A preservice teacher's practice of orchestrating classroom discussion when teaching linear equations

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This study investigated a preservice secondary school teacher's practice of orchestrating classroom discussion when teaching linear equations. Data were generated using video lesson recordings of nine lessons and were analysed using thematic analysis. Themes were developed a-priori from the theoretical framework and a-posterior from the data. Findings show that the preservice teacher's capacity to orchestrate classroom discussion was influenced by his mathematical knowledge for teaching. In particular, the preservice teacher was able to anticipate what students would do mainly by focusing on the correct solution processes but did not plan for expected students' errors and misconceptions and how to respond to students' non-conventional approaches. In addition, the preservice teacher monitored students' work by listening, observing students' work, and by asking the students to explain their solution processes but was unable to keep track of students' approaches because of lack of analysis skills and questions that could elicit students' reasoning and arguments. The preservice teacher also selected certain students to solve problems on the chalkboard in order to find out if the students' knew the "correct" solution process of a particular problem. Furthermore, the preservice teacher attempted to draw connections between algorithms but did not draw connections between students' mathematical ideas and other students' ideas because he did not give students opportunities to present their work. Implications of these findings for mathematics teacher preparation are discussed.

Key words: *Orchestrating classroom discussion, mathematical knowledge for teaching, preservice teacher, secondary school, linear equations*

Introduction

The rationale for Mathematics Education is to develop students' problem solving abilities, innovative, logical thinking and analytical skills, to develop ability to recognise problems and to solve them relating to mathematics knowledge and to stimulate and encourage creativity, originality and curiosity in the students (Ministry of Education, Science and Technology, 2001; Sa'ad, Adamu & Sadiq, 2014). Algebra provides opportunities to achieve these goals because it is a language of Mathematics (Li, 2008). However, several studies report that secondary school students experience poor performance in Algebra (Mamba, 2011; Egodawatte, 2011; Sa'ad et al, 2014). Thus, in order to improve students' performance in Mathematics in general, the teacher should enhance profound understanding and acquisition of Algebraic concepts and thinking skills. It is, therefore, important to study preservice teachers so that we improve teacher education to prepare good teachers.

Leading discussion is one of the tasks and activities that are important for skillful beginning teachers to understand, take responsibility for, and be prepared to carry out in order to perform their instructional responsibilities (Ball & Forzani, 2009). These tasks and activities are called “high-leverage practices” (p. 504). High-leverage practices are tasks and activities that powerfully promote learning and are central to skillful teaching (Ball, 2016). In a group or class discussion, the teacher students work on specific content together, using one another’s ideas as resources. The purposes of a discussion are to build collective knowledge and capability in relation to specific instructional goals and to allow students to practice listening, speaking, and interpreting. The teacher and students contribute orally, listen actively, and respond to and learn from others’ contributions.

Recently, research studies have begun to show that teaching practices are influenced by Mathematical Knowledge for teaching (Sherman, 2016; Snider, 2016: Mosvold & Hoover, 2017). Mathematical Knowledge for Teaching (MKT) is “the mathematical knowledge needed to perform the recurrent tasks of teaching mathematics to students” (Ball, Thames, & Phelps, 2008, p. 399). MKT consists of six categories: Common Content Knowledge (CCK), Specialised Content Knowledge (SCK), Horizon Content Knowledge (HCK), Knowledge of Content and Teaching (KCT), Knowledge of Content and Students (KCS), and Knowledge of Content and the Curriculum (Ball, et al., 2008). Literature also shows that a lot of research has been carried out on teachers’ MKT (Ball et al., 2008; Hill & Ball, 2009; Huang, 2012). However, research reports about the contribution of preservice secondary school teachers’ MKT on teaching practice are very scanty. For instance, review of research on MKT by Mosvold and Hoover (2017) found only one study on preservice teachers that focused on the influence of MKT on teaching practice. In addition, Sherman (2016) studied preservice elementary teachers’ early practice of eliciting and responding to students’ mathematical thinking. To this effect, the study reported in this paper was aimed at investigating how a preservice secondary school teacher enacted the practice of orchestrating classroom discussion.

