Grades or No Grades? Promoting Deeper Learning in a Middle Level Mathematics Methods Course

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Grades or No Grades? Promoting Deeper Learning in a Middle-Level Mathematics Methods Course

Abstract: This action research investigated pre-service teachers (PSTs) experiences with ungrading practices in a mathematics methods course designed for middle level PSTs (grades 4-8). This study analyzed archival data through the lenses of pedagogical content knowledge, growth mindset, and self-efficacy to investigate how PSTs’ experiences with the process of ungrading supported their development of pedagogical content knowledge. Throughout the course, verbal feedback was provided during class discourse and the interactive lectures and written feedback was provided for all submitted assignments. The feedback provided was both positive and constructive in nature. Based on the assignment or activity, constructive feedback was either provided to improve future work submissions or for a revise and resubmit of the current assignment. The findings provide evidence that the process of ungrading can be beneficial to learning. Ungrading supported PSTs by teaching them how to grow from the feedback provided and to reflect on their learning throughout the semester. The PSTs developed and improved their pedagogical content knowledge through the processes of revision and reflection. Ungrading is a process that takes more planning, support, and time, but the outcome is well worth the effort.

Keywords: ungrading, pre-service teachers, assessment, comment-only feedback

Methods courses are inherently designed to promote best practices for teaching in one’s content area. As a methods instructor, I often question if I am creating, and instructing, my methods course in a manner that meets the needs of my pre-service teachers (PSTs) as developing mathematics teachers. I do my best to model representations of practice that are aligned with The Mathematical Teaching Practices (NCTM, 2014) and I provide multiple opportunities for learning about how to teach mathematics, but is what I am doing enough? Are my PSTs developing an understanding of the “major concepts, assumptions, debates, processes of inquiry, and ways of knowing” in mathematics (CCSSO, 2013, p. 24)? Do my PSTs have opportunities to reflect on their commitment to diversity, equity, and inclusion to minimize their implicit biases (CAEP, 2021)? Are my PSTs developing a commitment to continuous learning by participating in self-assessment and reflective practices (AMLE, 2012; CCSSO, 2013)? Are they developing the pedagogical content knowledge (PCK; Shulman, 1987) and skills that are necessary for teaching middle level (grades 4-8) students? I believe the answers to these questions depend on how I assess, and provide feedback to, the PSTs. Can a shift in their focus from grades-based performance to feedback-driven performance advance their learning? To answer these questions, I knew I needed to
engage in practitioner research (Cochran-Smith & Lytle, 2009) to systematically study my own teaching practice.

Based on the research of Butler (1987) and the reading of Ungrading: Why Rating Students Undermines Learning (and What to Do Instead) (Blum & Kohn, 2020), I wondered if this level of learning I am seeking from my PSTs could be delivered by modeling a process of ungrading (Blum & Kohn, 2020) that focuses PSTs’ attention on feedback provided via comments-only – taking learning to a deeper level. For the purposes of this manuscript and the process followed in my course, I define ungrading as a process of providing feedback to students, devoid of numeric grades, to promote deeper reflection on their performance and to strengthen their commitment to continuous improvement as future educators. I developed this definition based on the works of Butler (1987), Blum and Kohn (2020), and Wiliam (2018). Rather than focusing on the grade received, PSTs read the feedback and a) apply the feedback to revise and resubmit the current assignment or b) apply the feedback to future assignments. Revising and resubmitting is always required for assignments not meeting expectations as stipulated in the instructions and/or rubrics. This process of ungrading should be consistent throughout the entire course to continuously support PSTs’ self-assessment and reflection. I propose ungrading can be incorporated into a course that requires final grades and that PSTs can be active participants in determining their final grades. As the instructor of the course, I only see what is submitted for each assignment, I do not have a lens to view the effort put into the development and completion of the assignment. It is the PST who knows exactly how much effort they put into each assignment, and, in my opinion, they should be allowed to bring that knowledge to the final conversation in which a course grade is determined.

The focus of this practitioner research was to investigate how PSTs developed PCK (Shulman, 1987) when traditional grades were removed from my undergraduate middle level mathematics methods course. The questions that guided this study were:

1) What were the pre-service teachers’ perceptions of the ungrading process?
2) How do middle grades mathematics pre-service teachers develop pedagogical content knowledge when feedback is provided through comments rather than grades?
   a. How does a pre-service teacher’s self-efficacy and growth mindset support the development of pedagogical content knowledge?
Theoretical Framework

This research is framed through the lenses of self-efficacy (Bandura, 1977), growth mindset (Dweck, 2006), and PCK (Shulman, 1986). Self-efficacy is the belief in one’s ability to perform tasks at specific levels of success. Self-efficacy pairs well with the concept of growth mindset – the belief that knowledge, skills, and ability are developed through effort (Dweck, 2006) – and is linked to an individual’s behavior and motivation (Bandura, 1977) when provided a task. It has been my experience that when an individual possesses a growth mindset, they are motivated to provide the effort required to achieve higher levels of success.

