ENHANCING PROSPECTIVE MATHEMATICS TEACHERS' NOTICING SKILLS THROUGH ONLINE LABORATORY SCHOOL ACTIVITIES

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This study investigated how prospective mathematics teachers' (PMT) noticing skills, (i.e., attending, interpretation, and decision-making) were influenced through online laboratory school (OLS) activities. OLS provided PMTs opportunities for online fieldwork and work with students. The activities included lesson planning with peers under the supervision of academicians and experienced teachers, teaching, reflection and getting feedback. PMTs' reflections on a video-taped lesson served as the pre-post assessment of the intervention. Quantitative analyses of data indicated PMTs showed statistically significant improvement in both interpretation and decision-making. Attending, on the other hand, was improved but not in a statistically significant way.

INTRODUCTION

Noticing skills in general are related to how teachers view certain situations related to teaching and engage in reasoning in order to make appropriate instructional decisions (Sherin & van Es, 2009). In recent years, teachers' noticing skills have been found to be critical in order to build instruction according to students' needs (Meschede et al., 2017; Sherin et al., 2011). For teacher education programs, the goal is to raise teachers who can be responsive to students' mathematical thinking (National Council of Teachers of Mathematics, 2014; Sherin et al., 2011).

Noticing has been conceptualized in different ways. While some scholars studied noticing as selective attention and knowledge-based reasoning (interpretation) (van Es & Sherin, 2002), others included aspects of decision-making in relation to what teachers attended to and made sense of (Barnhart & van Es, 2015). Decision-making or deciding to respond are considered as one of the most difficult aspects of noticing for teachers (Jacobs et al., 2010; Schack et al., 2013). Therefore, in this study, we conceptualize noticing as attending to what is noteworthy in the classroom, interpreting classroom events and decision-making (deciding how to respond). In order to prepare prospective teachers for noticing the complexity of teaching (attending, interpretation and decision-making), it is important to both study and support noticing by considering complex environments of teaching (Stockero et al., 2017).

There have been different types of interventions in order to support prospective teachers in noticing student thinking, most of which utilized video content (Santagata et al., 2021). Some researchers focused on designing programs where PMTs view and analyze video clips of student thinking in a specific mathematics content area (Jacobs

2022. In C. Fernández, S. Llinares, A. Gutiérrez, & N. Planas (Eds.), *Proceedings of the 45th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 4, pp. 107-114). PME.

et al., 2010; Shack et al., 2013), others included videos of whole-class instruction and opportunities to analyze student thinking observed in the classroom (Stockero et al., 2017; Ulusoy & Çakıroğlu, 2020) and by way of using structured frameworks such as lesson analysis (Santagata & Angelici, 2010). In order to support PMTs' noticing skills, in general PMTs are required to reflect on and analyze video cases as a group or individually. There are few interventions that provide opportunities for PMTs to be actively engaged in actual teaching practices in the context of noticing studies (Santagata et al., 2021). In this study, the aim is to fill this gap by providing opportunities for PMTs' active participation in teaching practices.

This study is part of a larger project on PMTs' professional growth in the context of Online Laboratory School (OLS). OLS is an online school which provided opportunities of fieldwork for prospective teachers in a private university during the COVID-19 pandemic. The quality of internship practices, and lack of cooperation between school mentors and teacher educators became problematic during this time (Özüdoğru, 2020). Similar to original laboratory schools (Mayhew & Edwards, 2007), OLS was founded so that prospective teachers could learn from core practices of teaching and under close monitoring and guidance of the teacher educators at a time where mentor teachers in internship schools had difficulties in conducting online teaching. In this school prospective teachers had opportunities to collectively plan lessons using a student-centered approach (by the support of teacher educators), engage in effective online teaching activities (DiPietro et al., 2008), and also reflection.

Purpose

The purpose of the study is to investigate the influence of OLS activities in prospective mathematics teachers' noticing skills. In particular, the study considers changes related to prospective teachers' skills of attending to significant events, interpretation and deciding to respond on the basis of interpretation as a result of participating in OLS activities.

METHODS

This study is a quantitative single group pre-post-test design. We quantify qualitative analyses in investigating the influence of OLS activities on PMTs' noticing skills.