Study context

Malawi is one of the countries which are experiencing challenges in the education system. Secondary school students’ performance in national examinations continues to be poor with only around 50 percent of students passing end-of-cycle examinations (Ministry of Education, 2008). Analyses of national examinations chief examiners’ reports for years 2008 to 2013 also indicate students’ poor performance in algebra in general and equations in particular. While explanations are available concerning system failure, (Ministry of Education, 2008), teacher knowledge and enactment of teaching practice are also vital in the development of students’ conceptual understanding.

In Malawi, learner centred approaches are advocated by both preservice and inservice teacher training programmes. The approaches mostly used in Mathematics classrooms include whole-class and group discussion, pair work, question and answer and explanation. Literature shows that Malawian teachers, both preservice and inservice, display challenges in the ways they use whole-class and group discussion when teaching Mathematics (Mamba, 2011). It is for this reason that the current study was conducted.

This study examined the following research questions: 1. How does a Malawian preservice secondary school teacher orchestrate classroom discussion when teaching linear equations?; 2. How does the preservice teacher’s MKT influence his ability to conduct classroom discussion when teaching linear equations? Linear equations were chosen because many students in Malawi find this a difficult topic to grasp. (Malawi National Examinations Board, 2013). The results from this study could inform preservice teacher educators about the content of Mathematics teacher preparation.

Theoretical framework

Stein, Engle, Smith, and Hughes (2008) developed a framework that consists of five practices for orchestrating classroom discussion including anticipating, monitoring, selecting, sequencing and connecting. These practices give teachers a roadmap they can follow before and during mathematics lessons to orchestrate discussions responsive to both students and the mathematics.

Anticipating: In their framework, Stein et al. (2008) assert that a teacher should begin with anticipating what and how students will solve the problems in the classroom. The authors advise teachers to solve the problems and find out what students are likely to produce. Anticipating also involves finding out which problems will most likely be the most useful in addressing the Mathematics. Anticipating requires that teachers solve the problem in as many ways as they can. Smith and Stein (2011) explain that "anticipating students' responses involves developing considered expectations about how students might mathematically interpret a problem, the array of strategies – both correct and incorrect − that they might use to tackle it, and how those strategies and interpretations might relate to the mathematical concepts, representations, procedures, and practices that the teacher would like his or her students to learn" (p. 8).

Monitoring: Monitoring students' responses involves paying close attention to students' mathematical thinking and solution strategies as they work on the task (Stein et al., 2008). Teachers generally do this by circulating around the classroom while students work either individually or in small groups. Carefully attending to what students do as they work makes it possible for teachers to use their observations to decide what and whom to focus on during the discussion that follows (Lampert 2001; Smith & Stein, 2011). Teachers need to listen, observe and identify key strategies that students use to solve the problems while students work on the tasks. Monitoring also involves more than just watching and listening to students. During this time, the teacher should also ask questions that will make students' thinking visible, help students clarify their thinking, ensure that members of the group are all engaged in the activity, and press students to consider aspects of the task to which they need to attend (Smith & Stein, 2011).

Selecting: Having monitored the available students' strategies during the lesson, the teacher can then select particular students to share their work with the rest of the class to get specific Mathematics into the open for examination, thus giving the teacher more control over the discussion (Lampert 2001). The selection of particular students and their solutions is guided by the mathematical goal for the lesson and the teacher's assessment of how each discussion will contribute to that goal. Thus, the teacher selects certain students to present because of the Mathematics in their responses. The relevant and key features of the problem solution strategies need to be noted. According to Stain et al. (2008), teachers are supposed to purposefully select those that will advance mathematical ideas. These need to be highlighted to make problem solving strategies transparent for the students.

Sequencing: Having selected particular students to present, the teacher can then make decisions regarding how to sequence the students' presentations. By making purposeful choices about the order in which students' work is shared, teachers can maximise the chances of achieving their mathematical goals for the discussion (Stein et al., 2008). They need to think about the order they want to present the student work samples. They need to decide where to present the most common or to present misconceptions first. The teacher might want to have misconceptions addressed first so that the class can clear up that misunderstanding to be able to work on developing more successful ways of tackling the problem (Smith & Stein, 2011). They also need to decide how students will share their work on the chalkboard.

