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Teachers' beliefs about the relevance of the mathematic curriculum given emerging societal crises and knowledge demands

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Abstract

In an era inundated with statistical and mathematical information through various media channels, members of the public must grasp these concepts if they are to understand global developments like public health crises and climate change. In this study, we explored teachers' beliefs about the relevance of the curriculum in the context of the COVID pandemic and sought to identify, from their perspectives, the changes needed to improve its relevance. We had 56 teachers participate in an online survey, eight of whom were also interviewed later. Our findings revealed that participants believed the curriculum helped prepare learners to understand certain aspects of the pandemic-related information. However, they noted that the information was more complex than mere mathematical calculations might be, so required a careful coordination of appropriate mathematical and contextual relationships. Many teachers suggested changes focused on providing more opportunities for learners to engage with real-life applications of mathematics. There were variations in teachers' perspectives on curriculum content, with some emphasizing the importance of broader cognitive processes while others focused on specific topics. These differences were influenced by factors such as teaching experience, educational background, and teaching phase.

Keywords: curriculum relevance, real-life context, mathematics, teacher beliefs, pandemic

Introduction

Citizens, including young adults from all walks of life, are inundated with mathematical information from diverse media channels of which they need to keep abreast. These include accounts of ongoing national and global developments and disruptions, such as those regarding public health and/or environmental and climate change issues (Bargagliotti et al., 2020). When the COVID-19 pandemic struck, it became necessary for governments, health institutions, and media to communicate volumes of mathematical information in a bid to keep ordinary people informed about the seriousness of the issue. The general public was provided with much information, as well as visualisations via news media, websites, social networks, and blogs as Gal and Geiger (2022) noted. There was also widespread use of new related terms like *flattening the curve* and *seven-day average* and the extensive use of modelling, with its specialist terms, became widespread. These terms require different and/or more advanced interpretations than the standard school statistics content provides and are not necessarily well understood by the public (Heyd-Metzuyanim, et al., 2021).

The COVID global crisis brought into focus concerns about whether the curriculum helped learners to understand the mathematical information presented in the media. To explore these concerns further, we set up this study to explore teachers' perspectives on these issues. We wanted to investigate teachers' perspectives on the relevance of the mathematics curriculum in preparing learners to navigate the extensive mathematics-related pandemic information and what needed to change or be emphasised so that it could be made more responsive to such real-world application. Accordingly, the research questions that underpinned this study were:

1. What are teachers' views about the relevance of the curriculum in helping learners understand the mathematics-related pandemic information presented in the media?
2. How did teachers perceive the difficulty of understanding the mathematics-related pandemic information presented in the media?
3. What are teachers' beliefs on how the curriculum could be made more responsive to real-life situations like the COVID pandemic?

With this small-scale study, we provide a snapshot of teachers' beliefs about the necessary changes to the curriculum in the light of the knowledge and data literacy demands brought about by the COVID pandemic. We hope that the study will lead to an interrogation of the curriculum and of related teaching practices, so that learners can be better prepared to understand the complex information disseminated about globally disruptive events, such as health crises and climate change, among others.

Literature review

In this review, we provide an overview of the intersections between and among teacher beliefs, statistical literacy, curriculum use, and the interpretation of mathematics in real life contexts. We begin by exploring how teachers' beliefs shape their approaches to mathematics education. We then delve into the context of the COVID pandemic during which understanding complex statistical information became crucial. Furthermore, we explore how

teachers make use of the curriculum as a resource before discussing the difficulties they face in fostering statistical literacy in their learners, and the significance of linking mathematical concepts to real-world applications.

Teacher beliefs

Teacher beliefs in this context refer to their deeply held convictions and understandings about the nature of mathematics, their roles as mathematics teachers, their students, the curriculum, and the learning process (see Cross, 2009; Kasa et al., 2024). Teachers' beliefs about mathematics influence the design and execution of their lessons and this, in turn, affects learner engagement and outcomes following mathematics lessons. Understanding these beliefs is therefore essential for fostering effective educational environments.

Teachers construct their own personal beliefs about the purpose of mathematics education, while pre-service teachers grapple with how to convey both the procedural and conceptual aspects of the subject (Yang et al., 2020). Warren and Nisbet (2000) found that some teachers believed that mathematics is a static and unchanging body of knowledge, while others had a mechanistic view that learning mathematics involves direct instruction and the accurate application of procedures. Kasa et al. (2024) identified different belief systems that permeate teachers' instructional approaches. For example, those who recognised mathematics as dynamic believed that it must be connected to the resolution of real-world problems, while those who believed in the abstract nature of mathematics emphasised the intricacy of the structure of knowledge. A study by Yang et al. (2020) found that mathematics teachers' dynamic beliefs about mathematics were strongly associated with their self-reported instructional practices and that these beliefs acted as mediators between their knowledge and such practices.

