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Mathematics Teachers' Interviewing Strategies for Diagnosing Students' Learning Obstacles

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ABSTRAK

Kesadaran guru akan hambatan belajar siswa sangat penting dalam praktik reflektif untuk mengembangkan desain didaktik yang efektif. Praktik reflektif guru matematika Indonesia dalam jabatan dalam mendiagnosis hambatan belajar siswa meningkat. Namun, terlepas dari pentingnya mendiagnosis hambatan belajar siswa untuk mengembangkan profesi guru, hanya ada sedikit bukti penelitian yang mendukung strategi guru matematika di Indonesia dalam mendiagnosis hambatan belajar siswa melalui proses wawancara. Tujuan penelitian ini adalah menganalisis strategi wawancara yang digunakan guru matematika untuk mendiagnosis hambatan belajar siswa. Penelitian ini adalah studi kasus kualitatif dan menggunakan analisis konten tematik. Guru matematika SMA dalam jabatan dari tiga provinsi di Indonesia untuk berpartisipasi dalam penelitian ini. Penelitian ini menggunakan rekaman video guru yang melakukan wawancara untuk menyelidiki hambatan belajar siswa, ditriangulasi dengan laporan guru. Temuan ini menunjukkan bahwa dua strategi utama guru adalah strategi sosial-emosional dan didaktis-pedagogis. Studi ini menyajikan penjelasan kami yang diperluas dari setiap strategi, serta beberapa saran untuk penelitian lebih lanjut, yang bertujuan untuk membantu membangun budaya praktik reflektif di kalangan guru matematika sebagai bagian dari pengembangan profesional guru.

ABSTRACT

The teachers' awareness of students' learning obstacles is crucial in the reflective practice of developing effective didactic designs. The reflective practice of in-service Indonesian mathematics teachers in diagnosing students' learning obstacles is rising. However, despite the importance of diagnosing students' learning obstacles for developing the teaching profession, there is little research evidence supporting strategies for mathematics teachers in Indonesia in diagnosing student learning barriers through the interview process. The purpose of this study is to analyze the interviewing strategies that mathematics teachers use in order to diagnose students' learning obstacles. This research is a qualitative case study and employs thematic-content analysis. In-service high school mathematics teachers from three provinces in Indonesia to participate in this study. This study used video recordings of teachers conducting interviews to investigate students' learning obstacles, triangulated with teachers' reports. This findings show that the teachers' two main strategies are social-emotional and didactical-pedagogical strategies. This study present our expanded explanation of each strategy, as well as some suggestions for further research, intending to assist in establishing a culture of reflective practice among mathematics teachers as part of teachers' professional development.

1. INTRODUCTION

In the process of professional development for in-service teachers, reflection is an essential component. The act of reflecting on one's teaching practice as part of professional development for teachers gives rise to the concept of "the teacher as researcher" (Ryan et al., 2016; Suryadi, 2019). Research carried out by teachers or groups of teachers is a way to deal with the actual 'challenge of practice' in discipline as they study the effects of planned interventions intended to enhance student learning.

For the discipline of mathematics, one of the underlying problems of students' cognitive processes, which can be a source of teachers' reflective practice, is that mathematical concepts are introduced inductively and then generalized to become deductive. According to the Theory of Didactical Situations

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(TDS) (Artigue et al., 2014; Brousseau, 2002), the teacher must present didactic situations of action, formulation, validation, and institutionalization for students' thought processes to progress from inductive thinking to deductive generalization. However, the didactic situations created by the teacher are not always prolific and can even present students with learning obstacles (Artigue et al., 2014; Brousseau, 2002). The learning obstacle is also knowledge, although this knowledge may be incorrect when applied to other mathematics domains (Brousseau, 2002; Suryadi, 2019). The learning obstacle's ontology is that each student is very likely to interpret a mathematics concept differently. The Theory of Didactical Situations is an epistemological base that distinguishes the concept of learning obstacles from learning difficulties (Dennis et al., 2016; Wijaya et al., 2019), students' errors (Götz & Gasteiger, 2022; Larrain & Kaiser, 2022), and misconceptions in mathematics (Parwati & Suharta, 2020; Theis et al., 2022).

Diagnosing learning obstacles is an attempt to determine the origins of students' knowledge that serves as a learning obstacle, which is the epistemological, didactical, and ontological origins of learning obstacles (Brousseau, 2002; Suryadi, 2019). Overcoming an obstacle demands work of the same kind as applying knowledge, that is to say: repeated interaction and dialectics between the students and the object of their knowledge. The first origin, the epistemological origin of a learning obstacle, is a learning obstacle arising from students' knowledge that has not been generalized deductively, causing students to struggle to apply it to all contexts (Liu, 2020; Marshall et al., 2021; Murray, 2015). The discovery of epistemological obstacles can guide teachers' reflective practice, resulting in improved didactic designs that improve students' ability to generalize concepts. The second origin of learning obstacles is the didactical origin, which refers to learning obstacles that arise from students' previous didactical experiences, either due to the curriculum, learning resources, or teachers' instruction. The discovery of didactical obstacles is a source of teachers' reflective practices, which include reviewing the correctness of the mathematical concepts, analyzing textbooks, and analyzing the structure and functional trajectory of a mathematics concept they taught (Effendi, 2012; Suryadi, 2019). The ontological origin of a learning obstacle is caused by students' mental and psychological immaturity in receiving new knowledge to replace the old knowledge structure they have.

Problems arise when students' learning obstacles crystallize into concept images, further distancing their knowledge from scientific conception, as shown by previous studies (Ardiansari et al., 2020; Nurwahyu et al., 2020). Hence, teachers' professional development should make an effort to raise teachers' awareness of recognizing and anticipating students' learning obstacles (Kidron, 2018; Marfuah et al., 2022). The central idea of diagnosing obstacles is to investigate why individual student forms the meaning of knowledge (which becomes an obstacle), what learning experiences forms this obstacle, and what the sources of the causes are. Diagnosing learning obstacles necessitates teachers' diagnostic competence to establish their identity as researchers. Diagnostic competence is teachers' ability to recognize students' reasoning and thinking processes, observe students' progress and obstacles, and respond appropriately to the diagnosis' conclusions (Chernikova et al., 2020; Wijaya et al., 2019). The diagnosis aims to enhance students' mathematical understanding and facilitate the development of individualized didactical design (Larrain & Kaiser, 2022; Wijaya et al., 2019). Furthermore, diagnosing students' learning obstacles is a strategic move in teachers' reflective practice in planning didactic situations and anticipating students' responses (Nopriana et al., 2023; Puspita et al., 2022).

