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Exploring Indonesian prospective teachers' teaching belief and teaching practice

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This study aims to report preliminary findings on prospective teachers' teaching beliefs and teaching styles when implementing their proposed problems. Three second-year Indonesian prospective teachers who were accustomed to the teacher-centered teaching tradition were involved in a brief collaborative workshop. In the workshop, they get an advantageous opportunity to broaden their perspective about mathematics teaching through sequential activities, such as formulating problems collaboratively, teaching practice, reflecting on their teaching practice, and providing suggestions to each other. After the workshop, they expressed their belief in the ideal problem-solving teaching style and implemented their proposed problem.

Keywords: Teaching belief, teaching practice, prospective teacher.

Introduction

In the early 1990s, the usual mathematics teaching technique in Indonesia was to directly explain the solution of mathematical problems (Kuipers, 2011). Subsequently, the most recent curriculum has been introduced as an attempt to upgrade educational traditions with the cornerstone: place problem-solving as a challenging skill to master and position students at the center of learning to collaborate and share ideas. Nevertheless, some challenges remain in practice, such as the persistence of conventional teaching traditions along with belief that an effective teaching style is to manage the class completely. Thus, when students from this environment become prospective teachers, it is not surprising that this belief naturally exists in their minds.

To support the new curriculum and address the existing belief for better teaching quality, a collaborative workshop was held with two principal activities: problem-posing which cannot be considered part of the conventional teaching tradition and implementing the posed problems in the classroom, which is directed towards a problem-oriented approach. Involving prospective teachers in problem-posing activities and asking them to implement their problems, accompanied by discussions, can be fruitful endeavors to enrich their perspective to mathematics teaching. Implementing their own problems appertains to the classroom activity in which prospective teachers will face in the future. Providing opportunities for prospective teachers to practice teaching from the early years of the training while most teacher preparation programs put it off towards the final year of the program constitutes a complementary point of this study.

This study focuses on the second principal activity and reports preliminary findings through the research questions: (1) What is the prospective teachers' belief about the ideal problem-solving teaching after the workshop? (2) What is the teaching style of prospective teachers when implementing their proposed problem before and after the workshop? As supported by Ellerton

(2013), disclosing how prospective teachers implement their problems after experiencing problem-posing activities will contribute to the literature.

Theoretical background

When it comes to teaching problem-solving, the diversity of beliefs emerges as an influential constituent of teaching styles. Some believe that teaching should be straightforward, focusing on clear explanations to pupils (Richardson, 1996). This belief seems to have developed due to familiarity with traditional teaching practices that favor teacher-centered learning. On the other hand, some believe that teaching should actively involve students to spur their thinking skills in which can be considered as student-centered learning (Kofa, 2018).

Nowadays, there has been increasing awareness in applying student-centered learning due to its prosperous benefits. One approach to student-centered learning is problem-oriented instruction. According to Kovács and Kónya (2019), problem-oriented instruction has three characteristics: (1) students analyze the situation of a mathematical problem, (2) students critically adapt to their own and their classmates' thinking, and (3) students learn to explain and justify their thinking. Considering one feature of problem-oriented instruction that the classroom activity evolves into a critical discussion of the problem being addressed, the implementation of problem-oriented instruction can be recognized by studying talk formats. Critical discussions are triggered by specific forms of talk that support a deep understanding of concepts and robust reasoning. Sohmer et al. (2009) characterized the talk format into four as shown in Table 1.

Table 1: Talk format

Talk format	Description
Recitation	The teacher completely controls the content and direction of the conversation by presuming special right to ask the questions and evaluate students' answers. Students are positioned as seekers for the correct answers that the teacher is looking for.
Stop-and-talk (Partner talk)	The teacher gives a pointed question to the students and asks them to discuss it with one or more partners. Students are positioned as active reflectors and contributors. During small group discussions, the teacher selects key voices among students to be heard by the entire community.
Student presentation and group critique	The teacher asks the student to present his/her work in front of the class accompanied by follow-up questions proposed by the other students or teacher. The presenter student is positioned as the expert of their work.
Whole-group 'position-driven' discussion	The teacher leads a discussion on a single problem or question which has more than one answer, so that reasonable arguments appear from the students. This kind of discussion promotes active participation of the students by proposing an idea and listening to each other even before being fully competent in the discussed domain.

Supportive talk formats for problem-oriented instruction, such as partner talk, student presentation and group critique, and whole-group position-driven discussion, require appropriate teachers'

behavior. Rott (2019) classified teachers' behavior when implementing problem-solving into three. In more detail, he stipulated the behavior at each problem-solving step by Polya (1945), as shown in Table 2. The classification refers to the differentiation between teachers as controllers or facilitators. The indicators show that the closely managed style represents a teacher-centered learning in which the teacher acts as a controller, while the other two styles are closer to the teachers' role as a facilitator which aims to generate mathematically rich and meaningful discussions in the classroom.

