An evaluation of secondary school mathematics textbooks in light of sustainable education in Zimbabwe

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Mathematics plays a major role in overcoming future challenges, and mathematical skills as well as problem-solving skills might help provide apt solutions to existing and upcoming economic, social and environmental challenges. Textbooks play a major role in mathematics lessons, and they influence how concepts are taught and learners' understanding of the concepts. The article analysed secondary school mathematics textbooks to find out how they were aligned with sustainable development goals. Content analysis was used to analyse four textbooks that are mainly used in the teaching and learning of mathematics at the secondary school level which are forms one to four in Zimbabwe. The aim was to present how education for sustainable development related content is addressed in the textbooks. According to the findings of the study, the three dimensions (economic, social and environment) of sustainable development goals were reflected in the four mathematics textbooks. Most of the sub-contents in the three dimensions were covered in the textbooks except for climate change, human rights, peace and security, sustainable consumption and narrowing the gap between the rich and the poor.

Keywords: mathematics, education for sustainable development, sustainable development, secondary school mathematics textbooks

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1 Introduction

In the current situation where the world is ever changing people are faced with many challenges globally that require immediate solutions. The education system should reflect the ever changing world so as to deal with societal, economic, political, and environmental challenges in the current situation and require in the future. Education ought to reflect the societal needs of a country, and the needs of the learners who take part in it if what is anticipated is to guide them as well as provide them with a chance for individual accomplishment to live in the 21st century (National Council of Teachers of Mathematics [NCTM], 1989). Sustainable development is a vital idea that meets the requirements of both existing and future generations by merging economic growth, environmental protection, and social development (The World Commission on Environment and Development, [WCED], 1987). Seventeen Sustainable Development Goals (SDGs) were suggested for the 2030 agenda (UN, 2015). The sustainable development goal 4 (quality education) of the 2030 agenda

indicates the significance of making sure that all learners attain the hands-on and theoretical knowledge required to promote sustainable development through education for sustainable development (ESD), global citizenship, gender equality, and human rights, amongst others. An all-inclusive and unified view of economic growth, environmental protection, and social development are crucial in ESD (Biström & Lundström, 2021). According to Miedijensky and Abramovich (2019), many countries have made educational methods to sustainability, for example, changing the curriculum to emphasis more on sustainability or developing sustainability-related activities. As a major priority in implementing ESD in schools, curriculum reorienting has been emphasised by UNESCO (2012). In order to reorient curriculums, it is vital to select and present suitable content and issues in the textbooks. Bell (2016) criticized the current educational structures for not being fully compatible with sustainability values. Bell further suggests that placing emphasis on the role of transformative pedagogy could impact the training of the future generation to be responsive to sustainable goals. However, research has revealed that countries are behind in achieving the 17 SDGs by 2030. Bell (2016) stated that students need to be prepared not only for employment in a sustainable economy but also be equipped with the values and skills that would enable them to live sustainably in this world.

Zimbabwe was not an exception as it updated the curriculum shifting from a content-based focus that put more emphasis on knowledge fulfillment, to a competency-based emphasis that reinforces learners' ability to apply knowledge, attitudes as well as skills in an autonomous, hands-on and accountable manner (Yingi, et al., 2022). The objectives of the updated curriculum are in line with twenty-first-century demands that learners need to be proactive and take the initiative to improve their environment as well as themselves (Yingi, et al., 2022). The word sustainable development was mentioned once in the mathematics curriculum. The curriculum plays an important role in determining the contents of mathematics textbooks, which is an important factor that influences the structure of lessons at secondary school level. Therefore, textbooks are an essential resource to ensure sustainability development in mathematics education. This study intends to explore how ESD related content are reflected in mathematics textbooks (from form one to four) used in Zimbabwean schools. Specifically, the study intends to answer the following question:

How the ESD related contents are distributed in the mathematics textbooks?

2 Education for sustainable development in relation to mathematics

Education is vital for the implication of sustainable development and is also a prerequisite for sustainable development (UNESCO, 2012). The relevance of education was stated as:

> "Education is key to the global integrated framework of sustainable development goals. Education is at the heart of our efforts both to adapt to change and to transform the world within which we live" (Didham & Manu, 2015, p.96).

ESD does not only avail information on environmental, social and economic issues, but also provides for individuals' perspectives, skills and values on issues like decision-making, sustainable life and livelihood in the society. Additionally, global and even local issues are the themes of ESD such that global issues, values, knowledge, perspectives and skills must be addressed in the curriculums (McKeown et al., 2002). WCED (1987, p.43) defined sustainable development as:

> "Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs"

Sustainable development might be fully realized if the three domains of economy, social and environment are thought of as a whole, inseparable and these are fulfilled together and amalgamated into the term (Turan & Çobanoğlu, 2012). Figure 1 shows the relationship between the three domains. There is an interaction between the three domains such that if one of them cannot be achieved, the other two result in failure to achieve sustainable development.