However, the results of previous study meta-analysis indicated that the teaching profession still struggled to increase its diagnostic competence and strongly suggested that teacher professionalism required facilitation assistance due to the abundance of empirical evidence regarding this struggle (Chernikova et al., 2020). Other study investigated the diagnostic competence of prospective Chilean teachers and discovered that they were frequently unable to provide an accurate and comprehensive diagnosis (Larrain & Kaiser, 2022). Then other study conducted focus group discussions with Indonesian mathematics teachers and discovered that, in addition to tests and classroom observation, only a small number of teachers were familiar with using interviews to diagnose students (Wijaya et al., 2019). In fact, verbal interactions between teachers and students, such as interviews and questioning, are epistemic activities that are critical to investigate students' thought processes as part of a diagnostic effort (Fischer et al., 2014; Kiemer et al., 2015). For this reason, we will focus on how the teachers conduct epistemic activities to diagnose learning obstacles in students through interviews. Understanding how teachers develop this strategy is a critical step toward understanding teachers' professional learning needs related to diagnostic competence, which will, in turn, impact teachers' reflective practice and professional development.

To our knowledge, research on mathematics learning obstacles seems to be primarily concerned with locating empirical evidence of the learning obstacle of students or college students when studying a mathematical topic. Some examples of such mathematical topics are fractions (Isnawan et al., 2022), trigonometry (Maknun et al., 2022), geometric transformation (Kandaga et al., 2022), rational numbers (Novita et al., 2022), derivatives (Puspita et al., 2022), combinatorics (Nopriana et al., 2023) and others. A

study focussing on the abilities of prospective mathematics teachers in analyzing students' learning obstacles (Jatisunda et al., 2022). Meanwhile, the reflective practice of in-service Indonesian mathematics teachers in diagnosing students' learning obstacles is on the rise (Herman et al., 2022; Nurhikmayati et al., 2022). However, those studies do not specify how in-service mathematics teachers in Indonesia develop interviewing strategies for identifying students' obstacles. Using this fact, we will fill gaps in existing research by highlighting the importance of addressing in-service mathematics teachers' professionalism issues related to diagnostic strategies of students' learning obstacles. For this reason, our study aims to analyze strategies used by mathematics teachers in diagnosing students' learning obstacles. To achieve this objective, we will examine several videos of teachers interviewing students when diagnosing learning obstacles.

2. METHOD

This study employs a qualitative approach with a case study research design. The intention of the case study research design is to investigate contemporary phenomena in the contexts in which they occur, mainly when the boundaries between the phenomena and the context are not clearly recognizable (Yin, 2018). The phenomenon we want to examine is the teachers' interviewing strategies in diagnosing learning obstacles. Meanwhile, the context of our research is the reflective practice of a group of in-service mathematics teachers in Indonesia. Using a case study design, we intend to systematically describe mathematics teachers' interviewing strategies for identifying and addressing students' learning obstacles based on the context we are researching, grounded on video thematic-content analysis. Participant of this study were ten high school mathematics teachers (three males and seven females) participating in our research from three different provinces in Indonesia (Daerah Istimewa Yogyakarta, Nusa Tenggara Barat, and Sumatera Barat). Participants have a wide range of teaching experience, ranging from one year to twenty. The subjects were chosen using convenience sampling. We obtained participants' permission to participate in this study. T1 through T10 are the pseudonyms used to refer to the teachers on our participant list.

Participants provided with a theoretical introduction to the significance of diagnosing student learning obstacles as a substance for reflective practice when developing a didactic design. We requested that participants bring the results of any written student exams they had taken before engaging in our research. Then, we asked the participants to practice diagnosing students' obstacles through the interview based on written test results. Each participant interviewed several of their students (15-18 years old) suspected of having learning obstacles and then used video recording (VR) to document it. All participants claimed this was their first time using interviews to diagnose students' learning obstacles. The VRs were our primary source of data. We collected a total of 18 VR. Of the 18 VRs, 15 VRs showed the diagnostic process individually and 3 VRs collectively (group interview). A total of 13 VR demonstrated the face-to-face diagnostic process, while 5 VR demonstrated the process online using video conferencing software. We also used participant reports of learning obstacle diagnoses to triangulate our findings.

The VRs are analyzed using thematic-content analysis (Kiger & Varpio, 2020). First, researcher created a verbatim transcript of the entire video. The transcript's significant scenes or sentences served as a reference through inductive analysis. Then labeled the references with codes that stated the teacher's strategy and correlated codes were grouped to form unified sub-themes (ST). In the end, related sub-themes were categorized under a single overarching theme that mirrored its constituent sub-themes. Following that, the initial coding was evaluated and compared. It was then investigated and reworked until all authors came to an agreement, resulting in more broadly acknowledged sub-themes and themes. Numerous sub-themes were recognized and organized during the analysis process under two primary themes as show in Table 1.

Before discussing our findings, we will demonstrate an example of how we labeled references in transcripts as indicators. The following is a transcript of a VR of Teacher 5 (T5), which analyzes students' learning obstacles related to the matrix topic. In this scene, students have difficulty modeling the contextual problem in the form of matrices multiplication $AB = X$ where A is a 5×3 matrix and B is a 3×1 matrix. We use tables to make it easier to list the references that show up in the VR as show in Table 2.

Table 1. Theme and Sub-Theme Developed in This Study

Theme	Sub-Theme	Description	Number of VR Showing the Description (of 18)
Social-emotional strategies	ST1.1 (eliminating students' anxiety)	Teacher's sensitivity to students' mathematics anxiety	18
	ST1.2 (motivating student)	Offering encouragement and support	18
	ST1.3 (flourishing social justice environment)	Awareness of student identity differences, and promoting equity throughout the process	12
Didactical-Pedagogical Strategies	ST2.1 (checking students' prerequisite knowledge)	Ensuring that students have the necessary prior knowledge	18
	ST2.2 (providing constructive feedback)	The feedback that informs students what next of a response or leads to a conclusion on how obstacles can be corrected	18
	ST2.3 (providing cognitive conflict)	Posing new problems that conflict with students' cognitive structures, where it acts as an obstacle	8
	ST2.4 (verifying students' learning resources)	Ask students to provide evidence of the learning resources they used to support their answers, such as textbooks, notes, websites, and smartphone apps.	6

