Understanding the contextual resources necessary for engaging in mathematical literacy assessment tasks

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Abstract

Mathematical Literacy (ML) was introduced in South Africa as a compulsory school subject for all learners who are not studying mathematics in Grades 10 to 12. In an ML classroom, mathematical skills are used to explore the meaning and implications of information in context. In this article, the notion of context in ML is interrogated by identifying particular constructs that can be used to illuminate the focal events in a contextual setting. It is argued that each context constitutes a particular domain with specific contextual resources which set out the parameters of engagement with the focal event of the context. It is shown that the contextual resources often differ from the corresponding constructs in the mathematics domain. It is then argued that in order to fulfil the life-preparedness mandate of ML, the differential purposes of the mathematics and contextual domains needs to be acknowledged and the corresponding implications with respect to the nature of ML assessments needs to be considered by ML practitioners.

Introduction

In South Africa authorities have been concerned with the low rates of participation in mathematics in the Further Education and Training Band. For example in the period 2000 to 2005, as much as 40% of all learners writing the matric examination did not take mathematics as a subject (Brombacher, 2010). In addition to the concern of learners not being exposed to mathematics past Grade 9 level, there is also the issue of learners not developing mathematics literacy skills such as those described by the Programme for International Student Assessment (PISA):

> An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen (Organisation for Economic Co-operation and Development (OECD), 2003, p.15).

The school subject Mathematical Literacy (ML) was introduced in an attempt to inculcate in learners a mathematical gaze on life-related issues (Department of Education (DoE), 2003; 2007). The aim of ML is to provide

> learners with an awareness and understanding of the role that mathematics plays in the modern world [and to enable] learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and to solve problems (DoE, 2003, p.9).

There have been different interpretations of the subject ML in South Africa, with many seeing it as a 'watered down' version of the real mathematics for those learners who cannot cope with studying the subject mathematics (Child, 2012; Jansen, 2011). These interpretations stem from a view that the purpose of ML is to learn more mathematics, which is not the intention. The curriculum documents clearly state:

> The competencies developed through Mathematical Literacy are those that are needed by individuals to make sense of, participate in and contribute to the twenty-first century world – a world characterised by numbers, numerically based arguments and data represented and misrepresented in a number of different ways. Such competencies include the ability to reason, make decisions, solve problems, manage resources, interpret information [. . .] to name but a few (DoE 2007, p.7).

The subject ML is not about learning more mathematics but about developing skills that will enable them to participate in (and not be excluded from) situations that use numerically based arguments. Thus ML demands a greater 'real life' authenticity than the usual mathematics classroom activities. In a mathematics classroom, contexts are used mainly to mediate the understanding of an abstract concept by using a concrete setting or to illustrate the applicability of mathematics in other settings. In an ML classroom, the contexts that are used are more authentic; for example, contexts in real life are selected (like billing systems of different cell phone providers) and it is intended that mathematical skills be used to explore the meaning and implications of the information in the context. By studying life-related applications, there is an expectation that learners will not be intimidated by a world "drenched with data" and "awash with numbers" (Orrill, 2001, p.xiv) and instead will seek to be more informed before they make decisions across various contexts. The context is the focus because the intention is that when learners encounter these contexts in their current or future lives, they will be able to make more informed decisions. Venkat (2010, p.55) refers to this focus as a "life-preparation" option.

One of the constraints to meeting this life-preparedness mandate in ML has been the form and structure of the assessment of learners' competencies in the subject. The highest contribution to the assessment in ML is via examinations and tests. For example, the summative assessment in Grade 12 for ML consists of two examination papers. Learners' performance in summative assessments may not necessarily imply a greater ability to critically analyse everyday situations using a mathematical gaze. In order to understand the various contexts, learners need more time and guidance in decoding and understanding the contextual settings. An examination setting cannot offer the space and time for this kind of engagement with the contexts.

In this article I am concerned primarily with identifying some of the challenges involved in recognising and using information, language and reasoning that is specific to the contexts in which the assessment is set. The design of assessment tasks for ML (with its emphasis on real-life contexts) has created a new set of demands, previously not encountered in the usual mathematics tasks. My argument is success at these contextualised tasks, requires more than just the application of mathematics rules and skills to problems based on the context. I argue that ML tasks that promote a life-preparedness orientation of ML require participation within two domains: the mathematics domain with its clearly articulated demands, rules and areas of application, and the contextual domains where these demands may sometimes not be so clearly articulated.

In this article I first set out constructs that can be seen as characteristic of the mathematics domain using Sfard's (2008) commognition theory. I then draw on Duranti and Goodwin's (1992) elaboration of a context to show that the contextual domain also consists of attributes particular to the context. By referring to previous ML assessment tasks I identify some of these contextual rules, visual mediators, and language and show how these are often different from the corresponding constructs in the mathematics domain. I then argue that in order to fulfil the life-preparedness mandate of ML, this differential nature of the two domains needs to be acknowledged, which has implications for the kinds of assessments that are prioritised in ML.

