or classification status and specified their majors. The control group (Section B) contained one senior, 15 sophomores, one freshman, as well as one student who did not disclose this information. Moreover, this section included seven elementary education majors, three education majors, three special education majors, one history with teacher certification major, one psychology major, one dental major, as well as one student who did not share this information.

Geometry Courses. In the geometry course, the control group (Section A) contained 20 students: 60% white, 25% black, 10% other, and 5% preferring not to disclose their ethnicity. The average age of these students was 23 with 55% of the students employed outside of the institution. The students also self-declared their year/classification and their majors. There were 18 juniors and 2 seniors; of these students, 18 declared their major as elementary education while the other 2 declared their major as education.

The experimental group (Section B) contained 19 students: 79% white, 11% black, 5% Asian, and 5% other. Their average age was 25 with 63% of the students employed outside of the institution. The students also self-declared their year/classification and their majors. There were 18 juniors and 1 senior; of these students, 17 declared their major as elementary education while the other 2 declared their major as education.

Materials and Procedures

Motivated Strategies for Learning Questionnaire (MSLQ)

At the beginning and again at the end of the 2018 spring semester, both experimental and control groups completed the MSLQ (Pintrich et al., 1991). The pre- and post-survey results of the MSLQ were compared to determine change/growth in self-regulated learning. According to the hypothesis, if students regularly write reflective learner logs and are provided periodic feedback from faculty, they would become more aware of how they learn and consequently develop into more effective learners.

The MSLQ is an 81-item self-report measure of metacognition related to students' motivation as well as learning strategies using a 7-point Likert scale with ratings ranging from 1 ("not at all true of me") to 7 ("very true of me"). Respondents indicate to what degree each item is true for them. The motivation scales included three components: value (intrinsic goal orientation, extrinsic goal orientation, and task value), expectancy (control beliefs and self-efficacy for learning and performance), and affective (test anxiety). The learning strategies scales included two sets of strategies: cognitive and metacognitive strategies (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) and resource management strategies (time and study environment, effort regulation, peer learning, and help seeking).

Learner Logs

Throughout the semester, students in the experimental sections completed regular "learner" log entries, with specific prompts, designed to promote self-awareness and self-reflection targeted at their own learning. Learner

logs were slightly modified to align with course content (See Table 1 below). For example, the prompt for the first entry for the educational foundations course asked students to reflect on the benefits of the course content as it relates to future courses and career goals. Another prompt for the fifth entry asked students to outline strategies or a game plan they were employing to study for the midterm exam. Then the prompt for the sixth entry asked them to assess the success of their game plan based on the results of their midterm exams. Students used this information to reflect on their learning preferences and what worked best for them in order to make needed changes. Similarly, for example, the first entry for geometry asked students to reflect on the importance of this course in relation to their career goals. Another prompt for the fifth entry asked students to describe how they plan to use the flipped classroom materials (self-checks, videos, and pre-class work) to support them as they prepared to take the midterm examination. Then, the sixth entry asked them to create a game plan for moving forward in the course to obtain the success that they wanted. This prompt was specifically designed to help them prepare for the final quiz of the course. This prompt also allowed them to revamp their learning preferences and determine what worked best for their success.

Learner Log	Educational Foundations	Geometry
1	Why is it important to learn the material in this course? Why might a college require this course? How does success in this course relate to your career goals? How does it relate to success in future courses? What, specifically, do you want to be able to do by the end of this course? Most important, you are an individual with a very distinct set of learning skills. How can these skills help or hinder you in achieving your goals for the course?	Why is it important to learn the material in this course? Why might a college require this course? How does success in this course relate to your career goals? How does it relate to success in future courses? What, specifically, do you want to be able to do by the end of this course? Most important, you are an individual with a very distinct set of learning skills. How can these skills help or hinder you in achieving your goals for the course?
2	Choose one or two skills you've acquired outside of school, such as playing a sport, playing a musical instrument, or making jewelry. What activities helped you the most in becoming proficient at these skills? How long did you spend watching someone else perform the skill, as opposed to practicing it yourself? Should learning in school be any different? Why or why not?	Choose one or two skills you've acquired outside of school, such as playing a sport, playing a musical instrument, or making jewelry. What activities helped you the most in becoming proficient at these skills? How long did you spend watching someone else perform the skill, as opposed to practicing it yourself? Should learning in school be any different? Why or why not?
3	As you know already, you are in a ``flipped'' class. A rough way to describe such a class is that the classwork occurs at home and the homework occurs in class. What advantages and disadvantages do you see to having the teacher and your fellow students available during the time devoted to the more advanced concepts, problems, and applications? In what ways will the flipped class be both harder and easier than a more traditional course? Why do you think a teacher might design a course in the ``flipped'' format?	As you know already, you are in a ``flipped'' class. A rough way to describe such a class is that the classwork occurs at home and the homework occurs in class. What advantages and disadvantages do you see to having the teacher and your fellow students available during the time devoted to the more advanced concepts, problems, and applications? In what ways will the flipped class be both harder and easier than a more traditional course? Why do you think a teacher might design a course in the ``flipped'' format?
4	How are you taking advantage of the at-home readings, videos, or pre-class work? Are you pausing and rewinding? Using a note-taking system such as Cornell notes? Writing down questions in the margins or in your notes? Summarizing the content? Self-testing? Reviewing your notes before class? In what ways can you make the at-home portion of class more interactive? Also, this work requires you to develop time management skills. How is that going for you right now? If it is not going well, then what can you do to better budget your time?	How are you taking advantage of the at-home readings, videos, or pre-class work? Are you pausing and rewinding? Using a note-taking system such as Cornell notes? Writing down questions in the margins or in your notes? Summarizing the content? Self-testing? Reviewing your notes before class? In what ways can you make the at-home portion of class more interactive? Also, this work requires you to develop time management skills. How is that going for you right now? If it is not going well, then what can you do to better budget your time?
5	We will have our first exam next week. How are you studying and preparing for it? What is your study game plan?	Now that we have discussed the details of the flipped classroom and you have received your midterm grade in this class, what are your plans for moving forward in this class? How do your notes assist you with the content? How do the videos assist you with the content? How do the self-checks assist you with the content? If you have not used any of these things, do you plan to? Explain. As I stated in class, I have to balance giving you time to do homework and time to engage in class discussions. We had a great discussion on solids and quadrilaterals; it helped to address

		misconceptions and conceptions. If you could choose, which would you prefer we do in class in the event that we do not have time for both. Why?
6	By now you have the results of your first exam. How did your study game plan work for you? What, if anything, would you change for the next exam? Were you faithful to the game plan? Did you learn anything about your own learning preferences, or what works best for you? Finally, reflect on your study strategy in light of the following quote: ``In college, the bulk of the learning should take place outside the classroom.''	We will have our second quiz on April 6th; this quiz will be completed in class. Fill out the Study Game Plan that I've uploaded into D2L, and turn it in for your sixth entry.
7	How are you taking advantage of the in-class component of flipped learning? Are you arriving prepared? Asking questions of your teacher and peers? Participating fully in group activities? If not, what has kept you from doing so, and how might you change this? How do our in-class activities relate to the at-home activities? Have you taken advantage of the opportunity to teach any of your classmates? If so, did you feel more in command of the course concepts after you did so?	By now you have your results of quiz 2. How did your study game plan work for you? What, if anything, would you change for the next exam? Were you faithful to the game plan? Did you learn anything about your own learning preferences, or what works best for you? Finally, reflect on your study strategy in light of the following quote: ``In college, the bulk of the learning should take place outside the classroom.''
8	How are you taking advantage of the in-class component of flipped learning? Have you kept up with submissions of Cornell notes by established deadlines? If so, did you feel more in command of the philosophical concepts discussed? Participating fully in class discussions? If not, what has kept you from doing so, and how might you change this?	For your last entry, reflect back upon your very first learner log entry. What have you learned about your own learning in the flipped classroom? How could you use your awareness of your learning skills in future courses? Since learning isn't merely an academic skill, how could you use this awareness in a career or hobby? Consider the following statement: Learning skills are just as important as course content in a college education. Agree or disagree? Why?
9	Reflect back upon Entry 2. Now that you've had experience in a flipped class, how would you compare your learning in this class to the acquisition of the skills you described? If you hadn't needed to demonstrate your skills daily in class, would you have been as prepared for class? Also, take a moment to ponder the handout on Anderson & Krathwohl's cognitive taxonomy. Your homework built a foundation in Remembering and Understanding. As specifically as you can, describe how classwork developed the upper levels of this taxonomy.	
10	For your last entry, reflect back upon your very first learner log entry. What have you learned about your own learning in the flipped classroom? How could you use your awareness of your learning skills in future courses? Since learning isn't merely an academic skill, how could you use this awareness in a career or hobby? Consider the following statement: Learning skills are just as important as course content in a college education. Agree or disagree? Why?	

