The Questioning Techniques of Primary School Mathematics Teachers in Their Journey to Incorporate Dialogic Teaching

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Abstract

Questioning is one of the critical repertoires in dialogic teaching. Teachers who set dialogic classrooms need to be able to use questioning effectively. Effective questioning techniques by teachers improve teacher-student instructional dialogues in primary school mathematics classrooms. In this study, the questioning practices of three primary school mathematics teachers were analysed in their journey to incorporate dialogic teaching. Data were gathered through lesson observations, video recordings and teacher interviews. The three teachers' classroom discourses were transcribed verbatim, and teachers' questions were analysed to find out the types of questions, how the teachers asked the questions and the feedback given to the student's responses. Findings from this study indicated that the three teachers used effective questioning techniques in ensuring dialogic teaching, with focusing, genuine enquiry, and closed testing questions being the most predominant. The teachers portrayed positive attitudes towards dialogic teaching and shared their comprehensive understanding of the approach.

Keywords: Dialogic teaching, questioning techniques, teachers' perceptions, primary school mathematics.

Introduction

In dialogic teaching, teachers create opportunities for learners to participate actively in classroom interactions, share their ideas and construct a common understanding of the concepts (Mercer & Dawes, 2014). The dialogic teaching approach has been implemented in the educational systems of Brunei Darussalam (henceforth referred to as Brunei) since 2017 via the Literacy and Numeracy Coaching Programme (LNCP). The dialogic approach was implemented in Brunei on the score that classroom interactions in various subjects, including mathematics, were dominated by teachers' closed-ended questioning. This limited students' opportunities to construct their mathematical thinking and understanding (Salam & Shahrill, 2014; Shahrill & Clarke, 2014; Shahrill, 2018). Mathematics has been emphasised in this present study because students have been observed to be passive in the mathematics classroom and mostly take information from teachers. Again, teachers are more interested in completing the mathematics syllabus for examination purposes (Shahrill, 2018; Shahrill & Clarke, 2019), and not much classroom communication that promotes higher-order thinking. Zakir (2018) similarly reported that preschool classrooms' culture was very "rigid and mostly on teacher-directed teaching" (p. 235). This arguably may impact students' learning styles as they go through their educational activities. There was, therefore, the need to re-organise teaching

approaches and lessons in schools based on the needs of students so that they could share their learning experiences and be active participants in classroom mathematics interactions.

The Ministry of Education (referred to as the Ministry) initiated the dialogic teaching initiative to improve the literacy and numeracy of students in Brunei. In 2014, the newly revised primary mathematics curriculum was introduced through the Numeracy Initiative Project organised by the Ministry's Curriculum Development Department (CDD). This was meant to meet the requirements of the National Education System for the 21st Century (*Sistem Pendidikan Negara Abad ke-21*, SPN21). The curriculum stressed the development of robust mathematical concepts and skills such as problem-solving, critical thinking, collaboration, and communication. All primary mathematics teachers were involved in the project to familiarise themselves with the new "Yes! Maths" curriculum package. This was based on a collaboration between the CDD and Marshall Cavendish Education Private Limited, Singapore.

In addition, the Brunei Numeracy National Standards framework outlined the criteria for the seven expectation levels of students. The expectation levels were aligned with the Programme for International Student Assessment (PISA) proficiency levels, in which Brunei has participated since 2018. The framework provides teachers, parents, the Ministry, and other stakeholders a form of measurement to match students' progress and achievement to the standards to know at which level students are in their learning. Others include the Centre for British Teachers (CfBT), which collaborated with the Ministry to create the 'Teaching for Mathematics Mastery' framework. It consisted of the requirements for effective mathematics teaching in Brunei. One of the emphases was on the teaching of mathematics content dialogically. This was conducted based on the work of Alexander (2017) through the LNCP. From the programme, international coaches have been deployed to primary and secondary schools to support the teachers in their development to be effective teachers. The coaches provide professional development for mathematics teachers in the schools with the anticipation of training them on the effective use of the mathematics framework through effective questioning and classroom collaboration.

The Ministry has been determined to ensure classroom interaction through the dialogic teaching approach, especially in mathematics classrooms at the primary school level, since 2017. However, there have not been systematic attempts to assess teachers' questioning, which is critical in ensuring a dialogic teaching approach in primary school mathematics classrooms. The only study on dialogic teaching in Brunei focused on primary school science teachers and the neglect of other mathematics teachers (Roslan, 2014). Other studies (Shahrill & Clarke, 2014) considered "teachers' talk" in senior high school mathematics classrooms. They did not comprehensively assess primary school teachers' use of dialogic teaching.

Meanwhile, the LNCP has been organising the Teacher Professional Development (TPD) programmes to equip primary school mathematics teachers to develop effective questioning techniques to ensure dialogic instructions. International coaches have also been assigned to conduct the TPD in schools to help mathematics teachers to develop their questioning techniques. Since 2017, TPD has focused on the types of questions used, who the teacher addresses the questions to, and how the teacher responds to students' initial responses (based on Alexander, 2017). Arguably, since the implementation of the revised mathematics curriculum emphasises dialogic teaching, there is a need to assess teachers' questioning techniques, which are vital in ensuring a dialogic teaching approach in primary school

mathematics classrooms in Brunei. In this study, we provide evidence for the shifts in the types of questioning and how these shifts impacted the nature of classroom interactions. We, therefore, aimed to assess the effective questioning techniques employed by primary school mathematics teachers as they move towards dialogic teaching. The study answered the following research questions: What questioning techniques are used by primary school mathematics teachers to incorporate dialogic teaching? And what are the perceptions of teachers in incorporating dialogic teaching in primary school mathematics instructions?

