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RESEARCH ARTICLE

Investigating the reassessment opportunity for prospective teachers within their initial required content course

Amanda J. Meiners[1], Angel Luis Figueroa-Rosado[2]

[1]Assistant Professor, Mathematics and Statistics, Northwest Missouri State University
[2]Instructor, Curriculum and Instruction, University of Alabama

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Abstract

In K–12 education, reassessment is a common practice, providing students with opportunities to enhance their understanding through low-stakes assignments. However, reassessment is underutilized in higher education, including during the challenges posed by the COVID-19 pandemic. Our study advocates for expanding the use of reassessment in university settings to promote holistic learning and focus on what shifts of change were made by students in an initial mathematics content course as they sought to gain licensure for teaching in a birth (daycare/pre-K setting) to eighth-grade classrooms. Our study took place during COVID-19 semesters and aimed to examine how using a reassessment approach early on in a gateway course for Prospective Teachers (PTs) affected the pass rate of the course. Results showed significant differences between the PTs who engaged with the test recovery and those who did not. We propose recovery opportunities like ours provide the necessary guidance to support early degree necessary classes that are typically gatekeeping and, as another, likely cause too few students within the courses because they were able to advance into the teacher pipeline and out into the field. Future studies may consider how the reassessment could be done more before the official summative assessment of a unit or chapter to continue the shifts in teaching practices and pedagogy that are constant within the K-12 education systems at the university level.

Keywords: mathematics education, prospective teachers, reassessment

• Corresponding Author: Amanda J. Meiners, email: ameiners@nwmissouri.edu

I. INTRODUCTION

Using reassessment within the educational field is constant as educators develop lesson plans, classroom discussion tasks, and assessments. Students can try the materials to develop their knowledge holistically, usually called formative assessment (Taras, 2005). However, these assignments should have no points attached. They are low-floor (a task where engagement can occur at each student's level) and low-stakes (an opportunity for students to gain feedback about their understanding without a grade attached; Meyer, 2015). The other type of assessment often used and assigned in the grade book is summative assessment (Taras, 2005). Summative assessments can focus on the student's learning depth and how they demonstrate the knowledge gained in a set time within a course. However, over the past couple of decades, summative assessment has increasingly been used as the final decision maker that has seen increases in mathematics anxiety (Boaler & Staples, 2008) and without looking longer term at the connections to the professional workforce connections (Sokhanvar et al., 2021).

Students' knowledge is assessed based on reading, comprehending, demonstrating, and producing an acceptable answer within the suggested time frame. The instructor then distributes values based on the alignment between what the student says, writes, or demonstrates some rubric level. Sometimes partial point values are given, while the correct answer with work is an all-or-no-point situation for others. Within K-12 education, reassessment is constant and often offered in various ways depending on the content area and/or grade level. For example, students can retake comprehension tests via reading programs or the spelling test on Monday and Friday with the highest score in the grade book. Boaler and Dweck (2016) discuss the idea of "yet" and lessening the mathematics anxiety students face by using alternative and deeper thinking conceptual tasks or opportunities for students to demonstrate their understanding. The consideration is that students have "yet" to gain a conceptual understanding of the materials and will have multiple opportunities to learn multiple strategies to gain the understanding. Adjusting mathematics teaching from everyone understanding at one moment and instead understanding when the student is ready, are all parts of the "yet" concept.

As Howard (2008) gathered from ternary students, their views of success or not were linked to their performance on summative assessment. Courses and content areas that offered multiple assessment types allowed students to filter their success in a way they felt demonstrated their learning and engagement with the materials at their speed. We know students engage and understand information at different speeds through the various memes and GIFs (graphics interchange format) often posted via social media. Examples include that popcorn kernels still pop at different rates and times under the same cooking conditions or that some plant types grow faster than others with water and sunshine. In university settings, redoing or reassessment is minimal despite the necessity, particularly in COVID-19. Reassessment is highly prevalent and encouraged within the K-12 educational settings. As such, Gallardo (2020) calls for consideration that higher education learning domains go beyond cognition, authenticity, and interdisciplinary features that can be more performance-based evaluations.

Furthermore, the Association of Mathematics Teacher Educators (Bezuk et al., 2017) Standards for Preparing Teachers of Mathematics' third assumption states that teaching mathematics requires pedagogical, content, and specific mathematical dispositions and knowledge that support learning the educator's development and their future mathematics students. This knowledge is significant as society and the educational community seek alternative strategies to recruit, retain, and diversify our mathematics teacher-educator pipeline. If prospective teachers (PTs), as students have engaged in reassessment opportunities, can continue to try these methods portrayed in the classroom with their future students. Our research project focused on what shifts of change were made by students in an initial mathematics content course as they sought to gain licensure for teaching in a birth (daycare/pre-K setting) to eighth-grade classrooms.