Table 1. Learner Log Prompts by Course

Results

For both courses (educational foundations and geometry), the experimental groups engaged in flipped learning along with the use of learner logs. However, the control group for these courses engaged in different formats. Educational foundations control group engaged in traditional lecture and included a limited amount of flipped learning, but did not write learner logs. Geometry control group engaged in a traditional lecture course without flipped learning and without the use of learner logs.

With this methodology, there were multiple hypotheses:

1. Implementing flipped learning throughout the semester will have a positive impact on students' motivation. (i.e., The Motivation Subscales of the students will have a positive change from the beginning of the semester to the end of the semester.)
2. Implementing flipped learning throughout the semester will have a positive impact on students' learning

strategies. (i.e., The Learning Strategy Subscales of the students will have a positive change from the beginning of the semester to the end of the semester.)

3. Self-Regulation based on Motivation and the use of Learner Logs - The use of learner logs and students writing about their learning would have a positive impact on self-regulation throughout the semester.
4. Self-Regulation based on Learning Strategies and the use of Learner Logs - The use of learner logs and students writing about their learning would have a positive impact on self-regulation throughout the semester.

When addressing the first and third hypotheses, a MANOVA test was conducted to compile data related to motivation subscales from both classes that engaged in flipped learning. The results for the motivation subscales showed a significant difference between scale means [F (5, 285) = 6.38, $p < 0.001$] and a significant difference in the motivation subscales over time, i.e., from pre- to post-semester, [F (1, 57) = 11.43, $p = 0.001$]. However, there is no significant two-way interaction between the subscales and time [F (5, 285) = 1.36, $p = 0.24$], and no significant three-way interaction between scale, time, and the use of learner logs [F (5, 285) = 1.69, $p = 0.14$]. It is necessary to note that of the total number of students (59) who completed both surveys (pre and post), 24 students used learner logs while 35 students did not use learner logs. Student motivation scores declined when learner logs were used with the exception of the intrinsic goal orientation subscale (see figure1). Student motivation scores decreased over time when learner logs were not used.

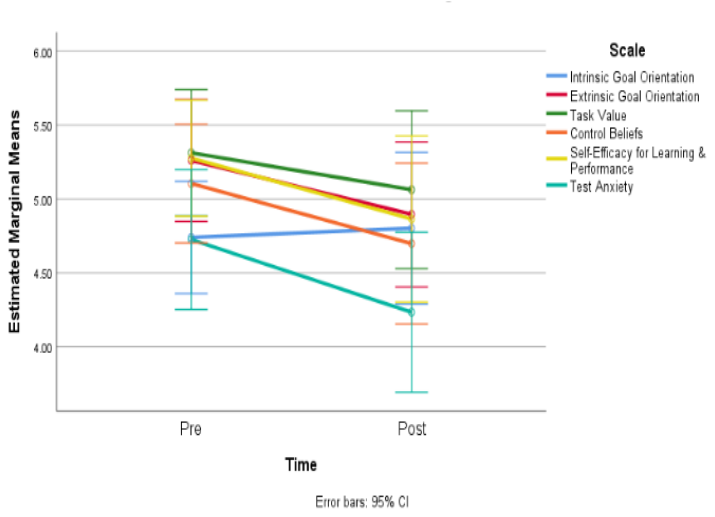

Figure 1: Change in Motivation Subscales with the Use of Learner Logs

When addressing the second and fourth hypotheses, a MANOVA test was conducted to compile data related to learning strategies subscales from both classes that engaged in flipped learning. For the learning strategy subscales, there is significance between scale means [F (7, 399) = 15.99, $p < 0.001$], significance in the learning strategy subscales over time, i.e., from pre- to post-semester, [F (1, 57) = 3.40, $p < 0.10$], and a significant two-way interaction between the subscales and time [F (7, 399) = 3.71, $p = 0.001$]. There is no significant three-way interaction between scale, time, and the use of learner logs [F (7, 399) = 1.57, $p = 0.14$]. When learner logs were used, there was an increase in the student learning strategy scores in elaboration and critical thinking; however, a decline was recorded in the other learning strategy scores (See figure 2). Student learning strategy scores decreased over time when learner logs were not used, with the exception of the peer learning subscale.

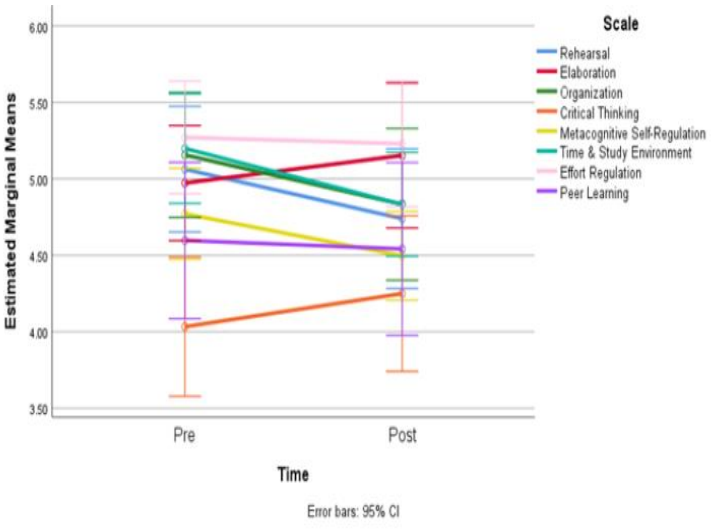

Figure 2: Change in Learning Strategy Subscales with the Use of Learner Logs

To further examine the results, data from each course were disaggregated separately. Based on the results from combining courses, some similarities were present; however, differences were exemplified. This is expected as one course is comprised of sophomore students who are in an educational foundations course, while the other course, geometry, is comprised of students who are juniors and seniors matriculating through the education program. For each of the courses, the data were separated based on students' use of learner logs. Because both groups (control and experimental) in educational foundations engaged in flipped learning, the results are presented in three ways: 1) With and without the use of learner logs 2) With the use of learner logs, and 3).

Without the use learner logs. In contrast, for geometry, only the experimental group engaged in flipped learning; therefore, the results for the geometry course are presented in two ways: 1) With the use of learner logs (experimental) and 2) Without the use of learner logs (control).

