CONTEXT FOR MATHEMATICS PAPER 1 AND MATHEMATICS PAPER 2: AN ANALYSIS OF GRADE 12 MATHEMATICS PAPERS IN SOUTH AFRICA

by

JUNIC MAGIDI

submitted in accordance with the requirements

for the degree of

MASTER OF SCIENCE IN MATHEMATICS, SCIENCE AND TECHNOLOGY EDUCATION

in

Mathematics Education

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: Prof L. D Mogari

FEBRUARY 2015

FEBRUARY 2015

45 899 916

I declare that '*Context for Mathematics Paper 1 and Mathematics Paper 2: An analysis of Grade 12 Mathematics Papers in South Africa'* is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Junic Magidi

Signature **-------------------------------------**

Date **--------------------------------------**

Context for Mathematics Paper 1 and Mathematics Paper 2: An analysis of Grade 12 Mathematics Papers in South Africa

by J. Magidi

Degree: Master of Science in Mathematics, Science and Technology Education.

Subject: Mathematics Education.

Supervisor: Prof L.D Mogari.

Abstract

The study intends to investigate the nature and cognitive demands of contextual word-problems posed in the FET mathematics examinations of IEB and NSC. The analysis of the mathematization of real-life situations to form contextual word-problems is based on the theory of authentic task situations. The theoretical basis for analyzing mathematics teaching and learning is the Realistic Mathematics Education (RME) theory. Data was obtained using the schedule of mathematization of real-life situations and the schedule of total marks of contextual word-problems and national performance.

All contextual word-problems included in the 2008-2013 question papers of IEB and NSC mathematics examinations were analysed. The research revealed that 509 marks out of 1800 marks were allocated to contextual word-problems in IEB examinations; whereas 473 marks out of 1800 marks were allocated to contextual word-problems in NSC examinations.

Key terms:

Horizontal and Vertical mathematization; Theme; Assessment for learning; Assessment as learning; Assessment of learning; Intended curriculum; Implemented curriculum; Attained curriculum; Theory of authentic task situations; Contextual subject; Contextual word-problems; Selective and Comprehensive mathematization;

A - Contents

B - List of tables

C - List of graphs

Data analysis graphs

D - List of figures

E - List of abbreviations

CAPS: Curriculum Assessment Policy Statement

DoE: Department of Education

DBE: Department of Basic Education

FET: Further Education and Training

GCSE: General Certificate for Secondary Education.

IEB: Independent Examination Body

NCERT: National Council of Educational Research and Training.

NCF: National Curriculum Framework.

NCS: National Curriculum Statement

NSC: National Senior Certificate

OECD: Organization for Economic Co- operation and Development

RME: Realistic Mathematics Education.

RWCF: Real – World Contextual Framing.

SACMEQ: South and Eastern African Consortium for Monitoring Education Quality

Chapter 1

1.1 Introduction

In South Africa, there are two different examinations for Grade 12. The first one, is called the National Senior Certificate (NSC), is administered to public schools by the Department of Basic Education (DBE). The second one, known as IEB, is administered to private schools by the Independent Examinations Body (IEB). The 2010, NSC matriculation examinations were written by 537 543 full-time students at 6 670 schools (Gravett & Gillian, 2011). On the other hand, the 2010, IEB matriculation examinations were written by 8 285 students at 172 independent schools (Mail and Guardian [online], 04 January 2011).

The Independent Examination Body is an independent agency which offers an alternative form of assessment and it is accredited by Umalusi, a South African agency responsible for quality assurance in school examinations. Both the IEB and the NSC offered the intended curriculum of the National Curriculum Statement (NCS), that is, the curriculum offered in South African schools from 2008 to 2013.

The Mathematics Curriculum Document emphasises that "tasks and activities should be placed within a broad context , ranging from the personal , home , school , business , community , local and global" (DoE , 2006: 19). Contextual word-problems should include social, political, environmental, economic, health, cultural, and scientific issues, whenever possible (Curriculum and Assessment Policy Statement (CAPS), 2012).

Contextual word-problems are presented using grammatical sentences, rather than mathematical symbols. The intention behind the use of contextual word-problems is to support the reinvention process which enables students to understand formal mathematics using experimentally-real problem situations. Contextual word-problems – in assessment for learning, assessment as learning, and assessment of learning – need to be sufficiently addressed in the intended curriculum, the implemented curriculum, and the attained curriculum.

While the primary aim of contextual word-problems in examinations is to assess the attained curriculum, their secondary purpose is to act as tools and benchmarks in teaching, learning, and internal assessment. In addition to being ends in themselves, contextual word-problems are also means to some other ends, in examinations. Indeed, they are tools used in assessment for learning, assessment as learning, and assessment of learning.

The intended curriculum refers to words and symbols which explain what is hoped for; whereas, the implemented curriculum relates to the actions taken to achieve what is hoped for. The attained curriculum is the evidence of these actions. It is important to note that educators and students respond more to the actions forming part of the implemented curriculum than the stipulation contained in the intended curriculum. As a result, the action of examining in context is far more effective in motivating educators to teach in context and students to learn in context than the intended curriculum's mere stipulation that context should be included in mathematics teaching, learning, and assessment.

Variations in past examination results, school dropout rates, and university throughput rates indicate differences in the attained curriculum from one year to another, from one examination body to another, and from examination Paper 1 to examination Paper 2. Therefore, it becomes necessary to determine whether there is any relation between variations in the implemented curriculum – in terms of the nature and quantity of contextual word-problems in the Grade 12 mathematics examinations – and variations in the attained curriculum, as suggested by drop-out rates, Grade 12 results, and university through-put rates.

1.2 Use of contextual word-problems in teaching, learning and assessment

In the FET band, mathematics emphasises the establishment of connections between mathematics and the real world. However, in examinations, contextual word-problems are often perceived as barriers by some students. This is because of these students' poor literacy levels which often prevent them from identifying the mathematical skills required (Sasman, 2011).

School examination papers are typically dominated by short, structured items that fail to assess sustained reasoning (Jones & Ingris, 2015). The use of a familiar context in a formal school curriculum may introduce cultural perceptions, values and practices into the classroom that may hamper the intended purpose of facilitating learning (Mogari, 2010). Research on contextual word-problems reveals that students find contextual word-problems difficult (Onabanjo, 2004).

The difficulty emanates from students' lack of the required ability, the irrelevance of these contextual word-problems to students' lives, students' lack of motivation to solve contextual word-problems, as well as their limited exposure to contextual word-problems (Bates & Wiest, 2004). Another issue associated with contextual word-problems is that assessment in context is not always appropriate.

While some contextual word-problems may be imbedded in real-life contexts, students are more likely to succeed if they suspend their knowledge of the real as well as the guidelines on how to resolve real life mathematics problems (Cooper, 1992). Although contextual word-problems may be meaningfully taught in the suitable contexts, their inclusion in the assessment of mathematics suggests that students do not benefit from questions which are forced into so-called real contexts (Fischer-Hoch & Hughe, 1996). Simply put, if improperly mathematized, contextual word-problems can do more harm than good to students.

Analysis of the content and style of examination papers is done against the backdrop of a conjecture that mathematics examination papers comprise mainly of short items that assess the rote learning of isolated facts and procedures (Noyes, Wake, Drake, & Murphy, 2011) in (Jones & Ingris, 2015). This fragmented presentation of mathematics is at odds with the stated aims of mathematics curricula (Noyes et al., 2011) in (Jones & Ingris, 2015), and fails what is valued most by educators and employers (Mclester & Mclntire, 2006) in (Jones & Ingris, 2015). In other words, some valid contextual word-problems may be assessed in the wrong context.

Indeed, performance in mathematics contextual word-problems is generally poor. This is because students seldom think realistically when applying real-world knowledge to mathematics contextual word-problems. Students often display what seems to be a suspension of common sense, when solving mathematics contextual word-problems (Schoenfeld, 1991). More often than not, students write non-realistic and logically inconsistent answers when attempting to solve contextual word-problems.

The major reason for the difficulty experienced by students with regards to contextual word-problems might be that real-life problems are inappropriately mathematized in the process of their conversion into contextual word-problems. This results in students failing to identify the link between real-life problems and contextual word-problems. Consequently, students fail to solve contextual word-problems at various stages of problem solving.

Indeed, students experience difficulties in converting a contextual word-problem into the appropriate mathematical form - horizontal mathematization - when trying to solve it (Hart, 1996). More often than not, students seem to be unable to create a mental representation that links the text of the word-problem to the appropriate mathematical expressions (Hart, 1996).