II. BACKGROUND

Assessment

Assessment is an integral part of the learning process for both the learner and the educator. With national reports such as A Nation at Risk (National Commission on Excellence in Education, 1983) and No Child Left Behind (NCLB, 2002) in the United States, assessment has become higher stakes increasing the negative feelings of and anxiety about mathematics learners (Boaler & Dweck, 2016; Griggs et al., 2013; Hoffman, 2010; Jenβen et al., 2015; Merz & Swim, 2008; Yazici et al., 2011). As Yang et al. (2021) described, testing or continuous assessment of learning can be good, but rather for the learning that learners demonstrate the learning they understand to have taken place, not simply reproducing tasks. Research on learner understanding of the reproduction of the process of tasks versus the connections and deeper thinking has shown that successful learners focus on making the connections between content concepts over memorization of how to complete a task in K-12 learning (Liljedahl, 2020) and traces further back into higher education learning (Browne & Freeman, 2000).

Within K-12 learning, learners engage with materials their instructors emphasize as necessary. One place within the learning is the emphasis on using feedback toward future understanding. Learners come from their K-12 experiences with more negative leaning views of reassessment, as many use a trial-and-error approach, creating struggle when processing the positive and negative feedback received (Peters et al., 2014). Adult learners, such as PTs, can use feedback more efficiently to rethink how they demonstrate their understanding and engagement during assessment opportunities and appropriately shift their study habits.

Reassessment

Promoting and developing opportunities for university-level learners, such as PTs, during their course work has been called by Heinicke et al. (2017), who asked that instructors incorporate contingencies that promote effective study habits into their classrooms, particularly within the lower division, entry-level, and gatekeeper type courses.

Such courses can include mathematics courses or other general education courses necessary to move forward within a learner's degree plan. Furthermore, Tai et al. (2018) noticed that courses that emphasize pedagogical self-assessment practices facilitate the acquisition of skills that students require both inside and outside of higher education. By engaging PTs in opportunities promoting interventions to reflect how they study and interact inside and outside with peers about the materials and shifts they plan to make for future improvements, alternative and reassessment approaches may allow PTs to connect content at a deeper level for their own future students.

Reassessment was defined as an assessment strategy that provides the learner, in our case PTs, another opportunity to demonstrate a mastery of the concept(s) being learned (Boaler & Dweck, 2016; Ruthven, 1994). Reassessment is important as PTs have often been provided multiple reassessment opportunities before entering the university settings. Within PTs previous K-12 education they have experienced many different redoing or reassessment methods; however, these opportunities begin to be minimalized, despite the necessity, particularly in COVID-19, during their university or post-secondary learning. As Gallardo (2020) called for consideration of reassessment within learning spaces outside of the K-12 system, providing PT''s opportunities they can experience are necessary to benefit both their current views of coursework as a student and for their future as an educator. Previous research into the idea of reassessment is not new to the education world, yet it has become more and more prevalent to be used within the K-12 system in the U.S. As Ginsburg et al., (2005), finding noted that in the U.S. that lower scores that many international countries may be attributed to the minimal connection's students had of the importance of mathematical concepts to real life and the foundation that was built before fourth grade. Often ideas and concepts were learned yet were not stored in a manner that promoted long term memory. For example, Wang and Heffernan (2014) considered the retention of mathematics concepts for students who were reassessed and how their relearning may move into participants long term memory while engaging in a unique, immediate, reassessment opportunity. Many PTs may have experienced such ideas sometimes known as Automated Reassessment and Relearning Systems (ARRS), but as Razzaq et al., (2023) recently noted provided a null result. As such, more insight into reassessment that may not be so automated necessitates consideration.

Benefits. As students, reassessment, or the opportunity to retake or redo, has increased within the K-12 classroom. These opportunities may include a complete redo of the assignment where the student's newest score overrides their previously achieved score, or a combination of the previous and current score averaged or weighted in a way that improves the recorded score. For example, Iglesias Pérez et al. (2022) and Sanchez et al. (2017) use systems focusing on peer corrections for formative and final assessments. Both noticed minimal differences in how students graded their peers versus how the educator would have graded their assignments. Furthermore, for students in K-12 grades with a rubric, their peers are assessed positive effects (Sanchez et al., 2017).