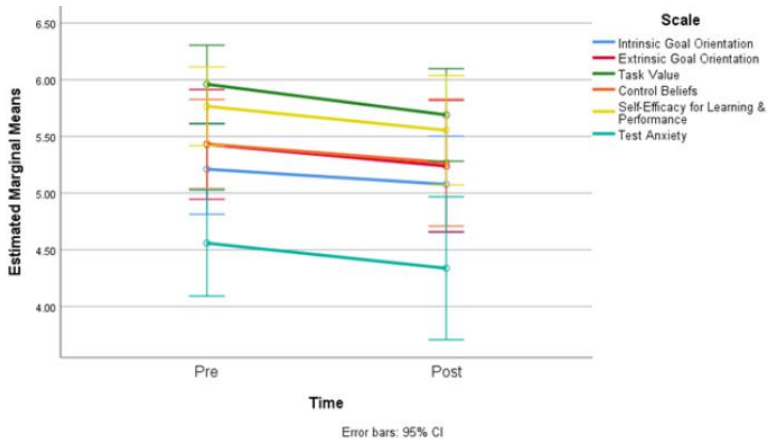

Figure 3: Change in Motivation Subscales (with & without) Learner Logs in Educational Foundations

A paired t-test on data from both educational foundations groups showed no significant difference in any of the motivative subscales. Contrary to expectation, the motivation scores of the students decreased throughout the semester (See Figure 3).

There is a significant mean difference in the six motivation subscales [F (5, 110) = 9.24, p < 0.001]. However, there is no significant difference in the motivation subscales over time, i.e., from pre- to post-semester, [F (1, 22) = 2.49, p = 0.129], and there is no significant two-way interaction between the subscales and time [F (5, 110) = 0.079, p = 0.995].

When examining these groups in relation to learning strategy subscales, there is a significant difference in rehearsal (p < 0.05), self-regulation (p < 0.10), and peer learning (p < 0.05). In fact, there is a significant decrease in rehearsal and self-regulation, and a significant increase in peer learning. The scores of the remaining learning strategies of the students remained constant, i.e., no significant shift/change. (See Figure 4).

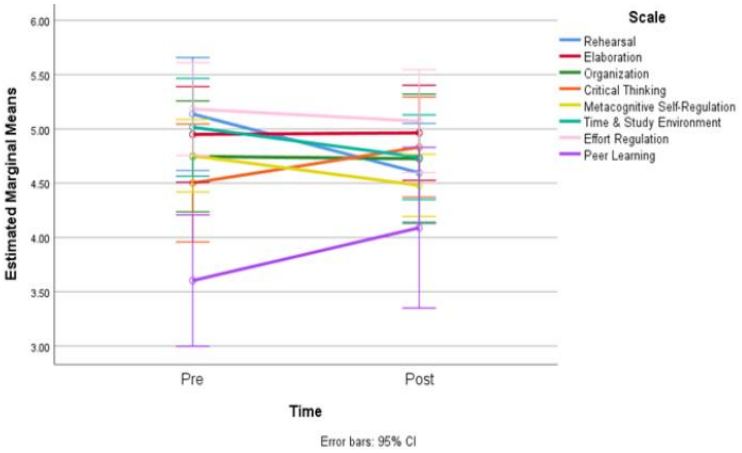

Figure 4: Change in Learning Strategy Subscales (with & without) Learner Logs in Educational Foundations

In examining the groups separately using the MANOVA test for the motivation subscales, there is significant difference between scale means [F (5, 105) = 7.56, p < 0.001]. However, there is no significant difference in the motivation subscales over time, i.e., from pre- to post-semester, [F (1, 21) = 1.62, p = 0.218] and, there is no significant two-way interaction between the subscales and time [F (5, 105) = 0.95, p = 0.993], and no significant three-way interaction between scale, time, and the use of learner logs [F (5, 105) = 0.418, p = 0.835]. It is necessary to note that of the total number of students (23) who completed both surveys (pre- and post-), 7 students used learner logs while 16 students did not use learner logs. Student motivation scores declined when learner logs were used with the exception of the intrinsic goal orientation subscale. Student motivation scores decreased over time when learner logs were not used. This is indicated in Figures 5 and 6.

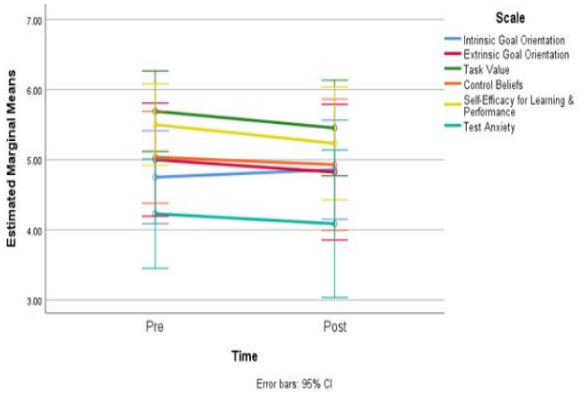

Figure 5: Change in Motivation Subscales with Learner Logs in Educational Foundations

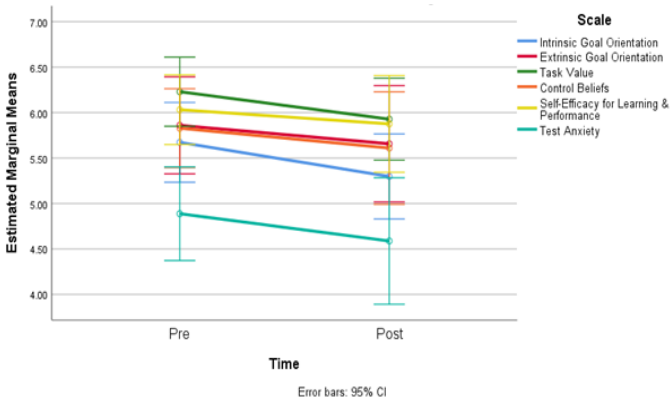

Figure 6: Change in Motivation Subscales without Learner Logs in Educational Foundations

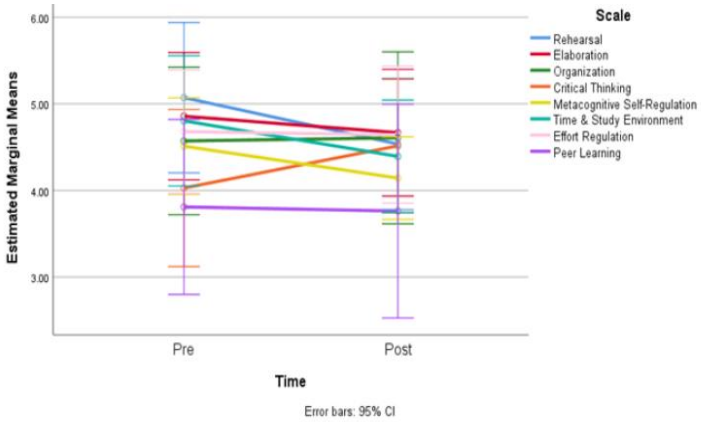

Figure 7: Change in Learning Strategy Subscales with Learner Logs in Educational Foundations

Moreover, for the learning strategy subscales, there is significance between scale means [F (7, 147) = 6.73, p < 0.001] with no significance in the overall shift in the learning strategy subscales over time, i.e., from pre- to post-semester, [F (1, 21) = 0.18, p = 0.675]. There is a significant two-way interaction between the subscales and time [F (7, 147) = 2.57, p < 0.05] with no significant three-way interaction between scale, time, and the use of learner logs [F (7, 147) = 1.09, p = 0.376]. When learner logs were used, there was an increase in the student learning strategy scores in organization and critical thinking, however, a decline in the other learning strategy scores. When learner logs were not used, student learning strategy scores in elaboration, critical thinking, and peer learning subscale increased over time, but decreased over time for the remaining subscales. This is indicated in the Figures 7 and 8.

Both groups (experimental and control) for geometry, were examined separately and their modalities were completely different. The control group was taught using a traditional lecture model and the experimental group was taught using the flipped learning model, and learner logs were used to document self-regulated learning. Therefore, the data for each course was examined separately. For the motivation subscales, there is significant difference between scale means [F (5, 170) = 3.09, p = 0.011], a significant difference in the motivation subscales over time, i.e., from pre- to post-semester, [F (1, 34) = 9.90, p = 0.003], and there is a significant two-way interaction between the subscales and time [F (5, 170) = 2.06, p < 0.10]. There is also a significant three-way interaction between scale, time, and the use of learner logs [F (5, 170) = 2.07, p < 0.10]. It is necessary to note that of the total number of students (36) who completed both surveys (pre- and post-), 17 students used learner logs while 19 students did not use learner logs. Student motivation scores declined when learner logs were used with the exception the intrinsic goal orientation subscale. Student motivation scores decreased or remained constant over time when learner logs were not used. In Figures 8 and 9, this information is shared and documented.