Complexity of the pandemic information and the need for statistical literacy

The COVID pandemic created the need to make sure that the general population understood the extent of the health threat, as well as the measures taken to slow the growth of the disease in attempts to flatten the curve. Significant volumes of articles were published by the media about the statistical models predicting the number of exponentially growing cases (Bargagliotti et al., 2020). Data visualisations were also used to illustrate effectively the complex information about the actual and the expected progress of the disease. Shreiner and Dykes (2021) argued that these developments show how important it is for learners to understand the concepts and conventions used in graphs and charts.

These communication tools used to share COVID-related information highlight a deeper issue that emerged during the pandemic—the important role played by statistical literacy in enabling people to understand and interpret media information effectively. Statistical literacy refers to the ability to understand, interpret, critically evaluate, and use statistical information in various contexts (Gal, 2002). It also involves acquiring the skills to read and comprehend data presented in graphs, charts, tables, and reports.

It is important that learners are given ample opportunity to participate in statistical problem-solving processes while doing projects arising out of real-life settings. These involve formulating statistical investigative questions, collecting data, analysing data, and interpreting the results. Participating in such activities will allow learners to develop these statistical literacy skills and allow them to move beyond just carrying out procedures and calculations (Bagagliotti et al., 2020).

Navigating the curriculum

Guiding learners to move beyond the data and compelling them to interpret, reason, and make meaningful connections from it is no easy task for teachers. What teachers emphasise in their teaching is influenced by their beliefs and knowledge about curriculum goals (Cross, 2009). When the curriculum is described in terms of topics that specify mathematical content e.g., fractions and linear graphs among others, this should convey the impression that there are topics that must be covered. The curriculum can also specify the cognitive processes, like, for example, reasoning and interpreting that encompass the mental actions in understanding and applying the content (Greenes, 2009). By connecting both aspects explicitly, teachers can create a road map for their learners' instruction. Sometimes education departments prioritise the listing of topics from the curriculum in workplans for teachers and this may then encourage them to view the curriculum as a list of topics that need to be ticked off to show that progress in teaching has been made (Mkhwanazi et al., 2021).

In a study with 75 mathematics teachers from KwaZulu-Natal, Umugiraneza et al., (2018) set out to explore the teachers' beliefs regarding the ways in which they could work with the mathematics curriculum. These researchers found that only 60% of the teachers actually used the curriculum document. They also found differences in the ways in which teachers believed they worked across the mathematics curriculum, based on their phase of teaching, their age, and their participation in professional development workshops. Umugiraneza and colleagues found that Further Education and Training (FET) teachers who taught Grades 10–12 found it harder to describe links across the curriculum when compared to their counterparts who taught Grades 4–9 and this difference was statistically significant. Furthermore, younger teachers (aged up to 40 years) were significantly less likely than older teachers to have used the curriculum documents. A further finding, related to teachers' professional development participation, indicated that teachers who attended professional development workshops were more likely to use the curriculum documents than those who did not (Umugiraneza et al., 2018).

Challenges faced by teachers in enhancing learners' statistical literacy skills

Many teachers struggle with statistical literacy themselves, making it challenging for them to target the development of these skills in their learners (Harrel-Williams et al., 2019; Umugiraneza et al., 2022). Mathematics teachers find instructional approaches related to computing well-defined mathematical and statistical procedures easier to manage (Lampen,

2015). Many mathematics teachers still rely on traditional methods instead of employing data-driven ones that focus on the development of statistical reasoning (Wessels & Nieuwoudt, 2011).

Studies show that teachers lack confidence in their ability to develop statistical reasoning among their learners. The study by Shreiner and Dykes (2021) found that only 11% of the teachers expressed confidence in their ability to guide learners effectively in engaging with data visualisations. Harrell-Williams et al. (2019), in their study about teachers' self-efficacy to teach statistics, identified three levels of engagement with the data. The first level is that of reading the data, which involves a literal reading of it. The second is that of reading between the data, which may involve making comparisons and observing relationships. The third is being able to read beyond the data and refers to the ability to make inferences and predictions about it. Teachers' self-efficacy estimates were lowest in the third level of reading beyond the data, which requires critical interpretation of it (Harrel-Williams et al., 2019). A related finding by Umugiraneza et al. (2022) was that teachers are more confident about teaching well known concepts and procedures, and less confident about instructional approaches that can develop critical thinking.