Literature Review

The Nature of Dialogic Classrooms

Dialogic teaching means teaching strategies should support continuous interaction between teachers and students and among students and their tasks (Yıldırım & Uzun, 2021). Alexander (2017) premised his conception of dialogic teaching on questioning. He argues that initial and extended questions are one of the features of classroom interaction in a dialogic classroom. Alexander stated, "questions are structured to provoke thoughtful answers, and - no less important answers provoke further questions, and are seen as the building blocks of dialogues rather than its terminal point" (p. 42). Alexander further presented four repertoires in implementing dialogic teaching, which have been adopted in Brunei classrooms: talk for everyday life, learning talk, teaching talks, and classroom organisation. The four categorisations were further regrouped into the role of teachers' questioning and the role of students' talks in the dialogic classroom.

Teachers' Role in a Dialogic Classroom

Although dialogic classrooms can be challenging as it comes with inclusion problems (Rapanta et al., 2021), teachers, as facilitators of their students' learning, should develop the needed competencies to implement it in mathematics classrooms. This is because using the approach in the mathematics classroom improves students' performance and reduces their mathematics anxiety (Ozbek & Uyumaz, 2020). The role of the teachers is crucial because they create an environment conducive for the students to feel comfortable and safe to participate in the discussion actively.

The teachers' role in classrooms is often associated with questioning. In the teaching and learning of mathematics, there should be an effective use of questioning to encourage students' participation to elicit their mathematical thinking and understanding (CDD, 2017). Alexander (2017) believes teachers can still use traditional teacher talk in their classrooms, incorporating rote, recitation, instruction, and exposition. These types of teacher talks play their roles in the classroom discourse. However, teachers need to ensure that their talks are not dominated only by these actions throughout the lesson.

Alexander (2017) emphasised teachers' need to include discussion and scaffold dialogues in their talks. Opening the opportunities for discussion will allow the students to express their ideas verbally. When the students translate what they think into verbal language, they are more likely to understand the discussed concept (Vygotsky, 1978). Scaffold language, in this sense, involves interactions that inspire students to think, questions that require students to demonstrate their mathematical thinking, and involves students' answers which are built upon

by following up with another question to expand their thinking and understanding. It also improves feedback, which pushes the students to their fullest potential, extended contributions, and exchanges that link together, forming collective understanding (Roslan et al., 2018).

The emphasis of dialogic teaching in Brunei's classroom is on the use of good questioning techniques to be employed by the teachers to elicit students' mathematical thinking and reasoning. As outlined in the teaching for mathematics mastery framework, there are different types of questions that the teachers can use to elicit different outcomes. These include focusing, genuine inquiry, closed and open testing, leading, statements, and rhetorical questions (CfBT, 2017). The teachers use questioning to challenge and build up the students' understanding by providing follow-ups to their answers. One way to follow up on the students' answers is by acknowledging whether they are correct. Giving positive acknowledgement even when students have answered incorrectly is an element of effective teaching (Alexander, 2017). Aside from acknowledging, the teachers shall build on the students' understanding or try to correct misunderstanding by probing the students' thinking (Alexander, 2017; Shahrill, 2013; Salam & Shahrill, 2014; Marmin et al., 2021). As part of dialogic teaching, Alexander theorises that classroom organisation is one of the repertoires of dialogic teaching. Organising the class effectively will allow the teacher to easily select the targeted students, groups, or pairs to contribute their input regarding the discussed concepts. The teachers will also enable volunteers to take part by raising their hands to indicate their choice to participate.

The Role of Students in a Dialogic Classroom

In a dialogic classroom, the students are expected to be interactive and actively participate in class discussions (Asterhan et al., 2020). Their talks shall reflect their mathematical understanding and reasoning. However, previous studies have reported the pedagogical style of several mathematics teachers does not allow students to talk in the classroom. Lee (2016), for example, found in Singapore that the teacher mostly dominated the classroom discourse. However, after the intervention, by incorporating dialogic teaching elements, the classroom discourse changed to encourage students' participation. Shahrill (2009), Salam and Shahrill (2014), and Shahrill and Clarke (2014) also encountered the dominance of the teacher talks in the lessons that they observed in Bruneian classrooms. Although there were shreds of evidence of teacher and students' interactions, they were brief and were not expanded to form whole-class discussions. Zakir (2018) calls the inadequate students' participation in instructional dialogues a "cultural issue in Brunei, where children are not used to an adult asking them for their perspectives" (p. 221).

Based on Alexander (2017), students should learn to narrate, explain, analyse, speculate, imagine, explore, evaluate, discuss, argue, justify, and ask questions. This suggests that in a dialogic classroom, the students should be given opportunities to expand their thinking and construct their knowledge (Wegerif, 2019). For Gillies (2020), students should play the role of "engaging in constructive discussion with their peers in inquiry group tasks, compare findings, and express their opinions" (p. 1). This implies that under the teacher's guidance, mathematics classrooms should be such that there is enough room for instructional dialogues, collaboration, and free expression of opinion and views about mathematics concepts by students compared

to mere spoon-feeding. The classroom environment should be conducive for students to play these crucial roles in the dialogic teaching approach.

Questioning Techniques Employed by Teachers

Oral questioning is vital in teacher-student instructional dialogues (Desli & Galanopolou, 2017). In mathematics classrooms, Mahmud et al. (2020) indicate that oral questioning encourages systematic and focused thinking abilities in students. This is because the kind of questions the teacher poses determines the way students think and prepare responses. Effective oral questioning skills increase students' inquiry and allow them to explore mathematical concepts. According to Celik and Guzel (2016), teachers can understand how their students master mathematical concepts, give the needed feedback, and plan interventional strategies through effective questioning. Oral questioning accounts for almost 60% of instructional time (Farrell & Mom, 2015); meanwhile, instructional outcomes are predicted by teachers' questioning behaviour (Maphosa & Wadesango, 2017).