Connecting: Finally, Stein et al. (2008) assert that the teacher helps students to draw connections among their solutions, other students' solutions and the key mathematical ideas of the lesson. The teacher can help students to make judgments about the consequences of different approaches for the range of problems that can be solved, one's likely accuracy and efficiency in solving them, and the kinds of mathematical patterns that can be most easily discerned. Rather than having mathematical discussions consist of separate presentations of different ways to solve a particular problem, the goal is to have students' presentations build on one another to develop powerful mathematical ideas. They need to craft questions to make the Mathematics visible to students. They need to compare contrast 2 or 3 students' work to find out the mathematical relationships in the solution processes and find the connection between the students' work and the original problem (Smith & Stein, 2011).

Research method

This was a qualitative descriptive case study involving one preservice secondary school mathematics teacher named Yani (pseudonym). Yani was in his final year of study at the time the data was being generated. He had taught in primary schools for seventeen years before joining the secondary school teacher education programme. I thought the participant who served as a primary school teacher for that long was the best participant to choose because he was an "information-rich" case for in-depth study (Yin, 2014). I generated data using video lesson recordings of nine lessons and nine lesson plans. Using video allowed me to record the events thoroughly. It also allowed me to look at the episodes multiple times for further analysis (Girden & Kabacoff, 2011). Before beginning the data generation, I asked for permission from the principal of the concerned college, the school head teacher and the mathematics teacher of the concerned class.

I analysed the data using thematic analysis (Ritche & Lewis, 2003). Firstly, I transcribed the video recordings in whole. Then, I analysed transcripts of selected episodes. I chose the particular episodes because they contained events that best showcased or illustrated Yani's ways of orchestrating classroom discussion. (Goldman, et al., 2007). I developed themes both *a-priori* from the theoretical framework and *a-posteriori* from the data (Powell, Francisco, & Maher, 2003). To achieve credibility of the results, another researcher analysed the data. In all cases we got at least 90% agreement, with no discussion between the researchers. Furthermore, the findings were read and critiqued by other researchers (Yin, 2014).

Findings

The presentation of the findings begins with summaries of the extracts from lesson plans and the video lesson transcripts for lessons 1, 2 and 4 and discussion follows.

Lesson summary

Lesson 1

Objectives: Students should be able to a) define equation; b) distinguish between equation and expression; c) solve linear equations in simple form.

Examples: a) identifying variables, coefficients and constants in the expression $4p+4q+3r+6$; b) comparing the expression $4x+4$ and the equation $4x+4=20$; c) formulating the equation $4+x=10$ from a word problem; d) solving the formulated equation; and e) solving the equations $16+x=25$, $x+9=23$, $19=10+3x$, $47=10h-33$ and $14-x=8$.

Exercise: Solve $3+8p=51$, $0+8d=56$ and $32=6+3k$.

Episode 1

Yani wrote $4x+4$ on the chalkboard and asked students to name it. Some students explained that it is an expression. The Yani wrote $4x+4=20$ and asked the students to explain what it was. Some students again said that it is an equation. Finally, Yani explained that an expression is a mathematical statement while an equation is a mathematical statement with an equal sign. Yani gave students an exercise presented in Figure 1. He asked the students to name an expression or equation.

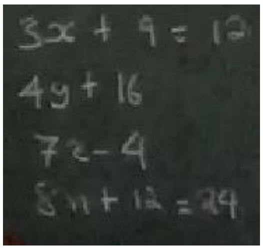


Figure 1: Students' exercise

Lesson 2:

Objectives**:** Students should be able to a) find the solutions to equations involving algebraic fractions; b) solve equations involving brackets and 3) solve equations using balance method.
Examples: a) Solve equations $19=10+3x$, $14-x=8$ in pairs, $3=\frac{24}{x}$ and $\frac{9}{x}=4$ involving fractions in pairs; b) solving equations involving parentheses like $4d+(5-d)=17$, $\frac{5-6}{3}=\frac{c-4}{2}+6$, $5(3c+4)-3(4c+7)=0$ and $\frac{3(2x+3)}{5}=2(3x-2)+4$.