This practitioner research was conducted in a middle level mathematics methods course designed for PSTs; therefore, it was also necessary to investigate the development of the PSTs’ PCK. This term, coined by Shulman (1986), illuminates the overlap of one’s pedagogical knowledge with one’s content knowledge. Shulman believed that individuals can be extremely knowledgeable about their content but lack the necessary pedagogical knowledge to be a facilitator of learning and conversely, one can possess deep pedagogical knowledge, but lack strong content knowledge to make learning meaningful and relatable. However, it is also possible for an individual to possess strong pedagogical knowledge and strong content knowledge, but not know how to cohesively blend them. It is only when an individual can effectively synthesize the two knowledge bases that they are said to possess PCK. This implies that teaching mathematics effectively looks and feels different than teaching science, language arts, or history effectively.

Figure 1

Visual Representation of the Theoretical Framework Utilized in This Research
This research sought to blend these three concepts – self-efficacy, growth mindset, and PCK – by creating an environment comprised of constructive feedback to develop the skills necessary to teach mathematics effectively without using traditional grades as a motivator. Figure 1 represents the embedded nature of this framework.

**Literature and Experiences Informing this Research**

The climate of many schools is centered around testing – grades matter. In the world of education, numbers speak loudly regarding which schools receive funding, which teachers receive praise in the form of increased salary and/or awards (or, from a deficit perspective, who gets to keep their job), and which students are tracked to gifted classes or referred for remedial services. At the college level, a student’s GPA can determine whether they receive a diploma, even if all coursework has been completed (for example, at our university, students must earn a minimum 2.0 GPA to graduate, but in our program, the minimum GPA for graduation is a 2.5). Additionally, a recent report on teacher burnout reported that although state-mandated testing has been reduced, district-level testing has increased, thus placing more demands on classroom teachers. These tests have led to teacher burnout and attrition (GaDOE, 2022). Furthermore, the test outcomes, which are often used to assess teacher effectiveness, do not consider the loss of instructional time (an increase in mandated tests leads to a decrease in time for instruction) or students’ diverse testing conditions (e.g., accommodations, anxiety).

I argue that there can be educational gains devoid of numerical grades. I returned to this realization after reading the book by Blum and Kohn (2020), a compilation of essays from secondary and higher education that speaks to the benefits of going gradeless. The concept of going gradeless was brought to the attention of educators by the research of Butler (1987) who determined student performance improved when students were provided feedback in the form of comments, only, as compared to the decreased performance evidenced when students received feedback in the form of grades, praise, or no feedback. Butler’s (1987) research has been supported more recently by the works of Bremser (2021) and Guberman (2021).

I stated above that I returned to this realization, which is, in fact, true. As a middle level educator for 9 years, I worked at a progressive PreK-8 school that believed in the power of feedback to influence learning, therefore students were not given grades, or traditional report cards. The school took a more individualized, standards-based approach to determine if students achieved the goal set for them or if they were still developing/emerging. To support objective assessment practices,
A brief narrative was written to define each student’s strengths and areas in need of continued support. Even in the 8th grade Algebra class I taught, in which students would earn high school credit (thus requiring a traditional numerical grade), I encouraged the development of mathematical understanding through a gradeless approach. After reading the work of Blum and Kohn (2020) I knew that I needed to return to my roots and complete a major revision with my middle level mathematics methods course – I needed to go gradeless!

Formative and summative assessments should be designed as an assessment for learning, not of learning (Wiliam, 2018). The assessments should focus on what we want students to do well while simultaneously providing opportunities for metacognition (Bremser, 2021). Furthermore, it is paramount to support PSTs’ development of PCK by modeling effective feedback strategies (Newton et al., 2020). Providing meaningful feedback that furthers learning is a skill developed over time, and although PSTs will not immediately become experts, they will experience the feedback from a learner’s perspective that can support their development as a teacher.

Regardless of the type of assessment given to students – quiz, unit test, essay, etc. – the grade received tends to be viewed by them as a measure of character rather than a demonstration of understanding (Bremser, 2021). How often have you heard students refer to themselves as “dumb” due to the grade received on a paper? If students consistently receive a “less than favorable” grade (which could be a 90 for some students!) they may begin to feel inferior to their classmates. Ungrading measures the learning that each student developed, not the achievement level or comparative standing of each student (Guberman, 2021). The comment-only feedback provided to students is meant to guide learning and support student achievement, not provide praise for a job well done or point out when one’s demonstration of understanding is not acceptable. I wanted to create the type of atmosphere in my course that focused on growth, not grades. Thus, the idea of redesigning my middle level mathematics methods course and going gradeless was born.

**Methods**

This practitioner research (Cochran-Smith & Lytle, 2009) was conducted to determine if incorporating comment-only feedback, absent of grades, in a “traditionally graded” undergraduate mathematics methods course could promote deeper learning and development of PCK for my PSTs. This qualitative study represents practitioner research because I completed the dual roles of course instructor and researcher participating in the systematic study of my practice while
teaching a middle level mathematics methods course. This study includes IRB-approved student archival data. Data was analyzed through the lenses of self-efficacy (Bandura, 1977), PCK (Shulman, 1986), and growth mindset (Dweck, 2006). Archival data was utilized since I chose to report on my experiences, and the experiences of my PSTs, around the midpoint of the semester and needed to collect all student data from the first day of classes. All my work from the start of the semester followed an action research framework. I continuously documented and reflected on my teaching, noting what could be changed or improved for future classes or iterations of the course. This is a practice I adhere to regardless of my involvement in practitioner research, but it was especially important during this semester of teaching as I embarked on a revision of my assessment practices.

