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What Constitutes a Good Mathematics Lesson?: A Narrative Inquiry into Preservice Teachers' Perceptions of Good Mathematics Lessons

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What constitutes a good mathematics lesson plan? In their teacher education program, preservice teachers (PSTs) are trained for planning mathematics instruction but often have difficulty in evaluating existing lesson plans and creating their own lesson plans. The purpose of this narrative inquiry is to understand PSTs' experiences of evaluating or designing mathematics lessons that they perceive as being good. The narratives of three PSTs who pursue high school mathematics teaching certification will inform us not only of their perceptions of a good mathematics lesson and lesson plan but also their process of finding the one that exists or creating their own.

Keywords: preservice teacher, teacher education, mathematics lessons, perception.
MESC Classification: B50
MSC2010 Classification: 97B50

I. INTRODUCTION

Every day, teachers plan lessons for more effective and successful teaching. To prepare their lessons, teachers use multiple forms of curriculum materials, such as textbooks, online resources, or materials from other teachers. They plan their instruction based on their perceptions and interpretations of various instructional materials (Brown, 2011). As mathematics teachers access more online curriculum materials than before, how they evaluate and adapt those materials including pre-made lesson plans and activities to meet their diverse students' needs has been emphasized in the field of mathematics education (e.g., McDuffie, Choppin, Drake, Davis, & Brown, 2018; Webel, Krupa, & McManus, 2015).

Lesson planning is one of the essential teaching practices that are emphasized for preservice teachers (PSTs) to learn during teacher education programs (Core Practice Consortium, n.d.; Teaching Works, n.d.). Although it is expected that PSTs to learn how

to evaluate existing mathematics instruction and design their own, little is known about their perceptions of a good mathematics teaching, which refers to "teaching as a process that promotes analysis, thinking, and problem solving" (Wilson, Cooney, & Stinson, 2005, p. 85) or a good mathematics lesson, which plays a significant role in the process of evaluating or designing mathematics lessons (Li, 2011). By exploring the PSTs' thoughts on what constitutes a good mathematics lesson, it will give us (educational researchers and teacher educators) a better understanding of the messages that PSTs take away from teacher education programs. This present study uses a narrative inquiry of PSTs' experiences of evaluating existing mathematics lessons and/or creating the lessons that they think it is in good shape based on their own perception of good mathematics lessons.

II. LITERATURE REVIEW

What constitutes good mathematics lessons? To answer this question, one may ask like, "What do you mean by 'good' lessons? In terms of what?" People may answer differently based not just on their knowledge, beliefs, or orientations but also their purpose of research. In the field of mathematics education, a set of teaching practices that we (educational researchers and teachers) desire our teachers (both preservice and in-service) to be equipped, has been described as exemplary, effective, successful, quality, or good teaching (Fenstermacher & Richardson, 2005; National Council of Teachers of Mathematics, 2014). These are all distinct but often interchangeably used due to the overlapping conception of desirable teaching.

Much of the prior research has documented and conceptualized good mathematics teaching rather than good mathematics lessons. For example, Rosenshine and Furst (1971) found that the clarity, variability, enthusiasm, task-oriented behaviors, and opportunity to learn are strongly associated with effective teaching. Wilson, Cooney, and Stinson (2005) found that high school mathematics teachers thought a good mathematics teaching requires a teacher's sound mathematics knowledge, promotes students' mathematical understanding, and engages and motivates students. They also expressed that their teaching experiences after completion of their undergraduate are the most important sources of their learning compared to other sources, such as professional developments or undergraduate teacher education programs. As they highlighted, preservice teachers have less experiences of teaching and learning mathematics with students compared to in-service teachers.