Interpretation of mathematical concepts in a real-world context

If we are to build on these findings, it is important to recognise that interpreting mathematical concepts within real-world contexts poses additional challenges. Research indicates that interpreting and recognising the implications of a concept set within a context can be more challenging because of the need to coordinate the information from the two domains—mathematical and contextual (Bansilal, 2013; Tall, 2011). The internal structure and properties of a mathematical concept or procedure are constrained when it is applied within the boundaries of a context because of the relationships that arise from the context. For example, the concept of inflation arises as an application of the percentage increase procedure, given by (B-A)/ A, where A and B are the original and final values of a quantity respectively. In the context of inflation, the formula becomes (i_1) = inflation rate = ($P_1 - P_0$)/P_0, where P_0 and P_1 are the average cost of a basket of goods in one year and the next year respectively, measured in a particular month (Bansilal, 2017). Here each of the quantities in the formula has a specific interpretation that leads to some of the characteristics of the inflation concept. The order of the difference in the numerator is fixed; the quantities P_0 and P_1 are related to the average cost at a particular month and the measurement is over two consecutive years. All these factors must be considered in interpreting the inflation rate figure since the relationships between the quantities are constrained by the context.

Bansilal's (2017) study on teachers' understanding of inflation found that 95% of a sample of 59 in-service teachers were able to carry out a percentage increase calculation correctly in a decontextualized setting. However, only 37% of the group could work out correctly how the cost of an item changed if it kept pace with inflation over a two-year period, given the relevant inflation figures. In other words, only 37% were able to carry out a two-step calculation using the given inflation rate figures. This wide disparity in success rates

illustrates the difficulty involved in interpreting specific calculations in a special context in which the relationships between and among the quantities underlying the concept are shaped and bound by the context.

A framework to describe the application of mathematics concepts in the COVID context

We draw on the work of Duranti and Goodwin (1992) who, in the field of linguistics, elaborated on the contextual attributes that need to be understood and interpreted for a person to participate in discourse about context. The authors argue that it is the context that provides the resources for the interpretation of the phenomenon under study. Drawing on previous work (Bansilal, 2013; Bansilal & Debba, 2012), we identify three contextual attributes that can provide the tools for working with the mathematical concepts applied in the context of the COVID pandemic.

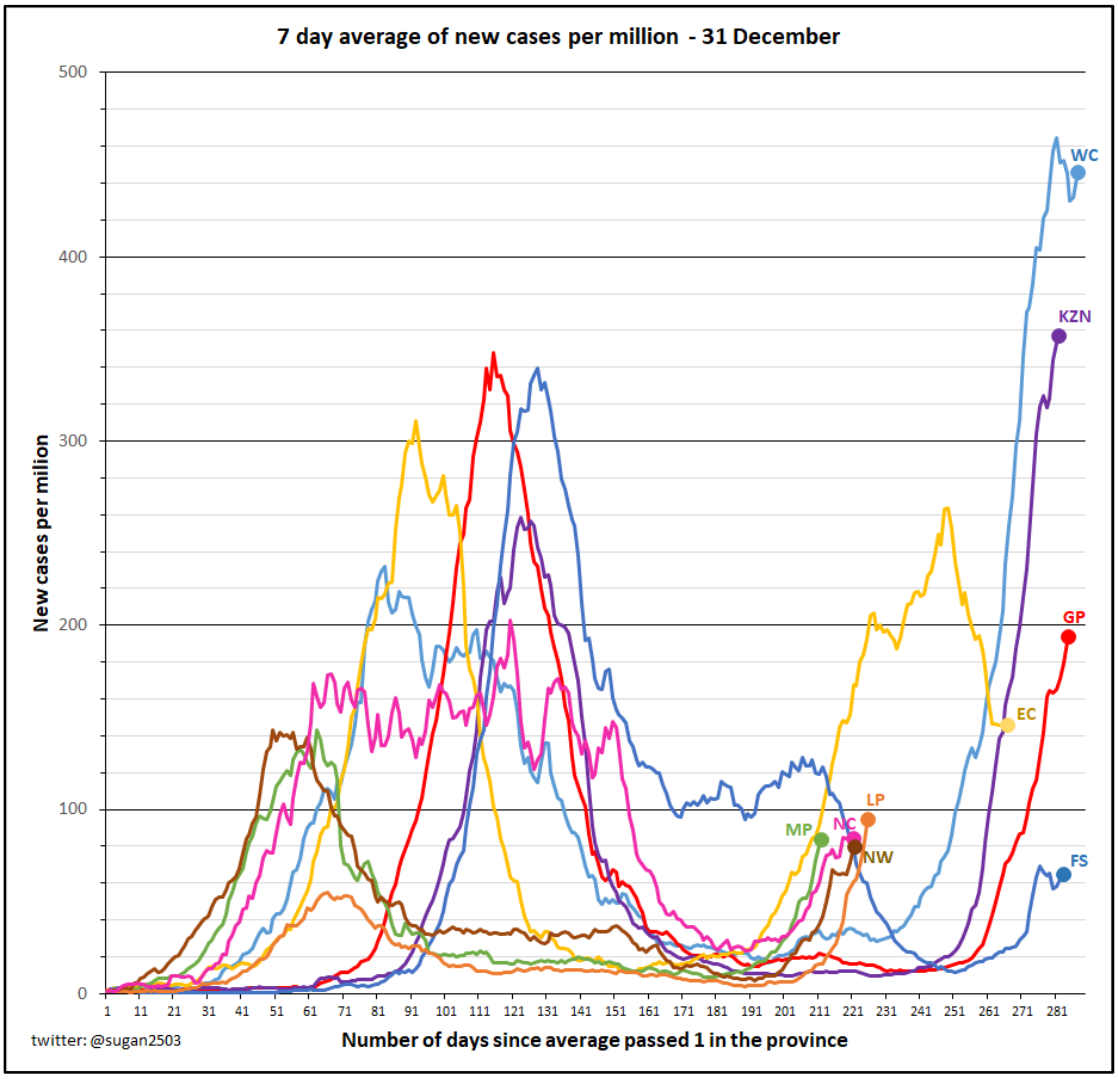
1. Contextual language. This refers to words or phrases that hold a particular meaning in the context. Examples of the use of contextual language in the COVID context include phrases such as *new cases per million*, *seven-day average* of new cases, and *flattening the curve*.