According to the CfBT (2017), teachers' questioning techniques focus on the type of questions to be asked, how teachers ask the questions and the feedback given to the students' responses. In Brunei primary and secondary schools, these questioning techniques have been adopted by LNCP to ensure dialogic instructional pedagogies. The questioning techniques' descriptions based on CfBT (2017) are provided in Appendices A, B and C.

Methods

Study Context

The present study was conducted in a primary school in Brunei. The education system in Brunei was established following the British education system and used a bilingual education policy (Muhammad & Petra, 2021). The English language (the second language) is used as the medium of instruction, although Malay is the first language (Sharbawi & Jaidin, 2020). The classroom culture in Brunei is different from other western counterparts because the country's philosophy and the Malay Islamic Monarchy (or *Melayu Islam Beraja*, often shortened as MIB) play a vital role in education.

Two social values that are part of the philosophy of the country and the Islamic culture are respect for old age and humility. For this reason, students are seen to respect their teachers or elders by not questioning their knowledge as the belief that they (elders) are more knowledgeable (Zakir, 2018). For this reason, classroom interactions have followed such traditional routes because students feel they may be challenging or disrespecting their teachers when they exchange conceptual words with teachers. This has extended to mathematics classrooms at the primary school level, where teachers closely question students to neglect students' interaction with teachers or among themselves. To solve this problem, there was a need to adopt Alexander's dialogic teaching in the mathematics classroom.

Research Design

The study uses the qualitative case study design. The design helps to comprehensively understand opinions and experiences about a particular phenomenon and generate new ideas

(Creswell, 2014). A case study is a valuable way to gather information which involves more minor participants (Zainal, 2007). Although case studies can be multiple or single (Bennet & Elman, 2007), the present study uses a single case study since the study focused on a specific phenomenon in a particular context (Crowe et al., 2011; Teegavarapu et al., 2008).

The qualitative case study design is deemed appropriate because there is a need to understand how primary school mathematics teachers use effective questioning to ensure dialogic instructions. There is also the need to examine how their perceptions of dialogic teaching affect and inform their practices. To obtain comprehensive information based on these parameters, this study observed and interviewed primary school mathematics teachers on how they ensure dialogical teaching. This signifies the use of multiple data sources, where data is converged in a triangulation fashion, to ensure the reliability of findings (Yin, 2003).

Participants

The participants were purposely sampled since they possessed the characteristic of interest of the study (Creswell, 2012). The three sampled participants were Year 6 primary school mathematics teachers who were directly involved in the LNCP as a Local Coach (LC), Potential Local Coach (PLC), and Learning Partner (LP). The LC and PLC are responsible for supervising the implementation of dialogic teaching in their school. Therefore, they were well informed on dialogic teaching as a pedagogical approach in mathematics classrooms. An LP is a person that the International Coach (IC), LC, and PLC coach under the LNCP. Yin (2003) opines that the nature of case study design makes sample size irrelevant but cautions that emphasis must be on getting in-depth information on the case. However, observing and interviewing three participants was sufficient since they were directly involved in dialogic training programmes and could provide in-depth information on how they implement it in their mathematics classrooms. Table 1 provides a summary of the teachers' demographic details.

Table 1
Participants' Demographics

	Participant 1	Participant 2	Participant 3
Gender	Female	Male	Female
Age	35	34	37
Highest qualification	MA Education (UK)	BA Primary Education (Brunei)	BA Primary Education (Brunei)
Teaching experience	9	8	14
Teaching experience in mathematics	2	8	14
Role in LNCP	Potential Local Coach (PLC)	Local Coach (LC)	Learning Partner (LP)

Note: The teachers' roles in LNCP are used from this point of the study

Instruments and Data Collection

Lesson observations and interviews were conducted over four months. By employing the non-participant observation technique, observations were made in five consecutive lessons for all the participants. Lessons were video-recorded to provide retrievable data of the real context of the lessons, and this was done to observe behaviours and patterns of interactions (Goldman

& McDermott, 2007). It also helped capture the participants' facial expressions, gestures, and body language during the lessons. The video recordings were necessary for the transcribing process of the lesson discourse. Field notes were also taken during the lesson observations. Three video recorders, which recorded the participants from several different angles within the same classroom, were set up in each class simultaneously. The first video recorder could capture a wide-angled frame and be placed where the full view of the class could be obtained. The second video recorder was focused on the teacher, whereas the third video recorder was focused on the students.

The dialogues during the video-recorded lessons were transcribed based on the categories in the LNCP tools. The LNCP tools were adapted and modified to suit this study. The tools are the extensions of the Teacher Performance Appraisal (TPA) form that evaluate the performance of a teacher and their students' achievement in a particular lesson, hence, the name TPA+. The content of the tools is as follows:

(a) TPA+ Lesson Observation Support Document (see Appendix D): It specifically looked at the type of questions the teachers asked, how the teachers addressed the question to the students, how the teachers responded to students' answers and the type of students' responses. The transcriptions for the lesson observations were recorded in this document.

(b) TPA+ Observation Tool (see Appendix E): This tool was used to tally how many times the abovementioned criteria were used.

At the end of the lesson observation sequences, a face-to-face interview was conducted with each teacher using a structured interview guide. The interviews were conducted to gain insights into the teachers' experiences and perceptions of incorporating dialogic teaching in their mathematics classrooms. The interviews also included video-stimulated recall interviews based on one to two chosen lessons. This helped recall the classroom discourses occurring during the lessons and identified when the teachers believed that dialogic teaching had happened during class interactions. The video-stimulated recall interviews supplemented the researchers' lack of involvement in the lesson and could avoid the biased evaluation of the contexts just by observing and reviewing the video recordings (Shahrill, 2017; Xu & Clarke, 2018). Also, the interviews were audio-recorded and transcribed for further analysis.