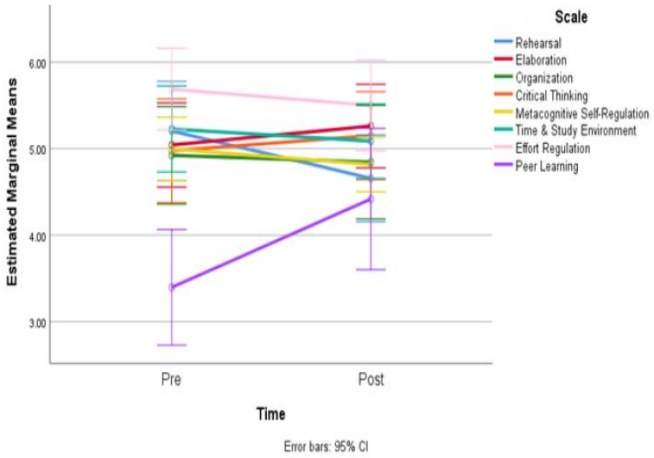

Figure 8: Change in Learning Strategy Subscales without Learner Logs in Educational Foundations

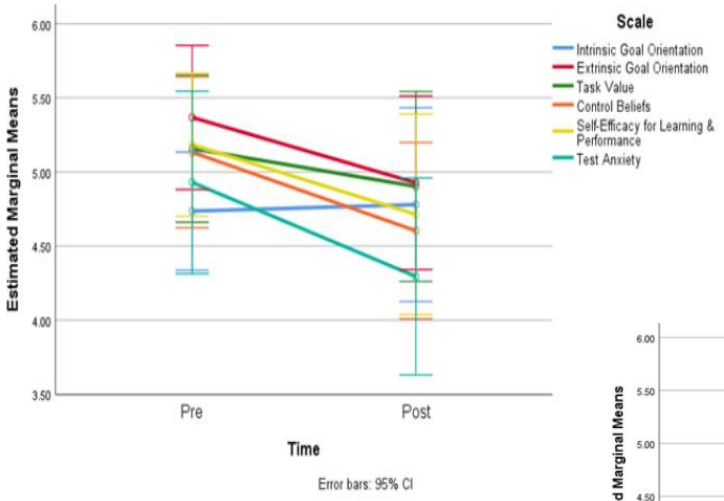

Figure 9: Change in Motivation Subscales with Learner Logs in Geometry

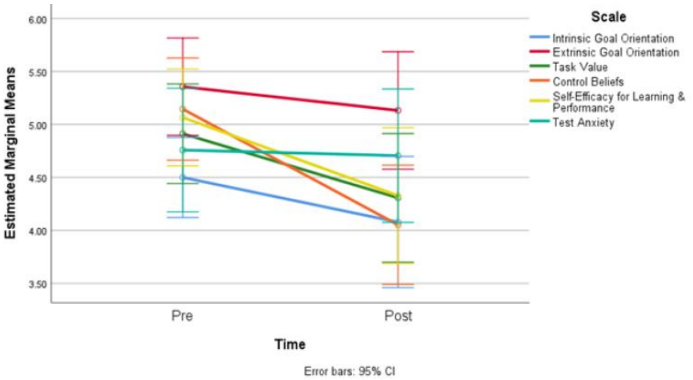

Figure 10: Change in Motivation Subscales without Learner Logs in Geometry

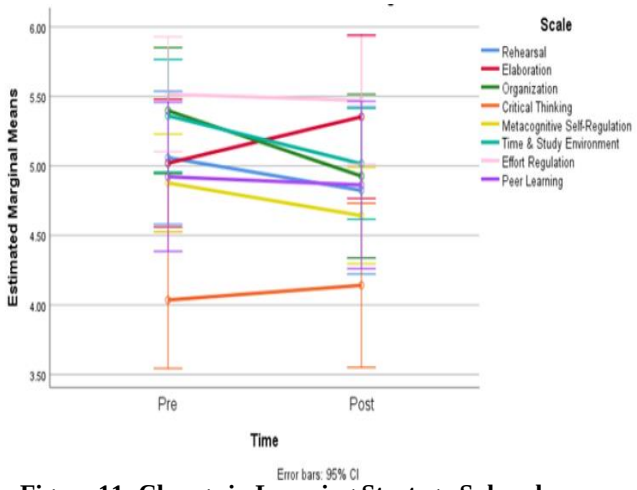

Figure 11: Change in Learning Strategy Subscales with Learner Logs in Geometry

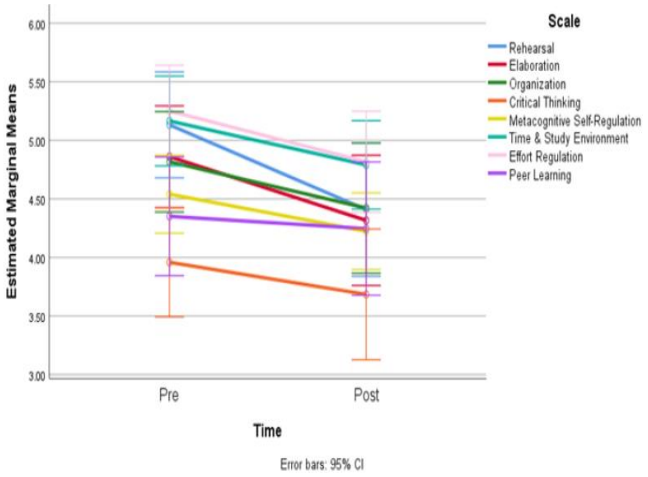

Figure 12: Change in Learning Strategy Subscales without Learner Logs in Geometry

For the learning strategy subscales, there is significance between scale means [F (7, 238) = 15.69, $p < 0.001$], and a significance in the overall shift in the learning strategy subscales over time, i.e., from pre- to post-semester, [F (1, 34) = 4.58, $p = 0.040$]. However, there is no significant two-way interaction between the subscales and time [F (7, 238) = 1.27, $p = 0.265$], and no significant three-way interaction between scale, time, and the use of learner logs [F (7, 238) = 1.28, $p = 0.261$]. When learner logs were used, there was an increase in the student learning strategy scores in elaboration and critical thinking, however, a decline in the other learning strategy scores. When learner logs were not used, student learning strategy scores decreased over time (Figure 11 and Figure 12).

Discussion

A qualitative analysis of the learner log entries complements the MSLQ findings. In order to review a randomized set of learner log entries, all students in each course were assigned a number, which was used to identify learner log entries for the students associated with the number selected. Numbers were selected using a random number generator. For each question and for each course, five numbers were randomly selected. If a learner log entry was not provided for a selected number, another number was randomly selected using the random number generator. And lastly, to analyze one student's entries for all questions, an additional number was selected from the experimental group of each course. Learner log entries associated with the randomly selected numbers were reviewed and analyzed for the following themes: a) Self-regulation and motivation and b) self-regulation and learning strategies. In the subsequent paragraphs, excerpts from learner logs for each course will be shared as well as a brief analysis to support the results of the MSLQ.

