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Promoting citizenship education in the mathematics curriculum: The Malawi secondary school experience

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Background: Malawi recognises the importance of citizenship education (CE) as evidenced by its stated goals of education. In secondary schools, CE is offered explicitly in an elective subject called Social Studies. Consequently, some students do not study it. Mathematics is a compulsory subject; therefore, integrating CE would benefit all learners.

Aim: Investigating the extent to which the Malawi secondary school mathematics curriculum promotes CE.

Setting: Urban classroom with two experienced mathematics teachers.

Methods: The first phase involved document analysis of the intended curriculum's ability to promote CE. The second phase focussed on analysing mathematics lessons and how they extent they promoted CE.

Results: The findings show that the curriculum promotes CE to a large extent, but this varies in the specific curriculum materials and the mathematics topics. The teaching also varies; learner-centred lessons offered more opportunities for CE than teacher-centred lessons.

Conclusion: We argue that providing for CE in mathematics should go beyond listing in the school curriculum. There should be more clear guidance on how to integrate it into mathematics teaching.

Contribution: Our study contributes in at least two ways: (1) Adds to literature on mathematics and CE drawn from Malawi context, which differs from contexts in most literature. (2) Adds to methodology by introducing a rating for CE in curriculum materials and analysis of lessons for CE through the lens of learner-centred continuum.

Keywords: citizenship education; mathematics curriculum; secondary school curriculum; learner-centred teaching continuum; Malawi.

Introduction

In Malawi, mathematics is a compulsory subject throughout the 8 years of primary and 4 years of secondary education, and is one of the subjects that has more time in the school timetable than other subjects. In secondary school, mathematics has five core elements namely: (1) *Number and numeration*, (2) *Pattern, relations, functions and change*, (3) *Space, shape and measurement*, (4) *Statistics* and (5) *Structure* (Ministry of Education [MoE] 2013a, 2013b). Each core element is divided into topics that are taught in the 4 years. The number of topics and amount of content vary across the core elements with the core elements of *Structure* and *Statistics* having fewer topics than the other three topics (MoE 2013a, 2013b). Through its expected outcomes, the Malawi secondary curriculum states that citizenship is one of the 'sets of essential skills to be acquired by a secondary school graduate' (MoE 2013a:viii).

There are 13 citizenship skills that are stated as essential for secondary school. These are:

1. demonstrate an understanding and appreciation of the symbols of nationhood
2. demonstrate a spirit of patriotism and national unity
3. apply decision-making skills necessary for participation in civic affairs
4. demonstrate a spirit of leadership and service
5. show respect for one's own and other people's rights and responsibilities
6. tolerate other people's attitudes and beliefs

7. demonstrate respect for the rule of law
8. understand the characteristics of good governance
9. initiate and implement community development projects
10. demonstrate a sense of good neighbourliness
11. demonstrate a sense of national, regional and international understanding
12. demonstrate cooperative behaviour
13. demonstrate personal and social responsibility (MoE 2013a:ix)

It should be noted that these general citizenship skills are expected of the entire secondary curriculum and not only mathematics. This prompted us to investigate the extent to which the mathematics curriculum promotes citizenship education (CE). We studied the curriculum materials and mathematics lessons to explore the opportunities made available for CE. We were guided by the following research questions:

- To what extent do the Malawi secondary school curriculum and approved textbooks promote CE?
- What opportunities for CE are made available in Malawian mathematics lessons?

Review of literature and Malawi secondary school citizenship education

Citizenship is a concept that has eluded a common and universal definition. It can stand for status, identity, values or an activity (Davies 2012). Similarly, there is no agreement on the form that CE should take. In his famous adage, Aristotle argued that 'the citizens of a state should always be educated to suit the constitution of their state' (Heater 1999). As a result, different societies offer CE for various reasons depending on their history, context and experiences (Johnson & Morris 2010; Smith 2003). For instance, of late, CE is offered to develop 21st century skills, values and competencies to enable society to respond to challenges posed by transnational migration, climate change, technological advancement, pandemics and food security concerns (Chronaki & Yolcu 2021; Maass et al. 2019). These changing aims in terms of time and place emphasise the evolving nature of CE. In Malawi, it has been argued that CE is offered both to consolidate multiparty democracy and to teach democratic values and skills, such as tolerance to diverse views, critical thinking, problem-solving and decision-making (Namphande 2018).

Abdi, Ellis and Shizha (2005) have argued that the democratisation process in sub-Saharan Africa was too swift for the citizens to get prepared for their roles as citizens of a democracy. Education, therefore, became a viable means to develop a more participatory and democratic citizenry (Harber & Trafford 1999). To this end, Malawi introduced Social Studies subject in the secondary school curriculum in 1998 'to provide students with skills which would enable them to actively participate as citizens of a democracy' (MoE 1998:v).

Despite its centrality as CE, Social Studies is not a mandatory subject. In schools where Social Studies is offered, it is an elective subject and some students choose not to study it. This is problematic considering that citizenship skills should be developed by all learners in all schools as future citizens. To develop competent citizens that participate in the affairs of society, Social Studies needs to be complemented by other subjects across the curriculum including mathematics. As Leighton (2012) argues, citizenship should pervade all the life of the school if the aims of the subject are to be realised. Leighton (2012) adds that if we want to develop students who will participate in society, then they should be given opportunities to participate in schools.

Westheimer and Kahn (2004), however, warn that participation alone is not enough to sustain democracy. They argue that education decisions and practices are not value-free and that they have a political consequence. Education can develop compliant citizens or justice-oriented citizens. It is the justice-oriented citizens that are instrumental in upholding democracy. Similarly, Giroux and Penna (1979) argue that there are ideological messages that are embedded in the content of the formal curriculum and the social relations of the classroom encounter. To unmask these hidden messages requires critical education.