It must be stressed that most students fail at the interpretation stage- horizontal mathematisation. Also, as noted in the Association of Mathematics Education of South Africa (AMESA) report on grade 12 students' performance in 2013 examination, students found it difficult to represent word-problems with appropriate equations- horizontal mathematisation (AMESA, 2013).Thus, they get very few, if any, marks in contextual word-problems in examinations.

To prevent this, mathematical contexts should be realistic and authentic so as to invite, or even force, students to use their common sense and experience of the real world in the different stages of their endeavour to solve contextual word-problems.

While some students fail to solve mathematics contextual word-problems, certain mathematics contextual word-problems fail students.

Sasman (2011) points out that in the Western Cape, for example, the analysis of the data on the average percentage scores obtained in each contextual word-problem in the 2010 NSC mathematics examination question paper reveals that students performed poorly. The contextual word-problems were questions number 7; 10 and 11. The average percentage scores were as follows: 22.9% for number 7; 15% for number 10; and 30% for number 11 (Sasman, 2011).

Different students perform differently in contextual word-problems. This might be a reflection of cultural capital inequalities in society. Improving the quality of primary schooling, particularly numeracy competence, is a prerequisite to the achievement of sustainable, quality education in secondary schools, FET colleges, and universities (Taylor, Fleisch & Shinder, 2008).

Now that efforts to improve access to education in South Africa are well underway, perhaps attention should now be focused on improving the quality and equity of education offered in the schools as well as issues of social justice, high drop-out rates and low university through-put rate. It is possible to pursue equity through mathematics education.

This can be achieved by providing students with tools that enable them to critique and act upon issues of importance in their lives and in their communities (Gutstein, 2006). Nevertheless, the attainment of this objective may be achieved through a realistic mathematics education which enables students to rediscover mathematics through solving real-world problems. Put differently, contextual word-problems have the potential to reduce inequalities in mathematics education and, subsequently, in society.

Although considerable research has been conducted on schooling outcomes in South Africa, none of it has analysed the use of contextual word-problems in the FET mathematics examinations of IEB and NSC. The nature of the mathematization of real-life situations to form contextual word-problems determines the quality of the resulting contextual word-problems.

Once again, there is paucity of research on the mathematization of real-life situations to form mathematics contextual word-problems in the FET examinations of IEB and NSC. This implies that knowledge about the extent to which the nature of the mathematization used to convert real-life situations into contextual word-problems affects students' performance remains limited.

Thus, this research investigates the nature and cognitive demands of the contextual word-problems posed in the FET mathematics examinations of IEB and NSC. The focus of the research is on both the implemented curriculum and the attained curriculum. The analysis of the implemented curriculum focuses on the nature of the mathematization of real-life situations in forming the contextual word-problems included in the FET mathematics examinations of the IEB and the NSC.

This means that similarities and differences between the various contextual word-problems posed by the two examination bodies have to be identified through the simultaneous use of qualitative and quantitative methods. The basis of the analysis of the mathematization of real-life situations is the theory of authentic task situations (see section 2.1). As for the analysis of the attained curriculum, it is based on students' performance in the contextual word-problems included in the FET mathematics examinations of IEB and NSC.

Furthermore, the research focuses on the themes and contextual subjects of the past examination, contextual word-problems posed in the past mathematics Paper 1 and Paper 2 examination questions. The research also focuses on the definition, algorithmitization and symbolisation aspects of mathematization (see section 2.2.1). The objective is to determine the relationship between horizontal mathematization and vertical mathematization.

A balance between horizontal mathematization and vertical mathematization is regarded as indicative of a comprehensive mathematization. Conversely, an imbalance between horizontal mathematization and vertical mathematization suggests a selective mathematization. The relationship between horizontal mathematization and vertical mathematization is an important tool that could support curriculum development.

1.3 Research Problem

1.3.1 Problem of study

The study intends to investigate the nature and cognitive demands of the contextual word-problems posed in the FET mathematics examinations of IEB and NSC.

1.3.2 Research questions

The study will address the following research questions:

Question1

What is the nature of contextual word-problems posed in the FET examinations of IEB and NSC?

The question will be addressed by focusing on the following sub-questions:

Question 1.1

What are the themes of the mathematics contextual word-problems posed in the FET examinations of IEB and NSC?

Question 1.2

What are the contextual subjects of the mathematics word-problems posed in the FET examinations of IEB and NSC?

Question 2

What percentage of total marks was allocated to mathematics contextual word-problems in the FET examinations of IEB and NSC?

Question 3

What is the balance between the horizontal mathematization and the vertical mathematization of the contextual word-problems included in the FET mathematics examinations of IEB and NSC?

Question 4

Are there any similarities and/or differences between the contextual word-problems posed in the FET mathematics examinations of IEB and those of the NSC? If any similarities and/or differences exist, what are they?

1.4 Significance of the study

The purpose of this study is to investigate the nature and cognitive demands of the contextual word-problems posed in the FET examinations of IEB and NSC. As noted in section 1.2, past examination contextual word-problems are significant tools and benchmarks in the mathematics teaching, learning, and assessment process. However, the use of context in mathematics assessment raises numerous issues relating to whether or not; the context makes a question easier or more difficult for the students.

Hence, this research seeks to describe, analyze, and explore the use of contextual word-problems in the FET mathematics examinations of IEB and NSC. The intention is to determine the extent to which the context simplifies or complicates the question for the students. The main aim of the research is to determine what works in the use of contextual word-problems in mathematics assessment.

The duration of both NSC and IEB past examination question papers is the 6 years (2008-2013) in which the NSC mathematics examinations were written. The NSC syllabus is the last syllabus before the current CAPS syllabus which started in 2014. An analysis of the previous syllabus is important in order to identify areas that need improvement in the current syllabus.

There are four major reasons for studying the history of mathematics education. The first reason is to understand mathematics education better. The second reason is to judge mathematics education issues wisely. The third reason is to identify aspects of mathematics education that need to be changed as well as understanding change in mathematics education. The fourth reason is to be prepared when history repeats itself.

The study also seeks to determine why students perform poorly in contextual word-problems as compared to algebraically-presented (i.e. symbols and notation form) problems. As noted in section 1.2, students' performance in contextual word-problems depends on their ability and the way in which real-life situations are mathematized. Sometimes, students fail to address contextual word-problems because they lack the ability to read, understand, and solve them. Other times, some students fail to engage with contextual word-problems because of the inappropriateness of the questions they are exposed to and their lack of experience in dealing with contextual word-problems.

As also noted in section 1.2, examinations are very powerful tools that can be effectively employed to address the imbalances of the past and to provide sustainable remedial action. In other words, they can compel previously disadvantaged groups to attain meaningful learning. Thus, sustainable equality can be achieved by encouraging disadvantaged students to work harder, rather than lowering the standards or adding extra marks to the scores of these students. Put another way, sustainable equality cannot be achieved by pulling down those who are up, but rather by pulling up those who are down.

The study also aims to establish any similarities and/or differences between the contextual word-problems of IEB and those of NSC. This might help to reveal the general underlying structure which accounts for the differences and/or similarities in the performance of IEB students and NSC students in contextual word-problems. In this regard, the study endeavours to highlight the similarities and/or differences between contextual word-problems asked by the two examination bodies, from one year to another and from Paper 1 to Paper 2. Hence, this research seeks to describe, analyse, and explore the use of contextual word-problems in the FET mathematics examinations of IEB and NSC.

In addition, the study champions for the setting of appropriate contextual word-problems. This will be achieved by highlighting the standards to be used in measuring the appropriateness of contextual word-problems in assessment for learning, assessment as learning, and assessment of learning. More often than not, educators and subject-advisors use past examination contextual questions as a benchmark for ensuring that the standard of contextual word-problems set for internal assessment is appropriate. As such, past examination contextual word-problems affect the way educators teach and how students learn.

This study also endeavours to analyse both the horizontal and the vertical mathematization in terms of definition, algorithmitization, and symbolism. The highlight of the relationship between vertical mathematization and horizontal mathematization in the FET examinations of IEB and NSC is an important process for curriculum development. The study also seeks to highlight the themes and contextual subjects of mathematics contextual word-problems in the FET examinations of IEB and NSC.

Since linear programming is absent in the CAPS syllabus, it is also important to highlight the gap that this contextual subject leaves so that arrangements can be made to fill it, if necessary. Thus, the study emphasises the percentage of past IEB and NSC examination contextual word-problems, whose contextual subject is linear programming.