Conceptual domains in mathematics

It is useful to draw upon Greeno's notion of conceptual domains in order to provide a link between discourses in mathematics and discourses in ML. Greeno (1991) describes a conceptual domain in mathematics as an environment with resources at various places in the domain (instead of the usual view of a subject matter domain as a structure of facts, concepts, principles, procedures, and phenomena that support the cognitive activities of knowing, understanding, and reasoning). Knowing the domain means knowing one's way around the environment and also includes the ability to recognise, find and use those resources productively (Greeno, 1991). A conceptual domain in mathematics would be an environment within which discourses of mathematics operate. Here I will draw upon Sfard's descriptions of signifiers, visual mediators, routines and narratives that can be seen as the tools and resources available in the mathematics domain.

Tools and resources of mathematics conceptual domains

Sfard (2008: p.xvii) introduces the term 'commognition', which is a combination of communication and cognition and emphasises "that interpersonal communication and individual thinking are two facets of the same phenomenon". By communicating with other learners, an individual's cognitive understanding is enhanced. Brodie and Berger (2010) explain that in Sfard's theory, mathematics as a discourse is characterised by the use of objects and signifiers, visual mediators, routines and narratives (Sfard, 2007; Brodie and Berger, 2010). These constructs are the elemental structures of the mathematics discourse and can be seen as tools and resources available to participants. As newcomers communicate with more experienced participants, they begin to use the tools and resources of the domains more appropriately, and this enhances their participation as their practices become endorsed by the community. These constructs are explained in the paragraphs that follow.

Sfard (2008, p.302) describes a *signifier* as a primary object used in communication. *Routines* entail the use of signifiers and narratives are often created around signifiers. A *narrative* is any "text, spoken or written that is framed as a description of objects or of relations between objects or activities with or by objects and that is subject to endorsement or rejection, that is, to being labelled true or false" (Sfard, 2007, p.572).

According to Sfard (2007, p.177) "*visual mediators* are means with which participants of discourses identify the object of their talk and coordinate their communication". An example of a visual mediator is a graph. Sfard (2008, p.147) sees visual mediators as providing the image with which discursants identify the subject of their talk and coordinate their communication. *Routines* are "well defined repetitive patterns in interlocuters' actions, characteristic of a given discourse" (Sfard, 2007, p.572). Routines are not merely mathematical procedures, but include these. Participation in the discourse is facilitated when interlocutors are able to consider both how and when routines are used. Here I consider routines as including rules, formulae and procedures. The process of participating in a mathematics discourse involves creating narratives about objects, visual mediators and routines in a new discourse.

Brodie and Berger (2010) explain that in Sfard's theory, mathematics as a discourse consists of sub-discourses which relate to each other in various ways. Some are isomorphic; some subsume others while some are incommensurable. For example, the Euclidean geometry discourse is incommensurable with the spherical geometry discourse because in Euclidean geometry, for example, given a line and a point, it is always possible to draw a second line through the point which is parallel to the first line. However in spherical geometry the equivalent of a line is a great circle (or arc of a great circle), and any pair of great circles intersect at two points , so it is not possible to find a second line parallel to the first line as is the case with Euclidean geometry. Within the whole number discourse, the multiplication of two numbers will result in a larger number while this does not always hold in the discourse of rational numbers even though the rational number discourse subsumes the whole number discourse. Flexible movement between sub-discourses is key to mathematical expertise. A conceptual domain can be seen as one in which a sub-discourse of mathematics operates e.g. circle geometry, or quadratic functions, or probability.

Contextual domains in mathematical literacy (ML)

Duranti and Goodwin's (1992) work on the meanings and role of educational contexts is of relevance here. The authors (Duranti and Goodwin, 1992, p.3) use the term *focal event* to identify the phenomenon being contextualised:

> When the issue of context is raised it is typically argued that the focal event cannot be properly understood, interpreted appropriately, or described in a relevant fashion, unless

> one looks beyond the event itself to other phenomena (for example cultural setting, speech situation, shared background assumptions) within which the event is embedded, or alternatively that features of the talk itself invoke particular background assumptions relevant to the organisation of subsequent interaction.

The context is thus a frame for the event being examined and provides resources for its appropriate interpretation. It involves two entities: a focal event and a field of action within which the event is being embedded (Duranti and Goodwin,1992). An important point is that because of its clearer structure the focal event often receives "the lion's share of analytic attention" while methods for analysing "the more amorphous background of the context" are not given as much emphasis (p.10). The authors contend that the danger of such an approach is that the focal event may be viewed "as a self-contained entity that can be cut out from its surrounding context" effectively rendering the "context as irrelevant to the organisation of the focal event" (p.10).

Duranti and Goodwin (1992, pp.6–8) identify four 'attributes' of educational contexts which are elaborated below in terms of how they relate to this study. (See also Bansilal and Debba, 2012).

1. Contextual setting: This refers to the social and spatial setting within which the interactions take place (p.6). The contextual setting in ML refers to the particular context that is under discussion.