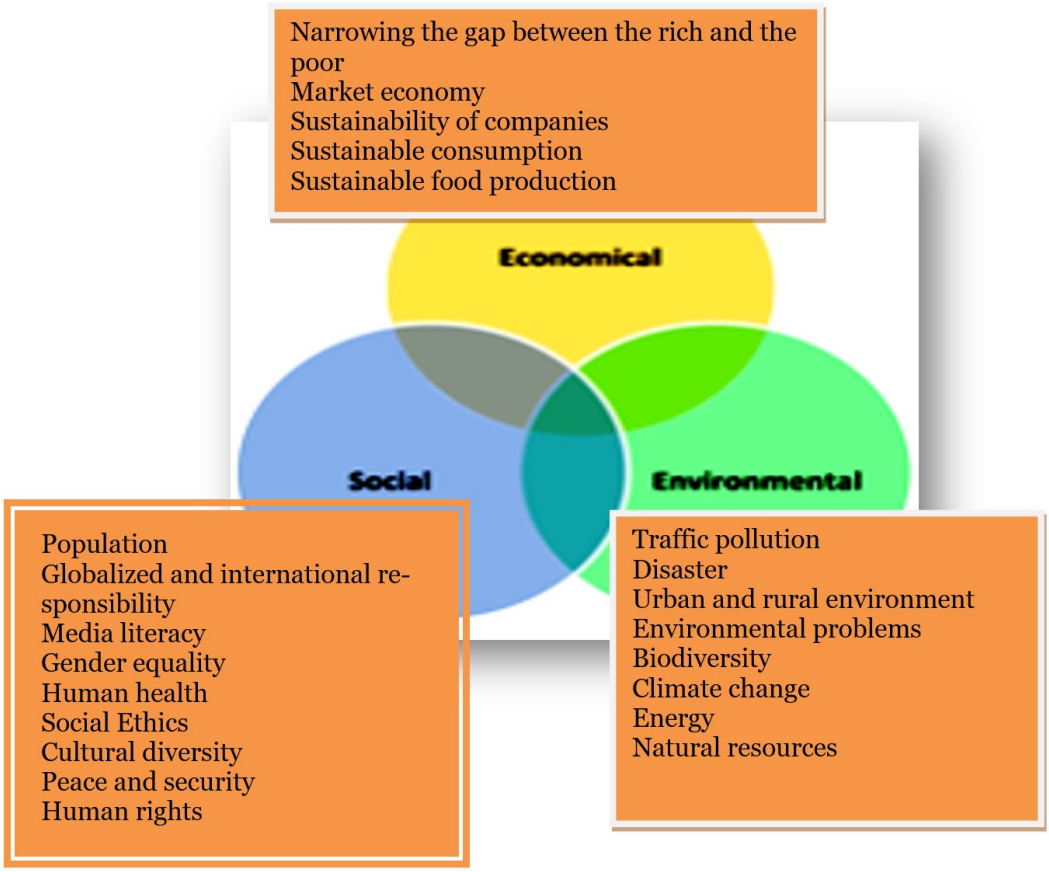

Figure 1. Sustainable development domains

The following are some of the contents in each dimension: market and consumption are associated to the economical dimension; social ethics, gender equality and culture are associated with the social dimension; and climate change, natural resources, disaster and energy are related to the environmental dimension (see Figure 1). The aims of environmental domain are to reduce pollution and other negative impacts on environment, mitigate the effects of industrialization and human activity, and seek to achieve sustainable utilization of resources in the interest of the upcoming generations (Azuka, 2015). The aims of the economic domain are to reduce and seek to eliminate poverty, achieve higher levels of success and enable sustained gains in economic welfare (Azuka, 2015). The aims of the social domain are to reduce and seek to eliminate other dimensions of poverty, improve the quality of health, education, housing, and other characteristics of welfare of individuals and communities, and enhance the quality of social interaction, engagement and empowerment (Azuka, 2015). The incorporation of the domains in ESD is not adequate to educate people who understand and adopt SD alone, but there is a need to equip citizens with SD related competencies because of the nature of the problems faced in

the globalizing world, that result in the solutions and new developments that have effects locally as well as the entire humanity. From this viewpoint, this requires individuals who can deal with difficulties and think about the future whilst taking into consideration the solution to today's problems such as environmental, economic and social that are at the center of SD for them to live a sustainable lifestyle.

Rieckmann (2018, p. 39) highlights the scope of ESD as:

> Education for Sustainable Development (ESD) aims to develop competencies that enable and empower individuals to reflect on their own actions by taking into account their current and future social, cultural, economic and environmental impacts from both a local and a global perspective.

The incorporation of the vital issues linked to sustainable development into the education sector as well as to gaining people's essential skills and behaviors for a sustainable lifestyle are all about ESD (Dannenberg & Grapentin, 2016).

According to Cutanda & Murga-Menoyo (2014) education has a transformative purpose and might be the place for generating a culture of sustainability. UNESCO has outlined the essential role played by education to bring changes in societies:

> Only education and learning at all levels and in all social contexts can bring about this critical change. Education is a fundamental lever of change contributing to poverty eradication, sustainable development, equity, and inclusiveness. It is also a means of realizing broader social, economic, political and cultural benefits. It empowers all people of all ages with the knowledge, skills, and confidence they need to shape a better future. (UNESCO, 2012, p. 13)

Bearing in mind that economy, society and environment are three domains of sustainable development, numerous issues connected to these domains are incomplete without the use of mathematics (Kim & Pang, 2022). Mathematics intertwined with those issues is useful in comprehending environmental, social and economic issues (Kim & Pang, 2022). Barwell (2018) establishes that numerous concepts in sustainability need mathematics skills, for example, mathematically modeling patterns of growth and decline, converting units and measuring. According to Barwell (2018), mathematics is important in understanding climate change at various levels, for example, description, prediction as well as communication of climate change. In addition, analysis of sustainability relies on mathematical representations, for instance, graphs, tables and mathematical equations (Kim & Pang, 2022). Sustainability-related situations were analysed using mathematical equations by Levin (2015).