Furthermore, the researcher will make recommendations and suggestions on the effective use of appropriate contextual word-problems in marketing mathematics to students, and motivating and retaining them. Indeed, the effective use of appropriate contextual word-problems can provide students with a model that will guide their thinking. This could make learning mathematics more interesting.

The study also stresses the need to take full advantage of examination-driven teaching and learning by setting appropriate mathematics contextual word-problems in examinations. Examining in context is far more effective in motivating educators to teach in context and students to learn in context than the mere principle that context should be involved in the teaching and learning of mathematics in the intended curriculum.

1.5 Definition of terms

Contextual word-problems: mathematical questions expressed as hypothetical situations explained in words, based on non-mathematical themes such as politics, economics, society, culture, science, constructions, environment, and so on.

Cognitive demand: mental activities required in solving a mathematics contextual word problem, such as thinking, understanding and remembering.

1.6 Structure of dissertation

Chapter 1 provides a background to the research problem, articulates the problem of the study, the significance of the study and definition of terms. Chapter 2 presents the theoretical framework of the study and an analysis of related studies. Chapter 3 outlines the methodology of the study. Chapter 4 covers the analysis of the gathered data and a summary of the findings. Chapter 5 provides the summary of the study, a discussion of the results, an illustration on how data have addressed the research questions, limitations of the study, conclusions drawn, and recommendations.

1.7 Concluding remarks

The intended curriculum is physical and exists independently from educators' activities and students' experience as noted in section 1.1. On the other hand, implemented curriculum is objective because it is experienced. Mathematics objects are mental constructs with little or no concrete referents. As a result, symbols are used to link the mental constructs with things. Since the attained curriculum is expressed in the form of symbols, it is subjective.

The nature of algorithmitization, definition and symbolization, determines whether the mathematization is vertical or horizontal. As noted in section 1.4, the study seeks to discuss the themes and contextual subjects of mathematics contextual word-problems that students have been exposed to in the FET examinations of IEB and NSC. Theoretically, context is supposed to make the mathematics question easier to the student. However some contexts can be barriers to students who are trying to solve mathematics contextual word-problems.

Chapter 2

Theoretical Framework

The study is underpinned by the theories of authentic task situations and Realistic Mathematics Education (RME). The former forms a basis for the analysis of the mathematization of real-life situations to form contextual word-problems. The theoretical basis for the analysis of mathematics teaching and learning in this study is the Realistic Mathematics Education (RME) theory.

2.1 Theory of authentic task situations

The foundation of the theory of authentic task situations is the assumption that if a performance measure is to be interpreted as relevant to a real-life performance; the measure must be done under conditions that are relatable to the stimuli and reactions that occur in real life (Fitzpatrick & Morrison, 1971). This means that for a school task to be authentic, it must both represent some task situation in real life and must mathematize all important aspects of that situation to a reasonable degree of accuracy (Verschafell, Greer, Van Dooren & Mukhopadhyay, 2009).

According to the theory of authentic task situations, school mathematics has been criticised for not being genuinely realistic (Verschafell et al, 2009). As a result, students do not make proper use of their real-world knowledge when solving contextual word-problems (Boaler, 1993). It is important to stress that the way a real-life situation is mathematized determines the quality of the contextual word-problem.

Since it is impossible to mathematize all aspects of the real world, the framework of authentic task situations specifies eight aspects of real-life situations that are crucial in their mathematization. These eight aspects determine the extent to which students may engage in the mathematical activities pertaining to the mathematized situation (Verschafell et al, 2009). An appropriate contextual word-problem is one that sufficiently addresses all eight crucial aspects.

It is very difficult, if not impossible, to mathematize all real-world situations in a way that ensures that the conditions for solving the contextual word-problem will be exactly the same as those for solving the related real-world problem. However, the characteristics of contextual word-problems and the conditions under which they are to be solved can affect the extent of the difference between resolving a real-life problem and solving a contextual word-problem (Verschafell et al, 2009).

This difference can, in turn, affect the similarities in the mathematizations used and the degree of common sense applied in solving the contextual word-problem. If the difference between solving a real-life problem and solving a contextual word-problem is too big, students are more likely to display suspension of common sense.

The eight crucial aspects proposed by the theory of authentic task situations were chosen because the clarity of their mathematization has an impact on the difference between solving a real-life problem and solving a mathematics contextual word-problem. This difference will, in turn, affect the extent to which students may engage in the mathematical activities that match the mathematized real-life situations, when solving contextual word-problems (Verschafell et al, 2009).

This match in mathematical activities has three aspects. The first aspect relates to the skills required in the process of creating a mathematical model, based on the real-world situation - horizontal mathematization. The second aspect encompasses the methods and concepts used in handling mathematical objects within the mathematical world to obtain mathematical results - vertical mathematization.

The third and final aspect relates to the skills required in interpreting the answer obtained in relation to other contextual word-problems and the real-life situation - progressive mathematization. This framework attributes students' apparent suspension of common sense, when solving contextual word-problems, to the inappropriate mathematization of real-life situations. Sometimes, the failure of students to answer contextual word problems is not a problem but an indicator of a problem.

The eight crucial aspects of real-world situations are (1) event, (2) question, (3) information, (4) presentation, (5) solution strategies, (6) circumstances, (7) solution requirements, and (8) purpose in the figurative context, (Verschafell et al, 2009). As far as event is concerned, the task described in the contextual word-problem must either have taken place or have the potential to occur in real life (Verschafell et al, 2009).

With regard to crucial aspect number two, the question asked in the contextual word-problem must be one that has been posed or might be posed in the real-life event mathematized in the task. Solving a contextual word-problem should not be regarded as only an end in itself; it must also be viewed as a means to some ends, such as solving real-life problems. The major function of any contextual word-problem is to give students experience in solving real-life problems.

Information includes values, models, and the data that are directly available in the situation or that can be obtained from it and on which the solution to the problem can be based. Information concerns three aspects, namely, existence of information, realism of information, and specificity of information. Existence refers to the fact that information accessible in the corresponding real-world situation is also available in the contextual word-problem. Differences in the accessible information can arise if the information from the mathematized real-life situation is withheld from the students in the mathematics contextual word-problem.

Moreover, differences in the accessible information can arise if additional important information is excluded from the contextual word-problem, or when additional unimportant information is added to the contextual word-problem. In both cases, the result is an overload of the question (Verschafell et al, 2009). The lack of information in the contextual word-problem can also occur when the description of the mathematized situation is short of contextual features. The fact that students do not get a clear picture of the situation results in misconceptions. Differences can also arise if the information given in the contextual word-problem has been substantially simplified or made more difficult than in the mathematized real-life situation.

Realism relates to existing information. The mathematization of this aspect with a reasonable degree of accuracy ensures that numbers and values in the contextual word-problem are very close to the corresponding numbers and values in the simulated real-life situation. Reality is the correspondence between the mathematical model and students' perception of real life (Stillman, 1998). Students' perception of real life might be different from the actual real life. A contextual word-problem that matches the actual reality but differs from the students' perception of reality might be considered unreal by them.

Thus, mark schemes need to sufficiently consider the degree of realism resulting from students' solution of contextual word-problems. Indeed, currently some answers are marked as wrong despite being correct. This may partly be attributed to the fact that some aspects vary constantly. For example the exchange rate on the day on which the examiner sets the paper might be different from the exchange rate on the day on which the students write the examination. As a result, it might be necessary to specify the date of the exchange rate or notify students that the exchange rate is an estimate.

The information available in the contextual word-problem should be specific since the text of the contextual word-problem describes a specific situation in which the subjects, objects, and places in figurative context are all specific. As such, the specificity of the information available in the contextual word-problem should match the specificity of the information available in the real world (Baranes, Perry & Siiegler, 1989). For example, the difference between sharing a loaf of bread and sharing a cake can lead students to reason differently (Taylor, 1989). Rather than saying, 'A certain man bought a car for R150 000', it is more specific to say, 'Mr Glen bought a Toyota corolla from Randburg Toyota for R150 000'.

Presentation refers to the way in which the contextual word-problem is communicated to the students. Presentation can be divided into two sub-aspects, namely, mode and language use. Mode refers to whether the problem is communicated to students orally or in written form. In written form, mathematics contextual word-problems can be presented in words, diagrams or tables. Presentation also involves the colours used. More often than not the colours are predominantly black and white. However, it is more desirable to use other colours in addition to black and white, especially in examinations for the youth. It is more realistic to illustrate green grass using a green colour as compared to illustrating green grass using a black colour.