Table 2. Fragments of Our Transcript Analysis Process

Row	Interview Transcript	Indicator
1	T5: "Let's focus on the first row of matrix A only, ignore the other rows. Try to explain what the first row of matrix A means?"	Providing constructive feedback
2	S: "Rating for the first marketplace."	
3	T5: "Nice! What do we want to do with it?"	
4	S: "Total rating score [for the first marketplace]."	Providing constructive feedback
5	T5: "of?"	
6	S: "The first marketplace."	
7	T5: "Right! How to get it?"	Checking prerequisite knowledge, providing constructive feedback
8	S: "We must multiply the rating scores with their respective weights."	
9	T5: "Correct!"	
10	T5: "Write down your idea to multiply it, please."	Checking prerequisite knowledge, providing constructive feedback
11	[In the video, we show the students writing and then show it to the teacher. According to the teacher's report, students perform basic algebraic operations without using matrices.]	
12	T5: "You did an excellent job! Yes, the total score can be calculated in this manner. Then, how do you translate this into matrices multiplication?"	Motivating students, providing constructive feedback
13	[In the video, students are seen writing something. The teacher's report confirms that students answered in the incorrect matrices multiplication form, as shown below]. $[8 \quad 9 \quad 9][3 \quad 1 \quad 2] = 51$	
14	T5: "I do not think it is a bad idea. Okay, what if we want to know how other marketplaces are rated overall? Let us look at the second market. How do you put the matrices together?"	Eliminating students' anxiety, providing cognitive conflict

Row	Interview Transcript	Indicator
15	S: [being silent appears to be thinking]	
16	T5: "How?"	
17	S: "Is it necessary for me to redo this matrix row [for the second marketplace]?" [We confirmed to T5 that "this matrix" refers to matrix B].	
18	T5: "What do you think?"	
19	S: "May I see the textbook?"	
20	T5: "Please." [while reading the textbook]	
21	S: "Oh yeah, I should have written the weights in column [of matrix B]."	
22	T5: "So, how is your idea?" S: "Is it like this?" [We confirm in T5's report that the student shows the correct answer to T5].	Eliminating students' anxiety
23	$\begin{bmatrix}8 & 9 & 9\\9 & 9 & 8\end{bmatrix}\begin{bmatrix}3\\1\\2\end{bmatrix}=\begin{bmatrix}51\\52\end{bmatrix}$	
24	T5: "Why is that?"	
25	S: "Because [the matrix declares] the weight. So, regardless of how many marketplaces exist, there is no need to change the [defined] weight column."	Providing constructive feedback
26	T5: "Great! Are you clear on the matrices multiplication rule now?"	Motivating students, providing constructive feedback
27	S: "Yes."	

3. RESULT AND DISCUSSION

Result

Theme 1: Social-Emotional Strategies

The first theme created to address the strategies used by teachers in diagnosing student learning obstacles is Social-Emotional Strategies. This strategy is made up of three sub-themes (ST), which are ST1.1 (eliminating students' anxiety), ST1.2 (motivating students), and ST1.3 (flourishing a social justice environment), as shown in Figure 1.

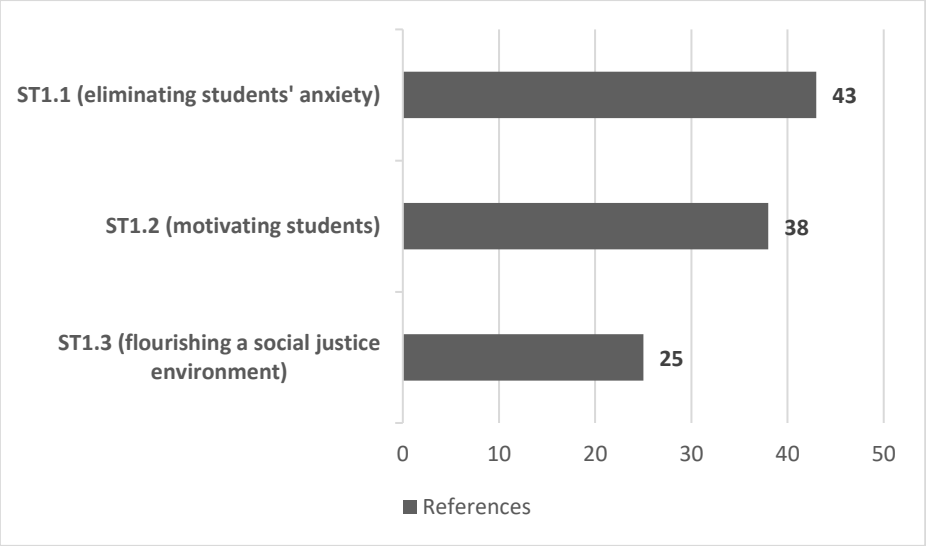

Figure 1. Theme "Social-Emotional Strategies"

The first sub-theme in Social Emotional Strategies is ST1.1 (eliminating students' anxiety). We found 43 references which we categorized into ST1.1 (eliminating students' anxiety). Example of description for ST1.1 eliminating students' anxiety is show in Table 3.

Table 3. Description Eliminating Students' Anxiety

No.	Interview Transcript
1	"Do not be worried; this is not a test."
2	"This will not affect your score. "
3	"We simply discuss things, do not hesitate to ask me. "
4	"How is your lunch? "
5	"It is okay if you forget the answer. I often did too. "
6	"Feel free to look up your notes or textbook whenever necessary. "

Base on Table 3, ST1.1 (eliminating students' anxiety) is the sub-theme with the most references to Social-Emotional Strategy. All the videos we analyzed have indicators that refer to the teachers' efforts to eliminate student anxiety, although in different portions. We may say that ST1.1 (eliminating students' anxiety) is the most frequently reported strategy by teachers in the category of social-emotional strategies.

Another sub-theme formed is ST1.2 (motivating students). We found 38 references for ST1.2 (motivating students). All of the videos contain references to ST1.2 (motivating students). In other words, during the interview, all participating teachers used strategies to motivate students. For instance as show in Table 4.

Table 4. Description Motivating Students

No.	Interview Transcript
1	"I know you can do it. "
2	"Do not give up. "
3	"What do you think? Why do we need trigonometry? "
4	"Have you made up your mind about which campus you want to attend in the future? "
5	"See, easy, right? "
6	"I am proud of you for doing your best."

For the last sub-theme in Social-Emotional Strategies, ST1.3 (flourishing a social justice environment), we note that only 12 out of 18 VRs provided the reference for this sub-theme. That is to say; there were 6 scene interviews where we did not find this strategy applied by the teacher. We found a total of 25 references, as an example show in Table 5.

