Challenges and Effects of Dialogue and Argumentation in Teaching Ordinary Level Mathematics in Zimbabwe

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Abstract

The purpose of the study was to examine the effect of challenges that affect the teaching of ordinary level mathematics using dialogue and argumentation approach in the mathematics classrooms in Zimbabwe. A descriptive survey was the method employed for the research. The subjects of this study consisted of approximately 100 Ordinary level Mathematics teachers and ten Mathematics Head of Departments selected from 72 public high schools in Gutu district of Masvingo province in Zimbabwe. Purposive sampling was used for selecting ten participating Mathematics Head of Departments for qualitative data. Random sampling was used for selecting samples of teachers for quantitative research. Quantitative data analysis was done using two statistical metrics namely the mean and the standard deviation while qualitative data was analysed by thematic analysis. The empirical findings of the study indicated that challenges such as class size, planning, attitudes, heterogeneity, lack of confidence, and lack of proficiency among challenges that have a significant but negative influence on the application of dialogue and argumentation in the teaching of Ordinary level mathematics. The main study limitation was that the results may not be transferable nationally since the study was limited to schools in the Gutu district of Masvingo province in Zimbabwe. These results have implications on the need for mathematics teachers to receive training on how to plan and implement the dialogue and argumentation teaching approach in the mathematics classrooms.

Keywords: dialogue and argumentation, Challenges, class size, heterogeneity, mathematical language, time.

Introduction

Mathematics teachers are faced with a challenging situation due to changes in ways of teaching the subject. The paradigm shifts to a heutagogical approach, which shifts the focus from teachers to learners, is cumbersome (Lehesvuori et al., 2018). Thus, changes in classroom practices are often associated with demanding challenges and dilemmas for the teachers who venture into new pedagogical territory. Teacher face challenges during the implementation of dialogue and argumentation teaching strategies in the mathematics. Mathematical problem solving abilities as allowed for through dialogue and argumentation of students are still low (Makamure, 2018).

In Zimbabwe, no matter how crucial mathematics is, there has been a growing national concern about the level of student’s achievement in ordinary level mathematics (Makamure, 2018). Although the Zimbabwe’s Ministry of Primary and Secondary Education (MoPSE) blueprint, 2016-2022, had been put in place to address the situation, the majority of students have not attained the minimum required competencies expected in the curriculum as confirmed by the Zimbabwe School Examination Council (ZIMSEC) Ordinary level (‘O’ level) mathematics results statistics that showed that the national percentage pass rates of mathematics never exceeded 25 percent since 2015 (ZIMSEC, 2021).

Studies by Almomani and Atou (2018), Alrabi (2018), Attard and Edwards-Groves (2018) and Makamure (2018) have also shown that students encounter many problems in their learning of mathematics. These learning problems mostly stem from the challenges teachers encounter when implementing instructional method in the mathematics classroom (Siew, 2018). Teachers are prime resources for realizing the goal of implementing dialogue and argumentation approach in the mathematics classroom. However, this has been hampered by various challenges affecting the teaching of ordinary level mathematics using dialogue and argumentation approach in the mathematics classroom. Lehesvuori et al. (2018) argues that implementing dialogue and argumentation in the mathematics classroom is declared challenging. Balancing between authoritative and dialogic interaction is a major challenge (Lehesvuori et al., 2018). Thus, addressing challenges in teaching is critical for teachers to be effective in their pedagogical practice. Therefore, this study sought to fill the gap by investigating the effect of the challenges that affect the teaching of ordinary level mathematics using dialogue and argumentation approach in the mathematics classroom. The following objective serves as the compass of the study: Identify the effect of the challenges that affect the teaching of ‘O’ level mathematics using dialogue and argumentation in mathematics classes.

Literature Review

This section discusses the impact of challenges teachers face in implementing dialogue and argumentation in mathematics classrooms. Bersch (2019) claims that teachers faced obstacles in adopting argumentation due to their students' language issues, particularly in expressing their reasoning in writing. Language-related issues in education pertain to students encountering difficulties with vocabulary, expressions, articulating ideas, and providing justifications (Bersch, 2019). These issues might lead to students developing a strong dislike for the argumentation approach, which in turn creates difficulties when trying to adopt the argumentation-teaching strategy in mathematics classes.
A study by Bersch (2019) also shows that teachers encounter difficulties while addressing the heterogeneity of their students. Heterogeneity concerns refer to challenges that develop due to variations in students’ performance levels (Bersch, 2019). Bersch (2019) found that teachers perceive low-achieving students to encounter significant difficulties with mathematical argumentation tasks, while high-achieving students perceive similar tasks as a distinctive challenge. As a result, teachers find it challenging to handle the vast range and generally opt against employing rationalization exercises in the classroom (Bersch, 2019).