The language used in the contextual word-problem should not be so different from the one used in the real-world situation in order to ensure that students use the same mathematics as in a real-world task and that they do not display suspension of common sense (Nesher, 1980). Answers that reflect a suspension of common sense can be an evidence of inappropriate presentation of a mathematics contextual word problem.

In addition, questions that ask about opinions seem to be more inappropriate as compared to questions that ask about facts. Opinions can neither be wrong nor right but facts can be wrong or right. One can only agree or disagree with an opinion, so any answer that a student gives to a question that requires an opinion is correct.

The terminology, sentence structure, and amount of text used in the presentation of the contextual word-problem should be accessible to students. In a mathematization of presentation, with a reasonable degree of precision, the contextual word-problem does not include difficult or ambiguous terms that hinder students' ability to solve the problem. This is only possible if the corresponding difficulties do not occur in the mathematized real-life situation itself.

Solution strategies are based on the role and purpose of solving the mathematics contextual word-problem. The two sub-aspects of solution strategies are availability and expanded opportunities. The availability of solution strategies depends on the match between the relevant solution strategies available to students when solving the contextual word-problem and those accessible to the persons described in the mathematized real-life situation (Verschafell et al, 2009). Expanded opportunities refer to the match in the strategies which can be used to solve the contextual word-problem and those that can be used to solve the real-life situation.

Circumstances are factors in the social context (Clarke & Helme, 1998) which influence the solution of the problem. This aspect is divided into five sub-aspects, namely, (1) availability of external tools, (2) guidance, (3) consultation and collaboration, (4) discussion opportunities, and (5) time. External tools refer to concrete tools outside the mind.

These include a calculator, a map, a ruler, a graph paper, or a set square. Writing a mathematics examination without a calculator or borrowing a calculator on the examination day can negatively affect a student's performance. Guidance refers to specific hints in contextual word-problems. Examples include "Using Pythagoras theorem” which would clearly cause a great difference in what the students are expected to accomplish in both the school situation and the real-life situation.

In real life, problems can be solved through collaboration between groups or by one person who receives some assistance. If the mathematized problem is solved through groups’ collaboration in real life, then it would be unfair to expect a single student to solve the corresponding contextual word-problem in an examination. Likewise, it is inappropriate to give students a task which is solved by one person in real life as group work.

Simply put, some tasks are for individual work, whereas others are for group work. Input from other people can affect the skills and competences which are required to solve a task (Resnick 1987). Contextual word-problems which mathematize problems solved through collaboration in real life should be given to students as group work. Such problems are unsuitable for individual examinations.

Discussion opportunities are the possibilities for students to ask about and discuss the meaning and understanding of contextual word-problems. Contextual word-problems which mathematize problems solved through discussion should be given to students as group work. This is because they are inappropriate for individual examinations. A lack of concordance between real-life problems and contextual word-problems in this sub-aspect can cause differences in the mathematics used. This has the potential to affect the experienced meaning of the contextual word-problem and the solution strategies applied (Christiansen, 1997).

In dealing with contextual word-problems, it is important to ensure that time restrictions do not cause variations in the possibilities of solving the given contextual word-problems, as compared to solving the mathematized real-life problems. Mark allocations need to sufficiently take into account the amount of time needed to read, understand, and solve contextual word-problems. Different solutions to problems can have different consequences for students. Pressures on students and their motivation for solving the given contextual word-problems affect the task-solving process. As such, they are aspects that need to be seriously considered in mathematization.

Solution requirements include both the solution method and the final answer to a question. Judgments on the validity of answers and the discussion of the solution methods can be part of the requirements in solving contextual word-problems. For example, students may be required to solve trigonometric problems, without using a calculator. In a mathematization, these requirements should conform to what is regarded as an appropriate solution in a corresponding real-life situation. Furthermore, students should be aware of this.

In some cases, students may be required to illustrate, draw, or write their answers on given diagram sheets. However, there might be mistakes on some of these diagram sheets. For instance, a diagram sheet for a cumulative frequency curve might have the y-axis starting from 50 to 100, instead of starting from 0 to 100. Only intelligent students will realise that the diagram sheet is inappropriate and will correct the y-axis, or will use their answer booklet instead of the diagram sheet.

In other words, while some diagram sheets might aid students in solving contextual word-problems, others might hamper students' attempt to solve contextual word-problems. It is also important to note that, adequate moderation can result in proactive, correction of mistakes, such as the one mentioned above, before the paper is printed and given to students. Reactive managements of mistakes, after the paper has been printed and given to students, are very difficult to implement effectively. Sometimes errata are issued, the marks of the question with mistakes are subtracted from the total mark, or, students are given free marks. All these reactive solutions are more likely to disadvantage some students whilst benefiting other students.

Finally, the purpose of finding the solution in the figurative context influences the appropriateness of the answer to the posed contextual word-problem. In other words, the whole solution method is dependent on the purpose (Palm, 2002). Thus, in mathematizations, it is essential that the purpose of solving the mathematics contextual word problem is as clear to the student as it is to the problem-solver in the real-life situation. Hence, the interest of the current study is on the cognitive demands placed by contextual word-problems on students.

2.2 Context and Mathematics Teaching, Learning and Assessment

The Department of Education (DoE) Curriculum Policy Statement (CAPS) of 2011 draws on Freudenthal's (1973) notion of mathematics and defines it as a human activity. Mathematics can also be defined as a science of concepts and processes that have a pattern of regularity and a logical order (Van de Walle, 2013) as well as a process of making sense of abstract objects using logic as a standard of truth.

2.2.1 Mathematics teaching and learning in context

In this study, the Realistic Mathematics Education (RME) perspective is adopted to discuss mathematics teaching, learning and assessment. RME has its roots in Freudenthal's interpretation of mathematics as a human activity and a system of student-oriented activities rather than being a subject to be transmitted to students (Van den Heuvel-Panhuizen, 2003).

The RME philosophy (1) encourages the use of real life and contextual word-problems in mathematics teaching through interactions with peers and educators, (2) rejects the mechanistic and procedure-focused way of teaching rather encourages learning by developing and applying concepts and tools in everyday life (Van den Heuvel-Panhuizen, 2003: 9) , (3) encourages discovery and invention of knowledge, and (4)argues that education goes beyond acquiring knowledge and skills instead it prioritises developing capacity to connect knowledge in order to discover and invent new ones (Snoek & Wielenga, 2001).

Educators and students use past examination contextual word-problems as resources. This has proven to be helpful because educators and students get a feel of contextual word-problems. For educators it is about how best to teach students to solve such problems and for students it is about improving their problem solving skills. Noting that mathematics teaching is not an end in itself, but rather a means to some ends.

These include ensuring that students are well prepared to pass examinations and that they can apply knowledge in order to successfully solve real-life problems. Likewise, learning is not only an end in itself; it is rather a means to some ends. It is for this reason that it is argued that for students to get used to contextual word-problems, more contextual materials need to be used in the teaching and learning of mathematics on a regular basis.

However, there is no guarantee that the use of context will always result in the desired effects. For example, students who do algebraic calculations correctly are more likely to base their responses on their own experience, rather than on the data given in a realistic problem, and this may result in loss of marks in a test or an examination. A contextual word-problem might require a student to calculate the amount of change remaining after he or she uses R100 to buy 1kg of pork costing R55 per kg. A certain student might argue that he or she will remain with R100 because due to his or her religious orientation, he or she cannot buy or touch pork. Another student who is used to buying 1kg of pork at R49 per kg might give the answer as R51.

A study conducted by Boaler (1999) found that between 31% and 42% of year 9 students could solve either abstract or contextual problems, not both. This implies that some students are exclusively good at contextual word-problems, whilst others are exclusively good at abstract problems. In some cases, the use of a cultural context in a class tends to introduce gender stereotypes that disadvantage one gender group.

A study by Mogari (2010), for example, found that boys performed better than girls due to the manifestation of cultural stereotypes in class through which girls were denied full participation in learning activities. In the same vein, the study by Little (2010) also found that girls prefer algebraic questions, whereas it was established that boys prefer context-based questions. It is important to stress the fact that some contextual word-problems are inappropriate. The inappropriateness results from the fact that the chosen contextual word-problems may be unfamiliar to many students because of their peculiarity.

The task of making educators see beyond constraints and realize the benefit of linking such a notoriously inaccessible subject as mathematics with real life is not an easy one. Classroom assessments are contextualized and dependent on educators' conceptions, norms, and practices. Thus, educators' conceptions, norms, and practices need to be aligned to the examiners' conceptions, norms, and practices. Put differently, internal assessment needs to be aligned to external assessment. If contextual word-problems are included in external assessments, then the onus is on educators and other stakeholders to include them in internal assessments as well.