Table 5. Description Flourishing a Social Justice Environment

No.	Interview Transcript
1	"May I record our conversation? "
2	"Is it okay if this session lasts about an hour? "
3	"You have the option of turning on or off the zoom camera. "
4	"If your phone does not support Jamboard, simply write your response on paper and send it to me via private messenger. I will present it on the screen; all you have to do is explain. "
5	"Is the roof of your hometown's traditional house the same as this triangular construction? "

Theme 2: Didactical-Pedagogical Strategies

Didactical-Pedagogical Strategies are the second theme we developed to understand better teachers' strategies in diagnosing student learning obstacles. To Figure 2, the Didactical-Pedagogical Strategies theme has four sub-themes, which are ST2.1 (checking students' prerequisite knowledge), ST2.2 (providing constructive feedback); ST2.3 (providing cognitive conflict); and ST2.4 (verifying students' learning resources).

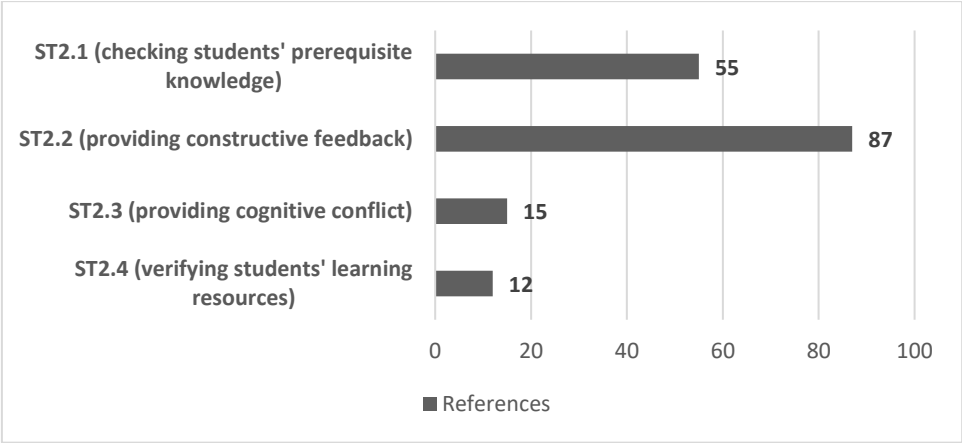

Figure 2. Theme "Didactical-Pedagogical Strategies"

Base on Figure 2, the first sub-theme in Didactical-Pedadogical Strategies we found is ST2.1 (checking students' prerequisite knowledge). We found 55 references indicating ST2.1 (checking students' prerequisite knowledge). We found a strategy for checking students' prerequisite knowledge in all the VR we analyzed.

An example of a scene that we categorize as ST2.1 (checking students' prerequisite knowledge) for example, we interpret from VR of T3 when interviewing students' learning obstacles in completing the task of rationalizing $\frac{2-\sqrt{3}}{2+\sqrt{3}}$. The scene in VR shows that the teacher checks students' understanding of the differences between $a^2 - b^2$ and $(a-b)^2$, which they learned in junior high school. It turns out that the student's prerequisite knowledge is not mature enough to distinguish the two forms because it is only based on memory without understanding the meaning of the two algebraic operations. Another example of ST2.1 (checking students' prerequisite knowledge) also occurs in the scene we present in Table 2, line 10.

The next sub-theme is ST2.2 (providing constructive feedback). We found 87 references to ST2.2 (providing constructive feedback) across all of the VR we looked at, making it the sub-theme with the most references for the didactical-pedagogical strategies theme. Constructive feedback differs from simple feedback. We labeled teachers' feedback as constructive feedback when the teacher's feedback supports the student's process of eliminating learning obstacles and obtaining the expected reference knowledge. The feedback that only informs students of the correctness ('yes', 'correct') of a response, does not include information about what is next of a response, not meant to probe students' ideas or thought processes, or does not lead to a conclusion on how deficiencies can be corrected, is interpreted as simple feedback and were not counted as constructive feedback. We provide examples of teachers' constructive feedback in Table 2.

ST2.3 (providing cognitive conflict) is the next strategy in the Didactical-Pedagogical Strategies theme. We discovered ST2.3 (providing cognitive conflict) strategy in 8 of the 18 VRs we examined. Cognitive conflict is created when a teacher gives students novel problems that challenge their existing ways of thinking, leading to a state of cognitive disequilibrium from which they can learn something new. We found 15 references that we classified as ST2.3 (providing cognitive conflict). We revealed an example of a strategy for providing cognitive conflict in a scene of VR of T1 in trigonometry when the teacher challenges students' knowledge

ST2.4 (verifying students' learning resources) is the last sub-theme in the Didactical-Pedagogical Strategies. Only 12 references indicating ST2.4 (verifying students' learning resources) in solving tasks that serve as obstacles came from 6 VR. We may say that this sub-theme is the least popular compared to other sub-themes in didactical-pedagogical strategies. Below is an example of references for this sub-theme in VR of T1.

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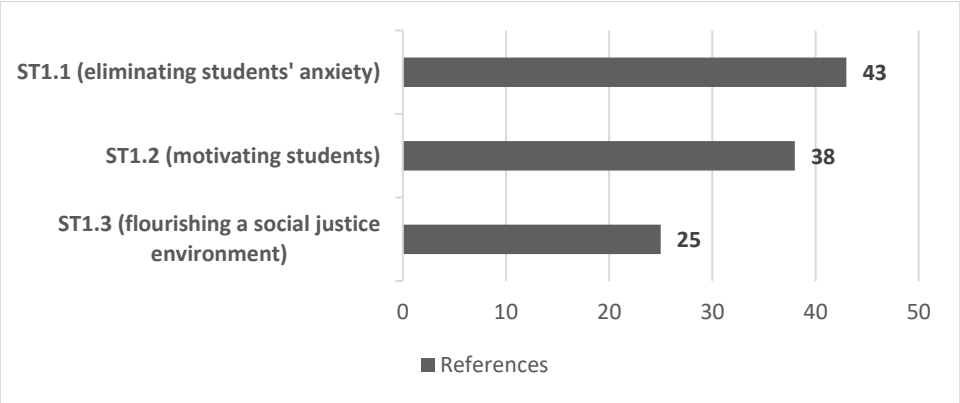