Mathematics education for SD was defined by Widiati and Juandi (2019) as efforts that are made to instill the value of attitudes, skills, character as well as knowledge by applying mathematical knowledge in areas of economics, culture, society and the environment so that the learning of mathematics becomes more helpful in supporting lives sustainably and the attainment of SDGs. Mathematics education for SD intends to make mathematics learning more practical, meaningful, and help with the development of 21st century competence such as creativity, communicative, critical thinking and collaborative (Widiati & Juandi, 2019). Such competencies are developed when problems in mathematics are presented in the form of applications in the environment, society and economics to enable students to solve future real life problems (Widiati & Juandi, 2019).

Mathematics plays an important role in meeting future challenges. In real life, decisions are made based on data in the modern-day era, hence the need for learners to develop as well as strengthen skills in mathematics. Such skills are crucial for education as well as training and have a significant effect on future employability and job choices. Employers search for workers who are skillful in mathematics for their problem-solving skills. Additionally, to the economic benefits, mathematics is also considered to be a tool that promotes social values as well as democratic values, for example, equality and justice. Democracy demands a means of communication and discoursing principles in a coherent manner, and because of the close relationship with rationality mathematics helps achieve democracy. Safford-Ramus et al. (2016) highlighted that democracy demands operational methods for its real application, and mathematics as well facilitates this.

3 Studies on Education for Sustainable Development

Madusise (2020) reported that mathematics textbooks influence mathematical learning through influencing classroom practices. Textbooks are intended to help teachers in organizing their teaching and suggest a way for learners to follow when examining a topic (Madusise, 2020). Mathematics textbooks play an important role in lesson planning and delivery, the quality of tasks assigned for learners in classrooms and for homework, instructional methods and their influence over the content of lessons and learning outcomes and achievement (Madusise, 2020). Textbooks can be used to influence the implementation of curriculum change in the context of curriculum reform. Research focusing on textbook and curriculum analysis in terms of SD conducted by Mohammadnia and Moghadam (2019) demonstrates that

SD, ESD and the recent study for SDGs are vital ideas that ought to be studied to prepare people for the future. Hence, textbooks and curriculums could be the starting point for comprehending the place of SDGs, SD and ESD in any country.

An analysis of sustainability-related activities in the social sciences textbooks was conducted by Martínez-Medina and Arrebola (2019) in Spanish elementary education. The study categorized activities as human modification of the environment, environmental issues, ethical consumerism, recycling, energy, and general activities. The findings revealed that environmental issues were the most recurrent in the textbooks, pointing to the relevance of understanding a broader range of contents linked to sustainability.

In another study, Andersen (2017) used both textbooks and workbooks from 1st to 6th-grade levels used in primary education in Luxembourg to categorize school tasks pertinent to sustainability according to action-based and task-based learning. The findings showed that in the textbooks little emphasis was made on sustainability, whilst topics in the textbooks cover sustainability implicitly. Additionally, a few tasks focused on environmental issues. The findings further revealed that neither task-based learning nor action-based was considered in the tasks with sustainability content.

At the primary education level, another study was conducted in Bangladesh to explore how ESD was placed in the national curriculum by Haque (2014). The study used both the newly updated 2013 curriculum and textbooks from 1st to 5th grades focusing on all subjects. The results of the study showed that a wide range of subjects linked to ESD was included in the textbooks. The new curriculum was regarded as an opportunity for the inclusion of significant issues such as personal, health, social and environmental education.

In addition, there are studies that focused on issues and contents concerning the society, environment and economy as the three dimensions of sustainability. For example, in a study by Kang (2010) content and organization of ESD reflected in the Korean environment textbooks for middle school were analysed. Kang's study used an analytic criterion that consist the three dimensions of SD including the related contents and topics. For instance, security, human rights and culture were related to the social dimension; market and consumption were related to the economical dimension; biodiversity, energy and natural recourses were related to the environmental dimension. The analytic criteria enabled an understanding of the ESD as they were organized within the three dimensions and their related components.

In another study, Kim and Pang (2022) investigated how contents related to SD were presented in Japanese, Korean, and Singaporean elementary mathematics textbooks. The study used an analytic criterion that comprised the three SD dimensions. The findings revealed that the sustainability-related contents were integrated in the textbooks. The study showed that the chosen elementary mathematics textbooks included the ESD-related contents of three dimensions of ESD: society, environment and economy. Most of the contents were related to mathematics content domains such as Data and Possibilities, Pattern and Number and Operations.

Researchers have analysed textbooks from numerous views such as the learners' view, the teachers' view, or a mathematical view (Stylianides, 2014). The literature revealed that most textbook analysis studies were carried out at the primary level, as shown earlier (see Andersen, 2017; Martínez-Medina and Arrebola, 2019; Haque, 2014). Therefore, this study aims to examine secondary school mathematics textbooks to better understand whether the content in the textbooks is reflective of the values of sustainable development as well as raise awareness of the relevance of the inclusion of such content in mathematics textbooks used widely in the Zimbabwean context.