Episode 2

During the second lesson, Yani wrote the equation $3=\frac{24}{x}$ on the chalkboard and asked the students to differentiate between the equation $3+8p=51$ and $3=\frac{24}{x}$. Maria answered by explaining that the equation $3=\frac{24}{x}$ has a fraction while the $3+8p=51$ is non-fractional. Then Yani asked the students how they would solve the equation involving a fraction. He gave an example of $\frac{1}{2}+\frac{3}{4}$ and asked questions.

Yani: Is this equation (meaning $3=\frac{24}{x}$) similar to this one (meaning $3-8p=51$)?

Students: No

Yani: What is the difference?

Student: Arrangement of numbers, $3=\frac{24}{x}$ has a fraction while $3-8p=51$ does not have a fraction.

Yani: That's right, here we don't have any fraction it is a simple straight line equation now do we know the value of x?

Students: Noooo!…,

Yani: How can we come up with the value of x? In the first place, let's look at the x, and 3. Remember we are doing with fractions, what do we do to find the value of something, let's say we have $\frac{1}{2}+\frac{3}{4}$, how do we solve this one?

Pemphero volunteered to simplify the expression and his solution process is presented in Figure 2.

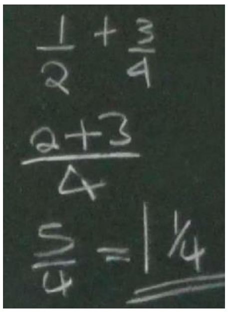


Figure 2: Pemphero's solution processes to $\frac{1}{2}+\frac{3}{4}$

After Pemphero had simplified the expression, Yani asked her to explain how he arrived at the answer.

Yani: How did you arrive at the answer?

Pemphero: I found the common denominator 4, then, I divided 2 into 4 to get 2. I multiplied 2 by 1 and got 2. Then I divided 4 into 4 to get 1. I multiplied 1 by 3 to obtain 3. Then, I added the 2 that I got previously and the 3. So we have $\frac{2+3}{4}=\frac{5}{4}$. Four divided into 5 gives 1and remainder $\frac{1}{4}$.

Yani: As she has clearly put it, she had at first to find the common denominator. Now, let's try to apply the same thinking in this problem over here (meaning $3=\frac{24}{x}$). Can someone solve this?

Madalitso volunteered and she solved it as presented in Figure 3.

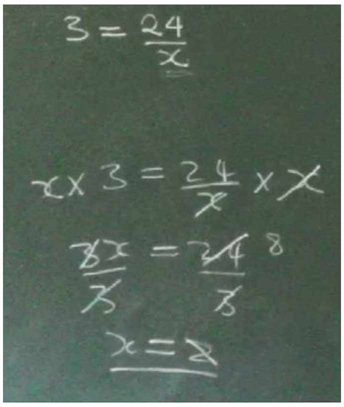


Figure 3: Madalitso's solution processes to $3 = \frac{24}{x}$

Since Madalitso solved the equation without explaining the procedure, Yani asked her to explain how she solved it and the conversation continued.

Yani: Can you now explain to us?

Madalitso: I multiplied the variable on both sides, then I cancelled it with the x below. Then I multiplied x and 3 on the left so I got $3x = 24$, I divided both sides by 3 to get $x = 8$.

Yani: Why did you multiply by x on both sides?

Madalitso: Because it's a variable.

Yani: No. It is because we want to find the value of x, and we multiply here by x and here by x.

Episode 3

In lesson 2, Yani gave the students the equation $4d + (5 - d) = 17$ to solve in groups. After the group work, some students presented their work. In solution process A (Figure 4) the student conjoined $2d$ and 5 on the left side and introduced d on the right side of the equation. After that, he ignored the d that he introduced to the right side. Thus he later had $9d = 17$. He divided by 9 on both sides and arrived at $d = 1\frac{8}{9}$. After this step, the student seemed to be doing something unrelated to the equation.