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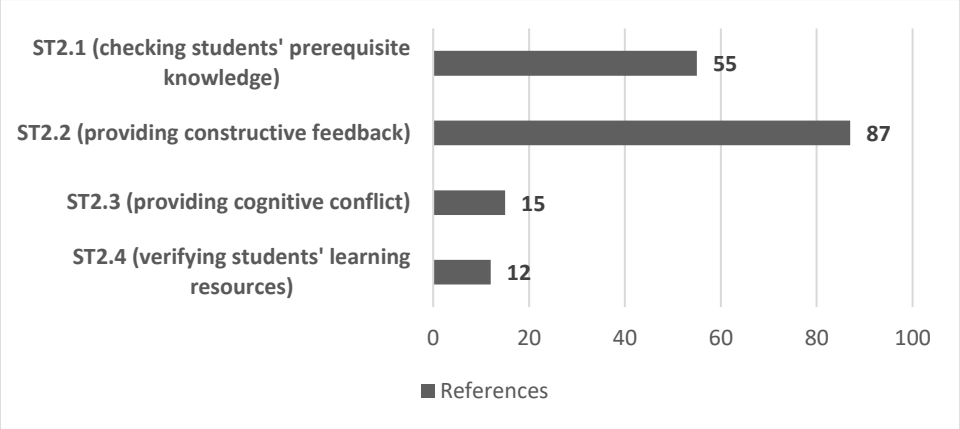

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Discussion

This research aims to identify interviewing strategies mathematics teachers use to diagnose students' learning obstacles. Administrative and policy demands often stymie teachers already on duties; as a result, genuine teacher inquiry—through which they learn more about their students and how they learn—is essential (Ryan et al., 2016; Suryadi, 2019), implies that reflective practice is critical for the professional development of teachers. In this section, we will discuss our findings on the reflective practice of mathematics teachers in Indonesia in diagnosing students' learning obstacles. These findings represent the research's fine-grain contribution to the teachers' professional development, particularly in Indonesia (Kiemer et al., 2015; Park et al., 2020).

The reflective practice of in-service mathematics teachers in Indonesia in diagnosing students' learning obstacles is expanding, although no research on teachers' diagnostic strategies has previously been conducted in Indonesia. We distinguish two major categories of interviewing strategies teachers use to diagnose students' learning difficulties: social-emotional and didactical-pedagogical strategies (D'Mello et al., 2014; Dignath & Büttner, 2018; Parwati & Suharta, 2020). We believe that the interview process teachers use benefits their professional development because it provides an excellent opportunity to profile their students' knowledge more personally and straighten students' concept image to correspond to the scientific concept.

Social-Emotional Strategies

Social-emotional strategies were built on ST1.1 (eliminating students' anxiety), ST1.2 (motivating students), and ST1.3 (flourishing a social justice environment). Based on our interpretation, social-emotional strategies are the teacher's actions or activities to foster social interaction and emotional bonds with students: before or during the interview. Teachers' social-emotional competency, particularly concerning students, is essential to students' mathematical achievement success (Cebollero-Salinas et al., 2022; Lozano-Peña et al., 2021). However, to our knowledge, the literature does not widely disclose the findings that teachers use social-emotional strategies when diagnosing students' learning obstacles.

In the videos we examined, eliminating students' anxiety and motivating students were both popular strategies. This finding is captivating because it demonstrates that teacher participants have adequate social-emotional competency in the humanistic relationship between teachers and students. In a broader context, our findings of social-emotional strategies such as eliminating students' anxiety, motivating students, and flourishing a social justice environment echo those discussed by (Aldrup et al., 2019; Khoule et al., 2017; Lazarides et al., 2019). For instance, previous study state that students in the process of remedial mathematics would have anxiety in themselves (Khoule et al., 2017). Even though diagnosing learning obstacles is not a remedial process, knowing that they are an interviewee will likely lift students' anxiety. Anxiety and difficulty understanding mathematical concepts are poles that influence each other (Aldrup et al., 2019; Khoule et al., 2017). Mathematics anxiety reduces students' mathematics learning achievement; conversely, low mathematics learning achievement will be a source of mathematics anxiety. We argue that the teacher's strategy in eliminating students' anxiety is evidence of the teacher's sensitivity in noticing students' emotional conditions. This strategy is supported by the findings which prove that students who feel their teachers are aware and care about their learning difficulties will have lower anxiety, especially at high school age (Aldrup et al., 2019). This diagnostic process will not work if students are anxious or even afraid. Students' anxiety can become a barrier that prevents teachers from accessing students' learning obstacles, so the teacher's actions to eliminate students' anxiety are a strategy that strongly supports teachers' reflective practices. As for motivating students, this strategy is consistent with research suggestion that teachers should focus on strategies that increase students' perceptions of teacher support (Lazarides et al., 2019). Students are more likely to be highly motivated and participate in learning activities when teachers are prepared to form caring bonds with them, learn about each student's strengths and needs, and offer encouragement and support (Jessup et al., 2021; Yu & Singh, 2016). As a result, motivating students and attempting to form bonds with them has the added benefit of emotionally involving students in the diagnosis process.

Advocates for social justice in mathematics education recommend integrating socio-political notions and concerns into mathematics education to increase students' engagement and motivation, raise awareness about personal and social inequity, and increase the significance and utility of mathematics as a subject (Kokka, 2022; Yolcu, 2019). This ideology is in line with the strategy implemented by the teacher in creating a social justice environment when conducting learning obstacle interviews. The teacher ensures

the student's willingness to participate in the interview; it reflects the teacher's efforts to build democracy so that students have space to express their rights. The teacher is also aware of the differences in student identities, including economic, cultural, and technological backgrounds, and creates an environment that promotes equity in the process. Giving students the option to turn on or off the camera during an online interview is a form of the teacher's strategy to rehumanize the online learning process (Jessup et al., 2021; Kokka, 2022; Lozano-Peña et al., 2021). However, not all analyzed videos referred to the strategy of flourishing a social justice environment. Our findings are consistent with other study state that there is still a need to expand mathematics in-service teachers' professional development research for equity and social justice (Yolcu, 2019). Hence, we believe that future studies on the choices and perceptions of teachers regarding incorporating social justice in mathematics instructional strategies are necessary.