Consequently, in addition to developing curriculum materials, educators also need to be capacitated and motivated to use these materials in classroom teaching and assessment. Alternatively, educators might be involved in the development of curriculum materials. There is need to shift away from talking to educators towards talking with educators in regard to curriculum issues in order to reduce inertia to curriculum change.

Learning mathematics involves generating strategies for solving problems, applying these strategies, and establishing if they led to meaningful solutions, Van de Walle et al (2010). In summary, learning mathematics involves horizontal mathematization, vertical mathematization, and progressive mathematization. The perspective adopted in this study is that mathematics was invented, not discovered.

Historically, mathematics evolved from the process of solving real-life problems. Since mathematics emerged out of practical life needs, the motivation for learning mathematics is reality. Learning mathematics should model the act of using mathematics to solve real-life problems. Hence, the focus of the current study is on the nature and cognitive demands of contextual word-problems posed to the grade 12 students. In mathematics, the truth can be re-invented through observations, simulations, and experimentation.

In the same way that teaching mathematics requires effort on the part of the educator, learning mathematics also requires effort from the student. Educators are only responsible for teaching, where they make content easier for students to understand. Hence, it is argued that the teaching of mathematics needs to be student-focused, for it to be effective and sustainable.

Simply put, mathematics teaching needs to focus on enabling students to figure things out by testing ideas, making conjectures, developing reasons, and offering explanations. Students should be encouraged to ask the educator questions, rather than always expect the educator to ask them questions. By so doing educators may be able to read the students thinking and this may also be helpful to them, when they plan their teaching.

For mathematics to be relevant to society and stay close to students' experiences, it should be based on real situations. Real situations include contextual word-problems and mathematical contexts in which students experience the problems presented as real. An important purpose of contextual word-problems is the establishment of proper connections between mathematics as a discipline and real-life situations. Mathematics contextual word-problems are the bridge between real life and academic mathematics. This bridge is crossed through horizontal mathematization. After the bridge, the mode of transport is vertical mathematization. Hence the interest of the current study is on contextual word-problems.

The teaching and learning of mathematics needs to provide students with guided opportunities to re-invent mathematics in the process of doing it. Adequate educator's content knowledge and appropriate methodology are both essential prerequisites. They ensure that students are appropriately prepared so that they can acquire the fundamental skill of mathematical proficiency (Sasman, 2011).

In order to effectively teach in context, educators need to master the skill of interpreting mathematical concepts and skills in relation to the context (Brown & Schafer, 2006). Currently, most educators are unable to adequately teach in context. This may possibly be attributed to the fact that they were neither taught in context at school, nor trained in context during educator training. It is therefore argued that it is necessary to teach in context both at school and when training mathematics educators because, according to (Brown & Schafer, 2006), this will enable educators to develop the skills needed to relate mathematics to the context.

Adequate initial training and in-service training can contribute significantly to giving educators the capacity to adequately prepare students to successfully solve contextual word-problems in examinations. The training of new educators as well as those already in the profession needs to be designed in such a way that it provides them with the skills that enables them to teach and assess in context. A change of teaching methodology might challenge students to become more independent thinkers who can effectively solve both mathematics problems and real-life problems.

If students learn mathematics in an isolated fashion, divorced from their experiences, they can quickly forget and will therefore be unable to apply what they have learnt. Rather than starting with certain definitions to be applied later, a mathematics educator must start with contexts that can be mathematized. To facilitate this, classroom experiments need to be designed in such a way that they enforce a culture of vertical mathematizing in students. For example, students can learn about profit and loss by doing a project on selling stationery at school. In other words, Realistic Mathematics Education emphasises the fact of giving students problem situations that they can imagine.

2.2.2 Language and Mathematics teaching and learning

Learning mathematics is more than mastering a collection of concepts and skills. It includes methods of investigating and reasoning, means of communication, and the notion of context. It also includes definition, algorithmmitization, and symbolisation. Since learning mathematics is similar to learning a language in another language (Kaphesi, 2001), mathematics can be regarded as a language which is predominantly taught in English, especially in the South African context.

As such, the teaching of mathematics contextual word problems becomes very difficult, if not impossible, for educators with a limited understanding of English, which is the medium of instruction. Likewise, for students who do not understand English properly, the effective learning of mathematics contextual word problems becomes very difficult, if not impossible.

It is important to emphasise that language contributes to poor performance in contextual word-problems. In South Africa, for example, the language of teaching, learning, and assessment is predominantly English. As a result, most students learn mathematics in their first additional language, while a few students learn mathematics in their home language (Third International Mathematics and Science Study (TIMSS), 1998) in (Howie 2003). In both the 1995 and 1999 TIMSS, 70% of South African students wrote achievement tests in their second or third language (Howie, 2003).

The 1999 TIMSS results revealed that South African students who spoke either English or Afrikaans at home achieved higher marks (about 100 points above the national average) than those who did not (Howie, 2003). In contrast, Howie also reports that students who spoke other home languages at home scored 20 points, on average, less than the English home language speakers. What is more, as Howie further indicates, students who speak African languages at home scored 100 points less than the other group of first-additional-language speakers.

Given the profile of IEB and NSC schools, the first two groups of students are more likely to write IEB examinations, whereas the third group of students is more likely to write NSC examinations. All examiners and moderators must be aware of the impact of language competency on all aspects of examination performance (Umalusi Report, 2004). Given that vocabulary knowledge is one of the most important determinants of success (Saville-Troike, 1991:8) and most students in South Africa learn in their first additional language, the issue of language needs to be sufficiently taken into account when setting, marking, and moderating examinations.

Students for whom English is the home language focus primarily on cognitive skills in an assessment task (Anstrom, 1998). Those who speak English as first-additional-language simultaneously learn mathematics as well as the language of teaching and learning. As it becomes evident, English tends to be a barrier to learning mathematics for many first-additional-language speakers (Umalusi Report, 2004).

The symbols < , > , - , = , + , % , : , ~ , ; as well as specialized language or Mathematical English (for example, hypotenuse, parallel, perpendicular, simultaneous equations, recurring decimal, rational) hamper students' ability to interpret and conceptualize mathematical texts , especially contextual word-problems (Earp & Turner, 1980).

Mathematical English is foreign to both home language and first-additional-language mathematics students. Mathematics achievement is generally poor for first language speakers because of the existence of highly specialized mathematical terms whose meanings vary from those used in everyday speech (Bell, 2003). It is even more difficult for first-additional-language speakers in that, while their counterparts focus on learning only the specialized mathematical language, they deal simultaneously with both the ordinary English language and the specialized mathematical language. Examiners need to put into consideration first –additional language speakers when choosing words to express contextual word problems.

Most students who write NSC examinations are first-additional-language speakers of English. As a result, they are more likely to have problems in understanding both ordinary English words and mathematical English words. In contrast, students who write IEB examinations are more likely to be home-language speakers of English. As a result, they are less likely to have problems with ordinary English words.

However, they are still likely to have problems with mathematical English words. The current study intends to shed more light on this issue. Educators who commented on the literacy skills required by an examination paper for comparative judgment were concerned about weakly performing students, or students for whom English is a first-additional language, (Jones and Ingris, 2015).

It is important to stress that incompetence in ordinary English does not necessarily imply incompetence in mathematical English. As a result, interventions targeting mathematical English knowledge gaps should differ from those aimed at ordinary English knowledge gaps. Some students have problems relating to ordinary English only, others have problems connected to mathematical English only, and yet other students have problems pertaining to both ordinary English and mathematical English. Simply put, different students have different problems which require different intervention strategies.

Educators need to identify whether students have difficulties in ordinary English language or mathematical English language before deciding on an intervention strategy. Students also need to know their weaknesses in order to effectively work towards overcoming them. This implies that English-first-language speakers may have an advantage over first-additional-language speakers who may struggle to understand the words in which mathematics is embedded (Durkin & Shire, 1991). This point needs to be seriously considered when teaching and learning mathematics. It is thus imperative that mathematics educators should strive to minimise the language disadvantage to first-additional-language speakers.

The need to address this issue offers an opportunity for sustainable and proactive remedial action. First-additional-language speakers need to put more effort, since they have to learn both mathematics and the language of teaching and learning. Educators of classes that have students who have English as their first-additional-language also need to realise that they have to simultaneously teach their students the language of learning and mathematics.