A study by Dimo et al (2021) on the challenges faced by the teachers in using dialogic approaches in the mathematics classes in Kenya established that the majority of the respondents stated that large class sizes affected the use of dialogic approach in the mathematics classroom. It is challenging to have productive dialogue between the teacher and the large number of students in the classroom, as well as between the students individually and as a group.

According to Bersch (2019), the needs of the centrally administered final examinations and the limited amount of time allotted for teaching are the external factors that give teachers the most difficulty when implementing the dialogue and argumentation teaching technique in the mathematics classroom. Teachers find it difficult to work with arguments and proofs in the real world of a classroom (Lekaus, 2019). Lekaus (2019) claims that teachers were worried about the erratic nature of students' contributions and the mathematics material. This made it difficult to keep track of the contributions made by the students and forced them to work against time limits and curriculum requirements, which made it harder for them to offer specialized student support.

Similarly, a study by Dimo et al. (2021) found that another difficulty in implementing dialogue and argumentation teaching strategies in mathematics classes was the short amount of time allotted for the course. According to Dimo et al. (2021), the amount of content that needs to be taught in the permitted time makes it difficult for teachers to implement the dialogue and argumentation approach in mathematics classrooms. The dialogue and argumentation technique takes longer since it involves providing an opportunity for another student to offer their perspective on a mathematical problem (Dimo et al., 2021). As a result, teachers therefore find it difficult to incorporate dialogue and argumentation in their mathematics classrooms.

According to Larson (2015), implementing dialogue and argumentation in mathematics classes can be difficult when trying to strike a balance between engagement and mathematical content. Larson (2015) asserts that the teacher is responsible for facilitating class discussion of key mathematical ideas. To ensure student authority, the teacher should also ensure that the conversation is based on the opinions of the students (Larson, 2015). As a result, teachers must keep responding to the material and the students. In order to teach so that the primary mathematical concepts are portrayed in ways that are compatible with both the mathematical content and the thinking of the students, Larson (2015) contends that it is imperative to provide meaningful questions. This is, as well, challenging to the teachers. To challenge students' thinking, the questions should provide a connection between their ideas and the key mathematical principles.

A study by Larson (2015) found that in order to elicit and use students' thinking as the lesson's focal point, teachers need to have a thorough awareness of both good and erroneous common solution methodologies. Placing students' thinking at the centre
of the class involves establishing connections between the primary mathematical ideas and the responses they evoked from them, generalizing from those connections, and supporting those connections with mathematical reasoning.

In support, Bragg et al. (2017) assert that teachers need to have a solid understanding of the content they are teaching in order to teach it successfully. Therefore, teachers need to be aware of the nuances of mathematical argumentation in order to assist students in developing their arguments. According to Bragg et al. (2018), if teachers are aware of the advantages of using mathematical reasoning in the classroom, they are more inclined to include it into their teachings. Thus, implementing dialogue and argumentation in mathematics classrooms is hampered by students' lack of skill and trust in the teaching methodologies.

According to Larson (2015), it might be challenging to facilitate a fruitful mathematics conversation in the classroom. Teachers need to attend to the requirements of each individual student as well as the needs of the class as a whole when conducting a whole-class mathematics dialogue and argumentation (Larson, 2015). According to Larson (2015), one significant issue is that when a class heavily relies on students' reasoning and thinking rather than practiced methods, the teacher has less control over the content. In a similar vein, Asterhan et al. (2018) discovered that teachers have frequently tried and failed to create and maintain dialogic classroom environments. These could have been instances of teachers quitting up because they did not see an improvement in student results right away, or they could have been instances of them failing to initiate or maintain dialogue (Asterhan et al., 2018).