Didactical-Pedagogical Strategies

We interpret didactical-pedagogical strategies as actions teachers took to gain access to students' ways of thinking and understanding of a mathematical concept. Didactical-pedagogical strategies are closely related to teachers' *mathematics knowledge for teaching* (MKT) (Ball et al., 2008; Buck, 2017). Didactical-Pedagogical Strategies is built on ST2.1 (checking students' prerequisite knowledge), ST2.2 (providing constructive feedback), ST2.3 (providing cognitive conflict), and ST2.4 (verifying students' learning resources). Two didactical-pedagogical strategies found in all VR are checking students' prerequisite knowledge and providing constructive feedback. We could say that two strategies are pretty noticeable among teachers for diagnosing learning obstacles. Given the participant teacher's professional background, this finding is not surprising. The teacher's strategy in ensuring students' prerequisite knowledge is an effort to diagnose ontogenic conceptual obstacles (Suryadi, 2019; Wahyuningrum et al., 2023). According to TDS, the process of students acquiring new knowledge intertwines situations of action, formulation, validation, and institutionalization (Brousseau, 2002; Marfuah et al., 2022; Suryadi, 2019). The role of prerequisite knowledge as a component of the situation of devolution before learning leads to the situation of action (Brousseau, 2002; Marfuah et al., 2022). When students' prerequisite knowledge is immature, they will struggle to carry out the mental actions required to formulate and validate mathematical tasks.

The primary goal of providing feedback is to close the gap between an individual's current level of knowledge, performance, and the desired outcome. The gap is a learning obstacle that must be overcome. Constructive feedback operates in students' task performance, process understanding of how to do a task, reasoning, and metacognitive process (Nurwahyu et al., 2020; Park et al., 2020; Rohati et al., 2022). The finding shows that providing constructive feedback is a strategy with the highest number of references in the didactical-pedagogical strategies theme, demonstrating that the in-service teachers in this study had prior experience developing didactic pedagogic interactions with students. This finding contrasts what discovered by other study about the ability of preservice teachers to provide constructive feedback, which was not so much an investigation of students' underlying concepts and logic (Park et al., 2020).

Another interesting strategy is the teacher's efforts to provide cognitive conflict. As seen in the dialogue, the teacher creates cognitive conflict to determine how students' understanding of the radian concept relates to the circle concept. Cognitive conflict is required to determine how robust the students' justification for their knowledge is (Parwati & Suharta, 2020). When students demonstrate uncertainty in dealing with conflicts presented by the teacher, the teacher can begin to investigate student learning obstacles. Aside from a wealth of information teachers can entice by providing a cognitive conflict strategy, our findings show that not all participating teachers use cognitive conflict to reveal the meaning of mathematics concepts to individual students. Previous study also discovered difficulties in high school mathematics teachers providing cognitive conflict to develop students' self-regulated learning (Dignath & Büttner, 2018). This finding is supported by other study who believe that the difficulty for teachers in bringing up meaningful cognitive conflict is due to the teacher ignoring the meaning of knowledge in individual students (D'Mello et al., 2014). As a result, a more in-depth research is required to determine why this strategy has not become a priority for teachers and what support teachers require to understand cognitive conflict as a strategy that can encourage reflective practice.

As for the last in our findings, the teacher's strategy of verifying students' learning resources is, in our opinion, an admirable contribution to the practice of teacher reflection. Teacher T1 stated in the report that the student's misunderstanding of the concept of radian was not entirely due to the immaturity of students' knowledge. The teacher realized that the presentation in the textbooks used by students only 'announces' that π equals 180° after verifying students' learning resources. The missing explanation affects students' self-interpretation of the concept of radians, which is unrelated to the concept of circumference. This perspective is critical for understanding the various meanings of mathematical concepts in each student as an individual, as well as a way for teachers to consider how to improve their didactical design to compensate for the shortcomings of the learning resources students use (Rosa & Orey, 2011; Suryadi,

2019). Evidently, learning resources such as textbooks may be a source of students' obstacles (Lundberg & Kilhamn, 2018; Marfuah et al., 2023). However, the fact that only six of eighteen VR displays scenes that can be classified as verifying students' learning resources suggests that efforts must be made to develop teachers' perspectives on learning obstacles to avoid clouding their diagnosis. The finding that checking students' prerequisite knowledge is far more popular than verifying students' learning resources suggests that teachers tend to see learning obstacles as factors caused by students. This finding is intriguing for future research into how much teachers reflect on the learning resources they promote to students that might contribute as a source of learning obstacles.

This study discovered two major themes and several sub-themes concerning teachers' interviewing strategies for identifying students' learning obstacles. However, we recognize that due to the limitations of our research participants, there must be other potential strategies that we have not yet captured. As a result, while the findings of this study are not meant to be generalized, we believe that the teachers' interviewing strategies for identifying student learning obstacles will be our contribution to the professional development of mathematics teachers. This finding prompted us to propose additional research on assisting mathematics teachers with a diagnostic competence of learning obstacles as part of their reflective practice. More research is also needed to investigate the impact of teachers' strategies on their reflective practice longitudinally and sustainably.

4. CONCLUSION

Using thematic-content analysis of video recordings, we discovered that teachers' interviewing strategies for diagnosing learning obstacles consist of two major themes: social-emotional and didactical-pedagogical strategies. We believe that teachers' epistemic activities to diagnose students' obstacles are inextricably linked to those two interrelated and inseparable dimensions of teacher diagnostic competence. Social-emotional strategies include eliminating anxiety, motivating students, and creating a social justice environment. Meanwhile, didactical-pedagogical strategies include verifying students' learning resources, checking students' prerequisite knowledge, providing constructive feedback, and providing cognitive conflict. We found that the spread of the strategies was uneven across all of the VRs. Some strategies appear to be minimally demonstrated, such as creating a social justice environment, providing cognitive conflict, and verifying students' learning resources; we propose that this finding be highlighted in order to improve teachers' diagnostic competence.

5. REFERENCES

Aldrup, K., Klusmann, U., & Lüdtke, O. (2019). Reciprocal associations between students' mathematics anxiety and achievement: Can teacher sensitivity make a difference? *Journal of Educational Psychology*. https://doi.org/10.1037/edu0000398.

Ardiansari, L., Suryadi, D., & Dasari, D. (2020). The concept image of students and teachers about the equal sign. *Universal Journal of Educational Research*, *8*(12), 6751–6764. https://doi.org/10.13189/ujer.2020.081240.

Artigue, M., Haspekian, M., & Corblin-Lenfant, A. (2014). Introduction to the Theory of Didactical Situations (TDS). In A. Bikner-Ahsbahs & S. Prediger (Eds.), *Networking of Theories as a Research Practice in Mathematics Education* (pp. 47–65). Springer International Publishing. https://doi.org/10.1007/978-3-319-05389-9.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, *59*, 389–407. https://doi.org/10.1177/0022487108324554.