2. Contextual rules or procedures. These are bound to the context and, in this case, need to be interpreted in the COVID context. For example, to compute the figure for the new cases per million, one would take the number of new cases and divide it by the population in terms of millions where the new cases are found. For example, if there were 253 cases in City A which has a population of 200 000, then 253/ 0.2= 1265 new cases per million in City A.

Another example is the rule used to work out the rolling seven-day average of new cases. The phrase *seven-day average* represents the average number of new infections reported over a rolling seven-day period. It smooths out daily fluctuations and provides a more stable view of the disease's progression and is used by public health officials to assess the effectiveness of control measures. In order to find the seven-day average for a particular day, say Day K, one would need to find the numbers for the past seven days and for the present Day K, that is for days k-6; k-5; k-4; k-3; k-2; k-1and k, to make up the seven-day average for Day K. Then for Day K+1, one would need to average the numbers for Days K-5 to K+1. This procedure is bound to the context since the quantities used hold a particular meaning in the context.

3. Contextual graphs. These are graphs used to present information about the context. For example, a common graphic used to share pandemic information was the graph showing the 7-day average of new infections as seen in Figure 1. The graph is somewhat difficult to understand with the inclusion of the different curves for the various provinces. In the concept of seven-day average, there is a moving set of seven values each day that must be averaged for the particular day, as explained above, under Contextual Rules. The further complication is that the values are derived from a rate (new cases per million). When plotted on a graph, the information becomes much more complicated and more difficult to understand.

Figure 1
Graph used to show the seven-day average of new cases per million in each province



Methodology

With the onset of the COVID pandemic, huge volumes of pandemic-related information were given by the media to the public to help them understand the progression of the pandemic and make informed decisions about their health and safety. The purpose of this study was to elicit teachers' views about the relevance of the mathematics curriculum in helping learners understand this COVID-related information. Furthermore, it sought to find out how they rated their difficulty in understanding the information and their beliefs about the changes needed to make the curriculum more relevant. This study forms part of a larger study by researchers from four countries (Brazil, Australia, South Africa, and Israel) on teachers' perceptions about content related to statistics and mathematics in print and in digital media regarding the COVID pandemic.

This study reports on South African data from KwaZulu-Natal, generated from responses to an online questionnaire that was circulated to over 300 teachers. This number was made up of

groups of mathematics teachers from two districts in KwaZulu-Natal, as well as postgraduate students from the School of Education who were also practising mathematics teachers. Fifty-six participants completed the voluntary questionnaire. Additionally, there were two focus group interviews each conducted with four teachers. The participants in the focus groups were selected from those who indicated in their questionnaire responses that they would be willing to be interviewed as well as their availability for the interviews.

The survey covered a wide range of topics, including teachers' perceptions regarding their exposure to pandemic-related media, perceived understanding of applications of mathematical concepts in the pandemic-related media, what they considered important in their teaching approaches, as well as their thoughts regarding needed changes in content and teaching methods. The survey combined Likert scale and open items. The focus group interviews were unstructured and expanded on some of the issues that emerged from the survey.