2. Behavioural environment: This refers to the framing that establishes "the preconditions for coordinated social action by enabling participants" (p.7) to project what is about to happen. In other words, it sets the scene for the focal event. In this case, the behavioural environment refers to the pedagogic setting which could be examinations, projects, investigations or other assessment or classroom activities within which the contextual task is presented.

3. Use of language: This refers to the ways "in which talk itself invokes context and provides context for other talk" (p.7). In this study we use the phrase 'contextual language' to refer to words or phrases that hold a particular meaning within the context.

4. Extra-situational background knowledge: This refers to the background knowledge that extends beyond the immediate setting, which is necessary for an appropriate understanding of the focal event. In this

study we define four aspects of this contextual background knowledge that is pertinent to the study. These are contextual signifiers, contextual rules, contextual graphs and contextual reasoning. The elaboration of these attributes (or elements, or constructs) illustrates that the contextual language, signifiers, visual mediators and rules, are contextual resources and tools) that must be used in order to cast light on the focal event. Assessment tasks are set around particular focal events of a context, and there could be different focal events arising from a common context, but these cannot be seen as self-contained entities. In order to cast light upon the focal event and understand the background of the surrounding context, it is essential to have access to these contextual attributes.

Similarly (to the notion of conceptual domain) we can describe a contextual domain in ML as the contextual setting which has its own tools and resources, including contextual language, contextual rules, contextual objects/signifiers and contextual visual mediators.The intention in a contextual domain is to use the contextual resources to cast light upon the focal event which cannot be interpreted without drawing upon the contextual resources embedded within the contextual setting, whereas in mathematics domains, the intention is to create new (or re-create existing) narratives using mathematics tools and resources. However contextual narratives are also created as part of the process of participating in the discourse operating in the contextual setting. In order to generate these narratives, a discursant needs to be able to understand and use the contextual rules, signifiers and contextual language, as well as engage in contextual reasoning which is the reasoning, arguments, assumptions, and justifications about issues arising in the context.[1]

Tools and resources of the contextual domain

In this section I present examples of the contextual tools or resources drawn from studies and educational documents. I will show that these constructs frequently differ in meaning, form and function from those in a mathematics discourse. The resources that are considered are the contextual signifiers/ objects; contextual rules/procedures, contextual graphs and contextual

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[1] Based on this discussion, one may argue that a mathematics conceptual domain also has a focal event around which the narratives are created, depending upon the task at hand. Hence a mathematics conceptual domain could be also be considered as one of the contextual domains of ML, where different contextual domains have different contextual resources.

language. These are tools which are used to participate in the discourse but also act as resources for understanding the focal event under consideration.

Contextual signifiers and objects

Contextual signifiers and objects are the signifiers or objects used in the context to convey specific information, and which have a meaning that is bounded by the parameters of the context. I present two examples, inflation rate and infant mortality rate, taken from ML assessment tasks.

Inflation rate signifier

In the context of inflation, the figures reported in the media each month as the 'monthly inflation rate' figures for the Consumer Price Index (CPI) need to be examined in detail before they can be understood. For example, in order to understand the reported monthly inflation rate figure of 6.15% (March 2012), one needs to recognise that a percentage actually represents a comparison. It is essential to understand what is being compared and to differentiate the figure (percentage) from a whole number.

The CPI is the average (weighted mean) cost of the 'shopping basket' of goods and services for a typical South African household. Price movements on the goods comprising the basket are measured and the CPI is compiled using the price movements per product and their relative weight in the basket (Bansilal, 2011). Inflation rate figures are usually reported on a monthly basis. Note that the monthly inflation rate refers to the year-on-year rate calculated on a monthly basis and is different from the month-on-month rate.

The process can be represented simplistically as follows: If P_1 represents the current average price level and P_0 the price level a year ago, the rate of inflation during the past year is measured by

$$(I_1) = inflation\ rate = \frac{P_1 - P_0}{P_0} \times 100\%. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Taking 5.60 % as I_1, the monthly inflation rate for May 2013, this means that P_0 and P_1 represent the price levels in May 2012 and May 2013 respectively.

A misunderstanding of what the inflation signifier represents may lead to students using the signifier as a whole number. However, in this situation the percentage denotes a relationship between the difference in the price levels

($P_1 - P_0$) and the price level P_0. The specific quantity associated with a percentage depends on its base value, thus two percentages associated with different base values cannot be directly combined by addition or subtraction.

Infant mortality rate

A second example of a contextual signifier is provided by a task on infant mortality rates used in the 2009 Grade 12 KwaZulu-Natal ML trial examination paper (KwaZulu-Natal Department of Education (KZNDoE), 2009). In the task, Table 1 (reproduced below) with the statistics of infant mortality between 2004 and 2008 due to different illness was presented.