Writing on the relationship between mathematical education and democracy, Skovsmose (1990) underscores the essence of critical education which can be attained through three key concepts of *critical competence, critical distance* and *critical engagement*. *Critical competence* entails the involvement of students in the control of the education process, while *critical distance* means that both teachers and students must be able to investigate and evaluate the seemingly value-free and objective structuring of the curriculum. On the other hand, *critical engagement* means that education must be problem-oriented. In this case, education must be oriented towards a situation outside the classroom. For Malawi with its centralised national curriculum and high-stakes standardised national examinations, it can be argued that *critical competence* and *critical distance* can be quite problematic to attain.

Skovsmose (1990) acknowledges the contradiction inherent in mathematical education and democracy when he advances two conflicting arguments namely the social argument of democratisation and the pedagogic argument of democratisation. The social argument of democratisation requires exploring mathematical content from the curriculum that has practical applications for democracy. This shows the direct relevance of mathematical education to democracy. The pedagogical argument of democratisation focusses on the process through which the content is presented in class. Skovsmose argues that there are a lot of hidden messages that are sent out during the process of learning mathematics, which may have either intended or unintended consequences. For example,

instead of focussing on solving real problems and developing creativity, mathematical education demands that students follow explicitly stated prescriptions, which have the effect of regulating students' behaviour and training them to follow routines and instructions. This practice, it is argued, socialises students to become servile to those in positions of power. Similarly, Simmt (2015) writes about stances in mathematical education that can potentially conflict with CE. One such stance is considering solutions in mathematics as either right or wrong. It is argued that the emphasis on getting the correct answer from the teacher or from a textbook without appreciating the thinking efforts of students teaches students subtle lessons that mathematics should be accepted unproblematically and that mathematics cannot be questioned. However, students need to develop a critical mind to question statistical claims made in advertising and the popular press where mathematical claims are not in the best interest of CE (Simmt, 2015). This means that to develop democratic citizenship skills in students, the dominating role of the teacher and the textbook should be questioned. Even where the curriculum and the textbook have content that shows applications and relevance to citizenship, the delivery process has to be interrogated. Accordingly, our study moved beyond the analysis of curriculum and textbooks and focussed on the process through observation of classroom practices.

Andersone and Helmane (2012) carried out a study that explored the role of textbooks in helping students develop knowledge, skills, attitudes and dispositions for democratic citizenship in Latvia. The study focussed on Grade 4 and Grade 6 textbooks by analysing the presence of themes essential to citizenship using the components of citizenship knowledge, citizenship skills, and citizenship attitudes and values. The findings showed that there was more emphasis on the development of citizenship knowledge and citizenship skills, while development of citizenship values and attitudes was given less attention. However, as alluded to earlier, there is bound to be a disjuncture between curriculum documents and classroom practice. Actually, Bradshaw (2014:14) alerts us that 'no matter how thoughtful and thorough our curricula, democratic education ultimately takes place between teachers and students'.

Considering that Social Studies in Malawi is not mandatory, and the importance of mathematics as a mandatory subject in the Malawi secondary school curriculum, it was essential to carry out a study to explore the extent to which CE was covered in the mathematics curriculum and approved textbooks. The textbooks are important because they are the only resources for many teachers and students. In addition, acknowledging the disjuncture between official documents and actual classroom practice, the study went further to explore the process of teaching to ascertain whether pedagogy in mathematics promoted the development of skills and dispositions essential for critical citizenship.

Theoretical and analytical frameworks

We first used Andersone and Helmane's (2013) three criteria for theoretical analysis of curriculum to study the Malawi curriculum materials. Then we used Guthrie's (2011) Classroom Teaching Styles model to study classroom teaching. Andersone and Helmane (2013) view CE from three aspects. The first aspect is knowledge about society; the second is skills that can be developed; and he third aspect is about attitudes, duties and rights.

They describe three criteria for the theoretical analysis of the curriculum:

1. Citizenship Knowledge
2. Citizenship Skills
3. Citizenship Values and Attitudes

We related the three criteria to the 13 citizenship skills stated in the Malawi secondary school curriculum and found that the skills relate to the indicators of the criteria. We therefore added to Andersone and Helmane's (2012) indicators as shown in Table 1, and used it as our analytical framework.

The Classroom Teaching Styles model by Guthrie (2011) provides a continuum of teaching styles ranging from teacher-centred to learner-centred, as shown in Table 2.

Guthrie's (2011) continuum contains five teaching styles: Authoritarian, Formalistic, Flexible, Liberal and Democratic. Each teaching style is characterised by four variables namely, teacher role, student role, content approach and reinforcement.

Guthrie (2018) classifies the authoritarian, formalistic and flexible styles under teacher-centred part of the continuum because these styles are dominated by knowledge transmission from the teacher to learners and there is no

TABLE 1: Analytical framework – Andersone and Helmane (2012:94) criteria aligned to the Malawi citizenship education indicators.

Andersone and Helmane (2012) criteria	Malawi citizenship skills indicators
Citizenship Knowledge *(contexts and application)*	demonstrate an understanding and appreciation of the symbols of nationhood
	demonstrate a sense of national, regional and international understanding
	understand characteristics of good governance
Citizenship Skills *(reasoning, justifications, critical thinking, problem solving)*	apply decision-making skills necessary for participation in civic affairs
	initiate and implement community development projects
Citizenship Values and Attitudes *(behaviour, tolerance)*	demonstrate a spirit of patriotism and national unity
	demonstrate a spirit of leadership and service
	show respect for one's own and other people's rights and responsibilities
	tolerate other people's attitudes and beliefs
	demonstrate respect for the rule of law
	demonstrate personal and social responsibility
	demonstrate a sense of good neighbourliness
	demonstrate cooperative behavior

TABLE 2: Classroom teaching styles model.