4 Methodology

In the current study documents in the form of secondary school mathematics textbooks were used as data gathering instruments. Document analysis which is a qualitative research technique is used to evaluate electronic or physical documents in order to interpret them and gain an understanding of what they portray and represent (Luneta, 2013). Physical sources particularly written documents can be examined, evaluated and also categorized using document analysis (Payne & Payne, 2004). Documents are an unobtrusive source of data whose accuracy and dependability can be counted on because they were not made at the researchers' demand, hence documents are expected to encompass authentic data (Yin, 2014). Additionally, documents are a stable source of data as they are physically available and also being time convenient to the researchers. Cresswell (2015) also noted that documents provide researchers with an opportunity to revisit and re-examine the documents to clarify any grey areas or gain more intuitions whenever necessary.

The Zimbabwean secondary education system comprises a six-year course encompassing lower secondary and upper secondary education. The lower secondary level comprises four years of schooling from form 1 to 4, leading to an Ordinary Lev-

el (O-Level) Certificate on successful completion. Learners have an option of joining the labour force, enrolling in non-academic tertiary education, or advance to upper secondary education after successful completion of O-level. The upper secondary comprises a two-year course where learners are offered Advanced Level (A-Level) (Form 5 and 6) studies in preparation for non-academic tertiary education and university. Zimbabwe has a mathematics national curriculum and the textbooks are aligned with the curriculum. Zimbabwean teachers rely on the syllabus provided by the Zimbabwe School Examinations Council (ZIMSEC) a body responsible for setting, marking and dissemination of the nationwide examination and the prescribed textbooks in their instructional practices (Chauraya, 2006). Each form has a prescribed textbook that aligns with the syllabus. For example, for form 1, the New General Mathematics Book 1 is the main textbook used, despite that there are other textbooks that can be used by both teachers and learners. The New General Mathematics series reflect the content and philosophy of mathematical education in Zimbabwe's secondary schools. Books 1 and 2 provide a full course at Junior Certificate level (form 1 and 2). Books 3 and 4 contain a substantial course leading to the General Certificate in 'O' level mathematics. Four secondary school mathematics textbooks (New General Mathematics Book 1 to 4 for form one to four) that were purposively selected were the sources of data. The textbooks were chosen because they are the main textbooks used in the teaching and learning of mathematics and were also authored by the same authors. The main textbooks were analyzed in terms of their content's compatibility with the ideologies of sustainable development. Corresponding to the definition of document analysis and the related research question, mathematics textbooks for forms 1, 2, 3 and 4 were analyzed and the findings described the corresponding contents from the textbooks for three SDG domains.

From the literature review it has been revealed that very few studies have presented an analytic framework for analysing mathematical content from an ESD prospective. Using information from previous studies that focused on ESD-related contents (Martínez-Medina & Arrebola, 2019; Kim & Pang, 2022; Kang, 2010), a framework of ESD-related contents was developed to explore ESD-related contents in the textbooks. The ESD dimensions presented in Figure 1 were used for data analysis. The three dimensions environmental, social, and economic dimensions comprised eight, nine, and five sub-contents, respectively (see Figure 1). Each related topic to the sub-content was elucidated and made clear through descriptions (see Table 1).

Table 1. Related topics by sub-contents of ESD

Dimension	Sub-content	Related topic
Environment	Natural resources	Water, atmosphere, soil, minerals, plants, animals, natural scenery, natural resources conservation
	Energy	Energy types, renewable energy, energy conservation
	Climate change	Global warming, greenhouse gases, abnormal climate
	Biodiversity	Ecosystem equilibrium, endangered species, biodiversity, biological conservation
	Environmental problems	Awareness of environmental issues, efforts to solve environmental problems, nature of environmental problems
	Urban and rural environment	Urban functions, urban problems, the aging of villages, improvement of environments residential environment, environmental problems, rural-urban gap
	Disaster	Types of disasters, causes and solutions of disasters
	Traffic pollution	Traffic pollution, traffic safety, environmentally friendly traffic solutions
Society	Human rights	Human respect, human rights respect
	Peace and security	Understanding nonviolence, nonviolence activities, dialogue and compromise, safety education
	Cultural diversity	Respect cultural diversity
	Social ethics	Correct social ethics, readjustment of legal systems
	Human health	Exercise, health, disease prevention and treatment, obesity, drugs, AIDS, food safety and security
	Gender equality	Gender discrimination issues
	Media literacy	Information communication ethics, media literacy
	Globalization and international responsibility	Understanding globalization, problems of globalization, international solution
	Population	Population growth, population distribution by region
Economy	Sustainable food production	Eco-friendly production, resource-circulating waste management, sustainable agriculture, eco-friendly agricultural products
	Sustainable consumption	Green consumption
	Sustainability of companies	Corporate ethics, corporate responsibilities and duties
	Market economy	Understanding market economy, market economic activity, sustainable commercial sales
	Narrowing the gap between the rich and the poor	Eradication of poverty, combating poverty

Source: Kim and Pang (2022)

The framework of ESD-related contents presented in Figure 1 and Table 1 were used for data analysis. An example of analyzing the content in the textbook is shown in Table 2. Figure 2 shows a temperature chart for a hospital patient.