Table 1: Statistics of infant mortality rates taken from KZNDoE (2009)

Year	Polio	Measles	HIV-Aids	Hep.B
2004	2	1	5	0,8
2006	1,8	1,2	3	0,9
2008	1	1,1	3	1

The information identifying the meaning of infant mortality rate appeared in a block at the beginning of a question, amongst other details, and is reproduced in Figure 1 below:

Figure 1: Meaning of infant mortality rate

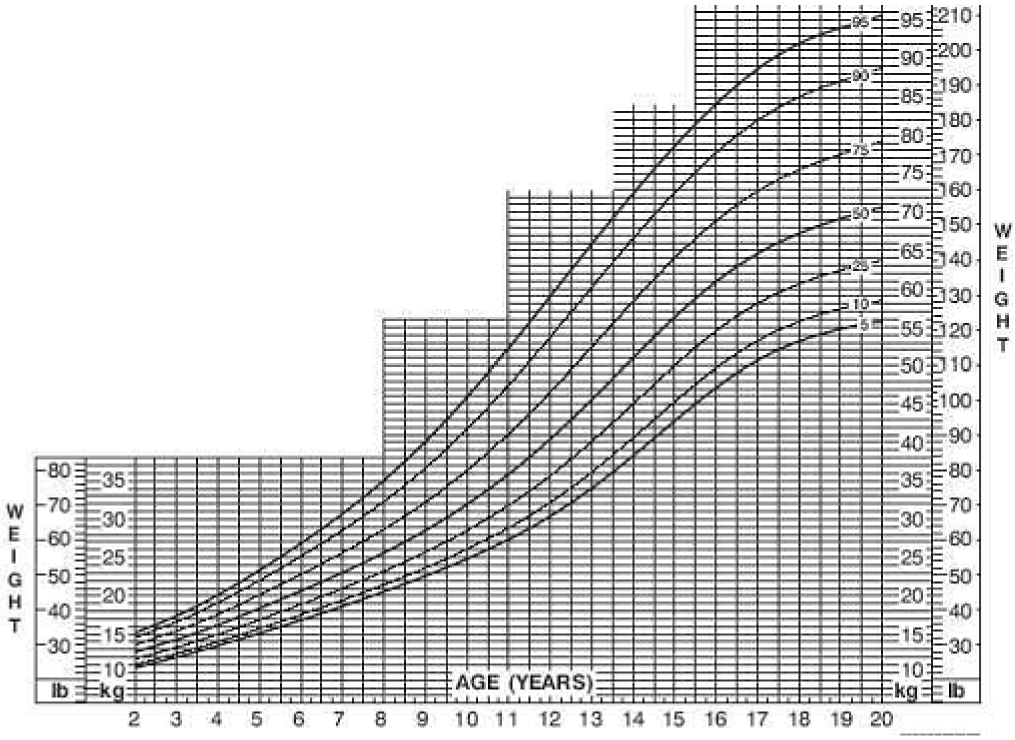
Between 2004 and 2008 research was conducted to assist the government in identifying causes of high infant mortality rate (i.e. the number of infant deaths during the first year of life per thousand live births). [Other details included.]

This meaning of infant mortality rate is complex. In order to answer the questions, learners needed to understand that, for example, the numeral 2 (2004, Polio) from Table 1 refers to the fact that two children out of every 1 000 children that were born (excluding stillborn) died of polio within their first year. These numerals have a specific meaning that is bound to the context, and is different from the way it is used in a whole number discourse for mathematics. These figures are not percentages or whole numbers and cannot be used as such.

Contextual graphs

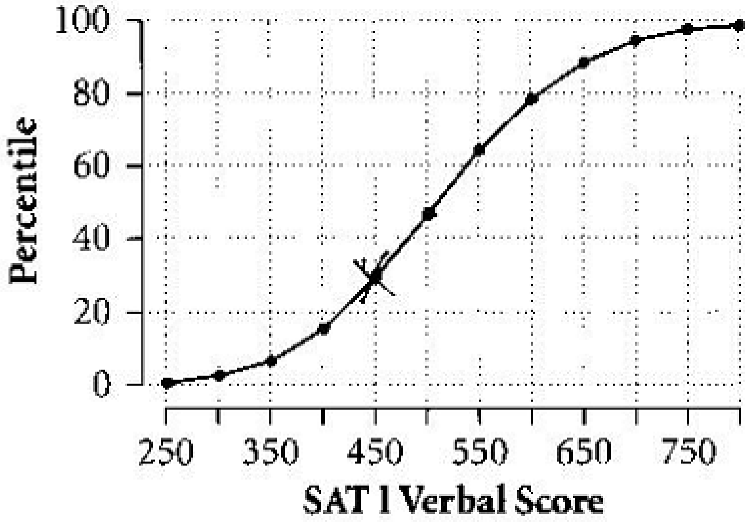
The term contextual visual mediators refer to visual information presented in diagrammatic, graphical, pictorial or other non-textual representation. Here I will just discuss contextual graphs. An example of a contextual graph is the widely used weight for age graphs. One example of this is the Boys weight-for-age percentiles which is presented in Figure 2 below.