Variables	Authoritarian	Formalistic	Flexible	Liberal	Democratic
Teacher Rule (authoritarian to democratic)	Formal and domineering, imposing rigid norns and sanctions.	Formal with well-established routines and strict hierarchical control.	Uses variety in methods and some relaxation of controls, but still dominant.	Actively promotes student-centred class room. Encourages pupil participation indecisions.	Leader of democratically based group. Coordinator of activities.
Student Role (passive to active)	Passive recipient of teacher-defined roles in behaviour and learning. Little overt interaction.	Passive, although some overt interaction.	More active role within constraints defined by teacher.	Works within fairly wide boundaries, especially in learning decisions.	Actively participates in decisions. Increasingly responsible for own actions.
Content Approach (teaching to learning)	Teaching of prescriptive syllabus with closely defined content for rote learning.	Organised processing of syllabus with emphasis on memorisation.	Some flexibility in use of syllabus and textbooks, with attention to learning problems.	Wide degree of curricular choice. Emphasis on learning processes rather than content.	Strong emphasis on student learning at individual pace. Teacher a resource.
Reinforcement (negative to positive)	Strict teacher control with strong negative sanctions (e.g. corporal punishment) enforcing obedience.	Strong teacher-based negative sanctions, especially focussed on learning.	Greater attempts to use positive reinforcement, backed by strong negative sanctions.	Increased emphasis on positive reinforcement.	Positive response to internal motivation, although with latent teacher authority.

Source: Guthrie, G., 2011, *The progressive education fallacy in developing countries: In favour of formalism*, Springer Science & Business Media

learner involvement in decision-making. Liberal and democratic styles are classified as learner-centred because they are dominated by knowledge transactions with learners taking an active role in constructing knowledge and decision-making. We found this model appropriate for this study because classroom practices that lean towards the democratic end of the continuum are likely to promote CE.

Research methods and design

The study was conducted in two phases: the first phase was analysis of curriculum documents and the second was observation of teaching. The curriculum materials included the teaching syllabus and two approved textbooks: *Arise with Mathematics* (Chitera 2013), which we call Textbook A and *Strides in Mathematics* (Hau & Lowe 2014), which we call Textbook B. We focussed on secondary school Form 1 (Grade 9) and Form 3 (Grade 11) because these do not have national examinations and therefore easier to have access to the classrooms in schools. Furthermore, learning from earlier studies, the pressure of national examinations affects the teaching approaches. We wanted a setting that is free from that pressure. In the first phase, we used the criteria by Andersone and Helmane (2013) to identify in the curriculum materials, the mathematics core elements and topics that promote CE. We classified each core element of the mathematics curriculum as high, moderate or low in what is offered in each of the three criteria as follows: we classified a core element as high in criteria if the criteria indicators were present in 70% or more of the topics under the core element. We classified them as moderate if present in 31% – 69% of the topics, and low if present in 30% or less of the topics. We also classified the approved textbook as high, moderate or low in each criterion if the topics in the textbook had the criteria indicators present in similar ranges of $\geq 70\%$, 31% – 69% and $\leq 30\%$, respectively.

The second phase was classroom observation for mathematics topics (Statistics, Probability and Polygons) classified as high in promoting CE. We used Guthrie's continuum to analyse lessons and classify the extent to which the teaching promoted CE. We observed a total of four lessons in Form 1 and five lessons in Form 3, taught by three teachers. The teachers were part of a larger study and were selected purposefully because they had different approaches to their teaching. Permission to conduct the study in secondary schools was granted by the MoE. All 3 teachers gave written consent and all 120 students gave verbal consent, where they agreed to be part of the study and to be video recorded. They were informed of their rights as participants, and that they were free to withdraw from the study at any time. They were also informed that the data would be used for academic purposes only and were assured confidentiality and anonymity.

TABLE 3: Theme codes for lessons.

Teacher role	Student role	Content approach	Reinforcement
Authoritarian teacher role	Authoritarian student role	Authoritarian in content	Authoritarian reinforcement
Formalist teacher role	Formalist student role	Formalist in content	Formalist reinforcement
Flexible teacher role	Flexible student role	Flexible in content	Flexible reinforcement
Liberal teacher role	Liberal student role	Liberal in content	Liberal reinforcement
Democratic teacher role	Democratic student role	Democratic in content	Democratic reinforcement

We used Guthrie's (2011) four variables across the five teaching styles to locate the teachers we observed in the continuum. We developed pre-determined themes under each role as shown in Table 3.

The nine lessons were video recorded, transcribed and then divided into episodes depending on lesson focus. Each episode was analysed and coded using codes generated from the data then the codes and themes generated from Guthrie's (2011) four variables. The coding was done by two of the authors independently, then compared. They discussed the differences and reached a consensus.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Ministry of Education, Education Division Manager, South East Education Division (No. SEED/ADM/VOL.II/477).

Results

The authors start by presenting findings from analysis of mathematics curriculum materials namely mathematics syllabus and textbooks to examine the extent to which they promote CE. This is followed by findings from lesson observation data to explore the opportunities for CE that are made available in mathematics lessons.

TABLE 4: Citizenship education in Malawi secondary mathematics syllabus.

Variables	Mathematics curriculum core elements					Overall
	Number and numeration	Patterns, relations, functions and change	Space, shape and measurement	Statistics	Structure	
Citizenship Knowledge	Moderate	Low	Moderate	Low	Low	Low
Citizenship Skills	High	High	High	Low	Low	High
Citizenship Values & Attitudes	High	High	High	High	High	High

TABLE 5: Citizenship education in approved mathematics Textbook A.

Variables	Mathematics curriculum core elements					Overall
	Number and numeration	Patterns, relations, functions and change	Space, shape and measurement	Statistics	Structure	
Citizenship Knowledge	Moderate	Low	Low	Moderate	Low	Low
Citizenship Skills	Moderate	Low	Low	Moderate	Low	Low
Citizenship Values & Attitudes	Moderate	Low	High	High	Low	Moderate

TABLE 6: Citizenship education in approved mathematics Textbook B.

Variables	Mathematics curriculum core elements					Overall
	Number and numeration	Patterns, relations, functions and change	Space, shape and measurement	Statistics	Structure	
Citizenship Knowledge	High	Moderate	Moderate	Moderate	Low	Moderate
Citizenship Skills	High	High	High	High	High	High
Citizenship Values & Attitudes	High	High	High	High	Moderate	High

Findings from analysis of curriculum materials (the intended curriculum)

We present our findings from the analysis of the mathematics syllabus in Table 4 and results from the analysis of the two textbooks in Table 5 and Table 6.