We use the pseudonyms QT 1− QT 56 to represent teachers' responses to the questionnaire. Codes such as IT1_1 and IT2_4 were assigned to teachers who participated in the two interviews, where IT1 and IT2 distinguishes between interview 1 and interview 2. The number denoted by the underscore 1–4 represents a teacher who participated in each interview. Hence IT1_1 denotes Teacher 1 who participated in Interview 1 while IT2_4 denotes Teacher 4 who participated in Interview 2.

The study used a mixed methods sequential explanatory design approach so the quantitative data was obtained and analysed first, and then the qualitative data was collected and analysed (see Ivankova et al., 2006). The Likert scale responses to the questionnaire were captured as percentages and represented in tables or pie graphs. The questionnaire also asked teachers specifically about what they considered to be key topics or ideas in mathematics essential to understanding the news that appeared. The responses to this open item were coded in terms of whether they focused on curriculum topics, data literacy skills, or cognitive processes. Examples of responses that were coded as topics are "Statistics or calculus" (QT5) or "Mean, mode, range, standard deviation" (QT1). An example of a response that was coded as process is "Understanding and interpretation of stats" (QT16).

The interviews were first transcribed and then analysed to provide more insights into responses related to quantitative data.

In the quantitative analysis, we used Chi-square tests to explore the relationship between pairs of variables that were made up of categories instead of being on a continuous scale. The variables that were studied were gender, teaching experience, and main teaching subject. Chi-square tests assess whether there is a significant association between two categorical variables while assuming independence between them, by comparing the observed frequencies of each category with the frequencies that would be expected if there were no relationship between the variables.

Table 1 provides a description of the 56 participants.

Table 1
Demographics of participants

Variables	Categories	Frequency
Gender	Male	25
	Female	31
Maths teaching experience	≤ 10 years	26
	≥11 years	30
Main teaching subject	Mathematics Further Education and Training (Maths FET)	18
	Mathematical Literacy (ML)/ Mathematics Senior Phase (Maths SP)/ Mathematics Primary (Maths Prim)	27

Results

In this section, we first consider the teachers' views about the relevance of the curriculum in terms of preparing learners to understand pandemic-related mathematical information. This is followed by the presentation of their views about their rating of how difficult they thought the pandemic- related concept was to understand. The third subsection focuses on teachers' views about what needs to be changed or emphasised to make it more relevant for learners to help them better understand information about such real-life situations.

Relevance of mathematics curriculum to real-life scenarios

Generally, most teachers agreed that mathematics teaching should enable learners to make links to real-life issues as shown Table 2. Teachers were asked to rate the following statements using a five-point Likert scale (strongly disagree, disagree, neutral, agree, agree strongly).

Table 2
Levels of agreement of participants to statements about linking mathematics to real life settings

Pandemic related concept	Agree	Strongly Agree
Mathematics teaching should develop students' abilities to link their school mathematics to real life issues	19.3%	78.9%
Mathematics teaching should develop students' willingness to be critical about mathematical or statistical information presented in the media	45.4%	53.6%

Pandemic related concept	Agree	Strongly Agree
Mathematics teaching should develop students' mathematical/ statistical literacy as an important capability for informed participatory and effective citizenship.	40.4%	57.9%

Table 2 shows that over 98% of the teachers agreed or strongly agreed that one of the goals of mathematics should be to develop learners' skills in linking mathematics to real-life settings, in being critical of media information, and in becoming effective citizens. This shows that the teachers agreed overwhelmingly that learning mathematics should help learners to participate and make informed decisions in situations that rely on mathematical reasoning.

With respect to the particular case of the COVID pandemic information, in the interview the teachers agreed that mathematics could help inform students more about the information presented about the pandemic because of the tools and resources it made available. Participant IT2_1 said during the interview,

> For them to understand media and news about coronavirus in the data handling analysis, statistics will definitely help your learners to understand.

IT1_3 explained,

> I think maths the subject allows them to analyze the stats, I know the media presents it in a very user friendly way, we can see who's positive how many deaths and you know you could see it per province and stuff like that, but I think math also allows them to . . . look at the seven day average and understand the meaning behind what a seven day average is.

Teacher IT2_1 felt that the work learners did in statistics and data handling gave them a vantage point from which to understand the media information while Teacher IT1_3 reflected that the maths that learners did at school could help them better understand the information.

However, Teacher IT1_3 raised the important point that the media conveyed the mathematics within the COVID context in a user-friendly and more accessible way. There is a subtle difference between how learners explore mathematics in the classroom, where the focus is on deepening an understanding of the mathematical concepts, and on how they explore media communication since in the former there is less emphasis on how the crucial mathematical information can best be conveyed so that it is understood; the purpose of the media communication is somewhat different from the pedagogical one. The ways in which the information was used and presented by the media illustrates that it is important for learners to be given opportunities in the classroom to explore how mathematics concepts are applied to real-world contexts.