I maintain a journal for each class I teach, but I felt it was pertinent for this class since I was embarking on the ungrading voyage. Each week after class I reflected on participation, questions about daily course topics and readings, and areas of confusion. I made sure to ask the PSTs if they had any questions regarding the feedback they had received on previously submitted assignments during each class. I wanted it to be clear to the PSTs that I wanted them to succeed and would provide support as necessary. All of their questions and feedback were documented in the journal at the end of each class. These reflections were not only utilized for this manuscript but also guided course revisions for future iterations of this course. In addition to my weekly course reflections, I documented assignment feedback in a spreadsheet for each submitted assignment.

This research is reflective of an action research framework (Anderson & Herr, 1999) because I was afforded the opportunity to make changes to my assessment practices throughout the semester, based on my PSTs’ needs. I was not bound by a stringent research design. Additionally, embedding this action research within the overarching frame of practitioner research allowed the focus to be on my role in supporting the learning of the PSTs (Lassonde et al., 2009). Although this research became a learning opportunity for me as an instructor, I chose to utilize an action research framework rather than self-study because my overall focus was on my PSTs’ development as future mathematics educators.

**Setting and Participants**

This course was conducted during spring 2021 at a large, rural university in the southeastern United States with a positive reputation for offering strong education programs. The participants in this study were four PSTs, who identified as female (three White and one Black), enrolled in my mathematics methods class as part of the undergraduate middle level teacher education program. Three of the
participants were first-semester seniors with mathematics as a primary content area for their teaching certification and one participant was a second-semester junior with mathematics chosen as her secondary content area for her teaching certification (in our state, middle level teachers are certified in two content areas).

Curriculum

This mathematics methods course was designed for PSTs who plan to teach middle level mathematics. The course description referenced in my syllabus and the campus catalog for spring 2021 was:

A study of teaching methods and materials, curriculum content, assessment strategies, and trends in middle level mathematics. A field-based component, which requires planning and teaching a mathematics unit in a middle level classroom is required.

Although the course description referred to the field-based component, it was a co-requisite of this course, and the planning and instruction of the mathematics unit (what I refer to in this manuscript as a learning segment) occurred in a separate course. The objectives of the course were aligned with program expectations as well as CAEP (2021), InTASC (2013), and the Association of Middle Level Education (AMLE, 2012) standards for teacher preparation.

Examples of course activities to develop PCK were weekly reading reflections and discourse; interactive lectures utilizing PearDeck merged with Google Slides; and the development of a lesson incorporating Lego robotics (based on learning about robotics throughout the course). In addition to these activities, PSTs developed several learning segment components. As noted above, the learning segment was developed in their field-based course, but specific components of the learning segment were part of this methods course such as the creation of concept maps, formative assessments, and a card game. A comprehensive list of the assignments can be found in Table 1 and an example of a course assignment, with the related rubric, can be found in the Appendix.
### Table 1

**List of Required Assignments for Spring 2021 Mathematics Methods Course**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1 readings and reflection</td>
<td>PSTs read from their class text (NCTM, 2014) and responded to 5 reflection prompts.</td>
</tr>
<tr>
<td>Week 2 readings and Flipgrid reflection</td>
<td>PSTs read from their class text (NCTM, 2014), reviewed a short video clip, and responded to 5 reflection prompts via the Flip video platform.</td>
</tr>
<tr>
<td>Rationale (became part of the learning segment)</td>
<td>PSTs rationalized the purpose for teaching the content of their learning segment; they were asked to: Imagine that you are making a pitch to your school’s student council/school board to include your learning segment in the curriculum of X grade. Your job is to convince the student council/school board of its importance in the lives of X grade students. What will students know and be able to do at the end of your learning segment?</td>
</tr>
<tr>
<td>Week 3 readings and reflection</td>
<td>PSTs read from their class text (NCTM, 2014) and responded to 7 question prompts.</td>
</tr>
<tr>
<td>Content Research Project (became part of the learning segment)</td>
<td>PSTs conducted research to demonstrate an understanding of concepts and skills that develop all young adolescent learners’ competence in mathematical understanding as related to their learning segment topic.</td>
</tr>
<tr>
<td>Concept Map (teacher version; became part of the learning segment)</td>
<td>PSTs created a visual “road map” of the content of their learning segment. This included vocabulary and content to be taught.</td>
</tr>
<tr>
<td>Concept Map (student version; became part of the learning segment)</td>
<td>PSTs created a student version of their concept map for completion during instruction of the learning segment.</td>
</tr>
<tr>
<td>Mid-semester self-assessment</td>
<td>PSTs completed a self-assessment (see Appendix) via Google forms.</td>
</tr>
<tr>
<td>Week 8 readings and reflection</td>
<td>PSTs read from the 2nd course text (Keeley &amp; Tobey, 2011), read 2 articles via Perusall, and reviewed 2-3 “3-Act Tasks.”</td>
</tr>
<tr>
<td>Formative Assessment Assignment (became part of the learning segment)</td>
<td>PSTs developed a formative assessment (see Appendix).</td>
</tr>
<tr>
<td>Week 9 readings and reflection</td>
<td>PSTs continued to read from the Keeley &amp; Tobey (2011) text, read 2 articles via Perusall, and responded to 3 reflection prompts.</td>
</tr>
</tbody>
</table>
I have…, who has…? Cards (became part of the learning segment)