As summarised in Table 4, looking at the indicators across the core elements, we found that citizenship knowledge was either low or moderate. This indicator was evident where there was application of mathematics to contexts where citizenship knowledge would be promoted. For example, in the core element of *Number and numeration*, the topic of social and commercial arithmetic has applications and discussions of taxes, benefits, loans and investments. The core element of *Space, shape and measurement* includes topics of trigonometry which the syllabus describes as being used in everyday life, using a calculator and solving problems in everyday contexts. Surprisingly, the core element of *Statistics*, which we would expect to relate to everyday life and social issues, is rated low because the syllabus does not offer connections to students' lives outside of school or to any social issues. Instead, the syllabus emphasises definitions of terms like mean, mode and medium and how to calculate these given a set of numbers. The topic of *probability* emphasises experiments, such as tossing coins, rolling dice and picking cards, then calculating the probabilities. The opportunity to link to everyday contexts and social issues was missed. In their study, Andersone and Helmane (2013) also found that the Latvian mathematics curriculum covers citizenship knowledge partially.

Citizenship skills are high in three core elements and low in the other two. This was evident where providing reasons and justifications for solutions or procedures, problem-solving and mathematical reasoning were expected. For example, under *Space, shape and measurement*, the syllabus suggests practical work and problem-solving to 'establish the relationship between exterior angle and opposite interior angles of a triangle' (MoE 2013b:16). This encourages problem-solving, critical thinking, reasoning and justifications which are all indicators of citizenship skills. The core elements of *Structure* and *Statistics* are low because they do not offer many of the skills; for example, in *Statistics* there is a lot of guidance on how to work with a set of data to calculate the measures of central tendency.

Citizenship values and attitudes are the most visible in the curriculum; we found this indicator high in all the five core elements. This is visible through the suggested teaching and learning methods. In most of the topics, there are suggestions for group work, pair work, peer assessment, group assessment, projects, presentations and discussions. These provide opportunities for learners to work together, express themselves, listen to different solutions by others and respect other learners' views and ideas. Thus, learning to be tolerant of others, which are all elements of CE under values and attitudes. Relatedly, these values and attitudes align very well with Malawi's collectivist culture which values the communal over individual living and individual accomplishments. With no similar study done in Malawi before, the present study will be insightful as it explores how the values espoused in the curriculum and aligned with cultural values are implemented in practice within the broader context of high-stakes standardised national examinations.

Comparing with Andersone and Helmane's (2013) findings, we see that they also found that citizenship skills and citizenship values and attitudes were more present in the Latvian curriculum than citizenship knowledge. As they explain, integration of CE in mathematics expresses itself by asking learners to investigate, pose questions, make and check assumptions and clarify questions, such as 'the growth

of the population, the distribution of limited resources, ecology, environment protection, health, risks and probabilities, etc.'. (Andersone & Helmane 2013:175).

As shown in Table 5, we found that in Textbook A, citizenship knowledge and skills are moderate in two core elements: *Number and numeration*, and *Statistics*, and low in the other three. While citizenship values and attitudes are high in statistics and Space; shape and measurement, and moderate in Number and numeration, they are low in the other two core elements of structure and patterns, relations, functions and change. In comparison to the syllabus, we see that except for *Statistics*, Textbook A has a similar or less presence of CE across the three criteria. *Statistics* is of interest because the syllabus does not offer much opportunity for citizenship knowledge and skills while Textbook A offers moderately. For example, books 2, 3 and 4 all relate to societal issues, such as human immunodeficiency virus and/or acquired immunodeficiency syndrome (HIV and/or AIDS), and statistics presented in media, and encourage students to work together to collect data, analyse and interpret the findings. Also of interest is the core element of *patterns, relations, functions and change* which rated high in the syllabus for citizenship skills and citizenship values and attitudes, but rated low in Textbook A in all the three criteria. The textbooks emphasise the mathematics content and procedures without much reference to contexts outside the classroom or problem-solving and other skills that would promote CE. For example, dice and deck of cards games are not common in Malawi context outside the classroom. Contexts such as the sustainability of the environment and the economy (Sunzuma & Luneta 2023) would provide more relevant outside classroom contexts.

For Textbook B, looking across the core elements, we found that citizenship knowledge is high in *Number and numeration*, low in *Structure* and moderate in the other three. Citizenship skills are high in all five, while citizenship values and attitudes are moderate in *Structure* and high in the other four. In contrast with textbook A which overall offers less CE than the syllabus, Textbook B offers more. In most of the topics, citizenship skills are evident through the indicators of problem-solving, critical thinking and asking learners to explain and justify their reasons. For example, book 1, after an activity of constructing polygons and angles using a ruler and a pair of compasses asks learners to write a short essay explaining reasons why the constructions of each shape work. Another example is from book 3 where after an activity of drawing the graph of $y = 2x + 3$ for values of x from –3 to 3 learners are asked to discuss with other learners whether it was necessary to use all the values of x from –3 to 3. Citizenship values and attitudes are promoted through suggestions of learners working together, presenting their ideas, and listening to others, which similar to the findings from syllabus, prepares learners to develop citizenship values and attitudes.

Overall, we found that Textbook A is low in citizenship knowledge and Skills and moderate in citizenship values and attitudes, while Textbook B, overall, is moderate in citizenship knowledge and high in the other two criteria. We see here that, again citizenship knowledge is less present than citizenship skills and citizenship values and attitudes, similar to the findings from the analysis of the syllabus. Interestingly, in their study of Latvian mathematics textbooks, Andersone and Helmane (2012) also found that citizenship skills were the most present, while citizenship knowledge and citizenship values and attitudes were partially present. In contrast to our findings, they discovered that citizenship values and attitudes were the least present. We found that citizenship values and attitudes were more present than citizenship knowledge, and Textbook A also more present than citizenship skills. The contrasting difference can probably be explained by the differences in contexts and the actual mathematics content in the curricula.