According to a study by Bragg et al. (2018), when teachers plan to use the dialogue and argumentation teaching technique in the mathematics classroom, they neglect to select mathematics assignments that give students the chance to hypothesize, generalize, justify, and cultivate a culture of supporting reasoning. In their preparation for using the dialogue and argumentation teaching technique in a mathematics classroom, Bragg et al. (2018) emphasized the need of projecting student replies, identifying opportunities for reasoning in tasks, and successfully inspiring reasoning. Open-ended assignments can offer a focused emphasis on the development of students' reasoning (Bragg et al., 2018). However, in order for these activities to be successful, teachers must be able to orchestrate fruitful mathematics arguments in the classroom by using the right kind of stimuli.

Chapin et al. (2017) state that choosing which type of teaching discourse to utilize and when to introduce it into the lesson is one of the main challenges teachers face. Dialogic education is just one technique in the toolbox and is not always the ideal one (Chapin et al., 2017). This suggests that dialogic teaching may lead to areas of mathematics learning where students grasp concepts in a common or naive way. This means that by asking probing questions, demanding that ideas be developed logically, and developing concepts with a broad range of applications, the teacher can encourage dialogue that push boundaries.

Students' views toward their mathematics teachers and toward one another have an impact on the implementation of the dialogue and argumentation approach in mathematics classes (Demo et al., 2021). There are situations where students feel that certain students are unreliable or with whom they have had bad experiences in the past (Demo et al., 2021). This suggests that they are unable to communicate with their fellow students about whom they hold negative attitudes.
According to Bragg et al. (2017), teachers find it challenging to alter the social norms that have been established in mathematics classrooms. The expectations that teachers and students have of one another’s roles, behaviours, and responsibilities make up these norms. As such, students who have grown acclimated to the customs will often be against reform efforts that try to alter the conventional classroom. This is a problem for teachers who want to use dialogue and argumentation in their mathematics classes.

Research Methodology

This section reports on the research design, paradigm, approach, methods and instruments used in the study.

Research Design, Paradigm, Approach, Type and Sampling

The research design, paradigm, methodology, techniques, and tools employed in the study are covered in this section. The study strategy that was used was a descriptive survey research design. The research paradigm of pragmatism was employed to direct the generation of knowledge in the study. The focus of pragmatism is on quantifiable and observable facts as knowledge. In this investigation, a mixed methodology was utilized. In this study, a sample of 100 teachers was selected using random sampling out of the entire population of O’ level Mathematics teachers at 72 schools in Gutu district of Masvingo province. The participants in this study also consisted of 10 Mathematics Head of Departments (HOD) purposively or judgementally selected from 72 secondary schools. Instruments used to collect data for this research were Mathematics Head of Departments’ interview and teachers’ questionnaire. Mathematics HODs’ interview generated qualitative data while teachers’ questionnaire generated quantitative data. Prior to starting data collecting, the researcher as part of administration requested authorization from Zimbabwe’s Ministry of Primary and Secondary Education (MOPSE) to conduct the research at the secondary schools. Informed consent for participants was also obtained. The respondents’ biographical profiles are displayed in Table 1.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Female</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Age</td>
<td>&lt;30 years</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>31-40 years</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>41-50 years</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>&gt; 50 years</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Educational level</td>
<td>Certificate in Education (CE)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Diploma in Education (Dip Ed)</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Bachelors degree</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Master’s degree</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Years of teaching experience</td>
<td>≤10 years</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>11-20 years</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>21-30 years</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>&gt; 30 years</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>
According to Table 1 findings, there are more male (59%) than female teachers in schools teaching ‘O’-level mathematics. Just 43% of the mathematics teachers at the ordinary level lack a degree, with the majority holding college degrees. Table 1 also demonstrates that the majority of teachers have 20 years or less teaching experience, which is consistent with the fact that the majority of teachers (59%) are under 40 years old.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Age</td>
<td>&lt;30 years</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>31-40 years</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>41-50 years</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>&gt; 50 years</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Educational level</td>
<td>Certificate in Education (CE)</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Diploma in Education (Dip Ed)</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Bachelors degree</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Master’s degree</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Years of teaching experience</td>
<td>≤10 years</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>11-20 years</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>21-30 years</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>&gt; 30 years</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

The results in Table 2 show that most of the Mathematics HODs are male (60%) and few are female. The results in Table 2 also show that most of the teachers are 50 years or below (70%) and out of these 70%, 40% are aged between 41 and 50 years, that is, are middle aged. It is also shown in Table 2 that most of the HODs (60%) are degree holders with 40% of these HODs being bachelor’s degree holders. This shows that most of the HODs have taken the root of upgrading themselves from just being Certificate in Education holders. The results in Table 2 further show that most of the HODs (60%) have between 11 and 20 years of teaching experience and this should be adequate enough for them to be able to effectively lead their departments.