Table 2: Teachers' behavior in each problem-solving step

	Closely managed	Neutral	Emphasizing strategies
Understanding the problem	The teacher explains the problem formulation.	The teacher does not comment on the problems and does not answer students' questions.	The teacher gives hints but does not explain the problem.
Devising a plan	The teacher tells the students which approach is correct to use.	The teacher does not give any guidelines and strategic support.	The teacher hints at (ideally) different approaches and encourages the students to follow their ideas.
Carrying out the plan	The teacher gives the students concrete content-related support (often early in the process).	The teacher gives (almost) no (strategic) help and does not answer students' questions related to the problem.	The teacher gives staggered aids (motivational/feedback/general strategic/task-specific strategic/content-related).
Looking back	The teacher fixates on results; perhaps, one (arithmetic) approach is presented.	Different approaches are presented; however, strategic ideas or the differences between approaches are not highlighted explicitly.	The teacher highlights approaches and strategies; results might also be presented, but it is of secondary importance.

By studying talk formats and teaching styles, we will find the connection between those two. For instance, recitation goes hand in hand with a closely managed style, while the other talk formats assist neutral or emphasizing strategies styles. In other words, the teaching style could be detected from the tendency to use a particular talk format, whether it leads to a productive talk or not.

Both talk formats and teaching styles during the lesson might indicate tendencies in beliefs about teaching. As Rott (2019) emphasized, teachers' belief is a component of professional teacher competence that influences their teaching behavior. Moreover, analyzing talk format and teaching style will cue whether the lesson appertains as problem-oriented instruction or not. Figure 1 illustrates the relation between talk formats, teaching styles, and problem-oriented instruction.

Another effort to improve mathematics teaching is to examine teaching practices as has been done in Japan. Through lesson study, Japanese teachers discuss lessons they have planned and observed

together which then direct them to look for ways to improve it and broaden their knowledge of the teaching profession (Fernandez & Yoshida, 2004). Thus, it is precious to adapt.

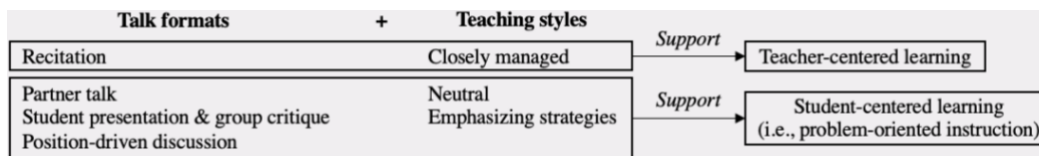


Figure 1: The relation between talk formats, teaching styles, and problem-oriented instruction

Method

The participants of this study were three second-year Indonesian prospective teachers (Vey, Ann, Kay – pseudonym) who enrolled in a 4-year mathematics teacher training program for grades 7-12 in a private university. To select the participants, 22 prospective teachers were offered to participate in the workshop and implement their proposed problem voluntarily. Prospective teachers who had a chance to implement their proposed problems with real pupils, such as those who handled a private course, a non-formal additional class outside of school which aims to strengthen the lesson provided at school, occupied the priority positions to be selected. The number of participants was limited based on several considerations: to get them more actively involved in the workshop and to make the activity during the workshop better observed since the workshop was held online due to the ongoing COVID-19 pandemic. The cornerstone of the workshop is adapting Japanese lesson study by involving prospective teachers. Figure 2 shows the problem-posing backgrounds and the implemented problems by Ann as one of the participants.

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31						
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Discover at least three patterns in this months' calendar, explain those patterns, and create a problem based on one of the above patterns!

The first implemented problem by Ann:

n	5, 6, 7, 8, 9	?	24, 25, 26, 27, 28
S	35	60	130

If $S=60$, determine the numbers in n for $S=60$!

Dad just bought a padlock for the fence. Please pose a problem based on the situation above.

The second implemented problem by Ann:

Dad just bought a padlock for the house fence. If Dad will set a password on the padlock consisting of 5 different numbers, specify how many codes can be set if the numbers are from 1 to 5 and the value of the password is less than 40.000.

Figure 2: The problem-posing backgrounds and the example of implemented problems

Table 3: Research activities

Pre-test	Posing problem autonomously related to patterns on calendar and implementing the proposed problem to pupils.
1st meeting (50 minutes)	Teaching reflection, giving feedback to each other, and discussing how the situation in mathematics classes should be.
2nd meeting (100 minutes)	Discussing several paradigms of problem-posing: free, semi-structured, and structured problem-posing.