PSTs created a deck of cards to represent a mathematics game in which students read a clue and another student responds with the answer, then reads their clue.

PSTs reflected on the semester. They were asked to respond to the following prompts:

- 3 big takeaways from this class
- 2 things you would like to know more about
- 1 suggestion for future students of this class
- Anything else you would like to add (optional)

Week 16 Flipgrid Reflection

Robotics Lesson Plan

PSTs created, and taught their peers, a lesson on a topic of their choice using LEGO robotics.

Final Self-Assessment and Reflection

PSTs reflected on their effort and learning throughout the semester (see Appendix).

Unessay

PSTs created an unessay, a creative and engaging creation of their choice to reflect on and/or deepen their understanding of a topic (or topics) investigated during the semester. They were expected to conduct research to inform the product.

Throughout the course, verbal feedback was provided during class discourse and the interactive lectures and written feedback was provided for all submitted assignments. The feedback provided on written work was both positive and constructive in nature, such as “this is a great start to this content research project, but there could be more depth with how the instruction will be carried out.” Based on the assignment or activity, constructive feedback was either provided to improve future work submissions or for a revision and resubmission of an assignment. More specifically, feedback given regarding reading reflections would ask for more depth in the connections made between the reading, their personal experiences, and prior practicum experiences (during spring 2021 we were still under COVID-19 protocols and PSTs were participating in an online practicum experience devoid of actual classroom experiences, but they did have prior experiences to make connections with). Feedback provided on the learning segment components was more focused on revision and resubmission to ensure PSTs were developing, and applying, their PCK to the creation of their learning segment. I maintained a spreadsheet to document student work and recorded all work as either exceeding expectations, meeting expectations, or not meeting expectations (requiring revision). Additionally, I recorded comments on the types of feedback I
provided to PSTs, such as “requires more depth” or “needs more connections to the course readings,” so I could determine if feedback was being incorporated into future assignments. See Table 2 for more specific information regarding my feedback.

### Table 2

**List of Assignments with Common Revision Areas and Examples of Feedback**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>No. of “revise and resubmit” requested</th>
<th>Areas needing improvement</th>
<th>Example feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Reflections</td>
<td>3 PSTs; 4 revisions</td>
<td>Citations; references; depth of responses</td>
<td>This was a strong reflection. Your citations are accurately formatted; be sure to include the references next week.</td>
</tr>
<tr>
<td>Rationale</td>
<td>4 revisions</td>
<td>Lack of depth with justifications</td>
<td>This is a strong first draft. I would like to see more depth regarding technology and pedagogy.</td>
</tr>
<tr>
<td>Content Research Project</td>
<td>4 revisions</td>
<td>Lack of depth; APA formatting; development of instructional strategies; support of diverse students</td>
<td>This is an acceptable first draft of this content research project, but it lacks some depth. See specific comments within the document to be addressed with your revision.</td>
</tr>
<tr>
<td>Concept Map (Teacher version)</td>
<td>4 revisions</td>
<td>Not completed digitally; missing definitions of vocabulary; need visuals</td>
<td>This is a strong visual map but does not include any definitions for the vocabulary.</td>
</tr>
<tr>
<td>Concept Map (Student version)</td>
<td>0</td>
<td>n/a</td>
<td>Excellent concept map for student use.</td>
</tr>
<tr>
<td>Formative Assessment Assignment</td>
<td>3 revisions</td>
<td>Grammar; objectives</td>
<td>This is well done, but there is a math error and one minor grammatical error. Please see my comments in the document and don’t</td>
</tr>
</tbody>
</table>
hesitate to ask if you have any questions. See the comments included throughout to make some of the questions stronger, or clearer. For example, on card #18 I would add “but no right angles” to differentiate from a rectangle.

Great job with this! I am proud of your perseverance and success with the robots.

I am so glad that your work with robotics this semester piqued your interest in robotics! Great work with this project.

In addition to these tasks and activities, PSTs were required to complete a mid-semester self-assessment of progress during week 8 of the semester and a final self-assessment (see Appendix for the self-assessments) at the end of the semester upon completion and submission of the unessay (Nelson, 2019) final project. Once PSTs completed the final self-assessment, they were required to schedule a conference with me to discuss their self-assessment and determine a final grade for the course. The final letter grade was determined through a discussion reflecting on each PST’s learning progression throughout the semester; they were asked to provide a verbal justification for their self-determined grade, and I would, in turn, provide my justification for the grade I generated.