Figure 2: Boys' weight-for-age chart (Department of Basic Education (DoBE), 2011, p.119)



Note that the way in which the percentile graphs are used here (Fig. 2) is different from the way in which they are usually used in the mathematics classroom. Here there are seven curves, showing a 95th, 90th , 75th , 50th , 25th , 10th and 5th centile plot, representing the fact that as a boy grows from 2 years to 8 years, 95% (5%) of the boys will have weight below the first (last) curve respectively. Usually a percentile graph in a mathematics context is a snapshot at a particular time, for example consider the example in Figure 3, taken from a textbook:

Figure 3: Percentile plot of score obtained in a test (Watkins, Scheaffer and Cobb, 2004, p.63)

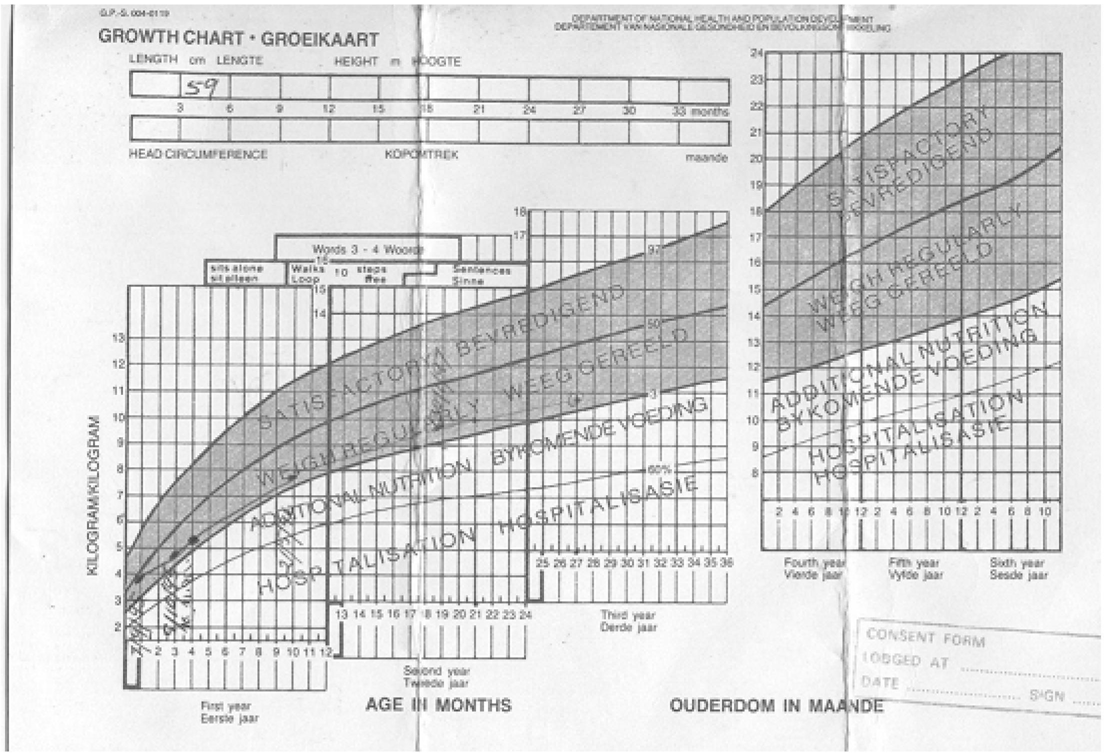


In this percentile graph (Fig. 3) the point marked with a cross shows that 25% of the group got a mark less than 450 while 60% of the group got a mark below 550. A typical question that could be posed in a mathematics class is to compare the two cumulative percentile plots for different subjects and ask why the values on these graphs differed. Another typical question could be to find the percentage of students who got a score below 350. However, in the contextual domain these charts serve a somewhat different purpose and the interpretations and use of them depend on the purpose.

Another example of the percentile plot is the weight for age chart (see Fig. 4) that is used commonly in South African clinics, different from the one used in Figure 2. A health worker may be concerned if the pattern of the weight of a particular child fell above the 97th or below the 3rd percentile curves, showing that the child's weight was very high or very low when compared to other children. The guidelines on the use of the charts specify the following:

> [If] the weights plotted of a 100 healthy children, the weight of 3 healthy children will fall above the 97th centile and the weight of 3 healthy children will fall below the 3rd centile. If a child's weight does fall above the 97th or below the 3rd centile it does not necessarily mean that the child is overweight/underweight or sick, but rather the direction of the child's growth that is important. However, if a child's weight is near or below the 4th line or 60% of average weight, the child is likely to be seriously malnourished (Department of Health (DoH), 2010, p.3).