Teacher IT2_1 was of the opinion that if we shifted to doing more statistics in class it would help learners to apply the concepts to the real-world context. The teacher said,

> That shift will be beneficial for the learners to try and make use of the statistics to understand what's happening in the real world, especially during this pandemic. And that is vitally important for them, because there's so much stats available about the pandemic and they need to interpret [them].

Teacher IT2_1 in the extract above pointed to the need to have the statistics presented in the media interpreted. This points to different levels of working with statistics. Research has identified that learners are well able to work with the procedures and calculations related to statistics, but find it harder to look beyond the figures and interpret them (Kazunga et al., 2023).

Engaging with the pandemic related information

In this sub-section, we explore teachers' rating of the difficulty of understanding the pandemic-specific information. With the onset of the pandemic, the reports drew on COVID-specific contextual terms and phrases related to mathematics concepts that were not familiar to the ordinary person. The COVID contextual language used commonly by the medical research community in sharing issues about diseases and their progress was not part of the everyday vocabulary of most people. Our participants were given the statements starting with "When I read the news/ media about the pandemic, I understand . . .". The five- point Likert scale options were: never; rarely; sometimes; mostly; and always. A summary of these responses appears in Table 3 below.

Table 3
Teachers' rating of difficulty in understanding COVID-related concepts

Pandemic related concept	Always (understand)	Mostly
Numbers of the total number of deaths due to COVID	38.5%	49.1%
Total number of people tested	35.1%	54.4%
Rate of "positive tests"	50.9%	38.0%
Predicted number of future deaths from COVID	21.1%	52.5%
Models or modelling of the progression of the pandemic	22.8%	42.1%
7-day average of infections	29.8%	43.9%

Generally, most teachers (between 65% and 89%) reported that they mostly or always understood the contextual terms used in the media to describe the progress of the pandemic. Those concepts based on counting numbers seemed to have been more easily understood, for example 90% of the teachers (Table 3) said they always or mostly understood the concept of the total numbers tested. For those concepts related to more complex mathematics, such as modelling, 65% said they almost always or mostly understood it in the context of the pandemic. There were differences in the teachers' rating depending on the complexity of the concept.

The pandemic concept of the 7-day average of new cases per million seemed to baffle many ordinary people but 30% of the teachers felt that they always understood this concept (see Table 3). During the interview, teachers offered their views about the complexity of this particular pandemic concept as applied to the pandemic. Participant IT1_1 said,

> Even after I teach average, the concept of average, if I have to give this graph to learners they will find it a bit challenging to make sense of the phrase seven-day average because we only teach average. . . they will find it a bit challenging because the concept of average, they understand average, but now you have a seven day average, what does that mean to them?

This teacher has alluded to the difference between calculating an average of a set of numbers which is commonly covered in the curriculum from primary school. Participant IT1_2 commented on the fact that the COVID concept of a rolling day average was a loaded term in saying,

> It's a loaded term that- the rolling seven-day average of new cases per million. . . and then it's a different value every day, the average for yesterday is different from today, and some values are common to both.

One teacher, IT1_1, also alluded to the further complexity of the contextual rule for the rate calculation where numbers represent the number of new cases per million in saying,

> Then you have [to consider that these are] new cases per million, million . . . that for that seven-day average to unpack that. . .

These comments illustrate how complex it is to apply a mathematics concept to a real-life context. In this case it involves the rules for average and rates per million, but these quantities are defined within the COVID context. In this setting 1T1_3 explained that

> more time should be given to stats and probability so learners need to get an idea of what these numbers mean. They need to understand the stat behind the pandemic.

The above comment is about helping learners understand the meaning of the statistics within the context. In the mathematics class concepts are often taught on their own and the complexity of the applications often depends on the complexity of the calculations. In this situation the complexity is driven by the variation of the different quantities within the context and one requires mental mechanisms of coordination that are recognized to be cognitively challenging when applied to different concepts (Bansilal, 2013).

Teachers' views about needed changes

When asked about changes that were needed to prepare learners to understand the news media bulletins about the pandemic, most teachers felt that more, or much more, class time was needed for these concepts as is shown in Table 4. The question posed to the teachers was: *If we want to prepare learners to understand the news media about a pandemic and its*

effects, is there a need to give attention to . . . ? The six options that were offered were: much less class time, less class time, no change, more class time, much more class time, I am not familiar with the topic.