Data and Analysis

Participant archival data was collected from one semester of implementation during spring 2021 and consisted of PSTs’ mid-semester self-assessments, submitted assignments, and final self-assessments as the data sources. Additional data sources included the spreadsheet I used to track my comments regarding PSTs’ performance on each task and my weekly journal reflections completed after each class with notes pertinent to questions, feedback, and performance (e.g., responsible for a younger sibling, employment obligations,
The first level of analysis consisted of a careful reading of PSTs’ responses to the mid-semester self-assessment and end-of-semester self-assessments, independently, to determine emerging themes (Creswell, 2018) and then a detailed review to identify overarching themes across the data sources. For example, as I read through the mid-semester self-assessments, it was clear PSTs were being open and honest. When asked about the effort they put towards their learning PSTs’ made comments referring to needing to “do better” or “put in more effort.” PSTs’ assignment submissions were reviewed, in conjunction with my spreadsheet, to determine if the feedback provided was incorporated to continuously improve throughout the semester and if the PSTs’ analyses of their performance on each assignment in their self-assessments aligned with my evaluation of their work to provide validity (Patton, 2002; Yin, 2018).

Findings

The findings provide evidence that the process of ungrading can be beneficial to learning and the development of PCK. PSTs’ self-assessments honestly reflected their self-efficacy and quality of work throughout the semester. When introduced to the concept of ungrading, PSTs were excited because, as they reported, it relieved them from the pressure of needing to receive an “A.” The feedback I provided supported stronger submissions on future assignments and classroom discourse that clearly integrated PSTs’ PCK and reflected their growth mindset. When reflecting on their experiences with the ungrading model, PSTs were open and honest about their areas for growth and effort expended in the learning process.

Pre-Service Teachers Were Honest

PSTs were honest and transparent when they responded to the self-assessments. Their honesty reflected their self-efficacy and growth mindset – they needed to admit to their areas of weakness before they could commit to improving in those areas. This was evident in responses noting a lack of demonstration of their learning and the need to improve their effort given to the completion of assignments. The mid-semester self-assessment provided the means for PSTs to self-assess their current efforts and set goals for improvement during the second half of the semester.

PSTs articulated the difference between their effort expended during learning (e.g., readings, class discourse) as compared to their effort when demonstrating their learning (e.g., assignment submissions). For example, during the mid-semester conferences, PSTs reflected on their effort to complete course
readings and how that compared to their effort expended to complete the written reflections based on the readings. At mid-semester, only 2 out of 4 PSTs admitted to completing 75-100% of the course readings, however, this number increased to 3 out of 4 PSTs by the end of the semester. Additionally, PSTs realized their need to improve their demonstration of learning when they admitted to completing only the basic requirements on reflections and assignments. PSTs admitted they were inconsistently providing their best effort. The PSTs clearly understood their areas of weakness and began to put forth more effort in demonstrating their learning. After the mid-semester self-assessments PSTs were consistently producing stronger assignments on the first submission, requiring a reduced quantity of feedback and less revision time.

When reflecting on class participation during the completion of the mid-semester self-reflections, PSTs were aware of their contributions during class. Two of the four PSTs reported only speaking when they were called upon, whereas the other two PSTs reported regular participation in class discourse. PSTs shared when they felt they were active participants during class, while also reflecting on the need to participate more. This self-reflection prompted each PST to participate more actively during class discourse and activities in the second half of the semester. The self-evaluations documented an area needing improvement and allowed me, as the course instructor, to ensure I created opportunities during class for each PST to develop and improve in this area without the added stress of a participation grade.

**No Grades Meant No Stress**

The PSTs reported that not having the added stressor of worrying about their grade for class participation and each assignment was an important factor that enhanced their learning. They reported their anxiety was reduced without reducing their performance and allowed them to grow from the feedback without the stress of a grade. One student reported that they initially thought that not having graded assignments would make the work easier, but quickly realized that the work was not easier, just less stressful without grades. Another student reported that removing grades removed stress and anxiety, but still allowed her to provide her best effort. However, one PST, who was very open to the idea at the start of the semester, found the feedback to be less motivating than a letter grade and realized that grades allowed her to track her progress throughout courses.

When completing the mid-semester self-assessment, PSTs were asked to reflect on their performance during the first half of the semester and determine a letter/numerical grade reflective of said performance. Of the four PSTs, 2-As, 1-B, and 1-D were reported. They provided strong justifications for these assessments
and committed to improving their efforts during the remainder of the semester as they continued to develop their PCK. At the end of the semester, all PSTs either maintained their A-level performance or improved from the mid-semester assessment, without the stress of grades along the way.

**Improved PCK**

When evaluating the development of PCK, the PSTs improved in their synthesis and connections to practice through the weekly reflections as the course progressed. The PSTs made stronger connections between the readings, their methods course experiences, and their prior classroom (field) experiences. PSTs developed a more pronounced level of ownership of their learning which was evidenced in their application of feedback and growth throughout the semester. PSTs’ ability to make connections between mathematical content and pedagogical methods experienced during class, in prior practica, and through the readings was evident in the depth of the reflections, which improved throughout the course.