Findings from analysis of lessons

Lesson 1: Statistics (core element Statistics)

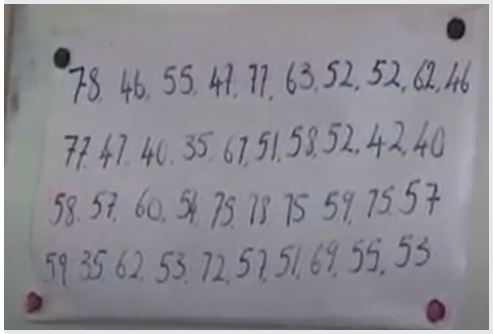
Teacher A began by asking learners to define the term data and give examples of data. One student described it as unprocessed information. Then, he explained the importance of grouping data and announced that the day's lesson was on grouping data. After using the question-and-answer method to define data grouping, he displayed a chart on the board, and the lesson proceeded as in the episode in Figure 1.

Using question and answer and lecture methods, the teacher and students completed the frequency distribution table with three columns, namely scores, tallies and frequency. Then, he asked learners to mention the class of marks with the least and most people. He also completed with the learners the frequency distribution tables for two other groups of data, one containing the ages of teachers in a school and the other containing the ages of people who were watching a football match in a school hall as an exercise and asked the learners to show the frequency distribution table and identify classes. Lastly, he asked learners different questions concerning the grouped data, like group with the lowest and highest frequency and say what it means in terms of age group of people who were watching football.

From the transcript in Figure 1, we notice that Teacher A used charts to display the data and decided the data to be grouped, meaning that he was authoritative in content as learners did not have an opportunity to decide the type of data to be grouped. He was somehow liberal in giving learners opportunities to decide the class interval (19, 25). His positive reinforcement of learners both correct and incorrect responses and not giving negative comments implies that he exercised mutual respect (15–21), hence liberal in reinforcement according to Guthrie's teaching styles and exercising tolerance in Andersone and Helmane's (2013) categories of CE.

Since he mainly asked learners open-ended questions like how to group the data (15) and what the intervals should be (23) that allowed for diverse learner opinions, then he was

flexible in teachers' and learners' roles. The data he used are from real life, for example, the ages of people and grades of students; these might have supported learners' abilities in applying the principles of data grouping in other real-life situations, hence promoting citizenship skills of context application (Andersone & Helmane 2013) as well as reasoning and justification skills necessary for participating in decision-making in different societal affairs. However, since he did not engage learners in more learner-centred cooperative teaching and learning approaches like group discussions and exploration or discovery (Guthrie 2011), which promote reasoning, critical thinking, problem-solving and decision-making skills, it implies that the lesson might not promote learners' development of citizenship skills.



charts TLM, teacher decides data uses

15. **T:** Who can think of how we can put these numbers together? (Points at the numbers on the chart). Who can explain how to put numbers that have some similar characteristics together? Reinforces positively, asks open question.
16. **S:** Try to find something common among the numbers. Gives response
17. **T:** Yes, true we should find something in common with a group of numbers, so how do we do that? Reinforces positively, asks open question, gives learners opportunities to suggest procedure
18. **S:** We should put the even numbers together and the odd numbers together. Gives response, suggests procedure
19. **T:** Okay we should put the even numbers together and the odd numbers together. Any other suggestion? But those are marks of students in mathematics, so what can we say in terms of performance if we put odd and even numbers together? Reinforces positively, asks open question,
20. **S:** May be put numbers that look the same together like 51, 52 and so on. Suggesting procedure
21. **T:** Very good, we should put numbers with same intervals together so that we can say how many are in group of 50s, 60s and 70s. So, to simplify that process, we use a table known as frequency distribution table. ...So, may be to start, let us identify the least number, what is the least number here? Reinforces positively, explaining, asks closed question, decides number to start with
22. **MS:** 35. Gives response
23. **T:** Okay so it means we can have numbers within the group of 30s not so, so that can be our starting point. So, who can think of an interval for the numbers in 30s? Reinforces positively, asks open question, gives learners opportunities to suggest interval
24. **S:** 30 to 40. Gives response
25. **T:** Okay 30 to 40, So, this is called a class or interval of data. So, what can be the other class or interval of data? Reinforces positively, asks open question, gives learners opportunities to suggest interval
26. **S:** 41 to 50. Gives response
27. **T:** Now there is a rule for deciding on the class of interval, we need to make sure that the number of items in each class should be the same. So, what is the number of items between 30 to 40? Reinforces positively, Explaining, asks closed question.
28. **S:** 10. Gives response
29. **T:** how about in 41 to 50 Reinforces positively, asks closed question
30. **MS:** 9. Gives response
31. **T:** So, what should our interval be so that we have equal numbers in both classes? Reinforces positively, asks open question

Blue, content; Orange, Teacher role; Red, learner role; Green, reinforcement; T, Teacher; S, student; MS, many students; SS, same student; TLM, Teaching and Learning Materials.

FIGURE 1: Lesson 1 – Teacher A's transcript.

Lesson 2: Probability (core element Statistics)

Teacher B started by announcing that the day's lesson was on using a tree diagram to find probability. He asked learners to explain anything that they remembered from their Grade 10 learning of probability, then he showed a coin and asked learners to mention the probability of getting a head when a coin is tossed and give a reason. He did the same with dice and then the lesson proceeded as in Figure 2.

The lesson continued with the teacher and students discussing how to come up with a general formula for the probability of independent events. Then he gave the problem for exercise: The probability of having an early lunch at boarding school is 2/3 every day. The probability of having beef for lunch is 1/7 every day. What is the probability that there will not be beef when lunch is late?