Table 4
Responses of teachers about changes in class time needed

Topic	More class time needed	Much more class time
Calculating the probability of a simple event	35.1%	24.6%
Interpreting percentages and averages	52.8%	17.5%
Reading and interpreting simple line graphs	54.4%	19.3%
Doing mathematical modelling	39.3%	32.1%
Interpreting complex graphs	49.1%	29.8%

The percentages in Table 4 show that most teachers believed that the amount of time we spend on applying these concepts to real-life contexts was not sufficient. Almost 80% of teachers felt that there was a need for greater emphasis on complex graphs of the type depicted in Figure 1. Teachers did not feel as strongly about extending the time for simpler concepts such as percentages (70%) and for calculating the probability of a simple event (59%), perhaps because they felt that learners understood those concepts well enough.

The questionnaire also asked teachers specifically about what they considered to be key topics or ideas in mathematics that are essential for understanding the news that appeared. The teachers' responses revealed two views about the curriculum. First, many teachers responded by naming a topic or topics. It seems that for some teachers the curriculum was comprised of a list of topics, as used in some departmental workplans, that need to be covered (Mkhwanazi et al., 2021). Second, some teachers referred to the big ideas or cognitive processes underpinning the topics or skills that they felt learners needed to know. This approach is more aligned to the notion of developing statistical literacy, therefore towards helping learners read between and beyond the data (Harrell-Williams et al., 2019).

Teachers reflected in the interviews that the guidelines from the Education Department itself seemed to encourage a view of the curriculum as a list of topics rather than one of trying to move towards developing these statistical literacy skills. for IT2_1,

> We are introducing more topics in stats, more work instead, where the focus should be for learners to understand the pandemic and interpret all the data that's available.

And, for IT1_1,

> Because the curriculum states, you have to do this, this, this, and then you've got like 100 questions on that particular topic designed by the Department how they ask the questions and you have to do things according to that.

In the first of the above excerpts, Teacher IT2_1 tried to explain why it was not useful to try to just cover topics that were disconnected. Teachers should try to help learners to interpret and try to understand the implications of the information. Teacher IT1_1 described how the education department prescribes lists of topics and questions that need to be covered.

Noting how important it is for teachers to try to consider the cognitive processes involved in learning mathematics beyond just listing topics (Greenes, 2009), we explored these more formally by using Chi-square tests. In analysing the teachers' responses in the questionnaire about what they saw as the key topics or ideas in understanding the information, we differentiated between responses that mentioned cognitive processes or skills (S), or topics (T). These categories give us a picture of the extent to which teachers think about the curriculum as a list of topics or whether they think in terms of enabling the development of the skills of interpretation, understanding, analysing, and judging etc.

In general, we found that teachers who described changes in terms of topics had only 13 years of experience, while those whose descriptions included cognitive processes had on average 18 years of experience of teaching mathematics.

Chi-square tests were used to test the relationship between teachers' tendency to list cognitive skills or topics in describing the curriculum changes and teacher demographic factors and those whose differences were significant are listed below in Table 5.

Table 5
Differences in describing areas of change

	Described cognitive skills / processes	**Listed topics**	**Difference is significant**
Education: post grad	72%	28%	p= 0.001
undergraduate	35%	65%	
Subject: Maths FET	26%	74%	p = 0.008
ML+SP+ Prim	63%	37%	

We found that teachers who had a postgraduate qualification were more likely to use descriptions about cognitive processes rather than topics, while those who had only a degree or lower qualification, were more likely to list topics, and this difference is significant. It was also found that FET mathematics teachers were more likely to list topics, compared to the other mathematics or ML teachers. Since FET teachers are under more pressure to complete the curriculum because of the looming matric examination, it is likely that they were more concerned about the topics they needed to complete and did not want to spend time thinking about what some consider to be peripheral issues. In the interview, IT1_3, a FET teacher, explained the pressure they felt,

> We are like stressed for time to finish, you know the syllabus. And all we're focusing, it is finishing the syllabus so that you know they can be ready for the exams.

This comment suggests that FET teachers find it difficult to think beyond their immediate demands of trying to complete coverage of the topics appearing in the curriculum, with little attention being given to connections between and among different areas.

Discussion

This study is about teachers' perspectives about the relevance of the curriculum and how it could be made more relevant for learners to better understand complex mathematical information disseminated by the media in the light of disruptive events.

The data showed that the teachers generally agreed that mathematics concepts studied at school could help learners better understand the pandemic information that was provided to the public. The teachers felt that increasing the amount of time spent on statistics may be of greater benefit to the learners. They emphasised that learners need to be more prepared to deal with real-life interpretations and applications of concepts that they encounter. This view is supported by the literature that advocates for mathematics curricula to reflect more strongly the links across the curriculum and apply lessons to real-life settings (Umugiraneza et al, 2022)

With respect to the knowledge demands related to the pandemic, the teachers found that many of the concepts were mostly or always understandable. They found that concepts dealing with less complex operations, such as counting (e.g., the total number of tests), more easily understandable than those that used more abstract applications of mathematics, such as modelling.