Data Analysis

The data from the interviews were analysed using thematic analysis. This helped in "identifying, analysing, and interpreting patterned meanings or 'themes' in the qualitative data" (Braun & Clarke, 2014, p. 95). The transcriptions from the interviews were read and analysed severally to determine the themes or categories. Triangulation of data sources was utilised to ensure the trustworthiness of the findings. This was to check the consistency of data obtained from the lesson observations and interviews. An IC was invited specially to become a member checker to ensure the transcription of the lesson observations, together with the second and third authors. Some parts of the video recordings were given to the IC, which enabled entering the data into the LNCP tools. The reason was to enter accurate data into the LNCP tools. Excerpts from the interviews have also been quoted verbatim to validate further the key findings that emerged from the interviews. Although this was a qualitative study, the transcriptions from the LNCP tools for the questioning techniques were analysed and

quantified to frequency and percentage counts. This step is to identify the questioning techniques that were more and less dominant or either, in the teachers' classrooms. This made it easier to compare the three classrooms. Frequencies and percentages were also used to depict situations in each of the teachers' classes and show the distribution in each category. The percentages were calculated by taking the frequencies of occurrences for each criterion from a category, dividing by the total number of occurrences and multiplying by a hundred.

Findings and Discussion

Questioning Techniques Employed by Primary School Mathematics Teachers

The three categories from analysing the questioning techniques employed by the three teachers were: the types of questions, how teachers ask the questions, and the feedback given to the students' responses. The transcriptions from 15 lessons were analysed based on these categories. Table 2 illustrates the frequency (N) of the questions that occurred during each lesson for the three teachers.

Table 2

Frequency Distribution of the Number of Questions Asked by the Teacher

Teachers	Lesson Number	N	Topics
PLC	1	122	Understanding ratio
	2	119	Equivalent ratio
	3	75	The ratio of three quantities
	4	72	Ratio and fractions
	5	104	Solving world problems on ratio
Total		*492*	
LC	1	40	Expressing one quantitative as a percentage of another quantity
	2	49	Finding the percentage of a quantitative
	3	47	Solving word problems on percentage
	4	32	Understanding ratio
	5	41	Equivalent ratio
Total		*209*	
LP	1	87	Calculating average
	2	56	Calculating total
	3	49	Solving word problems on average
	4	2	Meaning of average
	5	6	Relevance of average
Total		*200*	

From the five lessons observed from all three teachers (in Table 2), the PLC asks the most questions (492), and this is followed by the LC (248 questions) and the LP (200 questions). Although the teachers used the same lesson duration (60 minutes) and same year group to ensure uniformity, the number of questions asked by the three teachers varied due to the different lesson structures. The number of questions also differed due to the teachers' time spent on the whole class interactions. The whole class interactions occurred mainly during the starter activities, main teacher input, and plenary. The PLC spent an average of 10 minutes in each of her lessons on starter activities, 35 minutes on main teacher input, 20 minutes on group

work, and 5 minutes on the plenary. The LC spent an average of 5 minutes on his starter activities in each lesson, 20 minutes on main teacher input, 20 minutes on pair work or group work, 10 minutes on individual work, and 5 minutes on plenary. In comparison, the LP spent an average of 15 minutes on her starter activities, 25 minutes on main teacher input, 15 minutes on group work or pair work, and 5 minutes on the plenary.

The Type of Questions Asked

The types of questions the teachers ask are analysed based on the eight questions identified by the CfBT (2017). Table 3 illustrates the frequencies (N) and percentages (%) of the type of questions asked by the teacher participants in their consecutive lessons.

Table 3
Frequencies and Percentages of the Type of Questions

Types of questions	PLC N (%)	LC N (%)	LP N (%)
Focusing question	309 (62.8)	101 (48.3)	118 (59.0)
Genuine enquiry	79 (16.1)	73 (34.9)	56 (28.0)
Closed testing	74 (15.1)	35 (16.8)	22 (11.0)
Open testing	8 (1.6)	0 (0)	0 (0)
Statements	1 (0.2)	0 (0)	0 (0)
Leading	21 (4.2)	0 (0)	2 (1.0)
Rhetorical	0 (0)	0 (0)	2 (1.0)
Guess-my-mind	0 (0)	0 (0)	0 (0)
Total	492 (100)	209 (100)	200 (100)

From Table 6, the PLC predominantly asks focusing (62.8%), genuine enquiry (16.1%), and closed testing questions (15.1%). The LC asks focusing (48.3%), genuine enquiry (34.9%), and closed testing questions (16.7%). Similarly, the LP asks focusing (59.0%), genuine enquiry (28.0%), and closed testing questions (11.0%). Table 6 implies that all three teachers (PLC, LC, LP) predominantly utilise similar questions: focusing, genuine enquiry, and closed testing.

How Teachers Ask Questions

This category examines the way the teachers address questions to the students. How teachers ask questions was analysed based on the five categories identified by the CfBT (2017). Table 4 illustrates each category's frequencies (N) and percentages (%) of occurrences.