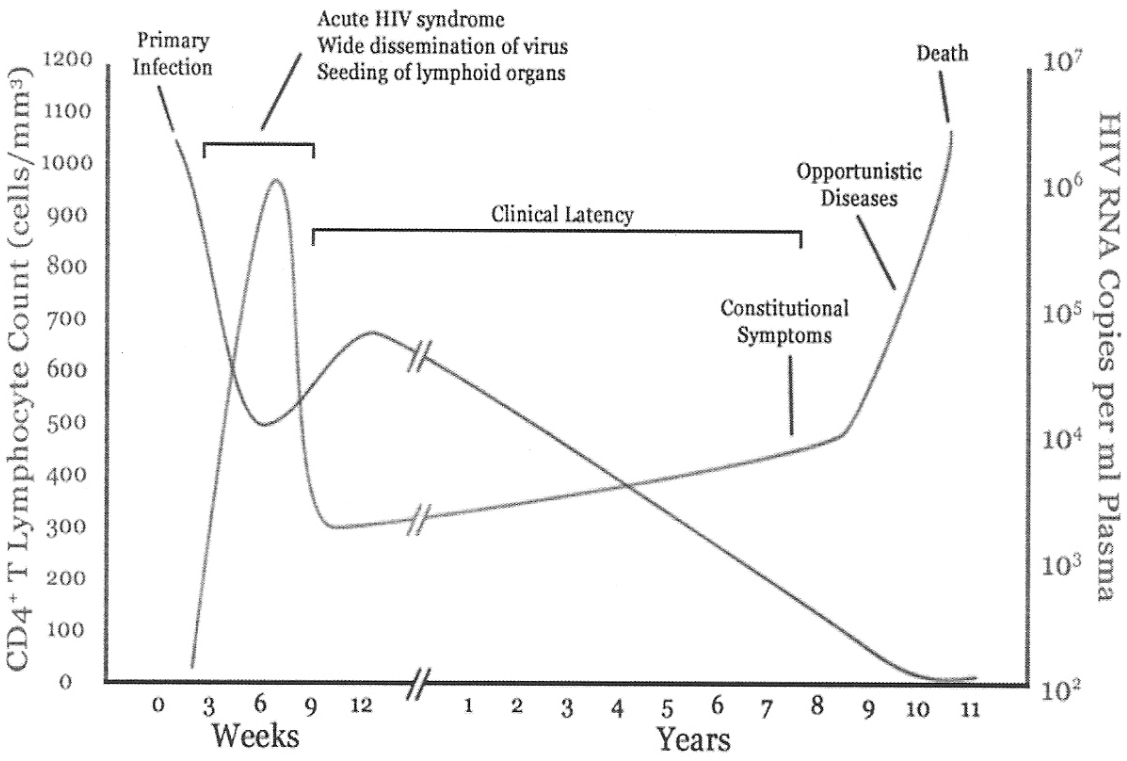
Figure 4: A typical weight for age chart, used in clinic in South Africa



In this context, the question that concerns the nurse would be whether the child's weight for age graph lies out of the normal limits, the direction of the growth (whether the weight was changing too fast or too slowly) and whether hospitalisation was to be advised if it fell below the curve representing 60% of average weight. Thus, in this situation, it is the spaces between the curves that are used to make interpretations, unlike the typical situation in mathematics where the points on the graph receive most attention.

Another example of a contextual graph appears below in Figure 5 showing viral loads and CD4 counts over a period of 11 years.

Figure 5: Graph showing the relationship between HIV copies (viral load) and CD4 counts over the average course of untreated HIV infected infections



Source: http://schools-wikipedia.org/wp/a/AIDS.html

The graph in Figure 5 was used to show the relationship between HIV copies (viral load) and CD4 counts over the average course of untreated HIV infection. This graph uses measurements on three variables represented on three axes (CD count, viral load and time) – a situation that would not normally occur in a mathematics class.

In a mathematics discourse at school level, graphs of functions are used to represent relationships between two variables, one of which is independent and one which is dependent. It is often the case that the formula depicting the relationship between the variables is provided and learners are asked to sketch a graph. Sometimes the graph is given and learners may be asked to derive a formula to represent the relationship symbolically. The questions focus on identifying properties or using the properties of generic curves to solve problems. In the contextual domain, however, it is the visual information provided by the graph that is important.

Contextual rules

Contextual rules are rules or procedures that are bound to the context and need to be interpreted by the learner. These rules are used for calculations in the context. Below are two examples: the first is taken from Bansilal, Mkhwanazi and Mahlabela (2012) while the second is taken from KZNDoE (2009).

Figure 6: Calculation of transfer duty of a house

The formula that is used to calculate the transfer duty, payable by a new home owner, is as follows:

- For a purchase price of R0 to R500 000, the transfer duty is 0%.
- For a purchase price of R500 001 to R1 000 000, the transfer duty is 5% on the value above R500 000.
- For a purchase price of R1 000 001 and above, the transfer duty is R25 000 + 8% of the value above R1 000 000.

This is a rule that must be followed in order to calculate how much transfer duty is payable by a new house owner. Other examples of situations which utilise similar calculations are income tax, water bills and electricity bills. The costs that are payable are described in different levels and can be described as an example of a piecewise function, where each piece is defined by a separate rule or formula over a specified domain. The next example of contextual rules (Fig. 7) is provided by a task that appeared in a provincial examination paper (KZNDoE, 2009).