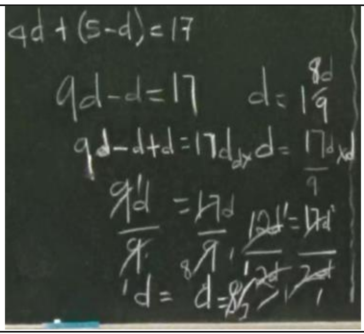
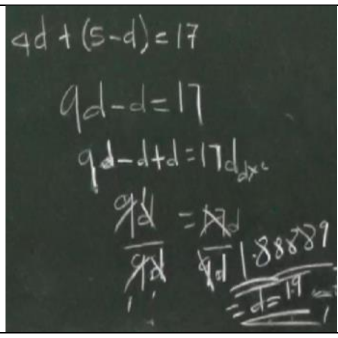
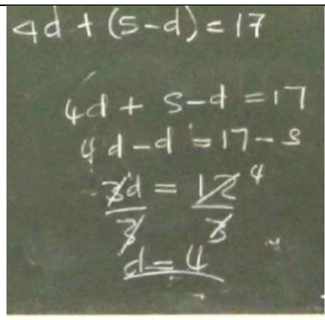
A	**B**	**C**
		

Figure 4: Students' solution processes to the equation $4d + 5 - d = 17$

The student in solution process B of Figure 3 seemed to follow the student in solution process A. So he erased the last part of his colleague's work and from $9d=17$, the second student came up with $d=1.888889$ which he rounded to $d=1.9$. Both the first and the second student exhibited the conjoining error. Despite these errors, Yani paid attention to the third solution process probably because the student produced a correct answer. He repeated the solution process and emphasised on coefficient.

Yani: This is correct (meaning solution C). So remember here, we have brackets. Now, outside the brackets we have a coefficient that requires multiplying by what is inside the brackets. Now, what coefficient do we have here?

Students: One.

Yani: Yes one. So we remove the brackets and come to the second step. Thereafter, you group like terms and you have $3d$ equal to 12 after adding and subtracting. Dividing by 3 on both sides gives $d=4$.

Lesson 4

Objectives: Students should be able to a) formulate equations from verbal representations and b) solve the equations so formed.
Examples: a) Changing subject of formula; b) translating $x+10=24$ and $2(x+12)=42$ to verbal representations by selected students and then others translating the verbal representations back to the equations; c) translating the word problem *If length of a rectangle is three times the width and the sum is 56 cm, what is the length and width of the rectangle?* into an equation.

Exercise: a) Solve the equations $2x+17=59$; b) Formulate an equation from the word problem *If Geoffrey has g marbles and Olivia has 7 less than those of Geoffrey, how many does Olivia have?;* c) solving the formulated equation $g+g-7=29$.

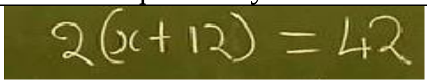
Episode 4

In this episode from Lesson 4, Yani had students verbalise algebraic relationships and then other students came up with equations from the verbal representations. He asked students to verbalise the problem where S1 means student 1, S2 means students 2 and so forth.

S1: I am x.
S2: I am 12 added to x.
S3: I am twice the sum of x and 12.
S4: I am 42, the result.

Yani helped the students to formulate an equation using the information. However, when a student (S5) came up with the equation $2(x+12)=42$, Yani disagreed and came up with $x+12+2(x+12)=42$ which was incorrect. The equations so formed are presented in Figure 2.