Although there were such efforts for identifying the dimensions of good teaching, less attention has been paid to what constitutes good lessons. In this present study, I view lessons as the plans for enactment, which are bounded by one or multiple class periods

whereas teaching is a process of enactment. In other words, teaching and lesson closely connect with one another but the former focuses on teacher's deliberate teaching practices and the latter focuses on the structure and content of lessons. As teachers design their lessons based on their personal/professional characteristics, such as beliefs, orientations, perceptions, etc. (Brown, 2011), it is important to investigate what perceptions teachers have and how these perceptions play role in the process of lesson planning. Therefore, it is important to understand preservice teachers' perceptions of good mathematics lessons or how they evaluate lessons and/or lesson plans with their limited experience with students in the classroom.

To this end, this study explores PSTs' perceptions of a good lesson and their experiences of determining a good lesson. The data presented in this study were initially collected for a bigger project that focuses on to what extent PSTs can articulate the differences between lessons. This present study only focuses on the questions on PSTs' perceptions rather than their capacities to design good mathematics lessons. This particular focus sheds light on how PSTs approach to finding or creating a good lesson and what characteristics of lessons or lesson plans they were looking for. It will help mathematics teacher educators to understand where their PSTs are and to equip PSTs with appropriate knowledge and skills for designing good mathematics lessons.

III. RESEARCH METHODOLOGY

Narrative inquiry can be defined differently depending on the purpose of studies, but generally it refers to "the study of stories" (Polkinghorne, 2007, p. 471), which has been an influential methodology not only in education but also in other disciplines (Kim, 2016). It focuses on "the human experience presented in narratives and stories" (Kim, 2016, p. 69). The view of human experiences as human lead storied lives is widely accepted among narrative scholars (Spector-Mersel, 2010). They are interested in *what* narrators *told* and *how* the narrators are *telling* (Riessman, 2007). By using narratives, educational researchers intend to interrogate the dominant view of the nature of education and reshape their understandings of education and schooling (Kim, 2016). Hence, through narrative inquiry, I invite the readers to rethink and reevaluate what characteristics of mathematics lessons make PSTs perceive as good mathematics lessons.

1. PARTICIPANTS

Three preservice teachers (PSTs), white females, who are in their junior year in their

middle and high school mathematics teacher preparation programs at a research university in the Midwestern U.S., participated in this study. These participant teachers were in the same cohort, which means they had been taking the same first and second mathematics teaching methods courses out of three courses—the first one in Fall 2018, the second one in Spring 2019, and the last one in Spring 2020. In addition to the second teaching methods course, the PSTs were doing their weekly field experience, visiting the same mathematics class weekly by working with their host teachers to fulfill the teaching licensure requirements. The entire cohort was informed about this study by the researcher visited the session of the course, and the three PSTs volunteered to participate in the study to share their experience of finding or creating good mathematics lessons.

2. DATA SOURCES

Data for this study were collected as part of a larger study, which is part of the requirements of the Ph.D. program that the researcher was pursuing. The main data sources for this present paper are the lesson plans or materials that the participants provided and an hour qualitative interview around their choices of the plans using a semi-structured interview protocol. The interview was conducted in April, in the middle of the Spring semester of 2019. Before the interview, the researcher asked participants to find or create a good mathematics lesson or lesson plan that they think is "good" based on their definition/beliefs of a good mathematics lesson. Participants sent their lesson plans before the interview, and the researcher looked through the plans and/or materials before the interview and prepared follow-up questions to elicit the characteristics of each lesson or lesson plan in addition to the developed interview protocol.

3. DATA ANALYSIS

Narrative analysis is used to reconstruct the three PSTs' narratives of their experiences of finding or creating lessons based on their perception of good mathematics lessons. To convey their narratives to readers, the researcher read through the entire interview transcripts multiple times and left marginal notes and analytic memos (Saldana, 2009) regarding the points that stood out. As this present study is part of a larger study on how PSTs do evaluate the outlined lessons and lesson plans, the researcher also analyzed the transcripts and their lesson plans by applying an existing analytic framework for interpreting the characteristics of lessons (and lesson plans) and their rationales of focusing on these characteristics of the lessons.