**Instrument Development**

A structured questionnaire with 10 items that used a five-point Likert scale was developed for collecting data on challenges faced by teachers when using dialogue and argumentation as a teaching strategy in Mathematics classrooms. The 10 items were as follows: 1. Students’ difficulties with the use of appropriate mathematical language. 2. Dealing with the heterogeneity problems due to the students’ different performance levels. 3. Dialogue and argumentation is time consuming to implement. 4. Dialogue and argumentation is time consuming to plan. 5. Planning to implement dialogue and argumentation. 6. Managing large class sizes affects the use of dialogic approach in the Mathematics classroom. 7. Unpredictability of students’ contributions that make following up difficult. 8. Balancing mathematical content against maximum participation of students in the lessons. 9. Lack of confidence in the use of dialogue and argumentation teaching strategies. 10. Difficulty in shifting from traditional Mathematics. Semi-structured interview guide was used to collect qualitative data from the participating Mathematics Heads of Departments (HODs). A semi-structured
interview allows the topic and questions to be chosen ahead of time. This gives the researcher the freedom to choose the interview’s format and question order. Participants can bring up topics that are not expected because semi-structured interviews are flexible and the researcher is not required to follow the interview guide (McMillian & Schumacher, 2010). It permits the researcher to pose questions not initially included in the interview guide, but that are nonetheless pertinent and significant to the investigation. Semi-structured interviews enable the researcher to delve deeply for clarification on the topics at hand by allowing for investigation and explanation of replies (Maree; 2010). Interviews provide the chance to cover any gaps or omissions in questionnaires (Kanika, 2015). Interviews provided an in-depth look at the beliefs, perceptions and experiences of the participating Mathematics Heads of Departments (HODs) on the challenges affecting the effective use of dialogue and argumentation in the teaching of O’ level Mathematics.

Results

This section discusses data validation for the measurement scale as well as how data were analysed.

Validation of the Research Instrument

To establish the reliability of the quantitative data, internal consistency reliability was measured using both Cronbach’s alpha and composite reliability metrics. The values of Cronbach’s alpha as well as of the composite reliability were between .768 and .920 and are above .7 thereby satisfying the benchmark value of \( \alpha \geq .7 \) for internal consistency reliability (Hair et al., 2010; Howell et al., 2010). Internal consistency reliability is therefore confirmed.

With regards to establishing convergence validity, standardized factor loadings, Cronbach’s alpha, composite reliability, and Average variance extracted were used (Hair et al., 2017). Standardized factor loadings ranged between .639 and .933 thus falling within the benchmark of SFL>.6 (Hair et al., 2010), Cronbach’s alpha and composite reliability values ranged between .768 and .901 hence falling within the benchmark of \( \alpha \geq .7 \) (Howell et al., 2010), and Average variance extracted values ranged between .650 and .733 thereby falling within the benchmark of AVE > .6. Since the benchmarks for each metric used to measure convergence validity were satisfied, convergence validity was thus achieved (Hair et al., 2014; 2019).

The researcher used Guba and Lincoln (1985) criteria of credibility, transferability, dependability, and confirmability to ensure rigor and trustworthiness of qualitative data.

To establish credibility is to seek to ensure that the study measures or tests what is actually intended (Guba & Lincoln, 1985). The researchers adopted Guba and Lincoln (1985)’s five ways of ensuring credibility, which include prolonged engagement, triangulation, peer debriefing and pilot testing. According to Guba and Lincoln (1985), prolonged engagement is crucial in helping to support the concept of credibility because it assists the researcher in testing for misinformation and building trust. Given the nature of the design research it was possible for the researcher to have prolonged engagement with the design. Triangulation allowed the researchers to view events from multiple perspectives. Thus, the researchers used triangulation strategy to reduce the effect of researcher’s bias. Peer debriefing is a process in which the researchers discusses the investigation with peers (Guba & Lincoln, 1985). Through peer
debriefing the researcher explored aspects of the research that might have otherwise remained only implicit. Peer debriefing enabled the researchers to search for biases and justification for research. It also enabled the researchers to discuss the direction of the research and methodological design. Credibility was also ensured by the use of pilot test to test the efficacy of instruments to produce reliable and valid results.