Figure 7: Calculation of points for teams playing in the FIFA World Cup (KZNDoE, 2009)

2.2 During the first round, a group of FOUR teams play round-robin matches (each team will play against every team in the group). The top TWO teams proceed to the knock-out stage of the last 16 teams.

FIFA awards 3 points for a **Win**, 1 point for a **Draw** and no point for a **Lose**.

The log table shown in TABLE 3 below is based on the following results.

Match 1: Spain 3 , South Africa 3
Match 2: South Korea 2 , USA 2
Match 3: South Africa 1, USA 1
Match 4: Spain 4 , South Korea 2

TABLE 3: Log Table

COUNTRY	WIN	LOSE	DRAW	POINTS
Spain	1	0	1	4
South Africa	0	0	2	**D**
USA	0	0	2	2
South Korea	0	1	1	**E**

2.2.1 Spain, South Africa, South Korea and USA are in the same group. Using the FIFA awards system, calculate the numerical values.

(a) D (2)

(b) E (1)

2.2.2 Some soccer fanatics are proposing a new format of awarding points, based on the following:

Proposed Format: Win (by a margin of 1 goal (e.g. 1- 0, or 2-1 , 3-2) = 3 points
Win (by a margin of 2 or more goals (e.g. 2-0 or 4-1) = 3 + 1 bonus point
Draw of less than 2 goals (0-0 or 1-1) = 1 point
Draw of 2 or more goals = 1 + 1 bonus point
Lose by a margin less than 2 goals = 1 bonus point
Lose by more 2 or more goals = no points

(a) Using the new format, how many points will a team have if it has won one match (4 – 2) and drew another match (2-2) ? (3)

(b) Determine the values of D and E in TABLE 3 if the points awarded were based on the Soccer fanatic's new proposed scoring method. (4)

2.2.3 The last round robin matches will be Spain against USA, and South Africa against South Korea.

(a) Using the FIFA scoring format, is it going to be possible for South Korea to overtake Spain? Give a reason for your answer. (3)

(b) South Africa and USA need a total of 6 points to guarantee their places in the next round. Suggest any score that will enable South Africa to move to the next round, using the soccer fanatic's scoring system. (4)

In the task, two contextual rules can be identified. The first is the FIFA calculation formula and the second is the proposed Fanatics formula, both of which are being used to calculate the number of points achieved by the different soccer teams. It is often the case that the contextual rule is given in verbal form, like the FIFA points system. However, some contextual rules may require learners to translate the rules into mathematical language before solving the problems; for example the second rule in Figure 7 may require one to write the subtraction and the percentage calculation using mathematical symbols.

Contextual language

Contextual language refers to specific terminology or phrases that carry a meaning in the context. For example, '200 free kilometres per day' in car hire scenarios may refer to the situation where the contract allows one to drive up to 200km a day without incurring additional charges; 'Base occupancy' in accommodation bookings refers to the number of people that can stay in the room/chalet without incurring additional fees; and 'Win by a margin of 2 or more' in the context of soccer goals refers to the situation where the difference between the goals scored by the winning and the losing teams is 2 or more than 2. Underlined phrases used in the contextual rule telephone billing such as "Calls are <u>charged per minute</u> for the <u>first 60 seconds</u> and thereafter in <u>increments of 30 seconds</u>" are further examples of the use of contextual language.

Another example of contextual language is the use of the word 'pizza' as used in the problem in Figure 8

Figure 8: Pizza problem

Pizza task
At a restaurant at the Waterfront in Cape Town, tourists have a choice of different pizzas:

Base	*Toppings*
Thick	Pineapple
Regular	Salami
	Tuna
	Mushroom

If a tourist buys a pizza with three toppings, how many combinations are possible? (Use any systematic counting method that you have learnt.)

The question above requires the knowledge that a pizza is a meal that consists of a base which could be thick or regular, with toppings which are placed on the base. This would help them understand that they first needed to choose between the bases and then make a second choice of three toppings from the four that were available. If learners do not understand what a pizza is, they would be unable to move on to working out the number of possible combinations (using mathematical rules) (Bansilal, 2008)

Discussion and concluding remarks

In this paper I have argued that the ability to participate in contextual domains requires access to the contextual resources (signifiers, rules, graphs, language). These contextual resources are necessary in order to understand the focal event around which the assessment task is set. The stance that I take is that the identification and use of these resources are often different from the mathematics-specific resources. This description of the relationship between the context and content suggests two different possibilities for the design of contextualised tasks in ML.

The first possibility is one in which the dominant discourse is that of mathematics. Tasks that take this line pose questions that require the creation of narratives that are endorsed in the discourse of mathematics. Such an approach would involve identifying the significant elements located in the discourse of the context, and using them in the discourse of mathematics. The contextual resources must now be used with objects, visual mediators and routines and narratives located in the mathematics domain in order to create a narrative that is endorsed in the discourse of mathematics. If that happens, then the elements of the two existing discourses together have been used to create a new discourse, which is commensurate with, recognised and endorsed in the mathematics domain. Thus learners who are successful at such tasks will extend their understanding of mathematics.