Having students demonstrate and engage with mathematics conceptually on assessments by using non-traditional methods has been called for by researchers in different ways. For example, Boaler (1998, 2014) states that all students are good at mathematics

but that, like Liljedahl et al. (2007) and Liljedahl (2016, 2020), follow the need to lessen student mimicking to demonstrate understanding and instead engage students in thinking that encourages mathematical wellness (Singh, 2021) through using exploration in such tasks as Dan Meyer's 3-Act (2015) or Kaplinsky's (2019) Open Middle tasks. As such, our study focused on the assessment phase and what benefits our PTs could effectively see throughout their semester-long course. Earl and Katz's (2006) and Berry's (2008) definitions of assessment-as-learning build on Yan and Boud's (2022) definition of the benefits of such assessments as our reassessment option as those that generate learning opportunities through active engagement while seeking, interrelating, and using evidence. Based on how our PTs engaged with a traditional exam with similarities to their end–of–program exam, this research study sought to see how shifting towards alternative reassessment methods as a one-off could assist PTs with their learning and how they could shift reassessment in their classroom.

Previous experiences. Many current PTs have grown up with these types of incorporation of items within their K-12 courses. As PTs enter their content-based courses, they learn firsthand how they may engage their future students. Callis (2017) demonstrated with their mixed-methods study of PTs that curriculum materials can support instructors using research-based instructional practices. However, the design of the materials impacts how instructors can use the materials to create mathematically powerful experiences. For PTs, this is essential to their engagement with course materials as their experience as a student is emulating what their future student may engage with while also having the lens of a future educator who will be required to balance the research- based practices with their own required curriculum to teach.

These previous experiences must be an integral part of the higher education classroom. Recently, Sokhanvar et al. (2021) called for similar assessments, sometimes known as authentic assessments or assessments that resemble how workplace engagement may take place and align with Boaler and Dweck's (2016) description of "yet" learning the content, even at the university level. Such assessments and engagement allow PTs to have a perspective as both a student and future educators. Furthermore, classroom instructors who build upon their previous learning experiences, such as Gao et al. (2020), mentioned providing guidelines and practice to balance the needs of PTs to keep learning the depth of the curriculum feasible based on classroom practices. For example, Jenßen et al. (2015) continued confirmation from Beilock et al. (2010) that using the Mathematics Anxiety Scale Revised, the math anxiety for pre-kindergarten educators within Germany was a substantial phenomenon. Furthermore, the PT's anxiety carried over to their students in future classrooms. Thus, it is necessary to provide engaging early childhood and elementary level PTs with alternative but authentic research-based assessment practices they can engage in as a student before reaching their future classroom.

Current Study/Research Problem

The research intention was to investigate the use of a reassessment opportunity within higher education, more specifically PTs. However, mathematics courses, retesting, reassessment, etc., are used at some universities or within particular STEM courses while

not so much with others. It is important to understand how this practice can be relevant in lower division or entry- level courses, particularly STEM courses, for PTs teaching mathematics students from birth to 8th grade. PTs, including those within the Birth to 8th-grade bands, will engage students mathematically from early childhood centers such as daycare, home centers, and Head Start types of settings up to middle school 8th grade. Three certification bands are included within the course: Birth to 3rd grade, Kindergarten to 6th grade, and 5th grade to 8th grade. The research question(s) that guided this research were:

1) Did the usage effect diminish over time (by semester) that PTs engaged with the credit recovery opportunity?
2) Is PT's engagement with the recovery opportunity proportionally significant by the points they recovered?
3) Do final grades differ significantly by PTs who engaged with the recovery opportunity?

III. METHODS

Our study took place during COVID-19 semesters using the modality of face-to-face with mitigation standards during the five fall/spring semesters from Fall 2020 to Spring 2022. PTs in the Birth to 8th-grade mathematics content course could engage with the opportunity to recover up to 75% of the missed points on their first exam each semester. To gain back these points, PTs engaged in a reassessment that strived to engage in continued learning opportunities and were required to have a passing score (65%) on the second exam.

Participants

Our study focused on a shift in class and course preparation strategy after PTs engaged in their first exam during their first required mathematics course for students majoring in early childhood or elementary education. Most PTs in the program identify as female, more than 95%, with the other 5% identifying as male. Most PTs at the university work full-time on-campus within the campus lab school and surrounding area districts and/or off-campus at local restaurants, factories, and similar hourly wage opportunities. As such, the course structure includes multiple and alternative assessments and assignments within the course beyond summative assessments. In addition, such methods are included so PTs learn based on their future profession and engage with assessment shifts that they can emulate.