Once reading through all three transcripts, the researcher used Riessman's (2007) thematic analysis to unveil what the participants *told* about why they think their chosen lessons are good. By focusing on the content of their narratives instead of *how* they were telling, it unpacks what the PSTs valued and emphasized. Narrative analysis, especially thematic analysis, often looks similar to ground theory as both use *cases*. While ground theory theorizes across, thematic analysis is more case-centered within each case and focuses less on finding the patterns across the cases. Thus, it tries to convey narrators' stories as intact instead of theorizing the phenomenon across the participants to generalize the patterns and findings.

The author of this present study coded each participant's transcript using the initial coding scheme that was adapted from existing literature. Then, emergent patterns within each participant's narrative were identified. As the narratives of the PSTs were overlapping but distinct, the researcher decided to convey their stories as is with minimal restructuring instead of presenting the themes across the participants by chopping out their stories and sorting them based on the similarities and differences between them.

To keep the PSTs' stories as intact, minimal resequencing of the narratives was applied by putting the narratives of each participant in the order that the researcher believes it helps readers to follow their stories. The researcher re-sequenced and excluded some chunks of their stories if these chucks are 1) not fully formed (see Riessman, 2007 for William Labov's six elements of a fully formed narrative) or 2) less relevant to the PSTs' experiences of finding or creating a good mathematics lesson. Related to that, I acknowledge that the resequencing and excluding the excerpts influence the PSTs' narratives that I share with the readers.

IV. FINDINGS: THREE VOICES

In this section, I first introduce the three PSTs' stories of their experiences of finding or creating a good mathematics lesson without any interruptions of my interpretations of these stories. Each story is named using the emergent patterns within each participant's story. After that, I present my interpretations as the examples of the messages that we (educational researchers and teacher educators) might take away in the discussion and conclusion section.

1. ALEXIS: THINKING THROUGH EVERYTHING THAT THE STUDENTS MIGHT THINK OF

Alexis represents the PSTs who are dealing with what their host teachers do (i.e., traditional learning) and expect her to do and what she has learned throughout her teacher education program (i.e., inquiry-based learning).

> My host teacher told me that I could teach the elimination method to solve systems of linear equations and he gave me all of his notes that he would normally use. I first looked at those and then I knew that I wanted to have some inquiry-based activity. I just wanted to try it out because that is what we have been learning the whole time in our mathematics teaching methods courses, and there was none of that in my host teacher's lessons. But I knew I had to keep part of his notes just because that is what he wanted to teach the students. I wanted to start out with an activity that kind of let the students discover, and then I was planning on ending with a more inquiry-based activity so that they would have the background for all three different ways to solve the systems of linear equations and spare a little more discussion. I set up the task that I wanted to do. I base that off of the first one they discovered a little bit about elimination [method], and then we [the class] went over what it was, and then the last, it can be solved with any of the three ways to kind of build into that. I wrote how I wanted to launch the task or bring it up to them by asking, "What is a solution of two lines?" (Alexis, interview, April 3, 2019)

As she mentioned, inquiry-based learning is her perceived message of what her mathematics teaching methods courses focus on. As she mentioned, however, "there was none of that" in her host teacher's lessons. She was dealing with the mismatches between what she has learned through her methods courses and what she has observed and witnessed in her host teacher's lessons. She wanted to try out "some inquiry-based activity" because that was what she has been learning. Also, she built her lesson using mainly two inquiry-based activities. Using these activities, she wanted to let the students "discover" a new method to solve systems of linear equations and want them to "discuss" the different solving methods that the students have learned. Later in her interview, she described inquiry-based learning as "getting students to work together and explain their thinking." It is clear that her perception of inquiry-based learning is student-centered, working together, and explain their thinking throughout the learning process, which she thinks make a good mathematics lesson. Then, Alexis took a turn and described what constitutes good lesson plans as she started describing her lesson plan format.