3rd meeting (100 minutes)	Analyzing a less feasible problem, fixing it collaboratively, and posing problem collaboratively by modifying the initial situation.
4th meeting (100 minutes)	Posing problem collaboratively by using a what-if-not strategy.
5th meeting (100 minutes)	Posing problem autonomously based on the given situation and fixing the proposed problems collaboratively.
Post-test	Posing problem autonomously related to the padlock and implementing the proposed problem to pupils.
After post-test	Filling out a questionnaire and teaching reflection.

The questionnaire was directed to capture the prospective teachers' viewpoint on ideal problem-solving teaching implementation. Among three styles, they were asked to choose which one is their ideal teaching style. Since this study is part of a larger research project, only two data are presented: data from the questionnaire after the workshop and data from the videos of teaching implementation at the beginning and at the end of the workshop. The teaching implementation data consists of 24 sections, 8 sections for each prospective teacher for the first and the second implementations. It was analyzed in terms of behavior by Rott (2019) and talk format by Sohmer et al. (2009). All teaching practice data were coded independently by two raters which resulted in 23 of the 24 cases (96%) being agreed. While the divergent code was recoded consensually thereafter.

Research findings and discussion

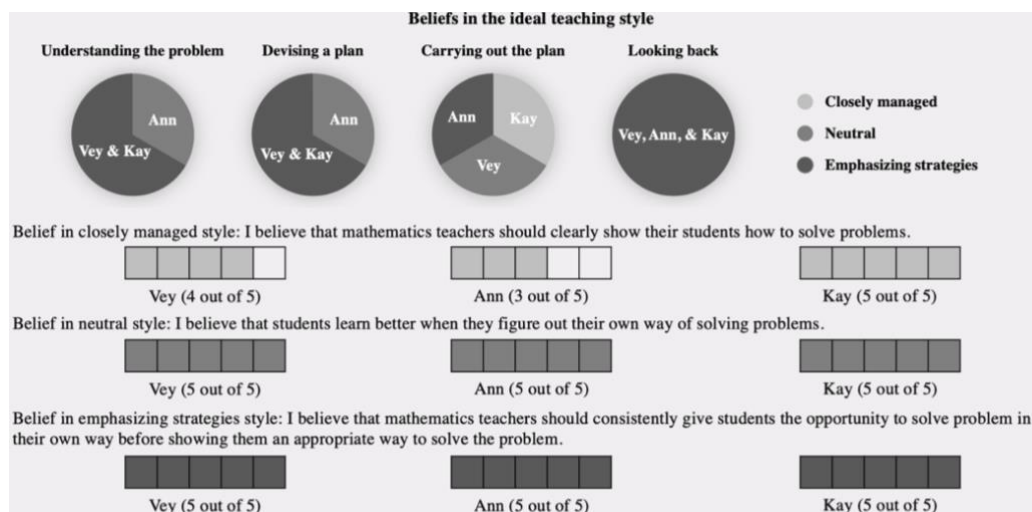


Figure 3: The results of the questionnaire

Based on pie charts in Figure 3 that show prospective teachers' beliefs about the ideal problem-solving teaching, a closely managed style was not the primary choice. It only appeared in Kay who believed in the necessity to control the class when carrying out the plan. Those findings were reinforced by the result of the second part of the questionnaire. All prospective teachers gave the maximum point to neutral and emphasizing strategies styles that signify student-centered learning.

The closely managed style became a secondary preference for them except for Kay, who did not indicate her teaching belief tendency (see Figure 3).

Figure 4 presents the prospective teachers' teaching styles and beliefs about problem-solving teaching. Considering the research of Ellerton (2013), which revealed the impact of problem-posing activities on prospective teachers while they were taking courses in teacher preparation programs and the impossibility to follow those prospective teachers into their classrooms once they became teachers, data in this study regarding the prospective teacher's teaching practice in implementing the problem they posed might be an alternative response to the condition.

In the first teaching implementation, Vey skipped the looking back step that appeared to be deemed unnecessary. As she recognized this step was consistently carried out in the lesson throughout the workshop, she stated, "Usually, if we arrive at the solution, that's all. We don't think if it's reasonable or not. Now that I think about it there should be follow-up activity like we did in this lesson". Realizing the importance of looking back step, she undertook the step in her second teaching implementation. Her teaching styles in the first and the second implementations were neutral and closely managed over the classwork activities. Particularly, in the second teaching implementation she thought that the fundamental counting rule, which is the mathematical background of the implemented problem, had been taught in school but evidently it was an unfamiliar topic for her pupils. There was a school lesson delay due to the covid-19 pandemic. This emerged as her consideration for performing the closely managed style. The only noticeable difference between the first and second implementations was the use of the talk format. In the first teaching implementation, recitation was applied in all problem-solving steps, while in the second teaching implementation, she applied position-driven discussion in the looking back step among recitations in the other steps.