Equation by S5	Equation by Yani



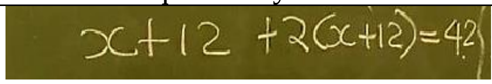
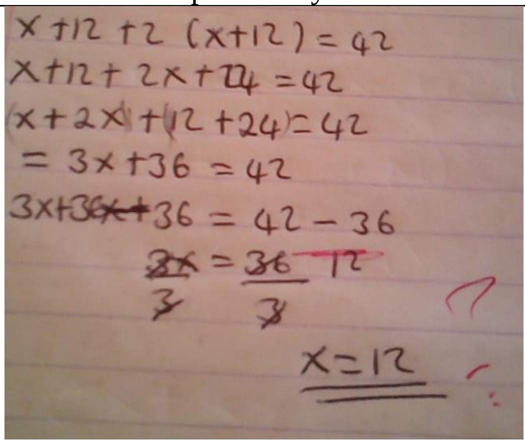


Figure 5: Yani's symbolic representation of a verbal problem

After he formulated the "equation" in Figure 4, Yani asked the students to solve for x. Then he went from one student to another to mark the written work. Two of the students' solutions are presented in Figure 5.

Solution process by student 6	Solution process by student 7



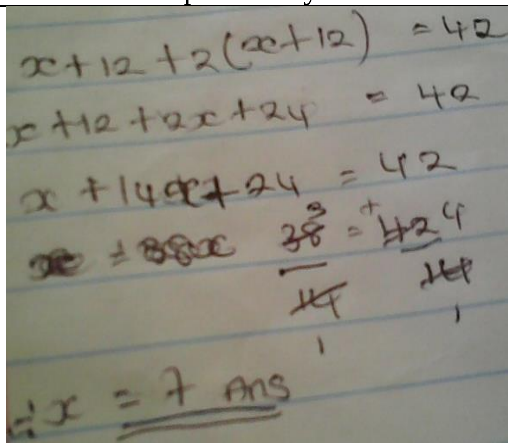


Figure 6: Students' solution processes for Yani's incorrect equation

Discussion

Setting Goals

Specifying the lesson goal is a critical starting point for planning and teaching a lesson (Smith &Stein, 2011). It is an a priori practice and must occur before enacting the five practices. For this reason, data analysis also involved setting goals and selecting tasks. The summaries for the lesson plans of three lessons, the lesson goals were mostly general; for example, Yani wrote, "by the end of the lesson, students should be able to formulate and solve linear equations". While "formulating and solving linear equations" is a reasonable expectation for the preservice teachers, it provides no detail on what students will understand about solving linear equations. Without explicit learning goals, it is difficult to know what counts as evidence of students' learning. Yani seemed to lack knowledge of the difference between arithmetic equations ($ax+b=c$) and algebraic equations ($ax+b=cx+d$) as well as the challenges students face when solving algebraic equations and this prevented him from setting explicit learning goals. Thus the limitations in CCK, SCK and KCS might have influenced Yani's limitations in setting explicit lesson goals.

Selecting Examples

Examples are a particular case of a larger class, from which students can reason and generalise (Watson & Mason's, 2002). Analysis of the examples involved whether they were appropriate for the lesson goals and in order of complexity. Findings show that some the examples were appropriate and in order of complexity. However the examples were mostly arithmetic such that $\frac{3(2x+3)}{5} = 2(3x-2)+4$ was the only algebraic equation which he selected in Lesson 2. Moreover, Yani's choice of examples was harphazard. For example in Lesson 2, he gave the students $4d+(5-d)=17$ and $\frac{5-6}{3} = \frac{c-4}{2}+6$ to solve one after another. Although these examples are in order of complexity, the skills and prior knowledge to be used to solve these two equations are different. This would lead to confusions among the students keeping in mind that they are a younger group of students aged between 12 and 15 whose cognition may not be as flexible as the problems would require. In Lesson 1, Yani selected examples that could help students translate word problems into equations but he had no objective for these examples. Furthermore, Yani over-planned the examples for every lesson such that, he failed to complete the planned work. These challenges might be influenced by Yani's limitations in knowledge of types of linear equations, (CCK), lack of clarity of lesson goals (SCK) and that he was not familiar with challenges students might face when solving the equations (KCS). Over-planning might also have influenced the limitations in the enactment of classroom discussion indicating limitations in KCT.