> I tried to format it [lesson plan] like the other lesson plan [that made by others]—the possible student approaches. I just tried to think through everything that the students might think of and what I would respond to that. I had trouble on my own, figuring out what students would do in every way to be prepared. Like the lesson plan that I gave you, it lists everything out perfectly how students will explore. But I found it is more challenging whenever I was doing it my own. [I] had nothing to look at to think about everything that students would do. Thus, it took me a while to find the questions to ask

> to support the students because it is so new to me… I would say the most important thing [in lesson planning] is to be prepared for different responses. That is something that I am trying to work on. Because, especially in this semester's teaching methods class, we cover a lot of things like "Why does this work?" or "You add a negative sign, but why?", I want to be prepared and I think a good lesson plan would be prepared to answer those questions. It is not just a procedure, but I mean, you have to be able to explain why it works. You have to be prepared for what students may get wrong and why it is wrong and how to relay that to the class too. (Alexis, interview, April 3, 2019)

She said she formatted her lesson plan using one of the sample lesson plans that she got from her instructors. She listed both "everything that the students might think of" and what she would respond to each of them (Table 1). She said the most important thing in lesson planning is to be prepared for students' different responses. She added that if she can be prepared the answers to the students' questions, such as "Why does this work?" or "You add a negative sign, but why?", it would be a good lesson (plan).

Table 1. Alexis's anticipation of possible student approaches

Possible Student Approaches	Questions to Ask
Can't get started	• What are the different methods to solve this problem? What solution are we looking for with a set of two lines? Is there a certain method you would like to use? What would happen if you plotted this point on the graph, how would you create two lines that intersected at this point?
Finish Immediately and can answer all the questions asked about their approach	• Can you solve and check by elimination and substitution to get the same intersection point? Is there another set of two lines that intersect at this point? Can you get another set of lines using a method you did not use before? (i.e. If they used a graph to solve can they now start by using the elimination method).
Students draw two lines that intersect but have trouble writing the equations	• How many points do we need to create an equation for a line? How many do we have? If we have two points, how do we find the slope? When we know the slope, how do we find the y-intercept?
All students solve by graphing	• Have you all checked to make sure your equations are able to be solved by both the elimination and substitution method? What if I took the graph away, could you all find two equations using a different method? How might you go about using the elimination method to create two equations?
Students find two equations but they do not intersect at (3,5)	• Where do these lines intersect? Can you show me by solving how they intersect at this point? If you have made a mistake, what is an easy fix for your equations?

2. ZOE: STATING ALL THE EQUATIONS THAT WOULD BE USED

Zoe represents the PSTs who are looking for prescriptive types of lessons and lesson plans, which are telling "exactly what to do at each part of the lesson." The following is an excerpt where she describes her process of finding a good mathematics lesson.

> I went on to NCTM and I looked for algebra lesson plans and a lot of them were very "bare bone." I did not really go for those [lesson plans]. The lesson plan that I chose was detailed so I went with that one. I opened the lesson plans and I really loved [it] so I tried to make sure that it told me exactly what you wanted the students to understand that. It was given the equations that we would use in the lesson. Just very detailed in what the students would be doing and what you want them to understand. I think a good math lesson would definitely state all the equations that would be used. Thus, I do not have to go up and look those up if I do not remember them perfectly. Also, it would be very planned that it would say "Step 1. the students would be doing this part and then they move on to this. We are hoping that they understand this and be very fluent." It tells you exactly what to do at each part of the lesson. (Zoe, interview, April 5, 2019)

As she mentioned, there are many lessons and lesson plans are very "bare bone." Consequently, she thinks a good mathematics lesson would state all the equations and questions to ask and describe what students do and what the teacher does in each part of the lesson.