Ann had been involving her pupils since the first teaching implementation. She received positive reinforcement for her behavior from her peers during a reflection and discussion meeting. They said, "I like how she communicates with her students" and "The class is active". In the second implementation, she maintained her behavior and even improved it. She obviously encouraged her pupils to express their idea by asking them to tell the strategy they used and explain their reasons. The closely managed style had been sidelined in favor of being neutral and emphasizing strategies. The combination of position-driven discussion and recitation remained her preferred talk format. She also organized student activities in which students worked on the task individually, rather than just implementing classroom work activities.

In the first teaching implementation, Kay controlled the class completely. She explained how to solve the problem without allowing her pupils to speak and only asked if they understood or not which led them to say they understood but probably not. The closely managed style with full recitation dominated her demeanor aside from trying to be neutral in the step of understanding the problem. At the discussion and reflection meeting, she received feedback from her peers. They said, "It looks like your implementation must be in accordance with your plan. You seem unfree and constrained while teaching" and "You must be confident. We are learning how to teach together. Keep your spirit up". The feedback seemed to spur her on to make improvements. Although the closely managed style continued to dominate in the second teaching implementation, she tried to be neutral in understanding

the problem and emphasized strategies in the looking back step. By involving pupils, she attempted to highlight several strategies to solve the problem that did not appear in the pre-test. Both the strategy and the result proposed by her pupils were considered. She let them choose their own preferred approaches. The entire lesson was classwork activity in both implementations, but she combined position-driven discussion and recitation in the second implementation.

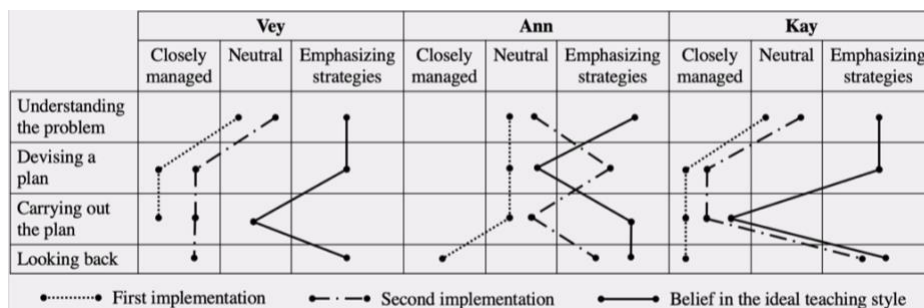


Figure 4: Teaching style and belief

The finding contributes to the literature on whether there is a link between belief and practice or not. This contradictory insight appears in Safrudiannur and Rott (2019). In this study, prospective teachers' beliefs and practices are not always in line. Among those three prospective teachers, only Ann holds a closer attachment between her belief and practice, either neutral or emphasizing strategies that belong to the student-centered paradigm. Meanwhile, belief in student-centered learning accompanied by teacher-centered implementation was found in other prospective teachers. The discrepancy between belief and practice brings out consideration of another aspect, i.e., their pedagogical knowledge since it directs them to a firm understanding on classroom management, lesson planning, and student assessment (Koehler et al., 2009).

The finding also reveals how adapted Japanese lesson study goes among prospective teachers. Discussions, sharing ideas, and giving suggestions to each other during the workshop provide them empirical experience about student-centered paradigm, as they were positioned not as receptive but active members in the class. They can reflect on the activity, make it as a shoot for their teaching belief, which then direct them to increasingly involve their pupils in the second implementation. As stated by Ambrose (2004), beliefs may lead to behavior in ways that could be depicted as habits. Moreover, their beliefs and the second teaching implementation which are more towards student-centered paradigm might be the impact of reflection and feedback activities, since reflection leads to finding new solutions and paths in teaching to improve learning (Šarić & Šteh, 2017) and helps teachers to become more successful (Lee, 2005). Thus, the whole activity during the workshop appears to be a fruitful endeavor.

Limitation, further research, and acknowledgement

This study only involves three prospective teachers in a short action. The contribution is part of ongoing research involving prospective teachers on the role of problem-posing and problem-oriented teaching in active mathematics learning. The workshop is conducted as an attempt to broaden their perspective about mathematics teaching. The author is a member of MTA-ELKH-ELTE Research Group in Mathematics Education, and this study is funded by the Hungarian Academy of Sciences through its Scientific Foundations of Education Research Program.

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