Table 4
Frequencies and Percentage of How the Teachers Ask Questions

Categories	PLC N (%)	LC N (%)	LP N (%)
Whole class (orally)	297 (60.4)	45 (21.5)	136 (68.0))
Whole class (physically)	27(5.5)	63 (30.2)	15 (7.5)
Individual volunteers	82 (16.7)	21 (10.0)	29 (14.5)
Specific students/pair/group	86 (17.4)	80 (38.3)	18 (9.0)
Not directed to anyone	0(0)	0 (0)	2 (1.0)
Total	492 (100)	209 (100)	200 (100)

From Table 4, the PLC mostly directs questions to the whole class orally (60.4%), specific students/pairs/groups (17.4%), volunteers (16.7%), and the whole class physically (5.5%). The LC targets specific students/pairs/groups (38.3%), the whole class physically (30.1%), the whole class orally (21.5%), and volunteers (10.1%). Similarly, the LP directs questions to the whole class orally (68.0%), volunteers (14.5%), specific students/pairs/groups (9.0%), and the whole class physically (7.5%). Irrespective of the various roles played by the teachers in LNCP towards inculcating dialogic teaching, their ways of asking questions follow the same trends. They mostly direct questions to the whole class (orally), specific students/pairs/groups, individual volunteers, specific students/pairs/groups, and the whole class (physically). This shows the varied questioning skills of the teachers as they incorporate dialogic teaching.

Feedback Given to the Students' Responses

This section explores the feedback practices of the teachers based on the six types of feedback outlined by the CfBT (2017). Table 5 shows the frequencies (N) and percentages (%) of the three teachers' feedback on the students' answers.

Table 5

The Percentage of the Feedback given to Students

Categories	PLC	LC	LP
	N (%)	N (%)	N (%)
Acknowledge	139 (28.3)	87 (41.6)	40 (20.0)
Follow up	242(49.2)	78 (37.3)	80 (40)
Compare	6(1.2)	5 (2.4)	3(1.5)
Adding to	77 (15.7)	33 (15.8)	54 (27.0)
Re-voicing	27(5.5)	6 (2.9)	20 (10.0)
Rephrasing	1 (0.2)	0 (0)	1 (0.5)
No response required	0 (0)	0 (0)	2 (0.1)
Total	492 (100)	209 (100)	200 (100)

From Table 5, the PLC predominantly uses follow-up (49.2%), acknowledgement (28.3%), and adding up to students' responses (15.7%). Similarly, the LC uses acknowledgement (41.6%), follows up (37.3%), and adds up (15.8%). The LP follows up (40.0%), adds up (27.0%), and acknowledges students' responses (20.0%). This implies that the teachers predominantly utilise similar feedback practices, namely: Follow-up, acknowledgement, and adding to, with the follow-up being the most prevalent.

Effective questioning that may lead to teacher-student dialogues was the motivation for the lesson by the LC. The lesson is full of follow-up, acknowledgement, and adding up to most of the responses from the students. The LC also allows an individual student and the whole class to respond to questions. This atmosphere presented in the LC lesson characterises dialogic teaching.

Teachers' Perceptions of Dialogic Teaching in Mathematics Classroom

After completing the lesson observation sequences in their respective schools, interviews were conducted with each teacher. This was to gain insights into the teachers' perceptions of

implementing dialogic teaching in mathematics instructions. The themes that emerged from teachers' perceptions covered the following: the importance of questioning techniques in dialogic teaching, dialogic teaching focusing on the students' centred learning, students' confidence by utilising dialogic teaching, and dialogic teaching not impeding the teachers and students' examination preparations. Generally, the three teachers report positive perceptions towards dialogic teaching. The teachers reported positive perceptions of questioning and saw it quintessential in ensuring dialogic teaching. They also perceive that dialogic teaching encourages child-centred learning and students' confidence and does not impede teachers and students' examination preparations. The excerpts from these themes presented below validate these findings:

Importance of Questioning Technique in Dialogic Teaching

Generally, the teachers perceived that questioning is key in dialogic teaching. According to the teachers, the different types of questions that they posed helped students participate more in class. To validate this finding, the PLC responded on the importance of questioning in dialogic teaching as follows:

> *For dialogic teaching, there should be three main things to note: the types of questions where the teachers shouldn't be too focused on close-ended and should be more open-ended to see how students respond to them. Then the second thing is how we pose questions in classes, where we'll try to move from asking it to the whole class and then try asking individually or, better, asking volunteers from students to answer but make sure that we give enough wait time before we call any students to answer. Thirdly, it will be on how to respond. How we respond to answers that students give. That is, we should acknowledge any answers that they have provided, and for good answers, maybe we can try to ask the students to explain to their friends and then teachers as well use the answers as prompters or guides to the next question that we want to ask and also, we can use the answers by praising students or rewarding and then avoid misconceptions we can re-explain what students give us and give the correct concept or from the misconceptions that they did.*
> (PLC)

The excerpt from the PLC depicts that effective questioning techniques in dialogic teaching help the students to talk, explain and share ideas. To the PLC, more open-ended questions should be asked in the mathematics classroom, and feedback should be provided to ensure a dialogic class. She confirms the types of questions used by the teacher, how the teacher asks the questions, and the feedback the teacher gives to the students' responses.

The LC also mentioned the importance of effective questioning techniques in dialogic teaching and commented as follows:

> *Ok, one of them is questioning techniques. So, how the teachers respond to the students' answers and also the type of answers the students give. How are we going to correct the students by rephrasing or re-voicing? The strategies on how the teachers question the students. Other than that, the questions can also be differentiated, so sometimes the challenging questions are for the high-ability, less challenging ones for the middle and low-ability students. So, basically, how the teachers question the students.* (LC)

The LC emphasise a unique mechanism apart from the questioning techniques. According to him, the need to differentiate the questions so that students from different abilities could participate in the lesson is relevant in dialogic teaching.