The learning segment components, created by the PSTs, incorporated the application of previous feedback and synthesized their content and pedagogical knowledge. More specifically, assignments related to curriculum (e.g., formative assessment tasks, robotics lesson plans) reflected strong pedagogical practices and deep content knowledge. Of the two formative assessment assignments required, the second submission reflected the development of stronger objectives and a chosen assessment (from Keeley & Tobey, 2011) more clearly aligned with the standard(s) and objective(s). The “I have…, who has…?” assignment (based on a card game played during several classes) reflected strong content knowledge and academic vocabulary developed throughout the semester through course content and previous assignment feedback. Finally, the robotics lesson plans created by the PSTs incorporated strong pedagogical practices based on collaboration, engagement, creation, prediction, and evaluation. The lessons were not designed for students to solve rote problems or answer direct questions. The lessons required students to collaborate in engaging activities using robotics to create problems to be solved, make predictions, and evaluate outcomes. The lessons required critical thinking and the application of problem-solving skills whilst engaging in mathematics. Each of the assignments reflected the PCK developed by the PSTs during the course. Furthermore, PSTs’ work with robotics throughout the semester provided another area to assess one’s growth mindset and self-efficacy. None of the PSTs had previously worked with robotics and self-reported being hesitant to engage with them in this methods course. However, each PST approached the challenge with an open mind, positive attitude, and always provided their best effort.
Discussion

A careful analysis of the data illuminated the findings of the study and allowed me to answer each of my research questions. For the first question, What were the pre-service teachers’ perceptions of the ungrading process? the data show PSTs appreciated the ungrading aspect of my mathematics methods course. This practice of ungrading introduced PSTs to a course that was “student-centered, unbiased, and fairly implemented” that also “foster[ed] purposeful learning and meaningful relationships” (Bishop and Harrison, 2021, p. 9). Feedback was provided to encourage deeper learning in an environment that supported the success of all PSTs by removing the stress related to grades. The ungrading aspect also supported PSTs by teaching them how to grow from the feedback provided and to reflect on their learning throughout the semester. Although all PSTs were open and receptive to the idea at the start of the semester, end-of-semester conferences revealed that one of the four PSTs preferred the use of grades as a motivator.

Regarding the second research question, How do middle grades mathematics teacher candidates develop pedagogical content knowledge when feedback is provided through comments rather than grades? findings provided evidence that the PSTs developed PCK through the process of revision. Teaching is an act of learning. As teachers, we learn from revision and reflection, and I believe this must be modeled. The PSTs received feedback for each learning segment component they submitted and were expected to revise and resubmit when expectations for the assignment were not met. This process of revising and resubmitting was not only meant to support their development of pedagogical knowledge and content knowledge but also to merge the two domains into one where they identified and utilized specific pedagogical strategies in their learning segment components based on the content to be covered.

Regarding the sub-question, How does a pre-service teacher’s self-efficacy and growth mindset support the development of pedagogical content knowledge? the findings reflect that PSTs’ self-efficacy (Bandura, 1977) and growth mindset (Dweck, 2006) strongly influence the development of PCK in the revise and resubmit process. Revisions and subsequent assignments submitted by the PSTs provided evidence of their self-efficacy (Bandura, 1977). Feedback was internalized to continuously improve their curriculum planning, as shown in the formative assessment assignments. Their positive growth mindsets (Dweck, 2006) were evident in the honest reflections provided on the self-assessments. I am confident the PSTs’ experience of accepting constructive criticism and using it to improve their curriculum planning will be a springboard for future growth and collaboration.
Implications and Limitations

What Did I Learn?

Participating in this practitioner research was a positive experience for me and appears to have been a positive experience for the PSTs (based on their self-assessments), although one PST did report preferring grades in our final conference. However, I found that much is still to be learned and improved upon. I already made changes to my course based on this experience for the fall 2021 and spring 2022 semesters, such as adding a mid-semester conference. During this first iteration of going gradeless (spring 2021), I realized that I needed to meet with the PSTs mid-semester to discuss their progress and reiterate my expectations. Honest conversations with each PST were necessary prior to the end of the semester so they could more clearly understand my expectations, based on their current performance, to support maximum growth and learning potential in the second half of the semester.

I also learned that utilizing ungrading requires much more time outside of the class (Newton et al., 2020). Providing constructive feedback that promotes learning, rather than providing the answers, needs to be well structured, sharing comments such as “good job” or “this answer is not correct” are not appropriate types of feedback for a gradeless course (Newton et al., 2020). Furthermore, scheduling meetings outside of class time can add to an instructor’s workload. If implementing ungrading with larger classes, the time commitment would also increase. To combat the increased time commitment, I suggest alternative assessment practices could be implemented to minimize the instructor’s workload. For example, include opportunities for peer feedback rather than relying solely on teacher feedback, revise the number of required assignments to be submitted, and limit conferences to 10-15 minutes inclusive of a clear discussion agenda. The final conferences for this study lasted approximately 30 minutes each, which was doable with four PSTs, but would likely not be possible with larger classes.