In this regard, the classroom becomes the ideal place to implement sustainable remedial action by ensuring that the disadvantaged students put extra efforts in their studies. The aim of remedial action in this context is to build the capacity of the disadvantaged students. It suffices to note that proactive remedial action is more sustainable as compared to reactive remedial action.

For example, students who have English as home language may have been able to understand the language used in the 2009 NSC Paper 2; however, some questions – particularly 2.3, 2.4, 5.7, and 11.1 – might have been difficult to the rest of the students (AMESA Report, 2009). This is because of the use of some unfamiliar words such as trend and bearing (AMESA Report, 2009).

Nevertheless, the main barrier to the effective use of contextual word-problems remains the fact that many educators, textbook-writers, and assessment-developers do not provide more realistic mathematical school tasks which adequately mirror out-of-school task situations (Palm, 2002). Simply put, contextual word-problems are perceived as artificial, puzzle-like tasks that are unrelated to the real world (Verschaffel, 2006). The opportunity cost of exposing students to such contextual word-problems might be a population of students whose majority remains alienated to mathematics in general and contextual word-problems in particular.

2.2.3 Mathematics teaching, learning and assessment

The use of context in mathematics teaching, learning and assessment is an internationally-accepted practice. When faced with a contextual problem, students are more likely to think their way through the problem, resulting in conceptual competence. However, when faced with an abstract numerically-presented problem, students are more likely to resort to rote-learnt algorithms, resulting in procedural competence. Understanding why a formula works is a more stable and transferable learning outcome as opposed to memorising its constitutive steps by rote. Meaningful learning involves using existing knowledge as assimilative context for new material.

Classroom assessments are contextualised and dependent on educators' conceptions, norms, and practices. These internal assessments need to be aligned with external assessments. In other words, if contextual word-problems are found in external assessments; then, the educators should also include contextual word-problems in their internal assessments. It is very important for educators and students to know and cover the scope of external assessments. Moreover, it is even more important for examiners to consider the scope when setting examinations. More often than not, students are unable to answer questions that are within the scope but which were not covered by the educator, as well as those which are outside the scope.

Students need to be given sufficient time to answer mathematics contextual word problems. Thus, the AMESA report for the 2009 National Senior Certificate examinations recommended that the examiners take the duration of the examination into consideration when setting contextual word-problems. Put differently, students need sufficient time to read, understand and solve contextual word-problems. Examiners also need to be mindful of the fact that first-additional-language speakers require more time to read, understand, and solve mathematics contextual word-problems as compared to home language students.

Hence, the current study will provide more information on the weighting of contextual word-problems in question papers developed by an examination body that tends to cater largely for English home language speakers and the one the caters for both English home language and non-English home language speakers.

Solving a contextual word-problem requires the formulation of a mathematical model- horizontal mathematisation- before solving the problem- vertical mathematisation. This is time-consuming and time needs to be considered when marks are allocated. This implies that, to some extent, contextual word-problems deserve more marks than algebraically-presented problems. However, it must be noted that contextual word-problems cover less content, for the same amount of time and marks, than algebraically-presented problems. The current study is pursued against this backdrop.

Different contexts serve different functions at different stages of assessment. Thus, it is important to ensure that all students are familiar with the chosen context. However, in multicultural societies such as South Africa, it is difficult for the selected context to match the reality of all the students. This is because the same context might invoke different realities for students who are of different cultural backgrounds.

As a result, the marking scheme needs to seriously consider the degree of realism brought by the culturally-diverse students who are expected to solve the given contextual word-problems. The need for reliable marking leads to examiners favouring short, structured items to ensure a limited pool of predictable responses from students (Jones & Ingris, 2015)

For example, to a white student in Sandton, a dog might be a pet whereas to an African student in the rural areas, a dog might be a hunting companion. Currently, some marking schemes fail to consider students' individual realism. This may disadvantage and frustrate students. A view is advanced by the current study that it may be advisable to select and use neutral and innocuous context when teaching mathematics in a multicultural class.

Three types of assessment are applicable to mathematics contextual word-problems, namely, assessment for learning, assessment as learning, and assessment of learning. Assessment for learning and assessment as learning are usually internal. Conversely, assessment of learning is usually external. Previous assessment-of-learning contextual word-problems can be used as current assessment-as-learning contextual word problems. As such, past examination contextual word problems become an important input in the teaching and learning process.

Unfortunately, there are students who face contextual word-problems for the first time during assessment of learning in external assessments. It would be more desirable if all students could face appropriate contextual word-problems at all stages of assessment. Sometimes, poor performance in mathematics contextual word-problems can be attributed to students' lack of experience in solving contextual word-problems. The current study is interested in knowing how different examining bodies in South Africa perceive contextual word-problems. It is opined that if an examining body considers such problems important it tends to have a significant number of such questions in the question paper.

2.2.4 Context and Attitude

Taking the growth mindset in teaching and learning mathematics in context can result in improved teaching and learning of mathematics. The growth mindset assumes that mathematical ability is more of a function of effort than an inborn ability. In line with this mindset, educators and students are motivated to put more effort in contextual mathematics education in order to improve learning and thus achieve better results.

However, if students doubt that they have the ability to answer contextual word-problems, they will not even attempt to answer them. Similarly, if educators do not believe that their students have the ability to answer contextual word-problems, the former will not put sufficient effort in ensuring that students have the capacity to solve contextual word-problems. It is therefore asserted that educators should desist from casting doubt on their students' potential to deal successfully with contextual word-problems.

A study by Mogari (2010) examined the difference in performance of boys and girls in solving problems on the properties of a rectangle after being taught in a familiar context entailing an activity of making a chassis of miniature toy wire car. The study revealed that even though classes were divided into small groups, in one of the schools involved in the study, lessons were educator-centred.

The educator found it necessary to use his usual style because he doubted the students' ability to work on their own and complete the task within the stipulated time (Mogari, 2010). On the other hand, students in the other school worked on their own much more efficiently because the educator often used co-operative learning and the educator only assisted students when they encountered problems.

Choosing an appropriate context can lead to a positive attitude and even some enjoyment in learning the mathematics embedded in it. Although using context in everyday teaching and learning can be time-consuming, it facilitates meaningful learning. In the long-run, the use of context can help to reduce mathematics drop-outs rates, improve pass rates, and eventually improve university throughput rates and make mathematics interesting and fun to learn.

The same examiner can compile different question papers depending on the instructions given to him or her. It was revealed that GCSE examiners, when freed from marking considerations, can produce an examination paper that is problem-based and relatively unstructured (Jones & Ingris, 2015). Examiners can be the starting point for a change in curriculum using assessment. It is important to give students exemplars before the first changed examination in order for them to prepare.

Finally, students always respond to educators' passion and enthusiasm. An efficient and creative educator effectively uses what is available to avail that which is unavailable. As much as it is important to complete the syllabus, it is crucial to engage the students and ensure that they learn meaningfully. The view put forth in the current study is that for students to cope better with contextual word-problems, students have to relate to the context or be familiar with the theme of a contextual word-problem and also have to be taught mathematics conceptually as by so doing it puts them in a better stead to elicit the embedded meaning of a typical contextual word-problem.

For some reasons, students have tendency to interpret contextual word-problems wrongly and thus solve them wrongly. It is conjectured that this is possible when the theme and context of a contextual word-problem are alien to a student. Hence, the interest in this study is largely on the type of contextual word-problems posed to students by the different examination bodies.

2.3 The Importance of Mathematics contextual word-problems

As noted in section 1.1, mathematics contextual word-problems can be defined as those in which the problem situation is experimentally-real to the students. These problems are presented using full sentences, rather than mathematical symbols. Contextual word-problems are thus stimulants that tease the acquisition of the mathematical concept through the rediscovery process (Altum, 2006). As noted in section 2.2, contextual word-problems are intended for supporting the reinvention process that enables students to come to grips with formal mathematics. In addition, contextual word-problems can function as anchoring-points for the personal reinvention of mathematics by students.

As also indicated in section 2.2, the current study is grounded on the RME theory which is based on Freudenthal's interpretation of mathematics as a human activity (Gravemeijer, 1994). Nevertheless, the context of the problems presented to students should not necessarily be the real world but must preferably be a context a student can relate to. Indeed, in some situations, fairy tales and mathematics can provide suitable contexts for a problem. The context is real as long as it fits students' perception of reality.

Contextual word-problems have a central role in mathematics education. This is because of their presumed motivational power and the current emphasis on the usefulness of what is learnt. Moreover, contextual word-problems can bridge the gap between informal mathematics knowledge and formal mathematics. Since contextual word-problems are created by mathematizing real-life problems, the quality of any contextual word-problem depends on the nature of that mathematization.