Data Collection

Data were collected from the first content degree required course for those intending to gain teaching certification for middle school and early childhood educators. The goal is to reintroduce PTs to materials they will be teaching in the future in a conceptual way while also connecting the previous procedures learned during their K-12 education.

The content covers understanding sets, logic/basic proofs, probability, statistics, number systems, and operations with number systems. This course is specific for these majors and does not fall into the typical name of any subject area of mathematics content. Assessments that were included in the end-of-term grade for students were ten take-home quizzes (about 10% of overall grade), three, unit exams (about 50% of overall grade), and one comprehensive final exam (20% of overall grade). The sole item looked at for this student was the first exam and offering an opportunity to support PTs' "yet" understanding.

As part of a reflective investigation of the reassessment opportunity, the possibility of collecting specific participation identification was not available. No specific identifiable participant data was collected to test between or within identity groups. After receiving IRB approval, data collection occurred from all sections of a gateway mathematics content course offered for the Fall 2020 to Spring 2022. All these semesters were completed within a United State regional public university during COVID-19 measures taking place on campus with minimal online courses. The data collected included PT scores for the semester's first, second, and final exams. PTs' data were included if they had a first, second, and final exam score but were not included if they dropped the course or their data set was incomplete (i.e., PTs completed the second exam, did not complete the final exam, or dropped the course). Over the semesters under study, 492 PTs met the criteria.

The Opportunity

The mathematics content course PTs are split into three units, each with a summative assessment, small daily assessments based on interactions with materials, and approximately weekly open-book quizzes, with a cumulative final at the end of the course semester. Each unit's exam is taken around every 5 weeks of the course. Each exam is given through the learning management system, and PTs are given 55 minutes to complete the exam in person. During the exam, PTs have access to helpful one sheet (8.5 by 11 in 1 side) of notes, a calculator without an internet connection, and scratch paper to submit their work from tasks. The first exam consisted of 15 content-based questions that employ formats that include multiple choice, multiple answers, short answers, multi-step extended, and short essays. After each first exam each semester, instructors meet to determine how PT's first exam score and final grade could be improved to demonstrate growth in their understanding of the content. The approach within this paper wanted to maximize PT's participation in the reassessment opportunity and effectively regrade the assignment. When the PTs completed a less than 5-minute recording of themselves creating and correctly solving a similar original task to the one on which the PT had missed the most points, up to 20% of the 75% were almost immediately regained. During the video submission, the PT explained the new original task thoroughly and reflected effectively on any misunderstandings from the first exam.

Additionally, PTs wrote up how they intended to specifically make shifts or changes to their future study habits that they looked to improve for the second exam. Both items with proper corrections were necessary. PTs gained 15% back if they showed continued minor misunderstandings and shifts considered, 10% for major misunderstandings and shifts considered, and no points if the task had severe

misunderstandings or was non-original. After PTs achieved at least 65% of their second exam, the other 80% of the 75% points returned. The PTs needed to attempt both items to have the opportunity to gain the points back. Instructors assumed that PTs followed through on the shifts of change they mentioned in their submitted documents. Attending student hours, student-led tutoring and homework sessions, and even consistently attending the course during their class time was not tracked, but generally followed up with PTs before the second exam.

Description of Data Analysis

Before the data analysis, a ratio (independent variable) was collected between the points gained by each PT when they retook the unit test and the points they lost when they first took the unit test for each semester (dependent variable). For example, if a PT lost 50 points, they could recover 37.5 points at most. We used this ratio to compare the differences in engagement by the PTs. We analyzed each semester separately, verified any changes in the percentage of PT recovery points, and then compared semesters.

Of the 492 PTs who took the course, 150 PTs chose not to engage with the assignment. Additionally, two PTs were removed from the analysis because they scored perfectly on the initial exam, which meant no recovery points were available. As such, for recording purposes, these PTs received a grade of zero out of zero on the recovery assignment.

We decided to include all 492 PTs in our analysis, as the data needed to be more balanced to the right due to 150 PTs needing to complete the assignment. This decision allows us to maintain a complete and ethical representation of the dataset to aid in guiding our decision-making interpretations, and it is essential to consider the impact of the skewed distribution on the results and draw appropriate conclusions (Song & Szafir, 2018). Additionally, it more appropriately represented how students willingly engage with credit recovery or extra credit assignments.