Context

In the context of the OLS, prospective teachers were actively involved in online teaching activities under the close supervision of seven supervisors for duration of eight weeks. The OLS included 15 online middle school mathematics classes. For eight weeks, 23 PMTs were involved in planning, teaching, and reflecting (see Fig. 1 for details). Following the observed lesson, a reflection meeting took place with the PMTs and a supervisor. Additionally, a weekly meeting was held during which all PMTs and supervisors gathered and discussed significant aspects related to the implemented lessons. All meetings and classroom sessions were video-recorded. In order to support prospective teachers' noticing skills, seminars on using online tools for teaching and

conducting lesson analysis (Santagata & Angelici, 2010) were also provided. The participants of the study were 3rd and 4th year prospective teachers who engaged in OLS activities and volunteered to submit both pre-and post-assessment (n=19).

Figure 1: Weekly Lesson Plan Preparation Process in the OLS

Data Collection

Pre-assessment was conducted at the start of the program while post-assessment was conducted at the end of the OLS activities. PMTs' noticing skills were assessed by a video-based assessment designed by researchers. The video is a separate record of a prospective teacher who taught a lesson on fractions. The specific lesson was selected by the researchers as there were opportunities 1) to observe different types of student thinking, 2) to reflect on the teacher's instructional decisions and student learning, and 3) to provide alternative suggestions as the instructional practices had room for improvement. The 40-minute video lesson was divided into five segments in order to assess noticing in a detailed way. PMTs were asked to write what they noticed in the given segment, why they chose to focus on the specific moment, and provide alternative instructional decisions based on their professional judgment.

Data Analysis

Video assessment included three noticing components of each video segment: attending to significant events, interpretation, and decision-making. PMTs' responses were first analyzed qualitatively by considering previous frameworks (Barnhardt & van Es, 2015; Jacobs et al., 2010; van Es, 2011): consistency with the events in the video, providing mathematical detail and evidence as well as depth of interpretation and appropriateness of suggestions. Each dimension was coded by two separate researchers as "emerging evidence" (coded as 1), "medium evidence" (coded as 2) and "robust evidence" (coded as 3). Inter-rater reliability was found satisfactory.

With regards to the attending dimension, emerging evidence suggested describing general aspects of the video excerpt, while medium evidence suggested PMTs provided

some mathematical details about teaching, and robust evidence referred to including sophisticated details about student understanding or teaching (identified by researchers). In the interpretation dimension, emerging evidence suggested only describing events while medium-evidence suggested making claims and providing evidence without providing mathematical details. On the other hand, robust evidence suggested establishing a relationship between student understanding and teacher actions, and providing evidence for the claims. With regards to the decision-making dimension, emerging-evidence indicated no suggestion or providing very general suggestions not in line with the video excerpt as identified by researchers. Medium evidence indicated providing suggestions with some mathematical detail but not considering student understanding. On the other hand, robust evidence indicated appropriate suggestions which were in line with the mathematics and student understanding evident in the video.

Pre-and post-assessment scores were determined by adding scores in each of the five parts of the assessment. The difference between pre-post assessment scores were analyzed by using the Wilcoxon-Signed rank test (IBM SPSS, 2012).

RESULTS AND DISCUSSION

The post-assessment included more evidence, mathematical details, consistency with events in the video as well as pedagogically appropriate suggestions for instructional decision-making in line with the observed student understanding in the video. Quantitative analyses revealed that PMTs' noticing skills changed positively. In particular, comparing the pre- and post-assessment scores revealed that the change in dimensions of interpretation ($Z = 92.00$, $p = .012 < .05$) and deciding to respond ($Z = 92.00$, $p = .012 < .05$) was statistically significant. On the other hand, the change in dimension of attending was not found to be statistically significant ($Z = 57.00$, $p = .42$).

While each PMT did not improve in all three dimensions, we provide in-depth evidence for one PMT's growth in noticing as observed in the analyses of the responses to the assessment. The paragraph below is how researchers described and identified significant aspects of one video segment. The following parts demonstrate how the PMT's noticing skills improved between pre-and post-assessment considering the researchers' commentary regarding the video assessment.