To establish dependability the researchers ensured that if the research were repeated, in the same context, with the same methods and with the same participants, similar results would be obtained. In order to address the dependability issue more directly, the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results. Thus, the research design must be clearly articulated.

Transferability is the extent to which the findings from one study can be applied to another (Guba & Lincoln, 1985). The concern often lies in demonstrating that the results of the study can be applied to a wider population. External validity is concerned with the extent to which the findings of one study can be applied to other situations. Thus, the use of well-established research methods ensures transferability.

The concept of confirmability is the qualitative researcher’s comparable concern to objectivity. The researchers ensured that the works of the findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher. Guba and Lincoln (1985) contend that a crucial measure for confirmability is the extent to which a researcher admits his or her predispositions. Recognition of shortcomings in the study’s methods and their potential effects on the research as well as the inclusion of an in-depth methodological description can allow for the integrity of the research results to be scrutinised (Guba & Lincoln, 1985). Thus, the researchers used triangulation strategy to reduce the effect of researcher’s bias.

**Data Analysis and Integration**

Two statistical metrics namely the mean and the standard deviation were used in the analysis of quantitative data of the challenges affecting use of dialogue and argumentation. These quantitative results were also supported by qualitative results from interviews with HODs. Thematic analysis was used in qualitative analytic procedures to process the interview data. It was revealed in the interviews that challenges negatively affect the effective use of dialogue and argumentation in the teaching of ‘O’ level Mathematics. Based on the responses of the HODs, the following were the sub-themes that came out: class size, planning, attitudes, lack of confidence, lack of proficiency, heterogeneity and language. Thematic analysis is a practical approach to qualitative data analysis that may be used to many qualitative approaches by means of data coding, theme search, and refinement (Kiger & Varpio, 2020). A theme highlights a significant aspect of the data that is pertinent to the study questions, and theme analysis is a method of identifying patterns in the data, whereby themes that emerge become categories for examination (Cardino et al., 2017). A rigorous thematic analysis can produce trustworthy and insightful findings (Moules et al., 2017). Thematic analysis has few prescriptions and procedures. So it is easy to perform. According to Moules et al. (2017), thematic analysis is a helpful technique for analysing the viewpoints of various research participants, emphasizing parallels and divergences, and producing unexpected findings.
### Table 3. Challenges Affecting Use of Dialogue and Argumentation

<table>
<thead>
<tr>
<th>SN</th>
<th>Nature of challenge</th>
<th>CM</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Students’ difficulties with the use of appropriate mathematical language.</td>
<td>3.0</td>
<td>3.019</td>
<td>.725</td>
</tr>
<tr>
<td>2</td>
<td>Dealing with the heterogeneity problems due to the students’ different performance levels.</td>
<td>3.0</td>
<td>4.441</td>
<td>.701</td>
</tr>
<tr>
<td>3</td>
<td>Dialogue and argumentation is time consuming to implement.</td>
<td>3.0</td>
<td>4.129</td>
<td>.682</td>
</tr>
<tr>
<td>4</td>
<td>Dialogue and argumentation is time consuming to plan.</td>
<td>3.0</td>
<td>4.517</td>
<td>.725</td>
</tr>
<tr>
<td>5</td>
<td>Implementing dialogue and argumentation is a difficult process due to students ‘attitude.</td>
<td>3.0</td>
<td>2.651</td>
<td>.725</td>
</tr>
<tr>
<td>6</td>
<td>Managing large class sizes affects the use of dialogic approach in the Mathematics classroom</td>
<td>3.0</td>
<td>4.911</td>
<td>.711</td>
</tr>
<tr>
<td>7</td>
<td>Unpredictability of students’ contributions that make following up difficult.</td>
<td>3.0</td>
<td>2.772</td>
<td>.691</td>
</tr>
<tr>
<td>8</td>
<td>Balancing mathematical content against maximum participation of students in the lessons.</td>
<td>3.0</td>
<td>2.708</td>
<td>.733</td>
</tr>
<tr>
<td>9</td>
<td>Lack of confidence in the use of dialogue and argumentation teaching strategies.</td>
<td>3.0</td>
<td>3.995</td>
<td>.819</td>
</tr>
<tr>
<td>10</td>
<td>Difficulty in shifting from traditional Mathematics classroom practice towards dialogic and argumentation learning.</td>
<td>3.0</td>
<td>4.583</td>
<td>.741</td>
</tr>
<tr>
<td></td>
<td><strong>Average metrics</strong></td>
<td>3.0</td>
<td>3.773</td>
<td>.724</td>
</tr>
</tbody>
</table>