Self-regulation and Motivation

Pintrich et al. (1991) describe the Motivation Scales and the Learning Strategies scales. Motivation Scales comprise three components—Value, Expectancy, and Affective. Value components include Intrinsic Goal Orientation, Extrinsic Goal Orientation, and Task Value subscales. Intrinsic Goal Orientation pertains to the degree to which the student perceives their participation in a task is for reasons such as challenge, curiosity, or mastery. Extrinsic Goal Orientation refers to the degree to which the student perceives their participation in a task is for reasons such as grades, rewards, or comparing their performance to that of others. Task Value pertains to the student's evaluation of how interesting, important, or useful the task is. Expectancy components comprise control of learning beliefs and self-efficacy for learning and performance subscales. Control of learning involves the belief by students that their efforts to learn will result in positive outcomes, as opposed to external factors such as the teacher. Self-efficacy for learning and performance refers to the student's appraisal of their ability to master a task as it relates to performance expectations on the task at hand. The Affective component relates to Test Anxiety subscale. Test Anxiety refers to negative thoughts that interfere with performance as well as the emotional and physiological aspects of anxiety.

Educational Foundations Courses

Student motivation scores declined when learner logs were used with the exception of the intrinsic goal orientation subscale. Students scored highly on the intrinsic goal orientation value subscale. According to Pintrich et al (1991), "having an intrinsic goal orientation towards an academic task indicates that the student's participation in the task is an end all to itself, rather than participation being a means to an end." Several entries are consistent with this

statement. A comment captures the general view of the course as beneficial to preparing students for the profession:

> Investigating the critical and contemporary issues in education...is a course that will be of great use to me. It will help me reach my goal to major in education. It has always been something I have wanted to do. I am already in the field of teaching and I am learning everyday how to become a better teacher. I want to be able to touch/impact as many lives as I can...

Other statements reveal student interest in engaging in elements of the flipped course to help them better prepare for, and get the most benefit from, class meetings while also building their learning skills:

> ...An advantage would be going over classwork at home on your own and coming to class already having learned the material. Allowing you to ask questions in class when doing assignments. It would take more dedication which could help build the skills in order to learn differently...
> I was never one to sit down and study but it has a lot of benefits so far. I like to know what we're doing next class and be prepared... So I can say I am definitely managing my time better than before...
> So far, a flipped classroom has been an eye-opening experience for me. I enjoy learning material at my own pace and teaching myself the way that I see best fit. A flipped classroom is designed to help students be more prepared for class and come to school ready to discuss different topics and gain input from other students as well as the instructor. This course has caused me to read textbook material outside of class and come to school ready to input my knowledge into a group discussion to learn even more and see different viewpoints on the subject matter. I feel as though being in a flipped classroom has helped me read and understand the subject matter more thoroughly and therefore get more out of the course.
> One of the best parts about class discussions is that I can ask my classmates if something confused me or was hard to understand. For example, I had a hard time understanding some of the ideas from chapter four and I was able to get a clearer understanding after coming to class and discussing the concepts with other students. Overall, I am using the flipped classroom to my advantage by learning concepts more thoroughly and at my own pace.

The other components and subscales (extrinsic goal orientation and task value subscales, as well as expectancy and value components) saw a decline. Extrinsic goal orientation pertains to the degree to which the student perceives themselves to be participating in a task for other reasons not directly related to participating in the task, for example, grades, evaluation, etc. (Pintrich et al., 1991). The caution from Pintrich et al. (1991) regarding the variability of student responses is worth noting.

Student motivation scores decreased or remained constant over time when learner logs were not used. Notwithstanding, this result is of negligible significance since Pintrich et al. (1991) propose using information to nurture skills in students that are advantageous to them.

Geometry Courses

Student motivation scores declined when learner logs were used with the exception of the intrinsic goal orientation subscale. Most entries indicated that students saw value in the mathematics course and that it would prepare them for the teaching profession. Additionally, students shared that concepts in the course were important in life. In the following excerpts, students provided their conceptions:

> ...The material in this course is what we as future educators are expected to know and be familiar with. In my opinion, if an educator is not aware of the material he or she is teaching there is no way an educator can expect their students to learn. Thus making it important for us to learn the material in this course....
> ... It is important for me to learn and master the material learned in this course, so that someday I can teach this material to my future students...

Entries revealed that students believed they would do all it takes to be successful in the course. Due to multiple challenging and/or negative experiences with math, some students stressed why it was important for them to put forth 100% effort in the course. This is evident in the following excerpts:

> ... If I do not feel comfortable with this information that will be reflected in my teaching. Thus making it critical I be successful in this course for my career goals. Not to mention, my success in this course can also impact future math courses I may take. The reason I believe this could have an impact on future courses is that math is a building block in many aspects...

> ...The first skill I have is determination. I am going back to school after being out for more than 10 years. I am trying to get through this program while pregnant and raising three children at home. This determination to succeed has gotten me far in this program and I am confident that it will get me through this class.

The aforementioned excerpts draw a connection between students' perceptions related to the intrinsic goal orientation, in which participation happens due to the end task itself, i.e., completing the course. These four excerpts are specifically from the first few learner log entries of the course. Towards the middle and second half of the semester, emphasis was placed on students' perceptions related to the flipped classroom design, which included the reflection aspect of learner logs. Evidence from their entries revealed that students believed that although the flipped design of the course is challenging, it did free up time for more student collaboration during lectures. It provided opportunities for them to hear other students' ways of reasoning as well as hear different perspectives of course concepts. Additionally, it was evident that students agreed that the course design allowed for more student engagement during lectures, provided opportunities for the professor to address more challenging components of a particular concept, and provided more time for the professor to assist students individually. The following excerpts from learner log entries highlight these perceptions:

> ...There are some advantages and disadvantages to having a flipped classroom design. Learning basic concepts at home and gathering questions on the unclear material can free up crucial class time for more complex topics. Moreover, having the teacher and your fellow students available to assist with instruction during class time can be extremely beneficial. It allows for valuable time devoted to the more advanced concepts, problems, and applications. The disadvantages of a flipped classroom are that it requires students to be diligent and learn the foundations of a lesson on their own. Some students cannot or will not pick up the skills needed without explicit instruction from the beginning. If they do not understand the easier content, then these students will be lost jumping into the harder material. If too many students do not learn at home, then the class time will need to be spent teaching the basics to the ones who did not grasp. Where then does that leave the ones who have already mastered it?
>
> ... In a flipped classroom, the process could be easier for the teacher and the students in certain ways. It is easier for the students to learn the content at home and practice what they learned in class with their teacher. For example, in a math course – if the students learn the skills outside of the classroom, then they will have more time to practice math problems during class to have a better understanding of how to set-up and solve the problems. A flipped classroom may be harder than a traditional classroom in certain ways as well. Some students may fall behind because they are not doing the research and learning on their own. Also, some students may find it difficult to learn the information outside of the classroom, which can also cause them to fall behind. I believe that a teacher might design a flipped classroom to challenge and motivate students to be independent and expand their knowledge outside of a classroom. In a flipped classroom, the students learn the content on their own, but they have more time to practice the skills they learned during their class time. This will allow the students to have a deeper understanding of the content – this is why I believe teachers might design a flipped classroom.
>
> ...There are different advantages and disadvantages of having a flipped classroom. Advantages would consist of being able to complete homework problems in class while having the teacher there for help if needed. Another advantage would be really getting to sit down and collaborate with one another on the problems students were struggling with. Having immediate help available for problems is an advantage to have questions answered right away. A disadvantage of a flipped classroom would be having to basically teach ourselves. Math is a difficult subject already, and having to teach ourselves the content is extremely difficult. Another disadvantage is if a student already knows how to do the homework problems, it may be a waste of time coming to class.
>
> ...Being in a flipped classroom is a very different experience versus being in a traditional classroom. I feel that there are several advantages and disadvantages that come along with being in this type of environment. I feel that it is very beneficial to work together with peers in class and help each other with difficult homework problems. It is very helpful to have that help, when in a traditional class; you are on your own doing homework. Another advantage is that you are able to work the problems on your own if you choose to do so, but also have that time in class to see what other ways your peers have answered the problem. This can be very helpful for those that may struggle with certain problems or concepts. Some disadvantages with the flipped classroom is that it is very difficult to learn math on your own at home. Math has never been my strongest subject and I need plenty of help in order to be successful in the class.