A second type of task is one that foregrounds the life-preparedness purpose of ML (Venkat, 2010). A life-preparedness perspective of ML implies that learners must be able to engage with issues arising from these contexts, that is the contextual resources must be used to throw light upon the focal events under consideration so that if necessary informed decisions can be made. Such an engagement could take on more serious issues such as whether a particular billing system is more affordable than another, or a more leisure-oriented issue such as figuring out how soccer league tables work. If ML seeks to develop learners who are able to make informed decisions, then it implies that learners should firstly understand that there are different discourses associated with the different contexts. Secondly, they need to access, use, interpret, and communicate with, the appropriate contextual resources that constitute the contextual discourse. The level of authentic engagement prescribed by a life-preparedness perspective requires that learners are able to participate fully in the contextual discourse, that is, they should be able to create narratives that can be endorsed by people who work with or understand the context in real life. Learners should be able to choose between different options when deciding on purchases, recognise unfair advertising and make decisions about saving. They should be undaunted about entering and increasing their participation levels in these contextual domains. They should actively seek to 'read the fine print' in contracts, in order to understand and use the contextual recourses for their benefit.

How can learners develop skills in recognising and using these contextual resources? Should the ML teacher just present learners with a variety of contexts and hope by working with them they will gain such skills, or can such learning be scaffolded? One possibility may be to organise focal events of certain contexts according to commonalities in their contextual rules, visual mediators, language and signifiers. For example, the rule for transfer duties is similar to the one for income tax, since both are based on the notion of a piecewise function, with the income tax being more complicated with more 'pieces'. Perhaps by first working on calculations based on the transfer duty context learners may better understand the use of piecewise functions, thereby making the more complicated rule used in tax tables easier to understand. In such cases, the consistency in patterns of the contexts (Greeno, 1998; Peressini, Borko, Romagnano, Knuth andWillis, 2004) may enable learners to use their experiences gained in one context, to work in another with a similar contextual resource. Similar organisation may be possible in terms of graphs.

Many researchers (including myself) call for a greater use of real, authentic contexts in the ML classroom. Does this mean that cleaned and simplified context should not be used in an ML classroom? On the contrary, cleaned contexts have an important role to play, as a starting point for a focus on particular contextual resources. The use of cleaned contexts can allow the teacher to shift the attention of the learner to a particular contextual resource, without having to deal with the noise from the authentic, uncleaned context.

A teacher can design specific tasks set around the rules or visual mediators or signifiers of particular contexts and thereafter present the more complicated, uncleaned real-life context. It is hoped that this article has brought into focus the important role of task design in ML, since much of the learning of ML is dependant on the classroom tasks that the learners engage with.

Another issue arising from this study is the role of the mathematics domain when participating in the contextual domain. I have argued earlier that a mathematics conceptual domain can be seen as one of many ML contextual domains, within which learners need to increase their participation levels. Curriculum developers should guard against making the mathematics domain the more dominant one, as this is contrary to the life-preparation perspective. Another issue to consider is whether learners who are more skilled participants in the mathematics domain fare better in ML assessment tasks. Certainly a person with a higher level of mathematical proficiency will have access to more mathematics resources than one who is not. For example, a person who is able to work with algebraic rules in an object-driven manner may be able to encode certain contextual rules by using algebra and thereby work more easily with the rule. Some studies (Bansilal *et al*., 2012; Bansilal, 2011) suggest that for some contextual rules, learners who are able to use the rules in the more sophisticated object-driven manner, rather than the usual routine-driven manner, can solve more complex problems based on the focal event. In such cases the more sophisticated use of the routine may help learners to deal with more nuanced issues arising from the contextual domain.

A further implication of this perspective is that assessments via examination setting do not necessarily encourage learners' participation in contextual domains, and may in fact render these aims meaningless. Research about learners' engagement with assessment tasks based on contextual domains has provided examples of learners who are disadvantaged when they do not recognise the crucial information about the contextual resources (Bansilal and Wallace, 2008. A survey of some school examinations (Debba, 2012; North, 2010) has indicated that many of the tasks require mathematically endorsed narratives. In order to create narratives that are endorsed in and appropriate to the contextual domain requires sustained engagement with the contextual resources. For learners to be able to use them productively, a more appropriate setting would be tasks that need extended periods of time, such as projects, assignments, presentations and debates, unlike the restricted setting of the 2- or 3-hour examinations.

It is likely that the purposes of ML are compromised by the country's fixation with assessment by examinations. I hope that I have demonstrated that, in order to make informed decisions, one needs space and time to engage with the context. This is limited in an examination setting. Thus curriculum designers need to identify enabling conditions for an ML curriculum and assessment plan that can fulfil a life-preparedness orientation, rather than presenting ML as a watered down version of the real mathematics, by using pseudo-contexts to ask easy mathematics questions.

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