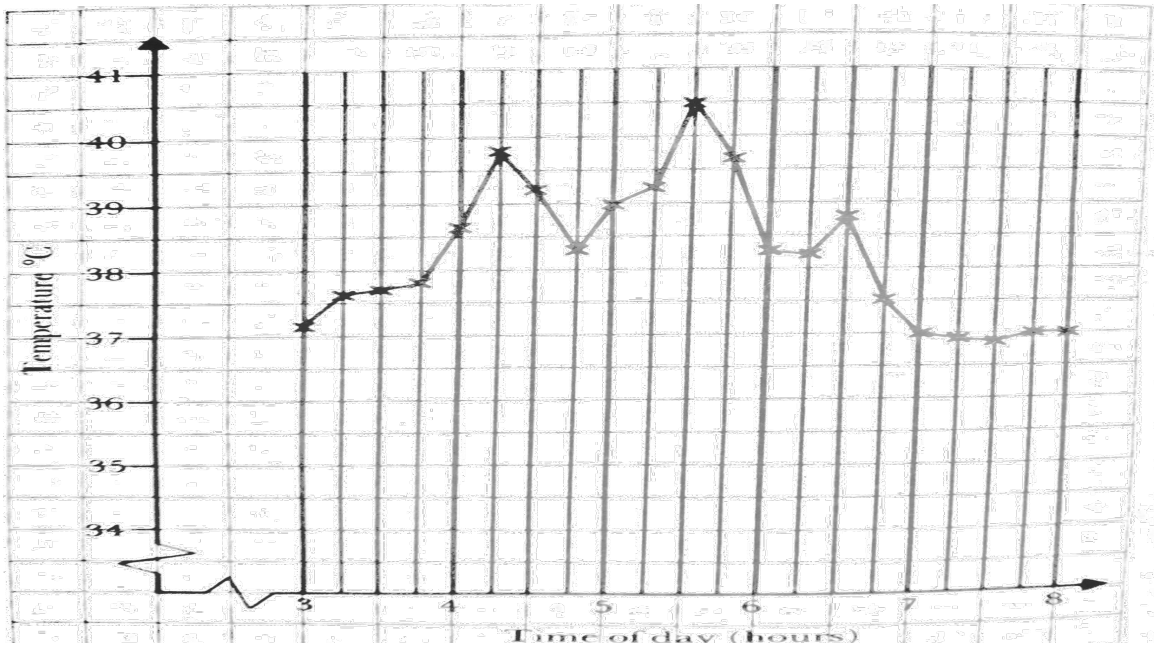

Figure 2. A temperature chart for a hospital patient.

Table 2. An example of analysing the content in the textbook

Content	The temperature is recorded every $\mathbf{1/4}$ hour and is shown in figure 2. What is the temperature of the patient at 0645? What is the highest temperature shown? How many of the recorded temperatures are above 39°C? At what time is the patient's temperature 39°C exactly?	
Result analysis	**Book level**	Book 1
	Dimension-Related topic	Social dimension-health
	Mathematics content domain	Graphs

The contents in the textbooks were coded and categorized by the two authors independently and the coding results were compared. The interclass correlation coefficient for the results was 0.947, indicative of very high inter-rater reliability. Inconsistencies emanating from the coding process were explicated through discussion.

5 Results

In the four secondary mathematics textbooks that were analysed, sustainability dimensions were present (see Table 3). The contents associated with environmental, social, and economic dimensions were presented in all four textbooks. Real numbers, sets, algebra, measures and mensuration and statistics were common mathe-

matics content domains in all four textbooks.

Table 3. Contents by dimension in the four secondary school mathematics books.

Book	Book 1	Book 2	Book 3	Book 4
Dimension	Environment Social Economic	Environment Social Economic	Environment Social Economic	Environment Social Economic
Mathematics Content domain	Real numbers, sets, algebra, measures and mensuration, statistics.	Real numbers, sets, algebra, graphs, variation, statistics, measures and mensuration, financial mathematics, geometry	Algebra, real numbers, sets, geometry, probability, financial mathematics, statistics, measures and mensuration, matrices, graphs	Real numbers, sets, geometry, trigonometry, algebra, probability, graphs, measures and mensuration, variation, financial mathematics, statistics

Other various mathematics content domains such as variation, geometry, probability, financial mathematics, matrices, graphs and trigonometry were covered in books 2, 3 and 4.

Figure 3 show how the mathematics content domains are presented in the textbooks in relation to the three domains of SD.