Dialogic Teaching Focusing on the Students' Centred Learning

The teachers perceive dialogic teaching as encouraging students' centred learning. In dialogic teaching, the focus is on the students' talk to construct the meaning of what they are learning. The teacher participants revealed that throughout their teaching, they observed that their students were able to talk, share their ideas and explain their ways of finding solutions. The following are the excerpts of the teachers' interview responses:

> *Dialogic teaching is one way of teaching that we involve all the students in their learning; make them share their ideas either with their peers or in groups.* (LP)
>
> *It changed from teacher-centred to student-centred. Students tend to give more opinions and ideas during the lesson. They are exposed to public speaking in terms of presenting their findings and methods. Most importantly, less teacher talk.* (LC)
>
> *Dialogic teaching encourages students to talk such that students should be doing more talking and explaining during the lesson, and in other words, it's more towards student-centred during the teaching and learning process.* (PLC)

The responses imply that the teachers have similar perceptions of dialogic teaching concerning its ability to encourage child-centred learning. The teachers perceive dialogic teaching as a platform for the students to be active in their learning, emphasising the students' contributions during the instructional process. Teachers become facilitators and effectively monitor students' learning. This indicates that the teachers generally have positive attitudes towards dialogic teaching.

Students' Confidence by Utilising Dialogic Teaching

The three teachers believed that dialogic teaching increases students' confidence and changes the way they participate in class. To validate this stance, the LP had this say:

> *In a way, it is good for the students as they can gain confidence in presenting their ideas.* (LP).

The PLC also commented similarly as follows:

> *After the use of dialogic teaching, students are more open to answering questions, and they are not afraid to volunteer. That is the one that clearly can be seen from my experience, and then they talk more during their activities.* (PLC)

The LC also shared the same view as follows:

> *From what I can see, the students tend to participate more. I've just taught them this year. At the beginning of the year, it was difficult for them to answer my questions and contribute their ideas. So, slowly I build them up. Now, I can see the difference from January until now. Now, they are braver in presenting their answers.* (LC)

Referring to the responses of the participants on students' confidence, the teachers perceive that dialogic teaching encourages them to create a student-friendly environment in which the students feel safe and at ease to share their thoughts, ideas, and opinions. This could be seen from the three teachers' classes during the observation. The students volunteered to share and explain their ideas. They gave reasons during their explanation and not just presenting the solutions to the mathematical problems. These observations confirm the teachers' reportage on the ability of dialogic teaching to encourage confidence in students.

Dialogic Teaching is not a Hindrance Examination Preparations

The participants did not see dialogic teaching as a hindrance in preparing students for external examinations. They commented that dialogic teaching helped promote the students' understanding of mathematical concepts as they prepared for examinations. The following is a comment made by the LC:

> *As a Year 6 teacher and an LC, it helps me to teach more concept-based teaching apart from chalk-and-talk. The students themselves find the methods on their own with a bit of guidance from the teacher, which is more to inquiry too. This helps the students to master the concept easily, and this allows them to improve their academic achievement, where they can think independently and creatively since they are already exposed to this approach.* (LC)

The LC perceives dialogic teaching as encouraging the students to learn and improve their achievement. According to him, dialogic teaching promotes inquiry-based learning, which makes the students independent in creating their methods or ways of solving mathematical problems.

The LP also reported as follows:

> *As a Year 6 teacher, dialogic teaching is also good, but towards the end of the Semester, it is good to have a small group with a balance of dialogic and drilling of past paper questions.* (LP)

According to the LP, there should be a balance between dialogic teaching and 'drilling' of past paper questions while students prepare for external examinations. This implies that in dialogic instructions, solving past practical questions should be added to instructions.

Discussions

Findings from the present study indicate that the teachers employed varied questioning techniques in their quest to ensure dialogic teaching. The results show that teachers use focusing questions, genuine enquiry, and closed testing in providing dialogic teaching. Roslan (2014) reported a similar finding indicating that teachers use different prompts for the students to give quality answers in the dialogic discourse. The kinds of questioning used are a positive move towards dialogic teaching, especially genuine enquiry questions. It allows students to explain how they get their solutions even though they can be incorrect. Teachers use it to assess the level of understanding of the students and can identify if there are any misconceptions or mistakes in the process. Genuine enquiry questions allow the students to construct their understanding by verbalising their thinking process (Vygotsky, 1978). This is corroborated by Alexander (2017), who advocated that in ensuring dialogic teaching, students should actively contribute their ideas and thinking to the whole class.

Even though closed testing was used as one of the top three frequently used types of questions, most teachers used it to recall multiplication and division facts at the start of the lesson. This implies that rote learning or recitation can occur in dialogic teaching, as it is unavoidable to ask the students these types of questions. The use of focusing questions as part of the predominant questioning techniques used by teachers is seen as scaffolding the students' learning and allowing them to understand their learning. This further confirms Alexander's (2017) assertion that discussions and dialogues are essential for students to succeed at their own pace in dialogic instructions. Students are, therefore, probed further through instructional

conversations to address their learning gaps, as exemplified in Vygotsky's (1978) Zone of Proximal Development (ZPD).

In this study, we found that the teachers also directed their questions to the whole class orally, the whole class physically, individual volunteers, and specific students or pairs or groups. Thus, teachers primarily emphasise instructional dialogues and classroom conversations that characterise dialogic teaching. Gillies (2020) found that science teachers' ability to use varied questioning in dialogic instructions exposes students to constructive discussions with peers to compare their findings on a task. Gillies' position has been reaffirmed among the students observed in the mathematics classrooms as their teachers employed dialogic instructions. It should be acknowledged that in asking questions using these approaches, there is the likelihood of targeting the higher-ability students to neglect low-achieving students. This notwithstanding, emphasises oral questioning and asking questions in pairs allows students to contribute and get their ideas across. This is particularly important in the mathematics classroom because students can participate in the teaching and learning process and will not remain passive throughout the lesson (CfBT, 2017).