IV. RESULTS

Research Question 1: Did the usage effect diminish over time (by semester) that PTs engaged with the credit recovery opportunity?

The point recovery opportunity started in the Fall 2020 semester. As such, we used that semester as our reference group. Before sharing the results of PTs' engagement during each semester, the descriptive statistics of all the PTs who did not or did recover points from their recovery unit test are in Table 1.

As shown in Table 1 and Figure 1, the data exhibit a significant degree of skewness, with large variations between Q1 and Q3 and from the mean and median results. The nature of the skewness in each of the semesters, either positive or negative, can be attributed to the participation of PTs who were and were not engaged in the recovery opportunity and the ones obtaining 75 % of the points recovered from the beginning.

Table 1. PT's engagement summary for all semesters

Time	n	Min	Q1	Median	Mean	SD	Q3	Max
Fall 2020	135	0.00	0.15	0.71	0.47	0.32	0.75	0.75
Spring 2021	68	0.00	0.01	0.26	0.29	0.27	0.40	0.75
Fall 2021	81	0.00	0.00	0.15	0.36	0.35	0.74	0.75
Spring 2022	94	0.00	0.00	0.15	0.35	0.35	0.74	0.75
Fall 2022	112	0.00	0.00	0.05	0.08	0.09	0.16	0.28
Overall	490	0.00	0.00	0.15	0.32	0.32	0.74	0.75

There is a noticeable pattern in PT's engagement, represented by the mean scores, with different variations during each semester. In Fall 2020, PT's engagement was significantly higher (M=0.47, SD=0.32) compared to Fall 2022, which experienced a substantial decline (M=0.08, SD=0.09). Reviewing the Fall 2021 (M=0.36, SD=0.35) and Spring 2022 (M=0.35, SD=0.35) semesters, it is noticeable that PT's engagement is almost identical, with a marginal difference of 0.01.

Semesters such as Fall 2021, Spring 2022, and Fall 2022 have a positive skewness, and Fall 2020 and Spring 2021 have a negative skewness distribution. In summary, PTs' engagement had a mean of 0.32, with a standard deviation of 0.32.

Research Question 2: Is PT's engagement with the recovery opportunity proportionally significant by the points they recovered?

In Table 2, we found the following results after conducting a linear regression model with the proportion of recovered points and semesters as our dependent and independent variables to verify the PTs' engagement in each semester. Within this question, we wanted to predict the effect each semester has on the PTs engagement on the credit recovery opportunity.

Table 2. PT's engagement during the semesters

Semesters	Mean	SE	t value	p-value
Fall 2020	0.47	0.03	19.05	$8.56e^{-60}$***
Spring 2021	0.29	0.04	8.24	$1.61e^{-17}$**
Fall 2021	0.36	0.03	11.24	$3.16e^{-26}$***
Spring 2022	0.35	0.03	11.80	$2.10e^{-28}$***
Fall 2022	0.08	0.03	2.97	$3.17e^{-3}$**

Our analysis revealed that the Fall 2020 semester served as the benchmark for evaluating the impact of the point recovery opportunity. We found that PTs' commitment to using the opportunity to make up lost points increased by 0.47 during this semester.

However, engagement in the recovery opportunity decreased by 0.18 in the following semester (Spring 2021), resulting in a 0.29 overall engagement. In the subsequent semester (Fall 2021), engagement in the opportunity increased by 0.07, resulting in an overall engagement of 0.36. However, in the following semester (Spring 2022), engagement declined slightly by 0.01, resulting in an overall engagement of 0.35. The last semester saw a decrease by 0.27 in engagement. These findings align with those presented in Table 1 and Figure 1, indicating that the estimate equally reflects the average values in PTs' scores across semesters.