Brousseau, G. (2002). *Theory of Didactical Situations in Mathematics* (N. Balacheff, M. Cooper, R. Sutherland, & V. Warfield (eds. & trans.)). Kluwer Academic Publishers.

Buck, M. F. (2017). Gamification of Learning and Teaching in Schools – A Critical Stance. *Seminar.Net*, *13*(1). https://doi.org/10.7577/seminar.2325.

Cebollero-Salinas, A., Cano-Escoriaza, J., & Orejudo, S. (2022). Social Networks, Emotions, and Education: Design and Validation of e-COM, a Scale of Socio-Emotional Interaction Competencies among Adolescents. *Sustainability (Switzerland)*, *14*(5). https://doi.org/10.3390/su14052566.

Chernikova, O., Heitzmann, N., Fink, M. C., Timothy, V., Seidel, T., & Fischer, F. (2020). Facilitating diagnostic competences in higher education—a meta-analysis in medical and teacher education. *Educational Psychology Review*, *32*(1), 157–196. https://doi.org/10.1007/s10648-019-09492-2.

D'Mello, S., Lehman, B., Pekrun, R., & Graesser, A. (2014). Confusion can be beneficial for learning. *Learning and Instruction*, *29*, 153–170. https://doi.org/10.1016/j.learninstruc.2012.05.003.

Dennis, M. S., Sharp, E., Chovanes, J., Thomas, A., Burns, R. M., Custer, B., & Park, J. (2016). A meta-analysis of

empirical research on teaching students with mathematicslearning difficulties. *Learning Disabilities Research and Practice*, 1–13. https://doi.org/10.1111/ldrp.12107.

Dignath, C., & Büttner, G. (2018). Teachers' direct and indirect promotion of self-regulated learning in primary and secondary school mathematics classes – insights from video-based classroom observations and teacher interviews. *Metacognition and Learning*, *13*(2), 127–157. https://doi.org/10.1007/s11409-018-9181-x.

Effendi, L. A. (2012). Pembelajaran Matematika dengan Metode Penemuan Terbimbing Untuk Meningkatkan Kemampuan Representasi dan Pemecahan Masalah Matematis Siswa SMP. *Jurnal Penelitian Pendidikan*, *13*(2), 1–10. http://jurnal.upi.edu/file/Leo_Adhar.pdf.

Fischer, F., Kollar, I., Ufer, S., Sodian, B., Hussmann, H., Pekrun, R., Neuhaus, B., Dorner, B., Pankofer, S., Fischer, M., Strijbos, J.-W., Heene, M., & Eberle, J. (2014). Scientific reasoning and argumentation: Advancing an interdisciplinary research agenda in education. *Frontline Learning Research*, *2*(3), 28–45. https://doi.org/10.14786/flr.v2i3.96.

Götz, D., & Gasteiger, H. (2022). Reflecting geometrical shapes: approaches of primary students to reflection tasks and relations to typical error patterns. *Educational Studies in Mathematics*, *111*(1), 47–71. https://doi.org/10.1007/s10649-022-10145-5

Herman, T., Prabawanto, S., & Suryadi, D. (2022). Implementasi Proleco-DDR untuk mengembangkan kemampuan profesional guru SD dalam pembelajaran matematika di Kabupaten Ciamis. *PRISMA*, *11*(2), 576–584. https://doi.org/10.35194/jp.v11i2.2585.

Isnawan, M. G., Suryadi, D., & Turmudi, T. (2022). How secondary students develop the meaning of fractions? A hermeneutic phenomenological study. *Beta: Jurnal Tadris Matematika*, *15*(1), 1–19. https://doi.org/10.20414/betajtm.v15i1.496.

Jatisunda, M. G., Suciawati, V., Nahdi, D. S., & Cahyaningsih, U. (2022). Pre-service mathematics teachers' professional competency development through analysis of learning obstacles. *EduMa Mathematics Education Learning and Teaching*, *11*(2), 180–190. https://doi.org/10.24235/eduma.v11i2.9277.

Jessup, N. A., Wolfe, J. A., & Kalinec-Craig, C. (2021). Rehumanizing mathematics education and building community for online learning. In K. Hollebrands, R. Anderson, & K. Oliver (Eds.), *Online Learning in Mathematics Education* (pp. 95–113). Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-030-80230-1_5.

Kandaga, T., Rosjanuardi, R., & Juandi, D. (2022). Epistemological obstacle in transformation geometry based on van Hiele's level. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(4). https://doi.org/10.29333/ejmste/11914.

Khoule, A., Bonsu, N. O., & Houari, H. El. (2017). Impact of conceptual and procedural knowledge on students mathematics anxiety. *International Journal of Educational Studies in Mathematics*, *4*(1), 8–18. https://dergipark.org.tr/en/pub/ijesim/issue/34535/381574.

Kidron, I. (2018). Students' conceptions of irrational numbers. *International Journal of Research in Undergraduate Mathematics Education*, *4*(1), 94–118. https://doi.org/10.1007/s40753-018-0071-z.

Kiemer, K., Gröschner, A., Pehmer, A. K., & Seidel, T. (2015). Effects of a classroom discourse intervention on teachers' practice and students' motivation to learn mathematics and science. *Learning and Instruction*, *35*, 94–103. https://doi.org/10.1016/j.learninstruc.2014.10.003.

Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*. https://doi.org/10.1080/0142159X.2020.1755030.

Kokka, K. (2022). Toward a theory of affective pedagogical goals for social justice mathematics. *Journal for Research in Mathematics Education*, *53*(2), 133–153. https://doi.org/10.5951/jresematheduc-2020-0270.

Larrain, M., & Kaiser, G. (2022). Interpretation of students ' errors as part of the diagnostic competence of pre-service primary school teachers. *Journal Für Mathematik-Didaktik*, *43*, 39–66. https://doi.org/10.1007/s13138-022-00198-7.

Lazarides, R., Gaspard, H., & Dicke, A. L. (2019). Dynamics of classroom motivation: Teacher enthusiasm and the development of math interest and teacher support. *Learning and Instruction*, *60*, 126–137. https://doi.org/10.1016/j.learninstruc.2018.01.012.

Liu, K. (2020). *Critical Reflection for Transformative Learning*. Springer. https://doi.org/10.1007/978-3-319-01955-0_7.