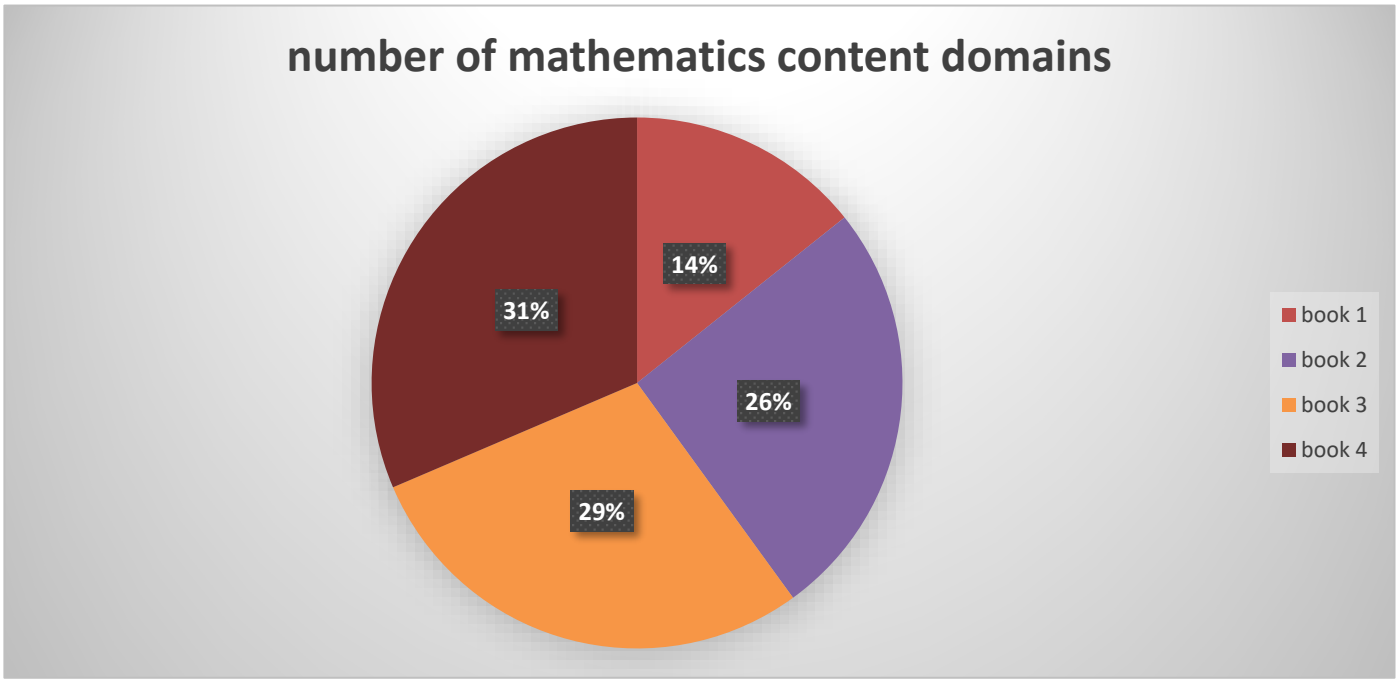

Figure 3. Distribution of mathematics content domains in books

The findings showed that book 1 had the least number of mathematics content domains, whilst book 4 had the highest number (see Figure 3). The distribution of the mathematics content domains is unbalanced in the four mathematics textbooks. It appeared that as the form progressed from one to four the number of content domains also increases gradually.

The ESD-related contents in the textbooks were categorized into sub-contents and their interrelated topics (see Table 1). The results showed that some of the sub-contents were not evident in the mathematics textbooks. Maybe it is due to the fact that the sub-contents and their interrelated topics of ESD do not focus exclusively on mathematics as alluded to by Kim and Pang (2022). Table 4 shows how the sub-contents in the environmental dimension are distributed in each of the textbooks.

Table 4. Distribution of sub-contents in the environmental dimension in each book

Book/Sub- content	Book 1	Book 2	Book 3	Book 4
Natural resources	Sets, algebra, real numbers, measures and mensuration, statistics	Real numbers, algebra, graphs, variation, statistics, measures and mensuration, geometry	Real numbers, sets, statistics, probability, financial mathematics	Graphs, measures and mensuration
Energy	Real numbers	Real numbers, graphs, statistics, financial mathematics	Sets	
Climate change				
Biodiversity	Real numbers, measures, and mensuration			
Environmental problems	Statistics			
Urban and rural environment	Real numbers, statistics		Sets, real numbers	Geometry
Disaster	Measures and mensuration, statistics	Real numbers		
Traffic pollution	Statistics			

Concerning the environmental dimension, all four books encompassed the contents linked to natural resources. An example of the natural resources from book 2 is "In the first six days of the month June, the rainfall was 39mm, 21mm, 17mm, 11mm, omm, 2mm. It did not rain on any of the other days of the month. Calculate

the mean daily rainfall for the six days and the mean daily rainfall for whole month". Another example of natural resources in book 3 "Is the height of height of Mount Everest is 8,85 ×103m. The height of Mount Kilimanjaro is 5, 89×103m. Write these heights in ordinary form and find the difference in the height between the two mountains."

Although, books 1, 2 and 3 covered sub-contents of energy, books 1 and 3 had one different mathematics content domain covering that sub-content. An example of energy from book 1 is "A test car travels 98,6km on 7,25litres of petrol. How many km does it travel on 1litre of petrol?" Another example of energy in book 2 is "Calculate the cost of 388 units of electricity at 10,72cents per unit."

In book 1, biodiversity, environmental problems and traffic pollution were covered. Examples of biodiversity from book 1 are "In the 1988-89 budgets it was decided to spend $19181160 on wildlife management. How might the finance minister say this amount in words?", "A small game reserve is roughly circular in shape and has a diameter of 8km. Estimate the area of the reserve in hectares." and "Mark out a small plot (about 1m2). Count out all things you find growing, living or lying on the plot. Record the number of things you find."