Students' perceptions of the flipped class highlighted advantages shared above, and disadvantages shared related to students' first experiences with the flipped classroom design. Most students felt that it forced them to teach themselves at home and prepare for lectures. This was hard to accept because students are used to a more traditional math class, where all concepts are initiated by the teacher. The flipped classroom design is opposite as it requires students to be exposed to the concept prior to attending class. As evident from the previous entries, it became frustrating; however, as students gained more experience with the design week after week they gained a deeper understanding of how it supports their learning of the material. This learning is related to developing self-regulated learners and more independent thinkers. Therefore, it is important to highlight the balance between the advantages and disadvantages of the flipped classroom. Use of the learner logs allowed these students to reflect as they engaged with course material, which as shown in the survey results, connects to the increase in the intrinsic motivation subscale.

Student motivation scores decreased or remained constant over time when learner logs were not used (similar to overall data results). Use of learner logs provided opportunities for students to reflect their perceptions related to the course throughout the semester. However, with the control group, students were not required to do so; therefore, their motivation strategies were not captured. This is definitely in line with the MSLQ document. As stated above, the authors suggest using the MSLQ results formatively to enhance student learning along the way. The fact that the results may appear counter-intuitive, therefore, is inconsequential to the usefulness of the instrument.

Self-regulation and Learning strategies

Pintrich et al.'s (1991) Learning Strategies Scales incorporated two components—Cognitive and Metacognitive strategies and Resource Management Strategies. Cognitive and Metacognitive Strategies include Rehearsal, Elaboration, Organization, Critical Thinking, and Metacognitive Self-Regulation subscales. Rehearsal involves strategies applied to simple tasks, such as reciting or naming, to activate information in working memory, rather than acquisition of new information in long-term memory. Rehearsal influences attention and encoding but does not affect critical thinking. Elaboration (paraphrasing, summarizing, note-taking, making analogies) helps students store information in long-term memory and begin making connections among information. Organization (clustering, outlining, extracting main ideas) helps the learner with appropriate information selection and construction of connections among information. Critical thinking pertains to student application of previous knowledge to new situations to problem solve or make decisions or critical evaluations. Metacognitive Self-Regulation involves planning, monitoring, and regulating. Planning involves activities like goal setting and task analysis which help activate prior knowledge organization and comprehension of information. Regulation refers to finetuning and continuous adjustment of one's cognitive activities, which helps improve performance as students learn to check and correct their behavior along the way. Resource Management Strategies include Time and Study Environment, Effort Regulation, Peer Learning, and Help Seeking subscales. Time and Study Environment refers to the student's ability to manage and regulate their time and study environment to achieve optimum performance. Effort Regulation pertains to students' ability to control their effort and attention amid distractions and uninteresting tasks, which signifies a commitment to completing one's study goals despite difficulties or distractions. Peer Learning refers to collaboration with one's peers, which has been shown to have positive effects on academic achievement. Help Seeking refers to the student's ability to recognize a gap in their knowledge, and then identify and seek help from someone (peer, teacher, librarian, etc.)

Educational Foundations

When learner logs were used, there was an increase in the student learning strategy scores in organization and critical thinking, however, a decline in the other learning strategy scores. According to Pintrich et al. (1991), organization pertains to strategies that help the learner select appropriate information and construct connections among the information to be learned, and critical thinking refers to the degree to which the learner reports applying previous knowledge to new situations to solve problems, reach decisions, or make critical evaluations with respect to standards of excellence. Several learner log entries highlight student attempts at self-regulation targeted at learning strategies employed to ensure success in the course:

> The way that I'm preparing for the first exam is by making a copy of the exam review and making sure I focus on the key points. The education timeline covers a lot of information, so I plan on reviewing centuries that were not part of my group assignment... I am going over my personal notes as well as class notes...reviewing Cornell notes. My study game plan is to give myself enough time to study, so I don't cram last minute due to bad time management.
>
> ...Hands on learning and repetition are two of the ways that I am able to successfully master a topic... I would at least try to make a jeopardy or memory game with the information provided to be able to have an additional approach while studying. I do think that my approach to memorization with repetition will be very successful. I will approach this method by reading the

material prior to class and taking notes and then taking notes again in class. I will then compare both sets of notes to make flash cards. I can then use these flashcards to study and prepare for exams and reference in the future.

Another skill that I have learned...is to write down my questions when reading. I think in most cases when I am reading something, I tend to glaze over questions that pop up and then I forget those questions. In the flipped classroom setting I engaged the material first by myself, so I felt the need to write down those questions and more importantly do my own research to understand the answer... other students are doing that as well and it is advantageous to the learning environment when those students compare research in class.

I keep track of my work daily and get it out of the way before it is due. I try to work on something whenever I get the chance. That's something I didn't practice in the past and I will continue to do now. It has helped me manage my time wisely, time that I don't have a lot of these days.

I use a checklist as a way to ensure I stay on task, by listing my tasks and checking them off one by one once completed. It also gives me a sense of accomplishment to take off tasks when completed. I use the Cornell notes in class and during the readings and write questions in the margins to ask in class. I participate in class discussions so that I can gain an understanding about what I read.

...I watch videos that are interesting and give the most information about the readings...

...I have made a decision that I would stay at school in the library on the day I have class two hours later to get caught up on readings and homework that is due...

It is evident from these comments that responding to learner log prompts nurtures a sense of self-reflection in students and encourages them to assess and be intentional about their learning strategies. As they see the connection between strategies they implement and increased understanding of the concepts addressed in the course outcomes, they become motivated to capitalize on those strategies as portrayed in the following excerpts:

...I find myself noticing things I could have done better when I observe others or pick up on helpful tips...

...learning skills are just as important in education as the actual information, maybe even more important because learning skills are applicable to everyday life and everyday situations. I think developing students with learning skills will set them up for success in the future. That is the goal of education in general...to cultivate a person who can face situations or new problems and use their learning and critical thinking skills to make the best outcome.

Teaching our classmates is a different twist to our usual style of learning. It gives us the opportunity to learn and recite the knowledge ourselves, making it more memorable. Not only that but it also builds our confidence as we practice speaking in front of our peers. We also confront different personalities and groups we learn to work with. The in-class activities sometimes relate to our lives outside of the classroom. The class discussions and some comments and answers are very helpful. Getting different points of view can change your mind and I appreciate the opportunity we get to speak about and give our opinions. As we direct the class our professor allows us to take over and assists us with any guidance or knowledge beyond us that she can add in or incorporate.

When learner logs were not used, student learning strategy scores in elaboration, critical thinking, and peer learning subscale increased over time, but decreased over time for the remaining subscales. The MSLQ is not a normed instrument (Pintrich et al., 1991), and the authors suggest using its results formatively to enhance student learning along the way. Again, the fact that the results may appear counter-intuitive, therefore, is inconsequential to the usefulness of the instrument.