Lozano-Peña, G., Sáez-Delgado, F., López-Angulo, Y., & Mella-Norambuena, J. (2021). Teachers' social–emotional competence: history, concept, models, instruments, and recommendations for educational quality. *Sustainability*, *13*(12142). https://doi.org/10.3390/su132112142.

Lundberg, A. L. V., & Kilhamn, C. (2018). Transposition of knowledge: Encountering proportionality in an algebra task. *International Journal of Science and Mathematics Education*, *16*(3), 559–579.

https://doi.org/10.1007/s10763-016-9781-3.
Maknun, C. L. L. Il, Rosjanuardi, R., & Jupri, A. (2022). Epistemological obstacle in learning trigonometry. *Mathematics Teaching-Research Journal*, *14*(2), 5–25. https://eric.ed.gov/?id=EJ1350528.
Marfuah, M., Suryadi, D., Turmudi, T., & Dahlan, J. A. (2023). Matrix algebra in high school: Didactic transposition to the regular and the emergency COVID-19 outbreak curriculum. *The 8th International Conference on Research Implementation and Education of Mathematics and Science (ICRIEMS 2021)*, *2556*(050013). https://doi.org/10.1063/5.0109906.
Marfuah, M., Suryadi, D., Turmudi, T., & Isnawan, M. G. (2022). Providing online learning situations for in-service mathematics teachers' external transposition knowledge during COVID-19 pandemic: Case of Indonesia. *Electronic Journal of E-Learning*, *20*(1), 69–84. https://doi.org/10.34190/ejel.20.1.2388.
Marshall, T., Keville, S., Cain, A., & Adler, J. R. (2021). On being open-minded, wholehearted, and responsible: A review and synthesis exploring factors enabling practitioner development in reflective practice. *Reflective Practice*, *22*(6), 860–876. https://doi.org/10.1080/14623943.2021.1976131.
Murray, E. (2015). Improving teaching through collaborative reflective teaching cycles. *Investigations in Mathematics Learning*, *7*(3), 23–29. https://doi.org/10.1080/24727466.2015.11790343.
Nopriana, T., Herman, T., & Martadiputra, B. A. P. (2023). Digital didactical design: The role of learning obstacles in designing combinatorics digital module for vocational students. *International Journal of Interactive Mobile Technologies (IJIM)*, *17*(02), 4–23. https://doi.org/10.3991/ijim.v17i02.34293.
Novita, R., Herman, T., Dasari, D., & Putra, M. (2022). Analyzing second-year university students' rational number understanding: A Case on interpreting and representing fraction. *European Journal of Educational Research*, *11*(3), 1747–1762. https://doi.org/10.12973/eu-jer.11.3.1747.
Nurhikmayati, I., Jatisunda, M. G., & Ratnawulan, N. (2022). The practice of reflection based on Didactical Design Research: An analysis of the geometry transformation material. *Jurnal Teori Dan Aplikasi Matematika*, *6*(3), 565–580. https://doi.org/10.31764/jtam.v6i3.8441.
Nurwahyu, B., Tinungki, G. M., & Mustangin. (2020). Students' concept image and its impact on reasoning towards the concept of the derivative. *European Journal of Educational Research*, *9*(4), 1723–1734. https://doi.org/10.12973/eu-jer.9.4.1723.
Park, M., Yi, M., Flores, R., & Nguyen, B. (2020). Informal formative assessment conversations in mathematics: Focusing on preservice teachers' initiation, response and follow-up sequences in the classroom. *Eurasia Journal of Mathematics, Science and Technology Education*, *16*(10). https://doi.org/10.29333/EJMSTE/8436.
Parwati, N. N., & Suharta, I. G. P. (2020). Effectiveness of the implementation of cognitive conflict strategy assisted by e-service learning to reduce students' mathematical misconceptions. *International Journal of Emerging Technologies in Learning*, *15*(11), 102–118. https://doi.org/10.3991/IJET.V15I11.11802.
Puspita, E., Suryadi, D., & Rosjanuardi, R. (2022). Learning obstacles of prospective mathematics teacher students on the concept of chain rules and alternative didactic designs. *Journal of Engineering Science and Technology*, 9–16. https://jestec.taylors.edu.my/Special Issue ICMScE2022/ICMScE2022_02.pdf.
Rohati, R., Kusumah, Y. S., Kusnandi, K., & Marlina, M. (2022). How teachers encourage students' mathematical reasoning during the COVID-19 pandemic? *Jurnal Pendidikan Indonesia*, *11*(4). https://doi.org/10.23887/jpiundiksha.v11i4.52756.
Rosa, M., & Orey, D. (2011). Ethnomathematics: the cultural aspects of mathematics. *Revista Latinoamericana de Etnomatemática*, *4*(2), 32–54. http://funes.uniandes.edu.co/3079.
Ryan, M., Taylor, M., Barone, A., Pesca, L. Della, Durgana, S., Ostrowski, K., Piccirillo, T., & Pikaard, K. (2016). Teacher as researcher, teacher as scholar, and teacher as leader. *New Educator*, *13*. https://doi.org/10.1080/1547688X.2016.1144120.
Suryadi, D. (2019). *Landasan Filosofis Penelitian Desain Didaktis (DDR)*. Pusat Pengembangan DDR Indonesia.
Theis, R., Junita, R., Kamid, & Iriani, D. (2022). Diagnostic tests based on three level tests on fixed materials for students with misconceptions. *Jurnal Pendidikan Indonesia*, *11*(4). https://doi.org/10.23887/jpiundiksha.v11i4.50452.
Wahyuningrum, A. S., Suryadi, D., & Turmudi, T. (2023). Students' prior knowledge as an ontogenic obstacle on the topic of ratio and proportion. *Jurnal Pendidikan Matematika*, *17*(1). https://doi.org/10.22342/jpm.17.1.18866.55-68.
Wijaya, A., Retnawati, H., Setyaningrum, W., Aoyama, K., & Sugiman. (2019). Diagnosing students' learning difficulties in the eyes of Indonesian mathematics teachers. *Journal on Mathematics Education*,

10(3), 357–364. https://doi.org/10.22342/jme.10.3.7798.357-364.

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). SAGE.

Yolcu, A. (2019). Research on equitable mathematics teaching practices: Insights into its divergences and convergences. *Review of Education*, *7*(3), 701–730. https://doi.org/10.1002/rev3.3163.

Yu, R., & Singh, K. (2016). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research*, 81–94. https://doi.org/10.1080/00220671.2016.1204260.