According to Table 3 data, teachers generally have difficulties \((M=3.773; \text{SD}=0.724)\) implementing dialogue and argumentation when teaching ‘O’-level mathematics. Furthermore, the results indicate that there are five main challenges that mathematics teachers face, ranked from most difficult to least difficult:

Managing large class sizes impacts the use of dialogic approach in the mathematics classroom \((M=4.911; \text{SD}=0.711)\) (see Table 3). This is consistent with the results of HOD interviews. Some of the non-verbatim responses of the HODs on the challenges posed by large class size in the implementation of dialogue and argumentation include the following:

> *All the HODs interviewed suggested that the large class sizes in the Mathematics classroom make it difficult for effective dialogue and argumentation among students. They also argued that teachers fail to manage or maintain dialogue and argumentation because of the high numbers of students in the Mathematics classroom. HOD 2 conceded that large class size lead to more disorder in the classroom, which ultimately affects student learning using dialogue and argumentation. HOD 7 suggested that large class size causes challenges including flexibility, classroom climate management and minimum attention to students, which make it difficult for effective dialogue and argumentation among students.*

Both quantitative and qualitative results delineate that it is challenging to have productive dialogue between the teacher and the large number of students in the classroom, as well as between the students individually and as a group.

The quantitative results show that shifting from traditional math classroom practice toward dialogic and argumentation learning is difficult \((M=4.583; \text{SD}=0.741)\) (see table 3). This is in agreement with the results of the HOD interviews. The non-verbatim responses of the HODs include the following:

> *HOD 04 argued that most students were unprepared for this dialogue and argumentation approach. The HOD posited that students had the opportunity to think hard about mathematical tasks, they were used to being shown the steps to use to solve a problem and then*
applying those steps to a set of similar problems. HOD 01 also argued that introduction of an dialogue and argumentation in the mathematics classroom was quite a challenging in that the students were more familiar with the teacher-centred approach.

The results of the quantitative and qualitative data shows that teachers have a hard time in changing the social norms that are in place in mathematics classes.

The quantitative results in Table 3 also show that planning dialogue and argumentation takes time (M=4.517; SD=.725). This is in line with the results of the quantitative data. The non-verbatim response of all the HODs was as follows:

Most of the HODs suggested that due to challenges of planning to implement dialogue and argumentation teaching approach, teachers fail to choose Mathematics tasks that provide students with opportunities to conjecture, generalise, justify and develop a culture of supporting reasoning.

The quantitative and qualitative results delineated that teachers need ample time to choose mathematics tasks that provide students with opportunities to conjecture, generalise, justify and develop a culture of supporting reasoning. This poses some difficulties to effectively implement dialogue and argumentation in the mathematics classroom.

The quantitative results show that teachers have challenges with addressing heterogeneity issues resulting from students’ varying performance levels (M=4.441; SD=.701) in the implementation of dialogue and argumentation when teaching O’ level Mathematics (see Table iii). This is corresponding to the results of the HODs interviews. Some of the non-verbatim responses of the HODs include the following:

Majority of the HODs suggested that heterogeneity problems which arise due to students’ different performance and interest in the learning of mathematics was another challenge faced by the teachers when using dialogue and argumentation as a teaching strategy. HOD 5 conceded that since students are different from each other in terms of their learning abilities it is challenging for the teacher to find ways of dealing with them in an effective manner. Similarly, HOD 4 indicated that it is difficult for the teachers to make provision of equal opportunities to all the students when using dialogue and argumentation approach in the mathematics classroom. HOD 3 also argued that it is difficult to avoid discrimination based on academic performance. HOD 8 conceded that it is challenging to ensure that teaching method is beneficial to all the students when teaching using dialogue and argumentation approach in the mathematics classroom. Similarly, HOD 2 suggested that it is difficult to ensure that teaching-learning materials meet the needs and requirements of the students.

These results show that teachers face challenges in dealing with the students with different performance levels in the implementation of dialogue and argumentation when teaching O’ level Mathematics.