Geometry

When learner logs were used, there was an increase in the student learning strategy scores in elaboration and critical thinking, however, a decline in the other learning strategy scores. From the self-regulation and motivation section above one can conclude that engaging in a flipped classroom experience is challenging, especially if it is a first experience. It is important for students to first understand all the learning aids that have been provided. This includes lecture notes, PowerPoints, videos, textbook examples, and self-checks. At the beginning of the semester, navigating use of these items to prepare for face-to-face class meetings was a huge learning curve. However, as students gained their momentum of navigating the course, they learned what they needed to do to be successful in the course. This is indicated in the following excerpts from the learner log entries:

> There seem to be countless benefits of having at- home readings, videos, and pre-class work. For example, after reading the notes prior to the class I am also given the opportunity to watch videos that relate to the material. By doing so I am able to compare the knowledge I obtained from reading the book to the video. In addition, when I know I am having trouble with something, in particular, I am able to use the video to my advantage. I am able to pause and rewind specific aspects of the video I may have trouble on. The video also serves as a reinforcement for the material I learned by myself. Equally important, I am able to use the video based on my learning pace and style. For most of my education, I have found it much easier if I am able to watch someone else solving a particular problem in order to learn compared to reading how to solve a problem...
>
> ...In order to make the at-home work more interactive, I need look at the PowerPoints, watch the videos, and complete the self-checks in that order. First, I need to read the PowerPoints, along with the book to take clear, strong Cornell notes. Then, I need to watch the videos to clarify how to do the problems, and take notes from there using examples. Then, with my notes from the books and the videos, finally, complete the self-checks. I believe that if I do this in that order, and designate time daily for the at-home work, that I can not only complete it, but I will also be prepared for class...
>
> ...I do a lot of pausing and rewinding, because as I've said before, I really have to stop and look at a problem for a while to make sense of it sometimes. The videos definitely help in those instances, because I will pause, rewind, or watch the videos multiple times, so I gain make sense of how it was solved. I do see the benefit of the Cornell note taking system, and I do utilize it, but sometimes I take that note taking system and make it my own, so I can better organize my notes to suit myself. I will say that I do feel as though the summary at the end of the Cornell notes has helped me, because I will sometimes stop taking notes, then continue a few days later, so when I write the summary it helps me to refresh my memory about what I took notes on previously. I will honestly say that if it was not for the summary, I would probably not look back at all of the notes I had taken, so the summary forces me to do that. The questions in the margins do help me, but only if I make the questions very specific to what I have written, so if I need to reference my notes very quickly the questions make it easy for me to find the information...
>
> ...When taking my math notes I like to look at the online PowerPoints because of their simplicity. I like to break up the different topics that are learning by creating different sections. On the right side of my paper, I will write the topics name and then will draw a line down my paper. Once I have the line separating my paper I will usually write the definition and will draw an example from the PowerPoint. When I have finished adding my information from the topic I will draw a line under the information to separate the next topic. At the end of the math chapter, I will review the notes I wrote the help me write a summary at the end of my paper. Overall I like taking notes this way at home because I can take as much time as I want. When taking notes I am home I am able to pause the PowerPoint and use as much time as I want on a slide. I can see this as an advantage to this class because I am a very slow writer. In math classes in the past, I have tried to take notes in class from the teacher's PowerPoint but I would always miss something or the teacher would go into the next slide before I finished writing...
>
> ...As for the video section of our online note taking, I like how I am able to pause and rewind what I am watching. In the past, I have become lost when teacher teach how to solve math problems, or even with other students do a problem on the board. With the video, I am able to go back and rewatch them whenever I want, which helps me sometimes. Usually, when watching the online videos I try to follow along, but can sometimes get lost. While I am able to review the video, I can see this being a big setback to the class. When I am finished take notes and review the online videos, I do what our teacher calls self-check. Self-checks are a way for us to test what we know. While doing the self-checks, I like to review the information in my notes to help me...

Reflecting on learning experiences supported students in enhancing their learning strategies to be successful in this course. As shared from the MSLQ data, elaboration and critical thinking were the two learning strategies that increased for the math students over the semester. These skills are essential for engaging in mathematical thinking and grasping mathematical concepts. In the following excerpts, students share what they have learned as a result of the flipped classroom experience.

> ...I can use my awareness of my learning skills in my future classes by still utilizing the flipped classroom learning process that I have become accustomed too, and also merging that process with the normal learning process of a regular class. By using my learning skills, it will enable me to gain the most out of my future classes. Since learning is not just an academic skill, I can use my

> new awareness in a career or hobby, by not being so dependent on someone to explain or show me how to do everything that I need assistance with. This awareness of my learning skills, will help me to critically solve or handle a situation myself in my future career...
>
> ...In the flipped classroom I did not feel as I had learned or mastered the content fully. Despite the fact, I was provided with all the necessary resources to succeed I still feel I am not proficient enough. Nonetheless, from this unique educational experience, I learned that this is not my ideal learning style. Although I do see the positive qualities of this educational approach such as inquiry learning and allowing students to think more critically on their own. Both of these learning skills will undoubtedly help me in future classes. I will be better prepared to take any courses that are similar to this one. Since this was my first experience with this class I will know what are the best strategies or techniques I need to do in order to learn and master the content...
>
> ...As the semester went on and talking with Dr. Howse about a flipped classroom, my thoughts about it started to change. I understood why we took notes at home instead of in class. It saved time to actually work with our peers on some of the problems instead of using the whole class period to copy notes down from the whiteboard. I prefer to take the notes at home before the class because then I came to class prepared and ready to talk about what I had just taken my notes on...
>
> ...I learned that a lot of learning has to be done on my own in order to be successful in a flipped classroom. Learning involves reading the text, taking notes, watching videos, and asking for help when needed. I have to come to class with knowledge already. I plan to use my awareness of my learning skills in future courses. I think that coming prepared to class with some knowledge would be of great benefit just like it has been this semester for me. The learning I would use would be note taking and using all the resources provided by the instructor. I like note taking as a way to gain knowledge and learn for upcoming classes. Even note taking can be used in a traditional class to keep up with what is being taught. Learning is a skill that is used in an everyday life. I will definitely be using it for my career...

Although the aforementioned entries do not specifically state that elaboration or critical thinking are enhanced for these students, it is important to note that reflecting on learning experiences through learner logs throughout the semester provides a lens for researchers to draw conclusions related to the definitions provided from Pintrich et al. (1991). The article describes elaboration as assisting students with storing information in their long term memory, which is a skill that is needed for mathematics. In the entries above, it is evident that students learned concepts/functions of learning that they will hold on to for future learning and job experiences. Moreover, critical thinking is described as a student's ability to apply previous knowledge to new knowledge to make informed decisions. To learn mathematics is to critically think about mathematics. The entries shared above also indicate that students learned how to make informed decisions regarding their learning. Both elaboration and critical thinking are key components of developing self-regulated learning.

When learner logs were not used, student learning strategy scores decreased over time. Use of learner logs provides a space and time for students to reflect on the learning strategies that they have used throughout the semester. However, students in the control group were not required to write learner log reflections; therefore, their learning strategies were not captured. This is definitely is in line with the MSLQ document. As stated above, the authors suggest using the MSLQ results formatively to enhance student learning along the way.

The fact that the results may appear counter-intuitive, therefore, is inconsequential to the usefulness of the instrument.

Summary of Discussion

MSLQ data as well as learner log analyses reveal information about student motivation and learning strategies. When learner logs were used in educational foundations, student motivation scores declined, except for the intrinsic goal orientation subscale where students scored highly. When learner logs were not used, student motivation scores decreased or remained constant over time. When learner logs were used in geometry, student motivation scores declined, with the exception of the intrinsic goal orientation subscale. When learner logs were not used, student motivation scores decreased or remained constant over time.

When learner logs were used in educational foundations, there was an increase in the student learning strategy scores in organization and critical thinking, but a decline in the other learning strategy scores. When learner logs were not used, student learning strategy scores in elaboration, critical thinking, and peer learning subscale increased over time, but decreased over time for the remaining subscales. When learner logs were used in geometry, there was an increase in the student learning strategy scores in organization and critical thinking, however, a decline in the other learning strategy scores. When learner logs were not used, student learning strategy scores decreased over time.