The findings of this study also show that the teachers did not have the same pattern in giving feedback to the students. This can be explained based on their differences in concepts taught, teaching experiences, and their status in employing dialogic teaching. Irrespective of this, all the teachers used feedback practices such as acknowledgement, follow-up, and adding, with fellow-ups being the predominant feedback practices. This is a positive indication of dialogic teaching. For instance, acknowledging students' answers, whether correct or not, signals to the students that their contribution to learning matters. It motivates the students to try, even though their ideas or solutions are incorrect.

Most importantly, the students become active in contributing to the whole class discussion and strive to develop mathematical knowledge by themselves (Vygotsky, 1978). Throughout the observation, it was evident that students were active in mathematical instructions and were engaged in the classroom discourse, as teachers used varied questioning techniques and feedback to ensure dialogic mathematics instructions. This evidence supports that instructional dialogues provide teaching and learning responses in which students contribute to the classroom discourse (García-Carrión et al., 2020).

In contrast and as an improvement on Zakir's (2018) findings that children in Brunei are not used to an adult asking them for their perspectives, the use of dialogue teaching improved mathematical dialogues with their teachers. Further, the study findings move away from the passive learning portrayed in previous studies in mathematics classrooms (Hanafiah, 2008; Salam & Shahrill, 2014; Shahrill & Clarke, 2014). The three teachers unanimously believed that the most critical element in dialogic teaching is the questioning techniques, indicating that questioning is the tool that drives mathematics classrooms towards dialogic teaching. This corroborates research findings from previous studies that effective questioning techniques are essential for students to be active learners (Salam & Shahrill, 2014; Shahrill & Clarke, 2014; Shahrill, 2018, Marmin et al., 2021).

The teachers in this study portrayed a positive perception towards dialogic teaching, as they believed in its benefits. In addition, their students displayed more activeness and confidence to participate in the teaching and learning process. Consistent with previous studies, Ozbek and Uyumaz (2020), for instance, reported that dialogic instructions reduce students' anxiety in

mathematics classrooms. Teachers' quests to use effective questioning skills bring the students on board, and they are free to share mathematical experiences due to teacher-student collaborations. The teachers also believed that dialogic teaching is not a barrier in preparing students for external examinations as it supports and strengthens their conceptual understanding. We believe the teachers' positive perceptions are due to the extensive TPD programmes and in-house mentoring on dialogic teaching. This positive perception exhibited by mathematics teachers indicates that they are more likely to implement collaborative instructions in their mathematics classrooms. This will allow the students to challenge themselves to think mathematically and provide reasoning for their views (Bozkurt & Polat, 2017).

The study found that effective questioning techniques are fundamental in dialogic teaching in mathematics classrooms. Although the teachers played different roles regarding LNCP (PLC, LC, LP), they all ensured instructional dialogues through effective questioning skills and reported similar questioning strategies. With their respective positions, irrespective of the topics they taught, duration, and teaching experiences, all the teachers incorporated dialogic instructions in their mathematics classrooms. After the launch of the LNCP, this is the maiden study to investigate mathematics teachers' questioning techniques in ensuring dialogic teaching at primary school levels in Brunei. The following recommendations are made; firstly, although the study focused on whole-class interactions between the teachers and students, it emphasised teachers' questioning and perception in ensuring dialogic teaching. It will be beneficial to focus on students' talk to determine the *dialogic* of their talk in mathematics classrooms. Future researchers may want to focus on using audio recorders to record students' talk during their interactions with pairs or groups. It can provide insights into the mathematical thinking and reasoning that the students discuss while completing their tasks together. Secondly, investigating students' perceptions towards dialogic teaching may also shed light on its impact on their learning process. A simple questionnaire may be appropriate in this quest and improve the generalisation problems. Thirdly, as shown in this study, the three mathematics teachers covered different topics in mathematics. Future studies may want to conduct investigations on the same study variables but focus on various subjects to study the patterns (if any) of the different questioning techniques adopted by the teachers involved in TPD in dialogic teaching (other than the PLC, LC, and LP).

Conclusion

The types of questions used by the teachers are crucial in eliciting different student responses. The way the teachers addressed the questions and provided feedback to the students can be seen as encouraging and motivating them (students) to share their ideas, thinking, and solutions to a mathematical problem. With teachers' positive perception toward dialogic teaching, they will have the opportunity to explore its advantages. The findings imply that the ability to use questioning effectively leads to instructional dialogues, which has been confirmed in the primary school mathematics classrooms used in this study. This can impact the students' learning and teachers' teaching practices as it brings different opportunities for both the teachers and students to explore. The teachers can use higher-order thinking questions to develop students' critical and creative thinking abilities. The students would be allowed to be

active in the construction of their mathematical knowledge. The present study's findings reiterate the importance of the TPD programmes on dialogic teaching. This study informs the Ministry and policymakers on the successful implementation of dialogic teaching, especially in mathematics classrooms, although there is more room for improvement.

Recommendations

We recommend future studies exploring the challenges of using dialogic instructions in primary school mathematics classrooms. Lastly, the present study provides evidence that primary school mathematics teachers use effective questioning techniques in ensuring dialogic teaching and have positive perceptions of it. We recommend that the Ministry maintain its TPD on dialogic instructions. Irrespective of the subject of instruction, policies should be strengthened so that teachers adopt effective teaching practices other than questioning to ensure dialogic pedagogy.