In addition to the time commitments noted above, it is also important to ensure you have the support of the administration. When required, instructors must be able to provide evidence of the PSTs achieving course and program objectives (Guberman, 2021). My experiences with ungrading would not have been possible if I did not have the support of my department chair. Another caveat to ungrading is that this mathematics methods course still required a final letter grade. Although I met with PSTs at the end of the semester to discuss their final grade, if I did not agree with their self-determined final grade, I would have needed evidence to justify the grade I believed best reflected their performance. For this reason, I kept
detailed notes on each assignment submission. Fortunately, the PSTs’ self-imposed grades did align with my assessment of their performance throughout the semester.

Finally, an important realization made through this systematic study of my practice was that class participation should not be considered in final course grades. Students have diverse comfort levels and shyer students should not be penalized for participating less than their peers during class. Participation should be encouraged, the level of participation should be discussed in conferences, and PSTs should reflect on their learning via participation, however, it should not be part of the basis for determining one’s self-efficacy, growth mindset, or final grade. Additionally, one’s development of PCK should be reflected via planning and instruction (although observing instruction is not part of this course), not through in-class participation.

**Limitations**

As with all research, this research has limitations. First, this was an extremely small sample size utilizing a large amount of archival data. Although the findings are promising for enhancing self-efficacy (Bandura, 1977) and a growth mindset (Dweck, 2006) while developing PCK (Shulman, 1986) more studies utilizing the impact of ungrading need to be conducted. The use of archival data limited the richness of the reported findings as my IRB approval did not permit the use of direct quotes from the PSTs. This precaution was taken to protect the PSTs from being identified, which was especially important given the small sample size. Furthermore, this was one mathematics methods class in one rural College of Education. Research studies should be conducted in all content methods courses in much more diverse Colleges or Schools of Education.

**Conclusion**

Moving my class to an ungraded platform was not easy to do, but it was well worth the effort based on my experiences in this practitioner research project and my analyses of both the PSTs’ assignment submissions and their self-assessments. However, I would be remiss if I did not share that this type of change to my class is continuously being reflected upon and revised as I continue to implement ungrading practices in additional iterations of my course. I am constantly seeking student feedback and searching for literature and research on this topic to continue to inform my practice. The first semester of implementation, being reported in this manuscript, taught me that I needed to be upfront and honest with PSTs from day one about the process of ungrading and my expectations – over-explaining is okay since this process is likely new to most PSTs. I learned that
it is important to conduct conferences with PSTs mid-semester and at the end of the semester. Room for growth can clearly be articulated via verbal feedback and conversation and I could learn more about the PSTs’ needs regarding my teaching and the feedback provided with mid-semester conferences. Finally, I realized that class participation should not be a part of the evaluation process. If I truly wanted the PSTs to support each other and commit to continuous improvement through in-class discourse, I found it was best developed through reflection, not via a grade.

The most important outcome of this research, from my perspective as the course instructor, is that the PSTs’ self-imposed, justified final grades aligned with my assessment of each PSTs’ performance throughout the semester. The PSTs clearly understood my expectations and rose to the challenges presented in my mathematics methods course, the most important of which, was developing their PCK regarding the teaching of mathematics. Ungrading is a process that takes more planning, support, and time, but, in my opinion, the outcome is well worth the effort. I am continuing to implement ungrading in my mathematics methods course, continuing to reflect and revise, and hoping to move more of my classes into an ungraded format.

Research into ungrading practices can open new doors to assessment practices at both the K-12 level and in higher education. An area for future research is to follow up with former PSTs to investigate the effect this experience has had on their current assessment practices as in-service teachers. Do they implement ungrading practices to support their students’ self-efficacy and growth mindset? I would also like to investigate how ungrading would work in my fully online courses, which are part of a graduate program for in-service teachers. It would be interesting to investigate if practicing teachers are as receptive to this mode of assessment as the undergraduate PSTs were and if their view of assessment practices is influenced by the experience.
References


Association of Middle Level Education [AMLE]. *Association for Middle Level Education middle level teacher preparation standards with rubrics and supporting explanations*. Association of Middle Level Education.


Bishop, P. A. & Harrison, L. M. (2021). *The successful middle school: This we believe*. Association for Middle Level Education.


Policy/communications/Documents/Teacher%20Burnout%20Task%20Force%20Report.pdf


Appendix
Example Assignment with Rubric
Formative Assessment Assignment

Instructions:
The reading you have been completing since Week 6 in the text *Mathematics Formative Assessment* (Keeley & Tobey, 2011) should have provided you with background knowledge on the importance of assessment, how to integrate assessment into your instructional practices/tasks, and how to use the data from the assessment to inform your practice. This week you are going to choose one formative assessment (from the 75 shown in the text) for your learning segment to assess your students' conceptual understanding, procedural fluency, and mathematical reasoning OR problem-solving abilities. In addition to completing this template (link to the template was provided) for the FACT you should submit any materials required to complete the assessment (completed by you) and an answer key for the assessment (if the assessment is one in which students are to write a response, you should submit an example of what you would expect from your students).