Anticipating

Three themes regarding anticipating were developed from the theoretical framework; anticipating what students will do, planning how to respond to student approaches and identifying responses that address mathematical goals. Findings reveal that Yani solved the problems before taking them to class. However, he neither anticipated students' errors and misconceptions nor problems which would most likely be the most useful in addressing the mathematics he was teaching. On his lesson plans, Yani produced correct solution processes that he expected his students to produce during class discussion and individual exercises. This could be a result of three problems. Firstly, it could be that Yani did not have enough knowledge of students' errors and misconceptions in the topic and this indicates limitations in his KCS. Secondly, it could be that Yani valued correct responses and solution processes more than the incorrect ones. Thirdly, it could be that Yani did not understand the value of anticipating students' thinking. The results suggest that MKT leads to effective lesson planning. Morris, Hiebert & Spitzer (2009) also provide clear research evidence that demonstrates the importance of teacher knowledge in the planning and the teaching of classroom Mathematics.

Monitoring

The results show that Yani monitored by listening, observing individual, group and pair work, and by asking the students to explain their solution processes. Episode 2 illustrates Yani's questioning to give students opportunities to explain. The questions that Yani asked include probing questions, leading questions and questions requiring “yes” or “no” answers. Probing questions are those that seek explanations from the students. They are aimed at checking whether correct answers are supported by correct reasoning. Leading questions potentially give students hints or guide the students in problem solving.

The results also show that Yani asked the probing questions such as “why”, “how” and “explain”. For instance in Episode 2 after Pemphero and Madalitso had presented their solution processes on the chalkboard, Yani asked them to explain their solutions. Both Pemphero and Madalitso explained the “how” of their solution processes. In the final sentence of Episode 2, Yani's explanation of the reason of multiplying by x on both sides of the equation $3=\frac{24}{x}$ shows that he lacked the knowledge of the "why" himself. The results also show that he also asked low order questions some of which required "yes" or "no" answers. The low order questions and lack of knowledge of the "why" of equation solving prevented Yani from eliciting students' ideas and higher order thinking.

Secondly, although Yani monitored students' progress by listening, observing and questioning, the results reveal his inability to keep track of students' approaches. For instance, in Episode 4, Yani asked students to solve the incorrect equation $x+12+2(x+12)=42$. In Figure 6, the question mark indicates that Yani was not sure of the exact difficulty for the student. He did not consider the students' samples worth discussing. He did not realise that student 6 made a computational mistake when subtracting 36 from 42 while student 7 committed a conjoining error. Student 7 added 12 and $2x$ to come up with $14x$. Infact, when solving the equation, student 7 combined 12 and $2x$ in $12+2x$ to come up with $14x$ because of inability to accept the lack of closure. Inability to accept the lack of closure is students' difficulty in holding unevaluated operations in suspension (Chalouh & Herscovics, 1988). Students perceive expressions as incomplete statements and they are unable to hold unevaluated operations as solutions to algebraic problems. This leads to the conjoining error whereby students use the notation for algebraic product for the algebraic sum (Stacey & MacGregor, 1994). Yani might not have called for discussion of these samples probably because he lacked knowledge of students' errors and misconceptions, inability to analyse students' solution processes and that he lacked "why" questions. The limitations in designing and framing questions that provoke students' talk might have resulted from Yani's inability to plan questions during the planning stage. This highlights the fact that, in order to listen to, analyse and understand students' thinking, teachers need CCK, SCK, KCS and KCT.

Selecting

The findings show that Yani selected particular students to present their mathematical work during the whole-class discussion. He selected specific students at the beginning of the discussion to present their work as the discussion proceeded. His typical way to accomplish "selection" was to write the problem on the chalkboard and then selected volunteers to solve the problem one after another. If the first student failed, he called other volunteers until one of the students produced a correct solution process. If the first student solved the problem correctly, he continued with another problem. This is illustrated in Episode 3 but Yani did not ask the students questions to explain their reasoning nor did he ask the other students any question regarding the three solution processes indicating limitations in SCK and KCS. Asking the students to explain their solution processes would help reveal their thinking and hence find ways of developing their thinking. Alternatively, Yani would let students solve the problem individually or in groups and then select those individuals or groups with particularly useful ideas to share with the class.