From the lesson on probability, in Figure 2, we notice that Teacher B was authoritative in content as he announced the lesson, and controlled the flow of the lesson content in moving from one activity to another (27, 29). He, however, gave positive reinforcements to learners who gave both correct and incorrect responses and he did not give negative sanctions, meaning that he exercised mutual respect (27, 29, 37), hence liberal in reinforcement throughout the lesson, and promoted citizenship values and attitude of mutual respect and tolerance. He used lecture, discovery and question-and-answer methods to facilitate learning of how to find the probability of an event (27, 37), meaning that he was liberal in the teacher role, and also promoted learners' development of citizenship values and attitude of tolerance and mutual respect of others' ideas, as well as reasoning and critical thinking skills. Since he asked learners both closed- and open-ended questions, such as why the probability of an event was a quarter, it means he asked questions that provoked learner thinking. Furthermore, the activity of developing a tree diagram and generating the probability of finding a head at the first toss and a tail at the second toss might have also promoted learners' discovery skills, hence

27. **T:** So, I want you to take out the coins that I gave you and toss it once, what are you getting. Discovery method, reinforces positively, asks closed question, decides content
28. **MS:** tail or head. Give response
29. **T:** So, can you present that on the coin tree branches, like probability of getting a head and a tail, Toss it again and say what you find, Discovery method, reinforces positively, asks closed question, decides content
30. **MS:** head or tail. Give response
31. **T:** So those of you who got the head at first toss, did you get a head too this time around? asks closed question
32. **MS:** No or Yes. Give response

...

37. **T:** Can you draw a tree diagram showing outcomes of both tosses in your groups. (He went on assisting the students in the groups, then latter on drew the tree diagram on the board through question and answer). Discovery method, reinforces positively, asks closed question, decides content
38. **T:** So, what will be the probability that when you get Tail at first Time you will get a head at second time of tossing the coin? asks closed question
39. **MS:** one, half, four or one over 4. Give responses
40. **T:** Tell us what you did, those of you who got 4 what did you do? asks open question

Blue, content; Orange, Teacher role; Red, learner role; Green, reinforcement; T, Teacher; MS, many students.

FIGURE 2: Lesson 2 – Teacher B's transcript.

enhancing learners' development of citizenship skills and values. Like Teacher A, Teacher B used a real-life situation that is directly related to the learners in the exercise, hence enhancing the learners' abilities in applying the principles of probability in other real-life situations, thus promoting CE through context application and decision-making through knowledge transfer of mathematics to other societal issues.

Lesson 3: Exterior angle on a triangle (core element Space, shape and measurement)

The lesson started with Teacher C asking students to define the interior angles of a triangle and mention their sum. Then she asked them to define the exterior angles of a triangle and draw its examples on the board and proceeded as in the lesson episode in Figure 3.

From the lesson transcript in Figure 3, we notice that Teacher C gave learners worksheets and decided what they should do with them; she controlled the flow of presentation of responses by learners, meaning that she was authoritarian in content and teacher role. She, however, did not dictate the sequence of measuring during the empirical activity, hence liberal or democratic in the teacher role. In terms of citizenship skills, this implies that she encouraged the application of critical thinking and decision-making skills. We note that like Teacher B, Teacher C was liberal or democratic as she involved learners in discussing and discovering the relationship between two interior angles and the exterior angle of a triangle, and she did not impose on group composition. Thus, she promoted citizenship values and attitudes of tolerance and skills of reasoning, critical thinking and problem-solving. She engaged with the differences in the learners' data respectfully without imposing negative sanctions on students who give wrong measures, hence liberal in reinforcement and promoting CE values and attitude of tolerance. However, the lack of use of real-life examples in the lesson might indicate that she did not promote knowledge transfer of mathematics to societal issues, hence lacked promotion of context application skills.

119. **T:** So, I want you to be in groups. I'll give you some worksheets, then, you measure the interior angles and exterior angles, right? *(After 15 minutes).* Let's start with group number one, come and write the values of the angles that you have. Group discussion, decides lesson content, uses worksheets as TLM.

120. *(Group representatives up to group 4 writes the angle measures on chalkboard).* Freely display their data

...

248. **T:** If you look at these measures of angles, they differ according to how you used measuring materials. What did we say about interior angles in a triangle? Yes! *(Nominates a student)* Reinforces positively, accommodates all measures, focuses learners' attention to content in focus, asks open question

249. **S:** They add up to 180 degrees. Decide what to say about interior angles in a triangle

250. **T:** 180 degrees. So, if you get 180 degrees after adding all interior angles that means you have the correct values of those interior angles, right? Reinforces positively.

251. **S:** Yes, responds freely

252. **T:** So, only for those who got correct values that *a* plus *b* plus *c* is 180 degrees add angle *a* and *b* and compare to *d.* What do you find? *(Nominates a student)* decides angle measures to use

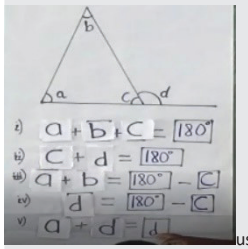
253. **S:** it gives value of d responds freely

...

256. **T:** So, if it gives the value of *d,* that means we're looking at two interior angles, *(points at a and b in the triangle)* and one exterior angle. So, what can we conclude about these angles? Asks open question

257. **S:** two opposite interior angles in a triangle add to one exterior angle. Logical reasoning, Responds freely

(Using the chart below, she develops the deductive proof through question and answer).



uses chart as TLM, decides sequence of proof

Blue, content; Orange, Teacher role; Red, learner role; Green, reinforcement; T, teacher; S, student; TLM, Teaching and Learning Materials.

FIGURE 3: Lesson 3 – Teacher C's transcript.

Discussion

In the syllabus and Textbook B, two of the three criteria for CE are rated high in three core elements. These are: (1) *Number and numeration*, (2) *Pattern, relations, functions and change* and (3) *Space, shape and measurement*. In the discussion, we focus on these three, and we especially note the stated outcomes of the core elements and their suggested teaching, learning and assessment methods. For each, we present the topics that have a lot of relevance to citizenship, and immediately follow up on each topic with a review of how it has been presented in the two approved textbooks. The first core element is *Number and numeration.* The learning outcome for this core element states that 'Students will be able to demonstrate an understanding of number systems and their properties and apply them in solving problems in everyday life' (MoE 2013b:3). Using the example of quadratic equations in Form 3, the syllabus suggests pair work, discussion and problem-solving among the teaching, learning and assessment criteria. The syllabus, in this case, promotes the use of authentic experiences in problem-solving. Correspondingly, Textbook A uses word problems in the examples and exercises to solve everyday, practical problems. This gives students an opportunity to practice problem-solving skills that can help them in solving social problems.