Rubric:
This rubric will be used to evaluate your submission.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Expectations</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Narrative includes:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• FACT number you will be implementing in your class</td>
<td></td>
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<tr>
<td></td>
<td>• Content standard/element(s) FACT will measure</td>
<td></td>
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<tr>
<td></td>
<td>• Detailed discussion of how you will implement the chosen FACT</td>
<td></td>
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<tr>
<td></td>
<td>• Discussion of how you plan to use the data to inform your teaching</td>
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</tr>
<tr>
<td>Materials</td>
<td>Materials should include:</td>
<td></td>
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<tr>
<td></td>
<td>• All materials required to assess your students using the FACT (should be created by you, NOT taken from the internet)</td>
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</tr>
<tr>
<td></td>
<td>• Answer key for the FACT (if the FACT is a student self-assessment you should provide examples of what you expect the students to say/write/do)</td>
<td></td>
</tr>
<tr>
<td>Grammar/Mechanics</td>
<td>Clearly written, well-organized, and demonstrates appropriate grammar, spelling, punctuation, and word choice. No more than 3 grammatical errors.</td>
<td></td>
</tr>
<tr>
<td>APA Formatting</td>
<td>All references and citations follow 7th edition APA format guidelines.</td>
<td></td>
</tr>
</tbody>
</table>
Mid-Semester Self-Assessment
(Provided as a Google Form/Survey)

The purpose of this self-assessment is to review, reflect, request feedback or assistance, and determine if any behaviors should be praised or revised before the end of the semester.

Please review your submitted work thus far and reflect on it to respond to the questions below.

Form adapted from:

What is your overall assessment of your effort towards your demonstration of learning?
What is your overall assessment of your effort towards your general performance in this course?
Have your contributions to the class discussions added depth to the conversations?
Why or why not?
Be honest, approximately how much of the assigned reading do you usually do?
- 76-100%
- 51-75%
- 26-50%
- 25% or less
How do you feel about your participation during class?
Do you ever talk about this class outside of class (to classmates or other peers)?
- never or rarely
- sometimes
- frequently
Are there concepts or topics you would like clarified? If so, what?
What do you hope to get out of the remainder of the semester?
If you were to give yourself a grade for this course right now, what would it be?
Why?
Does your beginning of semester goal need to be revised for the remainder of the semester? If yes, what should it now be?
Any additional comments you would like to share?
Final Self-Assessment
(Provided as a Google Doc to be completed and shared prior to final conference)

Final Self-Assessment for Conference
Please complete this self-assessment, share with me at least 2 hours before our conference, and bring it with you to our scheduled conference.

Please respond to each question honestly. Be sure to justify each of your responses and refer to course artifacts, concepts, assignments, etc.

Questions adapted from:

I. Reflect on and review your work from this semester.
   A. What readings and discussions were completed?
   B. What assignments were required of you?
   C. How did the course assignments compliment your practicum coursework?

II. Looking at Specifics
   A. List 3 of your favorite readings from this class this semester. Explain why you enjoyed them.
   B. List 3 of your favorite assignments or class activities from this class this semester. Explain why you enjoyed them.

III. General Reflection
   A. What do you know now that you did not know in August?
   B. What work was challenging? What was fun? What was useful? What didn’t seem useful?
   C. Did you learn anything unexpected?
   D. Did you expect to learn something that you didn’t learn?
   E. Did you change your mind about anything?
   F. If you were going to write about a mathematics myth - something people often believe to be true, but is false - what would it be? Why?
   G. What is a profound insight you gained this semester?
   H. Did you achieve your goal(s) for this class this semester? Explain.
IV. Some Feedback
   A. Did you ever talk about this class, or the assignments/activities, outside of class? Often? Sometimes? Rarely? What did you share?
   B. Did you become curious about anything new?
   C. How well did this class connect with your other education courses?
   D. What was your initial reaction to the lack of focus on grades? How do you feel about it now?
   E. What do you think you’ll remember in 5 years?
   F. Have you thought about the ways you learn? Have you observed anything that you might take forward with you?

V. The Numbers
   A. Approximately how many classes did you miss?
   B. In terms of participation in class, how engaged and mentally present were you in the class?
      ______ there and ready to go all the time
      ______ sometimes engaged and sometimes texting or surfing or doing other work for other classes
      ______ pretty unengaged
   C. Approximately how much of the reading did you do?
      ______ 90-100%
      ______ 75-89%
      ______ 50-74%
      ______ less than 50%
   D. Do you have any comments about…?
      i. The reading itself
      ii. Your reading of “the reading”

VI. The Evaluation
   Give yourself a ✓+, ✓, ✓-, or 0 for each activity or assignment

   ___ Week 1 readings and reflection
   ___ Week 2 readings and Flipgrid reflection
   ___ Rationale
   ___ Week 3 readings and reflection
   ___ Content Research Project
   ___ Week 4 readings and reflection
   ___ Week 5 readings and reflection
   ___ Concept Map (teacher version)
   ___ Concept Map (student version)
   ___ Week 6 readings
VII. Please suggest a grade for yourself, with comments.
   Grade _____
   Explain how you arrived at this grade.

VIII. Do you have any other comments?