Sequencing

The findings show that since Yani selected the students to solve the problems on the chalkboard anyhow, there was no students' work that he could sequence for presentation. The students were trying to solve the problems right on the chalkboard. The findings suggest that the students would benefit more if Yani gave them the problems to solve either individually or in groups and then having those students or groups with particular ideas present their work on the chalkboard. By making purposeful choices about the order in which to share students' work Yani could have maximised the chances of achieving his mathematical goals for the discussions. During planning Yani needed to consider possible ways of sequencing anticipated responses to highlight the mathematical ideas that were key to the lesson. Unanticipated responses could then be fitted into the sequence as he made final decisions about what was going to be presented.

Connecting

The findings also reveal that Yani helped the students to draw connections between concepts such as "expression" and "equation". In Episode1, he focused on differentiating between expression and equation because he said "students confuse between the two". Thus he helped the students to draw connections between key mathematical ideas in the lesson. Episode 2 illustrates Yani's ability to help students connect fractional and non-fractional linear equations in which a student explained that $3=\frac{24}{x}$ is a fractional linear equation while $3-8p=51$ is non-fractional. On the contrary, Yani encouraged students to apply ideas used to simplify the expression $\frac{1}{2}+\frac{3}{4}$ when solving the equation $3=\frac{24}{x}$ yet their algebraic structures are different and thus operations in the solution process for $\frac{1}{2}+\frac{3}{4}$ are different from the operations in the solution process for $3=\frac{24}{x}$. In this regard, Yani regarded an expression as an equation. This reveals that Yani had limitations in his example space for illustrating fractional equations. An example space is a collection of examples to which an individual has access at any moment, and the richness of interconnections between those examples (Watson & Mason, 2005). It might also be inferred that Yani lacked structure sense of linear expressions and equations indicating limitations to choose an example for a particular purpose which is part of KCT. Structure sense ((*surface structure, systemic structure and structure of an equation*) is the knowledge of the arrangement of terms and operations in an expression or an equation (see Mamba, 2011). Structure sense cannot be ignored and has to be recognised and used if algebraic problems are to be solved successfully (Herscovics and Linchevski, 1994).

Conclusion

In this study, Yani's ability to orchestrate classroom Mathematics discussion was investigated. The findings show that the case of Yani illustrates the need for guidance in shaping classroom discussions and maximising preservice teachers' potential to extend students' thinking and connect it to important mathematical concepts. For instance, he was able to anticipate what students would do mainly by focusing on the correct solution processes but did not plan for expected students' errors and misconceptions and how to respond to students' non-conventional approaches. The results also reveal that Yani selected particular students to share their work with the rest of the class. The selection was guided by the mathematical goal for the lesson. However, the selection of particular students was not based on their solutions because he selected the students before they solved the problems in their notebooks. He selected certain students to present in order to find out if the students' knew the "correct" solution process of a particular problem. The findings also show that Yani attempted to draw connections between algorithms but did not draw connections between students' mathematical ideas and other students' ideas because students' solution processes were not presented during the discussion. These findings confirm the finding that a key challenge mathematics teachers face in enacting current reforms is to orchestrate whole-class discussions that use students' responses to instructional tasks in ways that advance the mathematical learning of the whole class (Lampert, 2001).

These findings inform teacher educators about the content of Mathematics teacher preparation. The findings suggest that detailed anticipations though challenging are important to foster argumentation in the Mathematics classroom. In addition the findings suggest that teacher educators should help preservice teachers to analyse students' solution processes and ask questions during monitoring in order to sample students' work for presentations. Furthermore, the finding suggest that selecting and sequencing students' solutions are aimed at making connections between algorithms as well as between different solution processes and students' ideas. As such, teacher education programmes in Malawi would benefit more from guiding preservice teachers in anticipating, monitoring, selecting and sequencing students' solution processes for presentation and discussion. The findings also suggest that it is imperative to improve preservice teachers' MKT in order to improve their ability to orchestrate classroom discussion.

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