Acknowledgements

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Appendix A

Descriptions of the Types of Questions with Examples

Types of questions	Sample questions
Closed testing	The question has only *one* answer or demands a *"Yes" or "No"* answer. This type of question is primarily used in the examination. For example: *Is 3×4 = 12?* Or what is *3×4?*
Guess what is in my mind	Only the '*guess what is in my mind*' answer is acceptable. Any other way to come up with the answer is not encouraged or promoted. It does not support dialogic teaching and learning.
Rhetorical	The teacher will ask a question where the answer is not necessary, or the teacher will answer her/his question. The focus is on the teacher rather than on the students. No response is desired or allowed.
Leading	Often leads the students to answer what the teacher is thinking in her/his mind. Does not encourage creativity, promote independent thinking or find an alternative way to solve a problem. For example, *equal fractions are called….*
Open testing	The question has more than one answer or more than one way to solve the problem. The answer to the question is given; the students are encouraged to write a question for the answer. For example, *I have 4 edges, what might I be?*
Focusing	The intention is to guide and or scaffold learning so that students can achieve some degree of success. For example: *Which column do I write the ten in? (Focus is on writing the tens in the correct Colum)*
Genuine enquiry	The teacher does not know what the student is thinking, or the teacher does not have the answer. It promotes lateral thinking and supports dialogic teaching and learning. This can often lead to HOT types of questions. For example: *How do you know?*
Statements	The statements are often written or discussed with the students to promote higher-order thinking and or making connections to prior learning or planning to a new unit. It can be used in the starter activity or the plenary as a way to consolidate or extend learning. For example, *all triangles have three sides. Discuss. Or A square is a quadrilateral. Discuss.*

Appendix B

Descriptions of How Targeted Teachers Ask Questions

Categories	Descriptions
Whole class (orally)	The teacher asks the whole class and is commonly used in a whole-class discussion.
Whole class (physically)	Students need to show their answers physically, such as using mini whiteboards, number cards, concrete materials, and body parts
Individual volunteers	The teacher asks for volunteers or the students voluntarily answer the questions.
Specific students/pair/group	The teacher targets specific students, pairs, or groups to answer the questions.
Not directed to anyone	Occurs when rhetorical questions are used which do not need students to answer.

Appendix C

Descriptions and Samples of Feedback

Types of feedbacks	Description	Sample
Acknowledge	The teacher gives encouraging words to the students even though their answers are wrong.	Good job, nice try, excellent, thank you
Follow up	The teacher shows interest in the students' answer and pursues another question to get them to rethink it through. It often involves genuine enquiry questions.	How did you get the answer? Can you tell us more? Why did you say so?
Compare	The teacher compares what is being said or done by two or more students. This can help the students to rethink or spot any mistakes that they could do.	What is the difference between your answers? Do you think your work matches our step to success?
Adding to	The teacher adds up some more information to the students' answers.	Student: The ratio is 4 to 5. Teacher: The ratio of the circles to the stars is 4 to 5.
Re-voicing	The teacher reiterates students' answers by correcting the terms/grammar used or translating it from Malay	Fifteen minus three or Take away three from fifteen '*Pasal di sini ada dua nombor*' (Because there are two numbers here).
Rephrasing	The teacher paraphrases the student's answers or asks other students to do it.	Can you tell us what she had said just now but in your own words?

Appendix D

The TPA+ Lesson Observation Support Document
(Adapted and modified from Literacy and Numeracy Coaching Programme Materials)

Question Types (QT)
Closed testing (C); Guess-what's-in-my-mind (GM); Rhetorical (R); Leading (L); Open testing (O); Focusing (F); Genuine-enquiry (GE); Statements (S)

QT	**What** questions do teachers ask?	**How** do teachers question students? Circle one	Student Response Type: Circle one	How do teachers **respond** to students' answers? Circle one
		Whole class orally Whole class-physically Individual volunteer(s) Specific student/pair/group	Short utterance Full sentence Discussion of ideas Comparison/ conjecture/ generalisation	Acknowledge Follow up Compare Adding to Re-voicing Rephrasing

		Whole class orally Whole class-physically Individual volunteer(s) Specific student/pair/group	Short utterance Full sentence Discussion of ideas Comparison/ conjecture/ generalisation	Acknowledge Compare Re-voicing	Follow up Adding to Rephrasing
		Whole class orally Whole class-physically Individual volunteer(s) Specific student/pair/group	Short utterance Full sentence Discussion of ideas Comparison/ conjecture/ generalisation	Acknowledge Compare Re-voicing	Follow up Adding to Rephrasing

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Appendix E

The **TPA+ Observation Tool** (Adapted and modified from Literacy and Numeracy Coaching Programme Materials)

TPA+ Observation Tool

School	
Teacher	
Observed No.	
Date observed		Class observed	

Q	Teaching Content Dialogically	Tick to record final judgements				
		5	4	3	2	1
1	What are the types of questions that the teacher asks?					
2	How do teachers question students?					
3	How do teachers respond to students' answers?					

Q1. Teach content dialogically: What types of questions do the teachers ask?

Question Types	Tally
Ineffective Questions (Guess-what's-in-my mind/Rhetorical/Leading)	
Testing Questions (Closed & Open)	
Focusing	
Genuine-enquiry:	
Statements:	

Q2. Teach content dialogically: <u>How</u> do teachers question students?

Mini Whiteboard etc. (show me)	Targeted Student	Individual Volunteer	Chorusing

Q3. Teach content dialogically: How do teachers <u>respond</u> to students' answers?

Acknowledge: *Yes. That's it. You got it. No, Good try. Not quite. Thank you.*	Follow Up: *How did you get that answer? Why do you think that? Can you tell us more about that?*
Compare: *Do you feel that supports or contrasts with what Zayden thought? Thank you, Elon. That takes us back to what Zayden said.*	**Adding to:** The teacher develops the students' responses by adding more detail/further information.
Re-voicing: The teacher repeats the student's answer & may correct grammatical/vocabulary errors that the student made.	**Rephrasing:** *Can you tell us what Elon just said and tell us a bit more about it in your own words?*