The results of the quantitative data in Table iii shows that putting dialogue and argumentation into practice takes time (4.129; SD=.682) when teaching O’ level Mathematics using dialogue and argumentation approach. This is in accordant with the results of the quantitative data of HODs interviews. Some of the non-verbatim responses of the HODs posed by this challenge include:

All the HODs interviewed conceded that due to the restricted time available for teaching, it is difficult for the teachers to successfully use dialogue and argumentation in their Mathematics classroom. They argued that dialogue and argumentation approach requires more time because it entails exchanges of ideas between students.
The results of both quantitative and qualitative data show that it is challenging for teachers to employ the dialogue and argumentation approach in Mathematics classrooms given the amount of material that needs to be taught in the allotted time.

The results in Table 3 also show following five moderate challenges that affect the implementation of dialogue and argumentation in the teaching of O’ level mathematics to students, in order of extreme:

The quantitative results show a lack of confidence in the application of dialogue and argumentation teaching strategies (M=3.995; SD=.819) (see Table 3). This is consonant with the results of HODs interviews. The non-verbatim responses of the HODs include the following:

HOD 5 suggested that teachers require an understanding of the nuances of mathematical argumentation to enable them to assist students develop their mathematical arguments. HOD 7 argued that in order to teach effectively using dialogue and argumentation teachers must possess a thorough understanding of the content they are teaching. HOD 9 also suggested that teachers must also be aware of the subtleties involved in dialogue and argumentation. HOD 3 conceded that lack of confidence make teachers hesitant to use dialogue and argumentation teaching strategy. Similarly, HOD 6 argued that lack of confidence could be a roadblock to successful implementation of dialogue and argumentation teaching strategy.

The results of both quantitative and qualitative data shows that lack of proficiency and confidence in the teaching strategies poses a challenge in the implementation of dialogue and argumentation in the Mathematics classrooms. Thus, lack of proficiency and confidence affect the use of dialogue and argumentation approach in the Mathematics classrooms.

Quantitative Data in Table 3 also depict that students' difficulties using appropriate mathematical language (M=3.019; SD=.725) affect the implementation of dialogue and argumentation in the teaching of ‘O’ level mathematics to students. The quantitative results is in accordant with the results of the HODs interviews. The non-verbatim responses of HODs include the following:

HOD 07 argued that students’ difficulties with the use of mathematical languages was also a challenge. The HOD posited that most students were not fluent in mathematical language including mathematical vocabulary, symbolic representations, syntax, semantics and linguistics features. HOD 3 conceded that due to difficulties using appropriate mathematical language, students fail to make mathematics connections. Similarly, HOD 5 suggested that students struggle to express their ideas and fail to explain their mathematical solutions due to difficulties with the use of mathematical language.

The results of Quantitative and qualitative data delineate that problems concerning language cause students’ aversion to argumentation approach and as a result poses some challenges when implementing argumentation-teaching strategy in the Mathematics classrooms.

The results in Table 3 also show that unpredictability of students’ contributions that make following up difficult (M= 2.772; SD=.691) is a challenge when implementing dialogue and argumentation in the mathematics classroom. This is agreeing with the results from the qualitative data. The following is the non-verbatim response from HOD:

*All the HODs suggested that controlling the students’ discussion and arguments seemed very difficult since the students were enthusiastic and sometime emotional in the defence of their claims or beliefs.*
This made it challenging to monitor students’ contributions in the mathematics classroom.

The quantitative results also show that balancing mathematical content against maximum participation of students in the lessons (M=2.708; SD=.733) (see Table 3) poses some challenges when implementing dialogue and argumentation approach in the mathematics classroom. The results is harmonious with the qualitative results of the HODs interviews. Some of the non-verbatim responses from HOD include the following:

*All the HODs interviewed concurred that high levels of participation due to the use of dialogue and argumentation reduce mathematical content coverage. HOD 1 argues that it is difficult for teachers to ensure that main mathematical concepts are portrayed in ways that are consistent with both the mathematical content and the thinking of the students. HOD 3 also conceded that balancing mathematical content and participation is difficult since participation of students is greatly influenced by peer interactional tendencies that either promoted or impeded productive contributions.*

Furthermore, quantitative data in Table 3 also depicted that implementing dialogue and argumentation is a difficult process due to students’ attitude (M=2.651; .725). This is in tune with the results of the HODs interviews. Some of the non-verbatim responses of HODs include:

*HOD 08 specifically indicated that due to the students’ attitude towards each other, students cannot engage in constructive dialogue and argumentation with the colleagues they have negative attitude towards. HOD 09 suggested that due to the students’ attitude towards each other, students cannot have dialogue and argumentation with the colleagues they have negative attitude towards. It was the opinion of the HOD 10 that for effective use of dialogue and argumentation, the students require good interpersonal skills that will enable them relate well with the students in class and even with the teachers during mathematics lesson.*

This shows that implementing dialogue and argumentation in the mathematics is influenced by students’ attitudes toward the Mathematics teachers and toward each other.