Data portrays that critical thinking skills were enhanced for students in the experimental sections of the educational foundations and geometry. In addition, organization increased for students in the experimental section of educational foundations, while elaboration increased for students in geometry. These data highlight inherent connections between organization and elaboration in promoting critical thinking. Elaboration (paraphrasing, summarizing, note-taking, making analogies) helps students store information in long-term memory and begin making connections among information. Organization (clustering, outlining, extracting main ideas) helps the learner with appropriate information selection and construction of connections among information. Critical thinking pertains to student application of previous knowledge to new situations to problem solve or make decisions or critical evaluations. Developing and enhancing skills in organization and elaboration will help students advance along the critical thinking continuum.

The MSLQ is not a normed instrument. Pintrich et al (1991) designed it to be used at the course level, and assume that an individual student's responses to the questions might vary as a function of different courses. Therefore, a student might report different levels of motivation or strategy use depending on the course. They suggest using MSLQ results formatively to provide students with suggestions on how to increase their levels of motivation and strategy use. The authors of this article propose that student responses to questions might also vary as a function of other variables (how they feel about a particular task at hand, their perceived progress in the course at given points, etc.) and concur with the suggestion to use results to help students strengthen habits that lead to success. Feedback provided to students on their learner log entries along the way would help them reflect on and enhance their motivation and learning strategies and, therefore, strengthen self-regulation. Eventually, students would automatically apply self-regulation to build on skills that lead to success.

Conclusion

Developing Self-Regulated Learners

All study participants in educational foundations were sophomore-level students completing the course as a requirement for formal admission to the educator preparation program. The course is designed to engage students in analyses of critical and contemporary educational issues. Students reflect on, and interpret, the meaning of education and schooling in a diverse culture and examine the moral and ethical responsibilities of teaching in a democracy. The course is reading and writing intensive, therefore, lending itself to enhanced learning strategies such as organization and critical thinking, highlighted by the MSLQ results. Examining contemporary educational issues engages students in extensive reading, examination of trends and influences, critical discussion and debate with peers, and analytical writing. Students led chapter discussions in small groups, which allowed them to engage extensively with the concepts. Critical discussion and debate with peers forced them to think through their stances on critical issues and become more open-minded and informed about other people's positions. All these activities develop and enhance organization and critical thinking.

The MSLQ also identified an increase in intrinsic motivation for educational foundations' study participants. Intrinsic motivation is a logical outcome since students in this class have already made the choice to enter the teaching profession. This is also borne out in self-reflection in several learner log entries commenting on motivation to enhance teaching and learning strategies and be better prepared for the profession. The development of self-awareness as it relates to personal and professional growth is evident.

Geometry is a course in spatial and analytical reasoning; it supports students in their ability to use visualization skills to solve phenomena. Having this understanding of the content draws a connection between mathematics and the increased learning strategies (critical thinking and elaboration) for students enrolled in the course. Students completed pre-class work, which consisted of watching videos, taking notes, and completing self-checks of the material. Pre-classwork preparation enhanced the in-class working experience, which consisted of student engagement and collaboration. Engagement in mathematics is the same as engaging in critical thinking. This engagement coupled with self-reflection using prompted learner logs allowed students to engage in elaboration about geometric concepts as well as how they store the geometric information in their long-term memory. The ability to critically think and elaborate on thinking are skills that will support students in not only their career, but also in becoming productive citizens. Productive citizenship is the task of making informed decisions about oneself, family, community, state, country, and society. A teacher who engages in productive citizenship will model those qualities for their students. Critical thinking and elaboration are skills that are needed for personal growth as well as for the profession of education.

For motivation strategies, the MSLQ showed that the geometry students who reflected on their experience in the course demonstrated an increase in their intrinsic motivation. Intrinsic motivation comes from within oneself, so therefore, this strategy is one that is driven from an individual's personal experiences. By reflecting on their experiences using the learner logs, the geometry students, who are seniors in the education program, were able to consistently reflect from within as they engaged with the geometry content. And as seniors in the program, intrinsic motivation is a strength that drives students to complete their degrees as graduation is the goal.

Lessons Learned and Implications for Future Research

Pre-class Work Design/Preparation

Preparation for a flipped learning course is key in providing students with the appropriate pre-class experiences to drive learning during the in-class experiences. Therefore, ample time is needed for instructors to streamline the course material in a way that is conducive for students' benefit without the feeling of being overwhelmed. At times, the students expressed that it was too much material to decipher. This feeling of being overwhelmed may have impacted students' growth in their motivation as well as learning strategies. For instance, in the geometry course, weekly pre-class work included multiple videos, PowerPoint presentations, self-checks, and self-check answer keys; all these were provided as items that contained information related to the concept at hand. However, if these items are not logically sequenced or organized in a way to support students' reasoning about the concept, then student understandings' will be disjointed. In educational foundations, pre-class work consisted of completing readings and submitting Cornell notes by class time on the days readings/concepts were scheduled to be discussed. In addition, two or three students were assigned to lead class discussions on the readings. Discussion leaders prepared small presentations that included video clips or activities explaining concepts, as well as discussion questions. While such engagements prepared students well for meaningful class discussions and helped them develop self-regulated learning strategies, the discussion leader roles and heavy reading and writing load was overwhelming at times.

Providing Regular Individualized Feedback

The MSLQ is not normed and is a self-report instrument designed to assess college students' motivational orientations and their use of different learning strategies in a college course (Pintrich et al., 1991). The authors suggest discussing and providing individualized feedback to students about their MSLQ results. Students in both educational foundations and geometry were provided with their survey results, followed by a general class discussion about the instrument. Students generally agreed with their results. In addition to the MSLQ, the study conducted in educational foundations and geometry also used learner logs. Students received periodic feedback on their learner log entries in both classes. Students in educational foundations responded to 10 learner log prompts, and students in geometry responded to 8 prompts. Students in educational foundations received individualized feedback three times during the course of the semester, followed by general class discussions focusing on motivation and learning strategy skills. Students in geometry also received individualized feedback minimally, twice during the semester. There was no class discussion regarding learner log entries. The idea was that the students were provided with freedom to share their thoughts without filters, hence, the reason for minimal feedback for geometry students. Even though feedback received by students in both classes contributed to their growth in organization, intrinsic motivation, and critical thinking skills, the authors of this study believe that more consistent feedback on all learner log entries in the form of focused, individualized discussion/conferencing on each learner log entry would further advance student development in those areas. Deep/guided reflection is necessary to strengthen motivation and learning strategies. Though hypothesis is met in increasing motivation and learning strategies (self-regulated learning), consistent and meaningful self-reflection in any course helps drive self-regulated learning.

Whole Group Discussions on MSLQ Strategies

The quantitative data results from the MSLQ were intended to be used as a point of reference in discussing motivation and learning strategies and to help students reflect meaningfully about self-regulated learning. Using the MSLQ as a stand-alone without regular, focused/individualized discussions about motivation and learning strategies during course meetings likely diluted related impact on student development in these areas. In addition to students sharing their conceptions regarding self-regulated learning experiences, instructors can guide student growth in strategies by being more intentional about speaking with students about learning strategies. Intentionality can take on multiple forms. One specific form is providing constant individualized feedback on students' learner log entries. Moreover, learner log prompts could have been better developed in a way that guides students to reflect deeply about their self-regulated learning experience.

Using MSLQ Results to Generate Prompts

In addition, the authors of this study could have benefited from using initial MSLQ results and creating prompts that were better aligned to the MSLQ motivation and learning strategies scales. Such an approach would have strengthened the support provided to students and enhanced their development. Another component that may positively impact intentional strategy development is providing opportunities for whole class discussion related to motivation and learning strategies. Students completed the MSLQ, but there was never deep engagement about the self-regulated learning strategies. After taking the survey, the authors of this study recommend that both the experimental and control groups engage in periodic whole group discussion about the strategies as well as share their understandings of strategies. Such discussion would enhance their perception related to self-regulated learning

throughout the semester. With the understanding that self-regulated learning is reflective, opportunities for students to share motivation and learning strategies that worked for them may have impacted their responses in their learner logs entries, which may have also impacted their MSLQ post-survey responses.

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