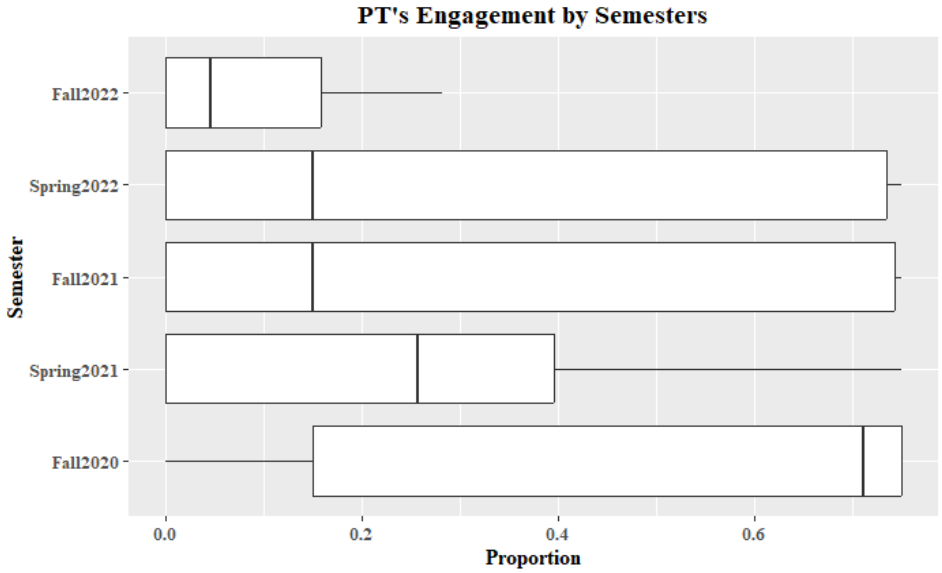

Figure 1. Boxplot of pts' engagement by semesters

Research Question 3: Do final grades differ significantly by PTs who engaged with the recovery opportunity?

To answer this question, we created four groups based on student engagement and success on the course: Group 1 included PTs who did not engage and did not pass; Group 2 included PTs who did not engage but still passed; Group 3 included PTs who engaged but did not pass; and Group 4 included PTs who engaged and passed. The table shows the number of PTs who engaged with the recovery opportunity and those who did not, along with their final course outcome (passed or did not pass) and includes the total number of PTs in each category.

Table 3. PT's engagement and course success groups

	Did not pass	Passed	Total
PTs who did not engage	45	105	150
PTs who engaged	81	259	340
Total	126	364	490

As shown in Table 3, it is evident that out of the 490 PTs who initially enrolled in the course, only 259 of them took advantage of the recovery opportunity and passed the course, which is 53% of the total PT population in our study. Conversely, 81 PTs engaged in the recovery opportunity but failed to pass the course. In addition, 45 PTs who did not engage in the recovery opportunity did not pass the course, but 105 PTs did. These findings indicate significant room for improvement in student engagement and academic success in this course.

We performed a proportionality test to investigate whether final grades differed between PTs who engaged with the recovery opportunity and those who did not. This test aimed to determine whether there were significant differences in the proportion of PTs who passed the course based on their engagement with the recovery opportunity. Specifically, we used a 2- sample test for equality of proportions to test the null hypothesis that the proportion of PTs who passed the course was the same for both groups. The alternative hypothesis was that the proportions differed.

Table 4. PT's course recovery engagement

	Group 1 (Did Not Engage in Recovery)	Group 2 (Engaged in Recovery)
Sample proportion	0.2143	0.5286
95% CI	(−1.0000, −0.2642)	
Test Statistic	$X^2 = 102.31$	

The proportionality test suggests that the difference in the proportion of PTs who passed the course between those who engaged with the recovery opportunity and those who did not was statistically significant ($p = 2.37e{-}24 < 0.05$). Specifically, the proportion of PTs who passed the course was 0.2143 for those who did not engage with the recovery opportunity and 0.5286 for those who did. This means that PTs who took part in the opportunity had a 50% higher chance of passing the course than those who did not engage with the recovery option.

Based on the results provided, there is strong evidence to suggest that the proportion of PTs who passed the course significantly differs between those who engaged with the recovery opportunity and those who did not. Additionally, the sample estimates suggest that a greater proportion of PTs who engaged with the recovery opportunity passed the course compared to those who did not engage.

V. DISCUSSION

Our study aimed to examine how using a reassessment approach early on in a gateway course for PTs affected the pass rate of the course. Data was collected over the five semesters from Fall 2020 to Fall 2022 in direct response to COVID-19 mitigation measures at a rural midwestern university. Data analysis used proportionality to check for

normalization and a t-test to check for differences between the initial iteration. The PT scores included were those that engaged with an original task, the unit recovery worksheet, and fully completed the course.

Our results found significant differences between the PTs that engaged with the test recovery and those that did not. Similar to Heinicke et al. (2017) incorporation of contingencies, we found that proving "yet" assessment gave PTs a second chance they had experienced in their K-12 learning years. Unlike their possible previous experiences, this was a one-time offer that guided PT' toward college study levels and coursework expectations. However, like Callis (2017) noticed, when PTs are engaged in practices that emulate how they would hopefully reassess their own future students, and like Iglesias Pérez et al. (2022), there is extra involvement in the relearning process for PTs and course instructors when using such an assignment.