Examples of environmental problems in book 1 are "A piece of land has enough grass to feed 15 cows for 4 days. How long would it last 1cow, 6 cows and y cows?" and "A 3-tonne lorry makes 10 journeys to move a pile of earth. How many journeys would a 5-tonne lorry make?"

Urban and rural environment was covered in three books except for book 3. Examples of urban and rural environment in book 1 are "The distance between two villages is 8km. A boy walks from one village to another. He walks most of the way but runs the last 480m. What percentage of the journey did he run?"; "The temperature in the refrigerator is 2,40C. What will be the temperature if it falls by 3,90C?" and "A goat is tied to a peg in the ground. The rope is 3m long. What area of grass can the goat eat?"

Disaster was covered in books 1 and 2. An example of disaster in book 1 is "The number of people killed and injured in a country during the first year was 8000 and 30023 respectively. During the second year was 9252 and 28854. Find the totals for each year. Which year was safer? How many people were killed in the two years?" Amongst the four mathematics textbooks, only book 1 covered most of the sub-contents of the environmental dimension except for climate change. Whilst the focal point was to solve all the examples using mathematical concepts or principles, this

might present opportunities for students to identify environment problems and think about SD.

Table 5 displays the distribution of sub-contents in the social dimension in the four textbooks.

Table 5. Distribution of sub-contents in the social dimension in each book

Book/Sub- content	Book 1	Book 2	Book 3	Book 4
Human rights				
Peace and security				
Cultural diversity	Real numbers, measures and mensuration	Sets	Sets, probability	Geometry
Social ethics				
Human health	Real numbers measures and mensuration, statistics	Sets, algebra, graphs, statistics	Algebra, matrices, sets, measures and mensuration, probability	Algebra, real numbers, sets
Gender equality	Real numbers, algebra, measures and mensuration, statistics	Sets, algebra, graphs, variation, statistics, measures and mensuration, financial mathematics	Algebra, sets, real numbers, probability, graphs	Real numbers, geometry, trigonometry, algebra, probability
Media literacy	Real numbers, algebra	Graphs, algebra	Algebra, real numbers, sets, geometry, probability, financial mathematics	Real numbers, statistics, algebra, trigonometry
Globalization and international responsibility		Graphs, financial mathematics	Financial mathematics	Real numbers, sets
Population	Real numbers, statistics		Real numbers, statistics	Real numbers,

None of the four books covered the contents related to human rights, peace and security and social ethics. All four books covered content related to cultural diversity, human health, gender equality and media literacy. An example of cultural diversity in book 1 is “There are many languages in Zimbabwe. Find the bases of counting in as many languages as you can”. Another example of cultural diversity in book 3 is “A soothsayer throws some chicken bones on the ground. From the pattern of the

bones she says that the rain will fall next week. Is this a good method? Does it always work compare this method with the use of rainfall records? Can rainfall records always tell us when rain will fall?"

An example of human health in book 4 is following an illness, a patient is required to take pills containing minerals and vitamins. The contents and the costs of two types of pill, Feelgood and Getbetta, together with their daily requirements are (pill, mineral, vitamin, cost); (Feelgood, 160mg, 4mg, 20cents); (Getbetta, 40mg, 3mg, 10cents). The daily requirement for Feelgood is 800mg whilst that of Getbetta is 30mg. A daily prescription contains x Feelgood and y Getbetta pills. State the inequality to be satisfied by x and y. Use a graphical method to show the solution set of x and y. Find the cheapest way of prescribing the pills and the cost".

An example of gender equality in book 2 is "In a school of 750 students, 320 are girls. 559 students do some kind of sport. If 101 girls do no sport, how many boys also do no sport?" Another example of in book 3 is "A boy cycles 16km in an hour and a girl runs4, 4m in a second. Which is faster?"

An example of media literacy in book 4 is "Calculate the cost of sending a telegram if it contains 69 words each costing 36cents". Another example of media literacy in book 1 is "A radio program has x minutes talking and 20 minutes music. How long is the program?" Another example of media literacy in book 2 is "A newspaper and a magazine cost 55cents together. The newspaper costs 35cents less than the magazine. Find the cost of each".

Books 1, 2 and 3 included the content related to globalization and international responsibility. An example of globalization and international responsibility in book 3 is in the first seven months of 1990 Zimbabwe exported Z$100000000 worth of goods to UK. How much forex (in pounds) did this create?" Another example of globalization and international responsibility in book 2 is "The exchange rate between Zimbabwean and British currencies is Z$1, 00=UK£0, 20. Find how many pounds are equivalent to Z$10 and Z$100. Hence draw a conversion graph for changing up to Z$100 to pounds".

Regarding population as sub-content, it was not covered in book 2 only. An example of population in book 4 is "In 1882 census, the populations of populations of 3 largest towns in Zimbabwe were Bulawayo-495300, Chitungwiza-172000 and Harare-658400. Round off these populations to 1 s.f and 2 s.f." Another example of population in book 3 is "In 1920 the population of the world was 1,81 billion. By 1990 it was 5,32 billion. Find the increase in the population during those 70 years".

Table 6 displays the distribution of sub-contents in the social dimension in the four textbooks.