A further layer of complexity in dealing with the pandemic information was the challenge of coordinating both the mathematical and contextual information in trying to grasp the meaning behind the context-specific language. The example of calculating the seven-day average was highlighted by the teachers. They explained that the procedure of working out the average of seven numbers is a simple one but the COVID-specific rule used in the seven-day average of the new cases-per-million was much harder to understand because of the constraints of the additional relationships that needed to be considered (Tall, 2011).

This is an example of a contextual rule that is bounded by the parameters of the COVID context and the interpretation of which depends on coordinating the notion of average with the contextual constraints of a rolling seven-day average as well as understanding that the numbers in the calculation were a rate (new cases by millions). Hence the contextual language used was very dense. Some studies have found that learners find it easier to carry out certain mathematics procedures in a decontextualized setting than when the concept is set within an authentic context (Kosako, 2013; Potgieter et al., 2008). Bansilal (2017) found in a sample of 59 in-service teachers, that 95% were able to carry out a percentage increase calculation correctly in a decontextualized setting, while only 37% could correctly work out

how the cost of an item changed if it kept pace with inflation over a two-year period, given the relevant inflation figures. The discussion of the context specific rule for the rolling seven-day average provides some insight into how a concept can become progressively more complex as the constraints of the context are considered. The representation of this information in different curves in one figure was more complex than those that are studied as part of the mathematics curriculum. The purpose of using the graph in Figure 1, taken from the media, was to show to the public the differences in how the disease progressed across various provinces. In contrast, graphs in the classroom are typically used to enhance understanding of mathematical concepts and relationships.

Teachers in the interview emphasised that we need to develop learners' skills in the interpretation of data that is a key aspect of statistical literacy. However, there are different levels of working with data identified: reading the data; reading between the data; and reading beyond the data which involves making inferences and predictions (Harrell-Williams et al. 2019). Research has identified that learners are well able to work with the first level, which may involve carrying out procedures and calculations related to statistics but find it harder to look beyond the figures and interpret them (Kazunga et al., 2023). Hence, much work is needed to help learners develop higher levels of skills in interpreting data.

Teachers also spoke about what needs to change in the curriculum to help learners better understand the information and make informed decisions in future scenarios. Most teachers agreed that a change is needed and believed that the amount of time we spend on applying some mathematics concepts to real-life contexts was not sufficient. The analysis also showed that there were differences according to how they expressed needed changes based on their beliefs about the curriculum. It seems that for some teachers the curriculum is comprised of a list of topics that need to be covered. There were others who thought of the big ideas and cognitive processes that they felt were important for learners. The teachers who preferred to describe the curriculum in terms of cognitive processes seemed to be older than those who viewed the curriculum as a list of topics. It could be that teachers' views, practices, and beliefs evolve and adapt as they gain experience in teaching. The study by Umugiraneza et al. (2018) found that since older teachers were more likely to use the curriculum documents compared to their younger counterparts they have had more time to think critically about the curriculum.

It was also found that teachers with a postgraduate degree were more likely to mention the cognitive processes than those without. This finding of differences between views of the curriculum according to levels of educational qualification is supported by the study by Umugiraneza et al. (2018), who found that teachers who attended professional development workshops were more likely to use the curriculum documents than those who did not. FET teachers who commented that they were under more pressure to complete the curriculum also displayed a preference for listing topics rather than specifying the underlying cognitive processes in the curriculum. This finding is not surprising in the light of the findings from Umugiraneza et al. (2018) that it was harder for FET (Grades 10–12) teachers to describe links across the curriculum compared to teachers who taught Grades 4–9.

Conclusions

We found that teachers believe that the mathematics curriculum helped learners to better understand some of the COVID contextual information disseminated by the media. However, they noted that this information was more difficult to understand compared to that involved in learners working with procedures in a simplified, decontextualized setting. This was because of the specific contextual language, rules, and graphs that were drawn from the COVID context that needed to be understood.

Furthermore, the findings reveal variations in teachers' perspectives on curriculum content, with some emphasising the importance of broader cognitive processes while others focused on specific topics. These differences were influenced by demographic factors such as teaching experience, educational background, and the phase they were teaching.

It is clear that many teachers agree that learners' statistical literacy skills need to be developed by bringing in a deeper focus of understanding, interpreting, using, analysing, and reasoning about information in various contexts. The onset of the COVID pandemic brought these needs into sharp focus, making them a more immediate part of teachers' experiences.

While teachers advocate for change, we need broader systemic shifts to enable meaningful educational transformation. Addressing these challenges requires collaborative efforts between and among educational stakeholders to create an environment that fosters teacher autonomy, professional growth, and innovative learning experiences.

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