Connections to Research Questions

For our first research question, did the usage of PTs participating in the test recovery diminish over time (by semester)? Based on Figure 1, proportionally, we say yes. However, we caution against that direction without considering why fewer PTs engage with the opportunity. To answer that, we go back to the goal of using the test recovery installation as an option. Due to mitigation measures of in-person teaching during the initial pandemic semesters, PTs and instructors adjusted and managed how to engage safely. As our data was collected, the pandemic formed into an endemic. As such, instructors and PTs adapted. These included shifts in advising the PTs about the location of the course within their course schedule of Fall or Spring based on their other responsibilities. Shifts like these align with research support for first-generation college students' continuation at their university/college (Griffith, 2021). The research team would caution to say that implementation of the test recovery diminished, but rather that fewer PTs found it necessary to use the test recovery as a "yet" assignment. Instead, as many institutions of higher learning have seen downward shifts in PTs, this program also saw fewer PTs choosing to go into the teaching field. As such, proportionally, fewer students took part in the "yet" assignment.

For our second research question, Is PTs' engagement with the recovery opportunity proportionally significant by the points they recovered? Based on the data collected and using a t-test comparison, we can say PTs who struggled to pass the course at the time of the first exam met the passing requirements by providing recovery options. By doing a reassessment, PTs improved their grade in the first part of the course, which also translated into how they prepared and engaged in the course leading up to the cumulative final. Our results aligned with Wang et al. (2012) as going beyond providing a single final grade on an assessment and instead looking toward satisfying the new learning requirements that PTs will need as future educators. Additionally, our study suggests that PTs learned about class and course preparation strategies that boosted their engagement with course materials beyond the first exam.

For our third research question, do final grades differ significantly by PTs who engaged with the recovery opportunity? PT's final grades were when they engaged with

the test recovery assignment. Although this would appear intuitively accurate, some PTs did not engage in the recovery (due to perceived high enough scores on the initial exam), and their final grades finished at least at or below projected grade values if they had instead engaged with the recovery opportunity. The research team would cautiously say that students slated to become future educators were shifting their views and beliefs of what it meant to succeed in class and shifting their mindset to become more sustainable toward engaging and teaching mathematics in the future (Ruge & Webber, 2021).

Importance of the Opportunity

Mathematics education has long sought to avoid a singular focus on summative exams. However, many mathematics and mathematics education content courses at the university level still use multiple summative assessments and a final to assess PT's knowledge, learning, and understanding of course materials. As such, the course setup was similar, which led to our focus on the points PTs gained back as the leading indicator of shifts of change that could show more indication as an approach to guide how small shifts could sustainably bridge the gap between K- 12 experiences and university expectations in early degree coursework, particularly for PTs.

Furthermore, shifts in teaching practices and pedagogy within K-12 education systems are constant, while at the university level, shifts are less. PTs may or may not have experiences they can carry into their classrooms with such alternatives, yet the authors call aligns with combining metacognition and the including the ideas of a growth mindset, the idea of "yet" learning (Wang et al., 2021). As such, if we want PTs to be open to alternative methods and opportunities that differ from what they had in K-12 systems, their university coursework should also provide those experiences and opportunities. We propose recovery opportunities like ours provide the necessary guidance to support early degree necessary classes that are typically gatekeeping and, as another, likely cause too few students within the courses because they were able to advance into the teacher pipeline and out into the field.

This study points to the importance of mathematics education and those engaging PTs within teacher education programs, particularly mathematics teacher educators, to offer reassessment opportunities such as a test recovery opportunity. During COVID-19, we (both PTs and those engaging with them during coursework) were managing through conditions vastly different than anything anyone had experienced during their teaching or learning. Although we (as a society) have made great strides to return to "normal" or what learning looked like before COVID-19 occurred, within mathematics education, we cannot undo or redo the experiences mathematics educators and current and future students faced. Additionally, similar considerations need to be a part of mathematics education. Rethinking how reassessment is taking place that is different than what has been done can be a first step in rethinking how changes can be catalyzed at the university level (Graham et al., 2018; Bush et al., 2020). Doing so may align with those changes that are being "catalyzed" as the United States National Council of Teachers of Mathematics (NCTM) continued publication response in their catalyzation series starting in the K-12 educational years (Bush et al., 2020; Graham et al., 2018; Huinker et al., 2020).