On the other hand, Textbook B is more specific in its approach towards developing knowledge and skills of civic competence. In the introduction, Textbook B hints on using quadratic equations to solve everyday problems. The unit summary uses word problems that focus on everyday social problems some of which have civic importance, such as solving climate change problems and calculating the sum of votes in a general election.

The second core element is *Patterns, relations, functions and change*. The learning outcome for this core element states that 'Students will be able to demonstrate an understanding of graphs, charts, relations and functions and use them effectively in different contexts' (MoE 2013b:23). Under this core element, we use the examples of *coordinate geometry*. The syllabus suggests the use of discussion, group work, pair work, peer assessment, group assessment and problem-solving as teaching, learning and assessment criteria. These methods, if properly used can allow students to solve

problems and to cooperate. Interestingly, the textbooks approach the topic differently. Textbook A focusses on the presentation of mathematical concepts with little attention to the development of other related skills. On the other hand, Textbook B provides word problems that relate to real-world issues of civic importance. For example, the use of coordinates to construct ramps to allow access into a building by people using wheelchairs. Additionally, the textbook poses problems, such as the decrease in women parliamentarians between two general elections to allow students to construct a linear model of this decrease. Students are also encouraged to work in groups, discuss and make presentations of their responses to the class.

The third core element is *Space, shape and measurement* and the learning outcome states that 'students will be able to solve problems involving shape, size, spaces relationships between the sides and the angles of triangles, Pythagoras theorem and trigonometric functions' (MoE 2013b:45). As it can be noted, problem-solving has been consistent in all learning outcomes. We give examples of circle geometry (angle properties). The suggested teaching, learning and assessment criteria include discussion, problem-solving, pair work, group work, peer assessment and pair assessment. Textbook A presents most concepts and problems in numerical form with some explanations to aid student understanding. However, some opportunities are provided for students to cooperate. Contrastingly, the introduction part in Textbook B shows the applicability of the angle properties in real-life situations. Throughout the topic, students are encouraged to work in pairs and share their work with others and also work in groups whereby the outcome is shared with learners in the class.

The preceding presentation shows that the syllabus encourages the use of problem-solving approach to the teaching of mathematics. In addition, the suggested criteria for teaching, learning and assessment also encourage students to solve problems, cooperate, make presentations and assess each other. These activities are likely to develop skills, such as public speaking, cooperation, deliberation and decision-making, which are essential citizenship skills. As Leighton (2012:112) asserts '[w]hen pupils work in groups to make decisions, to collaborate on activities, to evaluate their own and others' contributions to an activity, they are involved in active citizenship'. In addition, the approved textbooks also encourage the use of authentic experiences to solve problems. Maass et al. (2019) state that the authenticity of problems is considered as 'being true' in relation to whether the problem, taken from a situation in the real world, has occurred or might happen. As noted, Textbook B provides more authentic experiences than Textbook A. Using this textbook, students are, therefore, more likely to develop citizenship competencies. This point is emphasised especially considering that these are students' textbooks that may be used in the absence of a teacher. Relating these findings to Skovsmose's (1990) concept of critical education, it can be argued that the curriculum documents provide opportunities to develop *critical engagement* in students as the problem-oriented approach focusses on outside classroom situations. On the other hand, it can be claimed that the curriculum documents provide limited opportunities for the development of *civic competence* in students since students have little or no control over the education process. This argument is advanced considering that the curriculum is national and centralised, which is subject to high-stakes examinations. With topics prescribed, there is limited scope and flexibility for both teachers and students to exercise control.

The availability of opportunities to develop citizenship skills in curriculum materials is considered to be a positive development. However, we recognise that there can be differences between stipulations of the curriculum and actual classroom practice. As alluded to earlier, Bradshaw (2014:1) alerts 'no matter how thoughtful and thorough our curricula, policies, and procedures, democratic education ultimately takes place between teachers and students'. This means that teachers are instrumental in the actual development of citizenship skills. The next section provides more insight into actual classroom practice.

The three lessons that we have analysed fall under two core elements that our curriculum documents analysis showed that the syllabus responds differently to the three categories of CE by Andersone and Helmane (2013). The Geometry lesson, under the core element of *Space, shape and measurement*, responds moderately to citizenship knowledge and highly to citizenship skills and citizenship values and attitudes. The Statistics and Probability lessons which are under the core element of *Statistics* respond lowly to citizenship knowledge and citizenship skills, but highly to citizenship values and attitudes. Analysis of the implementation of the lessons using Guthrie's (2011) classroom teaching styles reveals that the lessons were implemented differently by the three teachers, ranging from more teacher-centred to more learner-centred teaching styles.

In terms of content, we see that all teachers mostly lie in the authoritative role as they decide the content and its flow, as well as the procedure. Some teachers allow some decisions and responses from the learners like how to group data, measure angles and present their findings. However, the teachers eventually led the students to one acceptable way of grouping data, finding the probability of independent variables and proving that the exterior angle is equal to the sum of two opposite interior angles. In such a way, students are taught to accept established content and routines. Thus, this confirms further that in Malawi, Skovsmose's (1990) concept of *critical competence* is problematic because of the centralised national curriculum. As Simmt (2015) argues, the stance in mathematical education of considering solutions in mathematics as either right or wrong potentially conflicts with CE.

In terms of teacher and learner roles, Teacher A lies in between formalistic and flexible as he at least uses question-and-answer teaching in addition to the lecture method, hence not absolutely formalist and he is also flexible in content flow. Teachers B and C lie between flexible and democratic as they

involve learners in cooperative teaching and learning approaches and are flexible and liberal in content. In terms of reinforcement, however, all teachers are between liberal and democratic as they exercise mutual respect and do not impose negative sanctions.