> The first thing that I notice in the lesson plan is that it had a lot of pre-made worksheets at one with it. I would not really have to create my own worksheet for every activity that I do. It also has its descriptive and what the students are not or should be doing. There is no confusion whenever students asked me "What are we doing?" This lesson plan has equations; it has descriptions, like the terminology. It explained exactly what it is and what the differences are. It has lots of options to go deeper on the very last page. It has questions to ask. I just thought it did not leave very much up to me as the teacher to figure out on my own. As a first-year teacher, I am not going to have the time to build amazing lesson plans and I do not have any premade plans. (Zoe, interview, April 5, 2019)

She also viewed good lesson plans are descriptive (e.g., differences between the terminology) and educative (e.g., accommodation, differentiation) and include materials (e.g., premade worksheets). As she explained the reasons why she wanted such descriptive lessons, she positioned herself as a "first-year teacher" and imagined that she would not have sufficient time to build every single lesson as she wants. So, she wanted the lessons that do not leave very much up to her to figure out the details, which are the opposite of the ones that she described as "bare bone."

> I honestly do not really feel like I have been taught how to make a lesson plan. I have some teachers like, "This is how you do this section." or "This is what should be in it." But I do not know specifically how to write that section, such as the format it should be in. I am just not very confident about putting it all together. When I was initially introduced to lesson planning, it had been four semesters without any introduction to lesson plans. I just was not taught how to make them or what they were. I was thrown into the deep end and told to create one without much information or instruction. When finding it, I was not sure how to or what made a good lesson plan, like what details. I created one [for other assignments] based on what I think works best, but I am not even sure if it is right. It did not really seem like we were told what to do or at least I was told what to look for or what to make sure it is in my lesson. (Zoe, interview, April 5, 2019)

Lastly, she expressed that she feels unconfident in planning lessons. She felt she was not taught what made a good lesson plan and how to plan lessons. She expressed her feelings about lesson planning and what she has learned through her teaching methods courses. She described it as feeling "thrown into the deep end" and she was not sure she found or created the mathematics lesson (plan) in good shape.

3. CARLA: FINDING SOMETHING FUN AND ENGAGING WITH

Carla represents the PSTs who prioritize students' motivation and engagement in the first place. The following is an excerpt from her interview, which explains why she wanted to do "something fun."

> It was what the host teachers told us [my field experience partner and me] to work with. They wanted us to do some sort of reviewing over factoring polynomials. We were like, "Okay, we're going do this lesson over factoring polynomials." The first thing that we looked at was where standards are. We just wanted to find the standards that worked with factoring polynomials and then we came up with the activity. We wanted to come up with something that would be entertaining for the students. We did not want students to do another worksheet because we have noticed in the classroom that they do a lot of sitting down—just doing worksheets and copying off the board. We did not really want them to do more of the sinless copied on work. We wanted them to be engaged, do their own work, and create their own thinking, and have them doing something fun. We thought maybe a game would be better. With that Bingo game, we thought it would have been more fun so that they could still factor all of the polynomials even if they did not have those factors on the cards… Therefore, the number one thing was something "fun." Something that would engage the students and something to have them stay engaged. Like that, the number one thing was making sure that they are wanting to do the work and not just like being forced to do it. Thus, finding something fun and engaging with was the two important things when finding a good activity to do with the students. If the kids enjoy the lesson, they are engaged, and they actually understand what you are trying to convey, I think is a good lesson plan. So, if you are trying to teach like quadratics and

> how to factor them and solve them and the kids do not know how to factor or solve them, then maybe there is something wrong with your lesson plan. Or, you need to just go about it in a different way. (Carla, interview, March 20, 2019)

As the students that she worked with were just doing worksheets and copying off the board, she wanted them to "be engaged, do their own work, and create their own thinking, and have them doing something fun." She said, "[T]he number one thing was something 'fun.' Something that would engage the students and something to have them stay engaged." She thought a game would work better for her lesson purpose. The Bingo game (Table 2) requires the students to factor all the given polynomials as part of it. It motivates them to work on the problems which make differences from just working on the review sheet. Then, she took a turn in the lesson plans and mentioned two components that make a good lesson plan—student engagement and student understanding. She added that if students are engaged and understand the content that the teacher wants to convey, then it is a good lesson plan. She attributes the quality of teaching to the quality of lesson plans. She viewed that students' engagement and content delivery are the quality indicators of mathematics lessons, and that lesson plans are the places that can be blamed if the lesson did not go well.