Researcher commentary regarding the video segment:

> *In this video excerpt, PMT aimed to introduce unit fractions, discussed the definition of it with some examples and showed unit and proper fractions on the numberline. She provided a chocolate bar example and focused on counting equally partitioned quantities; one piece of chocolate bar out of the whole, which was 9 equal pieces. She made one ninth (1/9) and later defined it as the unit fraction. After discussing this example on the chocolate bar, she moved to showing this unit fraction of 1/9 on the number line. She made the discussion of*

> *proper fractions that they were always between 0 and 1 and 0-1 interval on the numberline should have been equally divided for interpreting fractions.*

Comparing PMT X's response to the pre- and post-assessment:

> *The reason for choosing those parts was because the teacher navigates based on her questions or answers the students gave. Instead of giving the correct information, she tried to get students' attention by intentionally giving incorrect information in parts that must be emphasized. She tried to show that unit fractions are in fact proper fractions and therefore they are located in the interval between 0 and 1.* (PMT X, Part3, Pre, Code:1)

Qualitative analysis of the pre-assessment response was categorized as "emerging evidence" on attending and interpretation as there are not enough mathematical details, no focus on individual or whole group student understanding failed to provide a suggestion as instructional decision-making. Therefore, the response was coded as 1 for all dimensions.

Below is the same teacher candidate's post-assessment response to the same video excerpt:

> *In fact, the thing Student E said is correct, but its reason should have been investigated. His answer could have been examined further with questions like 'How did you understand that it was a unit fraction? What does unit fraction mean? What are the criteria for being a unit fraction?' If our answer is to get "1/9", then the question might have been asked as 'What was the amount of chocolate that Meryem ate?' If the question were asked in this way, students' misconceptions might have emerged. Maybe, students will respond as 1 by thinking about whole numbers instead of fractions…. It was nice that the teacher questioned the reason for number line's being constructed between 0 and 1 and students could explain the reason. It was told that proper fractions and unit fractions are located between 0 and 1. It was nice to partition the number line into parts with different sizes for getting student awareness. I think it got attention from the students and it was good to check whether students internalized the equal part situation.* (PMT X, Part3, Post, Code:3)

In the post-assessment, PMT X made a quality discussion focusing on 'equal' partitioning. Comparing pre-post assessment responses, it is evident that PMT X provided pedagogically and mathematically appropriate and specific instructional suggestions (decision-making), focused on student understanding and mathematics in the video segment (attending), and focused on the relationship between teacher actions and student understanding in the post-assessment and provided evidence for the claims (interpretation). This post-assessment response was considered as robust-evidence and coded as 3 for all three dimensions of noticing.

In summary, the results indicated that noticing skills of PMTs could be improved by way of OLS activities, including lesson analysis practices. Incorporating lesson

analysis is a frequently used method to enhance teacher noticing (Santagata & Angelici, 2010). Different from previous interventions, our study combines lesson analysis with online planning, teaching and reflecting activities in the context of building learning communities (Wenger, 1998) of prospective teachers.

In line with previous literature, the results of this study demonstrated that PMTs' noticing skills could be supported with carefully designed interventions (Barnhard & van Es, 2015; Schack et al., 2013; Stockero et al., 2017; Ulusoy & Çakıroğlu, 2020). In previous studies, it is acknowledged that decision-making is particularly difficult for both PMTs and teachers (Jacobs et al., 2010; Shack et al., 2013). A combination of being involved in lesson planning cycles, online teaching, and reflection individually and as a group (Fig. 1) may be associated with enhanced decision-making skills of PMTs as a result of the intervention. Unlike previous studies (Santagata et al., 2021), PMTs in our study were actively involved in teaching rather than solely viewing and reflecting on video content. Similar to previous studies (Ulusoy & Çakıroğlu), interpretation of PMTs were enhanced as a result of the intervention. This may be explained by providing reflection opportunities for PMTs both in lesson planning process and after lesson implementation as well as getting familiar with lesson analysis. PMTs had a chance to analyze relationships between teaching and student learning both individually and as a group during reflection meetings.

Existing literature has not focused much on teachers' noticing skills in middle schools or online teaching. In general, the interventions did not involve active teaching practices. The present study contributes to studying teacher noticing in an online teaching context as well as teaching middle schoolers actively. Future interventions similar to OLS may investigate PMT noticing in different contexts and with a larger number of participants. In this study, the dimension of attending was improved, but not in a statistically significant way. There is a need for further investigation about why attending scores did not improve as much as the other dimensions. This may be due to the nature of video assessment. There is still much to know about the design and incorporation of types of videos in the context of noticing studies (Santagata et al., 2021). Alternatively, it may be the result of close pre-post assessment scores in this dimension. Future studies may also investigate further whether PMTs' noticing skills of video content is related to their performance in online teaching or not, particularly their decision-making skills during teaching.

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