Maass et al. (2019; 2021) observe that promotion of CE requires learners to take active roles like that done in enquiry-based learning so as to develop critical thinking and decision-making skills.

This means that through the promotion of active learning approaches of group discussion and enquiry approaches, Teacher B promotes citizenship skills. As the findings show, the use of cooperative teaching approaches like group discussion also promotes citizenship values or tolerance and skills in reasoning, critical thinking and problem-solving skills. According to Namphande (2018), the promotion of skills of tolerance to diverse views, critical thinking, problem-solving and decision-making is one of the aims of CE in Malawi. Hence, it concurs with the worldwide aim of social studies which includes promoting learners' development of knowledge, values and skills necessary for participating in society (Hinde 2008; Tibbitts 2005). The values of tolerance and positive attitude are also observed with all teachers through their mutual respect by not giving negative reinforcement to wrong answers, but instead probing further or asking other learners.

Furthermore, the use of real-life scenarios to represent mathematics by Teacher B is regarded as necessary for promoting knowledge transfer and decision-making skills. These democratic skills are of civic importance in society (Maass et al. 2019; MoE 2013a) and promote the development of *civic engagement* (Skovsmose 1990). The use of both closed and open questions to promote learners' understanding and discovery of mathematical properties was also noted by Mass et al. (2021) as promoting CE. Although the teachers seem to be in strict control of the lesson content and sequence, they do adapt lesson content to suit class needs. As Guthrie (2018) explains, it is almost impossible for secondary school classrooms to be fully democratic because teachers are also obliged to ensure that the secondary education content is covered before learners write national examinations.

The findings have however shown that the use of knowledge transmission methods by Teacher C and also at times by Teacher A might not promote learners' development of citizenship skills and values as also found by Namphande (2018) in social studies education in Malawi. Thus, although in the syllabus the core element of *Space, shape and measurement* respond highly to the two categories of development of citizenship skills and values by Andersone and Helmane (2013), the realisation of these might depend on the way it is implemented in classroom. Similarly, although the topics under the core element of *Statistics* responded lowly to CE categories, the approach used to teach these topics might enhance the development of some categories of CE. Thus, we agree with the MoE (2013a) that the successful realisation of the goals of education in the Malawian curriculum largely depends on classroom practices that involve learners in learner-centred pedagogies for enhancing communication, decision-making and critical thinking skills like exploration, investigation and group discussions. One common observation in all lessons was that despite opportunities to develop critical engagement in students through problem-solving approaches, no lessons took a critical approach to education. The absence of critical education, as espoused by Skovsmose (1990), means that students are unable to go beyond problem-solving and develop a critical attitude to see hidden messages contained in curriculum documents. The outcome of this approach is that while mathematics education in Malawi can develop personally responsible, and participatory citizens, it is unable to develop justice-oriented citizens (Westheimer & Kahne 2004).

Conclusion

In concluding the article, we revisit our research questions (1) To what extent does the Malawi curriculum promote CE? (2) What opportunities for CE can be made available in mathematics lessons? Our findings conclude that in general the mathematics syllabus for secondary school promotes CE, but the extent varies across the three criteria of Citizenship Knowledge, Citizenship Skills and Citizenship Attitude and Values. Citizenship knowledge is the least promoted probably because it is not easy to incorporate knowledge of society in the context and application of mathematics. There is also variation in the five mathematics core elements and how each promotes CE. Three core elements were rated moderate to high in their promotion of CE and again these varied across the three criteria. Overall, one of the two approved textbooks rated high in citizenship skills and citizenship values and attitudes and rated moderate in citizenship knowledge. The other textbook rated moderate in citizenship values and attitude and low in the other two criteria. This further illustrates the difficulty of integrating citizenship knowledge in mathematics as also observed by Andersone and Helmane (2013). The differences in the textbooks also illustrate differences in the way the authors translate the syllabus. Hence, it indicates the need for a clearer presentation in the syllabus of how CE can be integrated into mathematics.

Regarding teaching, the study revealed variations in the way teachers provide opportunities for CE. Learner-centred lessons offered more opportunities than teacher-centred lessons. It is interesting to note that the lessons under the core element of *Statistics* provided opportunities for CE, unlike the syllabus. While the lesson on circle geometry constrained opportunities for CE, although the core element rated high in the syllabus. This emphasises the importance of the teacher in implementing the curriculum and therefore has implications for teacher education. Promoting CE needs to go beyond listing in the curriculum materials. This is the role of teacher education through pre-service, in-service and professional

development courses of mathematics teachers. A common observation across all lessons was the lack of critical education, which would allow students to question supposedly value-free assumptions contained in the curriculum.

While it is good that the Malawi curriculum recognises the importance of CE and lists 13 citizenship skills that are desirable, it is only the first step towards achieving the goal. The 13 skills are general and for the entire secondary school curriculum across all subjects. It would be advisable for the mathematics curriculum to translate these into how they can be applied or integrated into mathematics.

Our study had some limitations, including that we decided on our own rating and not based on previously trialled ratings. Furthermore, we selected lessons based on what we saw as interesting to illustrate the differences in curriculum implementation. With these limitations, we do not claim the generality of the findings to teaching mathematics in Malawi, but we illustrate how the opportunities for CE can be afforded or constrained. The findings, therefore, can relate to other contexts similar to Malawi, and can provide insights to many other contexts different from Malawi.

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Authors' contributions

M.K's contribution includes conceptualisation of the study, literature review, methodology, data collection and analysis, writing sections of the original draft, reviewing and writing sections of revised drafts, proofreading and editing completed drafts.

P.N's contribution includes conceptualisation of the study, literature review, data analysis, writing sections of the original draft, writing sections of revised drafts, reviewing and editing revised drafts.

L.M's contribution includes literature review, methodology, data collection and analysis, writing sections of the original draft, reviewing and writing sections of revised drafts.

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Data availability

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Disclaimer

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