Table 2. Carla's bingo task and assessment plan

Lesson Plan	Rationale
The Task • We will hand out Bingo sheets to each student. • We will then have a student draw a polynomial written on a piece of paper and read the polynomial to the class. The class will then factor the polynomial individually and mark on their sheet if they have the polynomial. • At the end, the student will have to tell the class what factors they marked and the polynomial that went with them in order to determine if it was a Bingo. • The winner will get a candy immediately after winning and the entire class will get an extra one for their effort during the activity (two for the winner, one for the rest of class)	Assessment strategies • As an informal assessment, we will have the winning student(s) explain to the class how they factored their polynomials to get the factors they ended with • At the end of the activity, we will also have the entire class look at several types of polynomials and have them explain the easiest factoring technique for each. This is to assess whether or not they are understanding factoring methods

V. DISCUSSION

The purpose of this study was to explore PSTs' perceptions of a good mathematics lesson and their experiences of finding (or creating) such a lesson. The three voices of the PSTs indicate that even the PSTs who have taken the very same courses and shared the norms within their cohort, can perceive different messages and take up distinct ideas from their instructors and coursework.

In addition to the three voices of the PSTs, I found that the PSTs attended to similar characteristics of the lessons (or lesson plans) for different reasons. For example, although both Alexis and Zoe looked for questions to ask students, Alexis wanted to prepare the questions to ask in response to each of the possible student approaches (i.e., solution strategies), whereas Zoe sought pre-made questions to ask students in order to guide them to think deeper. They both see the ones with questions to ask are good mathematics lessons but the processes of preparing the questions and the reasons why they want to prepare such questions are different. Another example is that both Alexis and Carla focus on the activities to determine a lesson is good or not. Alexis uses such activity as part of her examination of a lesson, whereas Carla puts such activity as the center of her examination of a lesson. They both attended to the details of the activities but one viewed it as one of the components that are consisted of a good mathematics lesson and the other viewed it as a central piece of such a lesson. One may argue that these are not the only examples of similarities and differences between the participants. However, as I mentioned at the beginning of the section, these are my interpretations of the PSTs' narratives only for helping readers.

VI. CONCLUSION

This present study focuses on PSTs' perception of a good lesson (plan) and what they are looking for when searching for a good lesson plan. The three PSTs attended to different characteristics of lessons and lesson plans by 1) thinking through everything that the students might think of, 2) examining whether it states all the equations that would be used, and 3) making students fun and engaged—may not the only voices that we (educational researchers and teacher educators) hear from our PSTs. Rather, I would like to acknowledge that these voices of the PSTs show the differences in the perceptions of good mathematics lessons and lesson plans and that of the takeaways of their coursework and interactions with their host teachers and students. As we have emphasized eliciting and incorporating student mathematical thinking in our instructions, we need to elicit and

incorporate PSTs' thinking on teaching and learning mathematics in our teacher education programs.

In addition, as the findings of this study show, we (educational researchers and teacher educators) cannot expect the same outcomes of our teacher education programs. Although the PSTs that I interviewed experienced the very same instruction their past two years, their perceptions of good mathematics lessons differ one from another. Their field placements definitely influenced the goals of their instruction and the perceived needs of their particular students. Thus, it is important to count PSTs' field placements when we examine the effectiveness of our teacher education programs. Consequently, it would benefit us to hear more about PSTs' challenges of learning to teach mathematics and their perceived messages from the experiences in the teacher education programs.

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