As noted in section 1.1, the Mathematics Curriculum Document emphasises that "tasks and activities should be placed within a broad context , ranging from the personal , home , school , business , community , local and global" (DoE , 2006: 19). Hence, the current study seeks to provide further insight into nature of contextual word-problems students have to deal with. Mathematics tasks embedded in students' realistic contexts can promote sustainable learning and, as a consequence, improve students' problem-solving skills. Problem-solving may be time-consuming; but, it promotes non-routine thinking (Khumalo, 2010).

An ideal contextual word-problem serves six major roles. The first role is to improve accessibility by enabling students to understand difficult mathematical concepts. The second role is to relate mathematics to real life. The third role is to estimate students' ability to use analytical and mathematical skills to solve problems. The fourth role is to motivate students to understand the importance and applications of mathematical concepts. The fifth role is to develop students' creative, critical, and problem-solving skills and to provide them with suggestions and strategies on how to solve given problems. The sixth role is to make the questions more transparent and elastic. It is against this background that the current study's interest is on contextual problems.

Furthermore, context can also be regarded as a model that guides students' thinking (Claussen-May, 2005: 39). The context in which the mathematical question is set might act as the mental scaffolding through which students can formulate a solution to a contextual word-problem (Glasser & Strauss, 1967). Having a model that guides thinking is a more sustainable alternative to the rote learning of algorithms.

According to research conducted in the USA, contextualising problems helps students to answer mathematical questions. Furthermore, frequent assessment helps to refine concepts and deepen students' understanding (Perreira & Du Toit, 2010). These researchers recommended a better matching of curriculum to the abilities of educators and students. Frequent use of contextual word-problems in internal assessment contributes significantly to preparing students for contextual word-problems contained in external assessments.

The critical indicators for Realistic Mathematics Education, in any curriculum, are teaching-in-context and assessing-in-context. Assessment in context needs to be done during assessment for learning, assessment as learning, and assessment of learning. The nature and quantity of contextual word-problems in previous assessment of learning will determine the nature and quantity of contextual word-problems in current assessment for learning and assessment as learning. The nature of contextual word-problems refers to the significance, contextual subjects, and theme frequency of contextual word-problems.

As indicated in section 2.2.1, some education stakeholders view mathematics education as a means to an end - passing examinations - rather than an end in itself. As a result, teaching in context becomes a reflection of past examination contextual word-problems. In addition to being important tools for the assessment of learning, past examination contextual word-problems are also important inputs in the mathematics teaching and learning process. The nature and quantity of contextual word-problems in any examination constitute the most important indicator for the extent to which mathematics education is linked to real life in any curriculum. Contextual word-problems are evidence of the link between mathematics education and real life.

Nonetheless, assessing mathematics in context does not imply exposing students to a sequence of contextual word-problems. Tasks need to be carefully designed, for effective assessment to take place. Hence, the current study intends to gain more insight into the nature of contextual word-problems. Examiners and educators need to have a high level of subject-matter knowledge and a good understanding of the discipline of mathematics (Grossman, Wilson & Schulman, 1990) so that they are able to effectively mathematize contexts. A balance between vertical mathematization and horizontal mathematization also needs to be established.

2.4.1 Horizontal mathematization and vertical mathematization

In RME, mathematics education is organized as a process of guided reinvention. This means that students can experience a process which is similar to the one through which mathematics was invented. The reinvention process is guided by the mathematization of concepts (Freudenthal, 1973). Horizontal mathematization is the transformation of a problem field into a mathematical problem (Treffers, 1987). In horizontal mathematization, students conceptualize mathematical tools which can help them to organize and solve a real-life situation. Moreover, horizontal mathematization is an effort to schematize a problem until a problem statement that can be solved using mathematical methods is created (Treffers, 1987).

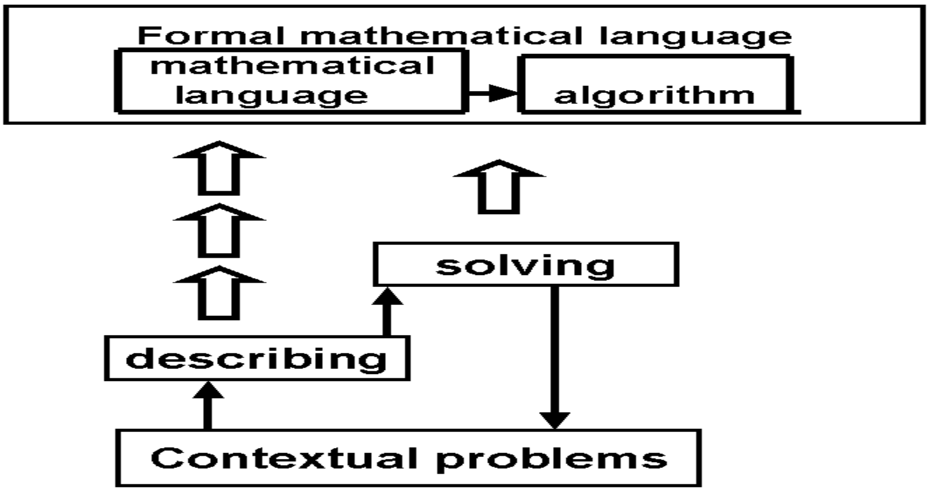
The constituent of a problem field is non-mathematical, given that, it relates to a real-world situation. Thus, the function of horizontal mathematization is to make the problem more accessible to a mathematical treatment. This enables the conversion of the problem from the world of life to the world of symbols. Moving from the world of life, in which one lives and acts, to the world of symbols is called horizontal mathematization, (van de Heuvel-Panhuizen, 2001). As for vertical mathematization, it is the process of reorganization within the mathematical system itself. It is achieved by mechanically and comprehensively reshaping and manipulating symbols, in a reflective way (Gravemeijer & Terwel, 2000). Table 2.1, illustrates the difference between horizontal mathematization activities and vertical mathematization activities.

Table 2.1– Horizontal mathematization activities and vertical mathematization activities

Horizontal mathematization activities.	**Vertical mathematization activities.**
Identifying and describing.	Reasoning.
Schematizing.	Generalization and formalization.
Formulating and visualizing a problem	Representing a relationship in a formula.
Discovering regularities.	Providing regularities.
Discovering relationships.	Refining and adjusting models.
Recognizing isomorphic aspects in different problems.	Using different models.
Translating a real-world problem into a mathematical problem	Combining and integrating models.
Translating a real-world problem into a known mathematical problem.	Formulating a mathematical model.

As seen from table 2.1, notwithstanding their difference, both forms of mathematization seek to form a model of reality. The horizontal mathematization process focuses mainly on ordering, schematizing, and building a model of reality ensuring that the problem can be solved by mathematical means. Conversely, the vertical mathematization process focuses predominantly on learning strands. Many mathematicians interested in education narrows mathematization to the vertical component, whereas many educationists turning to mathematics constricts mathematization to the horizontal component (Freudental, 1991). Fig 2.1 shows the guided reinvention model.

Figure 2.1: The Guided Reinvention model



(Fig 2.1, Gravenmeijer, 1994)

Figure 2.1, illustrates the process of reinvention. It shows that both horizontal mathematization and vertical mathematization have to occur to enable the development of basic mathematics concepts.

Initially, the horizontal mathematization activity of designing a formal or informal mathematical model for a contextual word-problem is used to convert a real-world situation into a mathematical problem, as shown in the diagram above. Then, the vertical mathematization activities of solving, comparing, and discussing are undertaken to generate a mathematical solution. Finally, progressive mathematization is derived from the interpretation of the solution and the strategy to other contextual word-problems.

Three levels of contextual word-problems can be distinguished, depending on the relationship between vertical mathematization and horizontal mathematization. Level 1 mathematics contextual word-problems are exclusively solved through horizontal mathematization. Level 2 mathematics contextual word-problems are entirely solved through vertical mathematization. Level 3 mathematics contextual word-problems are solved through short-term progressive mathematization.

Normally, the level of difficulty in solving contextual word-problems increases from level 1 to level 3. It is important to emphasize that both horizontal mathematization and vertical mathematization must take place for basic mathematics concepts to be developed. Furthermore, as noted in section 1.4, it must be stressed that the relationship between horizontal mathematization and vertical mathematization is a very important tool for curriculum development. Hence, the current study is interested in the balance between the two forms of mathematization of contextual word-problem questions posed to students.