**Discussion**

This section discusses challenges that affect the teaching of O’ level Mathematics using the dialogue and argumentation approach in the Mathematics classroom. It was established in the study that challenges such as large class sizes, restricted time, the students’ attitude towards each other; heterogeneity problems and balancing mathematical content against maximum participation of students in the lessons have a significant but negative influence on the application of dialogue and argumentation in the teaching of O’ level Mathematics. This further suggests that the more the challenges, the more the teachers will be negatively affected in their teaching of Mathematics using the dialogue and argumentation approach.

A number of past studies confirm the above results. A study by Dimo et al. (2021) found that challenges such as large class size negatively affected students’ engagement level in Mathematics classrooms during the use of dialogue and argumentation as an approach which utmost affect their academic performance. Studies by Bersh (2019) and Lekau (2019) demonstrated the negative influence of challenges of the teaching of Mathematics using the dialogue and argumentation approach. Both results of their
studies confirmed the negative role of challenges such as limited time allocated and class sizes on the effectiveness of dialogue and argumentation as an approach to the teaching of Mathematics.

Bragg et al. (2018) also highlighted the impact of challenges such as those related to effective planning to implement the dialogue and argumentation approach, to select appropriate dialogue and argumentation activities that are capable of providing students with the opportunities for conjecturing, generalising, justifying and developing a culture of evidence based reasoning. The results of a study by Bragg et al. (2018) showed that teachers who understand the benefits of dialogue and argumentation in a Mathematics classroom are more likely to prepare more adequately for Maths lessons, frequently use the dialogue and argumentation approach and have confidence in the use of the approach when compared to the other group of teachers.

Further, with regards to the challenge of limited time available for teachers to use the dialogue and argumentation approach, which by its nature a time consuming approach, is another challenge teachers face when teaching Mathematics using the dialogue and argumentation approach. Studies by Bersh (2019) and Lekau (2019) found that limited time in the teaching of Mathematics using dialogue and argumentation make it difficult for students to adequately and effectively contribute to class discussions and this affects their level of understanding Mathematics. In his study, Larson (2015) found that limitation of time was a challenge to using the dialogue and argumentation approach since balancing mathematical content against expected maximum student participation continue to be a challenge teachers face.

**Conclusion**

It was concluded from the study that the issue of challenges such as large class sizes, restricted time, the students’ attitude towards each other; heterogeneity problems and balancing mathematical content against maximum participation of students in the lessons are among the challenges that negatively affects the effective use of dialogue and argumentation in the teaching of O'level Mathematics. Large class sizes in mathematics classroom is notable challenge experienced by the teachers teaching ordinary level mathematics using dialogue and argumentation approach. It was also concluded that teachers still do not have exact models of how to orchestrate dialogue and argumentation interactions, even they are aware that it will have a positive effect on students’ learning.

**Recommendations**

It is recommended that the teachers should use various strategies to deal with challenges affecting the effective use of the dialogue and argumentation approach in the teaching of ‘O’level Mathematics. The teachers should also use pedagogical repertoires to effectively respond to any teaching challenges in Mathematics classroom during the use of the dialogue and argumentation teaching approach. Furthermore, teachers should adapt teaching and classroom resources to accommodate the different needs of heterogeneous students. Thus, dialogue and argumentation teaching should be planned to consider diversity.

**Implications of the Study**

There is need to allocate more time to Mathematics lessons to ensure the effective use of the dialogue and argumentation approach in the Mathematics classrooms. There is
also need to train Mathematics teachers on how to plan and implement the dialogue and argumentation teaching approach in the Mathematics classroom. Thus, Mathematics teachers need to be trained on the nuances of mathematical dialogue and argumentation approach.

**Study Limitations**

The main study limitation was that the findings of this study might not be transferable nationally since the study was delimited to only schools in Gutu district of Masvingo province in Zimbabwe. Studies involving many respondents are needed to understand the problems and challenges of different situations and approaches that can be used when teaching ordinary level mathematics using dialogue and argumentation approach in the mathematics classroom in Zimbabwe.

**References**