As PTs sometimes come with a dichotomous view (only correct or incorrect) of mathematics from their K-12 education, it is important for mathematics education and mathematics teachers and educators within the postsecondary system to consider what changes can be made, allowing structures and systems to be dismantled not to impede PTs access to success in mathematics. Although some in mathematics may say this is down through retaking complete courses or other similar superseding opportunities, such opportunities limit students based on a single final grade at the end of the term. Including reassessment opportunities during the coursework can guide PTs to rethink study habits, have discussions with classmates and instructors, or consider how to regain materials not yet understood the first time and apply their understanding within mathematics materials connected to the next exam. Such opportunities also allow mathematics teacher educators to guide PTs in thinking about mathematics as a web of thinking rather than a continuum of skills to be learned.

Limitations and Recommendations

Like any research project, ours has limitations outside our control. While the data was collected, the COVID-19 pandemic was still a considerable concern and affected PTs' motivations and attitudes within and outside the course. Although we did not survey or measure these items, students were in and out of quarantine, using hyflex teaching methods, attended courses more leisurely than in previous years, and often worked full-time to support family members and themselves. After data collection and while this paper was forming, some PTs shared this anecdotal information. As such, the reassessment assisted with these conditions, but as the pandemic continued to evolve and turn endemic, we continued the reassessment as a means to demonstrate the idea of "yet" to PTs and the mistakes in and outside of the mathematics classroom were inevitable and necessary to gain deeper thinking and connection to the content they would be teaching in the future. Additionally, there was no demographic data, i.e., gender, socio-economic status, age, etc., as the data was collected to analyze the opportunity for use beyond COVID-19 semesters internally.

Another limitation was that about 10% of PTs retake the course any semester, with some retaking the course more than once. The opportunity developed to be one of those helpful factors to minimize the gatekeeping of the course. However, for the PTs retaking the course, prior knowledge that the reassessment opportunity may occur was thus known to these PTs, and they asked questions about the opportunity. However, the instructor's decision to keep offering the opportunity was based on the overall course average on the first test being lower than 70%, as was atypical before the pandemic. The opportunity to engage with the reassessment was a moment-by-moment decision for instructors with a balance of refining in the future and current PT's expectations of an automatic second chance if the first exam did not go as well as the PT intended.

Additionally, a limitation was that the instructors' views about their engagement with the opportunity and resources provided for students were limited to anecdotal and not included as part of the study. Future research may be more successful in including field notes and the instructor's viewpoints about the how and why of the more subjective

decisions. Based on PT's engagement (about 30% of the total data set chose not to engage with the opportunity), more understanding of how the changes to faculty thinking and views of the assessment would be an interesting shift of study.

Future studies may consider how the reassessment could be done more before the official summative assessment of a unit or chapter. Based on our findings, one recommendation is the importance of a second chance for many PTs in the first few semesters while returning to on- ground/in-person course expectations while navigating COVID-19 mitigations. Many PTs come into this as their first math course at college and the first required degree course of their program, a gateway course, as some call it—all the materials PTs see at various points are within the K-12 standards. For many PTs, it has been between 5-10 years and in a manner that was about recall and memorization rather than understanding. Having a second chance to show understanding minimizes the gateway view of the course. Another caution we offer is the first exam or non- wrap-up effect (Goulas & Megalokonomou, 2020) in any class. The PTs are learning and engaging with an exam and format for the first time as college students. The farther off the university property PTs lived, the more likely they were to have little to no internet access or connectivity opportunities. Also, usually in K-12 experiences, PTs may have been allowed to directly go back to specific or exact questions when they retake and fix errors. This opportunity contrasted to that as the course items allowed PTs to revisit similar mathematical concepts using multiple strategies and representations throughout the course. Having the test recovery at such an early stage and giving PTs the autonomy to choose to improve, the instructors were engaging PTs in learning good study habits and seeking out helpful opportunities early in their coursework and career as future educators. Another consideration would be to see how reassessment opportunity similar may be taken up in a non-PT, content-based courses like pre-calculus or calculus.

One caution the research team would offer going forward for future research is figuring out ways that allow similar levels of autonomy to PTs or students in their classrooms while also allowing for a "yet" have understood the materials well enough but minimizing the extra items required or sometimes known as "hoops" for participants to go through. By minimizing the hoops participants would need to go through, fewer institutional barriers are in place for all, hopefully creating a visible equitable opportunity. Therefore, it may be advisable to investigate why engagement with the recovery opportunity translates into higher course passing rates.

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