Table 6. Distribution of sub-contents in the economic dimension in each book

Book/Sub- content	Book 1	Book 2	Book 3	Book 4
Sustainable food production		Statistics	Statistics	Measures and mensuration
Sustainable consumption				
Sustainability of companies		Graphs		
Market economy	Real numbers, algebra, statistics	Algebra, variation, graphs, statistics, financial mathematics	Matrices, algebra, real numbers, statistics, financial mathematics	Variation, financial mathematics, statistics, algebra, measures and mensuration
Narrowing the gap between the rich and the poor				

Concerning sustainable food production as a sub-content in the economic dimension, it was covered in three books except for book 1. An example of sustainable food production in book 2 is “A farmer has 100 cows, 40 sheep, and 65goats. Draw a pictogram to show these animals. The production of coffee in tons in 2-year from 1982 to 1990 is given as (year, tons); (1982, 750); (1984, 1600); (1986, 3800); (1988, 3200); (1990, 4100). Show the increase on a bar chart and a line graph”. Sustainable food production was covered in various mathematics content domains implying that this sub-content is easy to integrate into the mathematics teaching and learning. Sustainability of companies was only covered in book 2. Market economy as a sub-content in economic dimension was covered in all the four textbooks. An example in book 3 is “A factory increases its annual production of radios from 4325 to 4671. Calculate the increase per cent. Calculate the number of radios it would have had to produce for an increase of 12%”. Sustainable consumption and narrow the gap between the rich and the poor were not covered in any of the four textbooks. In the Zimbabwean context, this might imply that it is not easy to connect issues to do with sustainable consumption and narrow the gap between the rich and the poor in the teaching and learning of mathematics.

6 Discussion

The society faces SD related challenges every day that have resulted on discussions on how to develop the nation socially and economically with the intention of achieving environmental sustainability (Echegoyen-Sanz & Martin-Ezpeleta, 2021). Education plays a crucial role in SD, and it has been highlighted by different policies both locally and internationally (UNESCO, 2014). Mathematics has vital roles to play in SD and for the general development of the world at large (Azuka, 2015). Given the crucial role played by mathematics in SD, the findings of the current study show great potential of relating mathematics content to SD as revealed in the mathematics textbooks. The findings are encouraging and there is a likelihood of integrating SD into the teaching and learning of mathematics in Zimbabwean context.

In the four mathematics textbooks that were examined, the three sustainability dimensions were present. The findings are in line with Serow (2015) whose study showed various mathematics content domains related to ESD in mathematics textbooks. This might imply that ESD-related content could be connected to various mathematics content domains. The finding concurs with Kim and Pang (2022) whose study revealed that the three SD dimensions were present in the elementary mathematics textbooks that were analysed. In addition, the study revealed that some sub-content were totally absent in some textbooks and abundant in some others. The findings are in line with earlier findings by Mohammadnia and Moghadam (2019) who indicated an uneven distribution of SD sub-contents. Unlike Kim and Pang (2022) who reported that geometry and measurement were not covered in the textbooks, the only content domain that was not covered in any of the ESD-related domains in this study is vectors.

Regarding the environmental dimension, mathematics content related to natural resources was present in all the four textbooks. The finding concurs with earlier findings by Kim and Pang (2022) who reported that natural resources as sub-content were covered in Japanese, Singaporean and Korean textbooks. It appeared as if the sub-content of natural resources is easy to combine with mathematics, whilst climate change appears to be difficult to combine with mathematics as it was covered in any of the four books. Regardless of the belief that mathematics is vital in grasping and addressing the climate emergency because so much is understood about the world through mathematical models and representations (Barwell, 2018), none of the four books covered climate change, yet it's a global concern.

Concerning the social dimension, the absence of the contents related to human rights, peace and security and social ethics in the four books contradicts Kim and Pang's (2022) findings in Japan, Korea and Singapore where social ethics and peace and security was covered in all the textbooks. Cultural diversity, human health, gender equality and media literacy evident in the four textbooks were among the sub-contents of social dimension mentioned in textbooks by Nguyen (2019).

Regarding the economic dimension, all four books covered market economy and none of the four books covered sustainable consumption and narrowing the gap between the rich and the poor. The findings disagree with Kim and Pang (2022) who reported that sustainable consumption was covered in Japanese and Singaporean textbooks, whilst narrowing the gap between the rich and the poor was covered in Korean textbooks.

The findings of the current study contribute to the understanding of the presence of SD related content in mathematics textbook in Zimbabwe. Mathematics textbooks have a great potential for integrating SD related content in the teaching and learning of mathematics. The findings might be useful for textbook writers, educators, policymakers and mathematics teachers to have a clearer picture of the current content in textbook and to take measures to improve it aligning with the contents of ESD.

7 Conclusion

The three dimensions of sustainability that is the environment, society and the economy were evident in the four mathematics textbooks. The findings might be construed as that the reflection of all three dimensions in the four mathematics textbooks is notable for the accomplishment of SD from all dimensions. In fact, it was not surprising that natural resources in the environmental dimension were covered in all four textbooks. However, some sub-contents such as climate change in the environment dimension, human rights, peace and security and social ethics in the social dimension and sustainable consumption and narrowing the gap between the rich and the poor in the economic dimension were not covered in the four textbooks. The results of the current study give rise to the assumption that such social, economic and environmental sub-contents need to be incorporated into mathematics textbooks to guarantee that SDGs find their way into the mathematics classroom. In addition, all the sub-content of the three dimensions of SD should be addressed equally in all the textbooks.

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