2.4.2 Short-term progressive mathematization and long-term progressive mathematization

Short-term progressive mathematization consists of a shift from horizontal activities to vertical activities, which often revert back to horizontal activities (Pirie & Kieren, 1994). Conversely, long-term progressive mathematization entails using mathematical realities resulting from previous mathematizations as context for additional horizontal mathematization.

2.4.3 Selective mathematization and comprehensive mathematization

Selective mathematization implies that the solution to a given set of contextual word-problems predominantly requires either horizontal or vertical mathematization. Conversely, comprehensive mathematization requires a balance between vertical mathematization and horizontal mathematization in order to solve a set of contextual word-problems. And this is one of the issues the current study seeks to gain more insight into. Positive selective mathematization is whereby more marks are allocated to vertical mathematization as compared to horizontal mathematization. On the other hand, negative selective mathematization is whereby more marks are allocated to horizontal mathematization as compared to vertical mathematization.

2.4.4 Symbolization in horizontal mathematization and vertical mathematization

Symbolization separates a concept from its concrete embodiments. This provides a means to record and communicate findings. In addition, symbols are inputs for further mathematical reasoning and conceptualization. In horizontal mathematization, symbols are used to record and communicate thinking. For example, when a student is presented with a contextual word problem to solve, the student has to first present the problem in a mathematical form using symbols. However, in short-term progressive, vertical mathematization, the recorded and communicated symbols are used as inputs for further mathematical reasoning and conceptualization. Furthermore, in long-term progressive, vertical mathematization, the previous symbolization activities are used as inputs for other dynamic and rational symbolization activities.

Vertical mathematization requires students to take symbolization from the base level of formulation and communication to a higher level of abstraction. The progression from using symbols as a means to record and communicate ideas to using them as inputs for further mathematical reasoning and conceptualization reflects the progression from horizontal mathematization to vertical mathematization.

In the case of contextual word problems, after the student has presented it in the mathematical form using symbols – horizontal mathematization - the student has to then invoke mathematical procedures, principles and theorems to generate a solution to the problem – vertical mathematization. Of interest then, is the cognitive demand the entire mathematization process places on students when they attempt to resolve contextual word-problems and this is the focus of the current study.

2.4.5 Algorithmitisation in horizontal mathematization and vertical mathematization

Instead of learning mathematics through acquiring algorithms, students can participate in the process of algorithm generation. Indeed, students can be viewed as producers of algorithms rather than consumers of algorithms. Thus, if a task is presented without any algorithm, students should engage in the practice of creating procedures for solving given problems.

The lack of generalization in students' procedures is characteristic of the horizontal mathematization and can be a basis for shifting to the vertical mathematization. When resolving contextual word problems students have to develop algorithms that force them to engage in the activity of reflecting on and generalizing their previous work. The practice of developing a general procedure, based on past experience with particular cases, represents a vertical mathematization aspect of algorithmitising.

2.4.6 Defining in horizontal mathematization and vertical mathematization

Defining functions as an organizing activity in horizontal mathematization. Conversely, in vertical mathematization, defining is a means for generalizing, formalizing or creating a new mathematical reality. Descriptive defining is an example of a horizontal mathematization activity; while constructive defining is an illustration of a vertical mathematization activity.

Descriptive defining is about outlining a known object based on a few of its characteristic properties; whereas constructive defining refers to the modelling of new objects based on familiar ones (Freudenhtal, 1973: 457). The movement from horizontal mathematization to vertical mathematization is achieved by using the organizing activities of horizontal mathematization as a basis for vertical mathematization activities which include generalizing, abstracting, elaborating, and making conjectures.

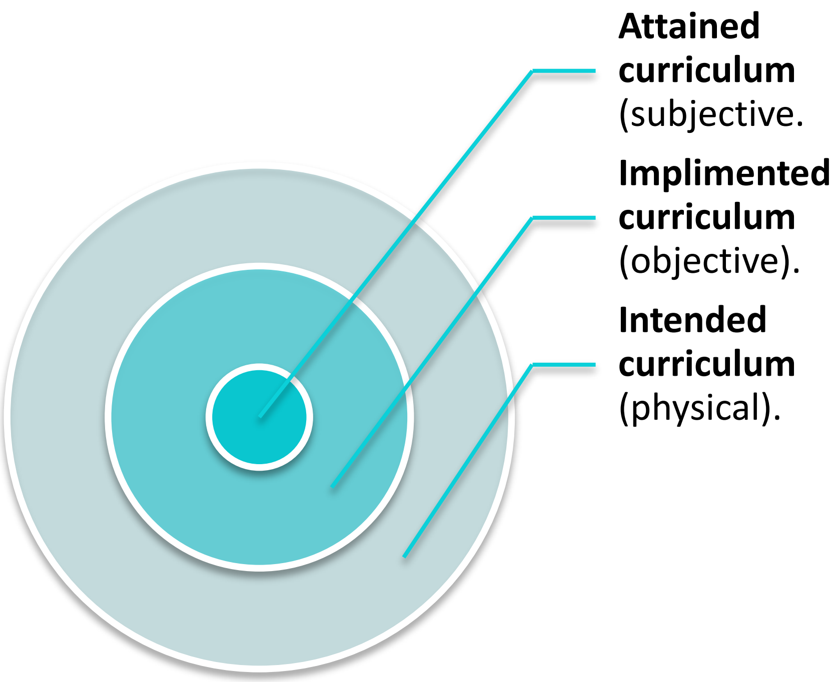
2.5 Content analysis

As noted in section 1.1., three types of curriculum can be identified, namely, intended curriculum, implemented curriculum, and attained curriculum. As also noted in section 1.7, the intended curriculum, is the mathematics content as it is defined in the curriculum documents, is physical and exists independently from students' experience. Thus, the intended curriculum can be elicited through content analysis of curriculum documents.

It is also noted in section 1.1 that implemented curriculum is the mathematics content as it is interpreted by educators, subject advisors, and examiners who make it available to students. It is thus elicited through content analysis of question papers. It is against this background that the current study has been conceptualized to determine the nature and cognitive demands of the contextual word-problems posed. As also noted in section 1.7, since implemented curriculum is experienced, it is objective.

As also mentioned in section 1.1, the attained curriculum refers to the outcomes of schooling. It includes concepts, processes, and attitudes towards mathematics that the students have acquired in the course of their education. Attained curriculum is derived through content and textual analysis of examination reports. As also noted in section 1.7, since the attained curriculum is expressed in the form of symbols, it is subjective. Fig 2.2 shows the three types of curriculum.

Figure 2.2: The three types of curriculum.



(Figure 2.2 was designed by the researcher).

Fig 2.2 shows the relationship between intended curriculum, implemented curriculum and attained curriculum. Intended curriculum is the largest because it exists without being experienced. Implemented curriculum is smaller than intended curriculum because students will not experience everything that is in the intended curriculum. Attained curriculum is smaller than implemented curriculum because students will not understand everything that they experience. Some student answers in examinations will be wrong even if the students have experienced everything in the examination. The efficiency of any education system is determined by the difference between the three types of curriculum. The smaller the difference, the higher the pass rate, and the more efficient the education system. The bigger the difference, the lower the pass rate, and the less efficient the education system.

Maintaining the intended curriculum is important in order in order to have experienced and competed, educators, markers, examiners and textbook writers. Constant intended curriculum changes might result in the education system having partially experienced educators, markers, examiners and textbook writers.

Accumulation of educational resources and knowledge is slower if the intended curriculum is always changing. Parents and care givers find it hard to assist students in doing homework if they were not exposed to that new curriculum. Schools have to buy new textbooks and former students cannot pass on textbooks to siblings and relatives because the curriculum is different. As a result, constant curriculum changes compromise the efficiency of the education system.

Some educators have never been exposed to Euclidean geometry at school and educator training but they are supposed to teach it, in the CAPS syllabus. There are educators with 20 years experience in teaching mathematics but 2 years experience in teaching Euclidean geometry. If the curriculum keeps on changing, the current Grade 12 students might be required to teach Linear programming when they become educators. In the world of specialization, some students will do courses that require pre-requisite knowledge of Linear programming, for example, and other students will do courses that require pre-requisite knowledge of Euclidean geometry.

Instead of removing certain topics from the syllabus, it might be better to add on new topics, give students options and allow educators to specialize in certain topics. During the second year, students who write Advanced Level examinations have the option of specializing in mechanics or statistics. Conveniently so, most commercial students specialize in statistics whilst most science students specialize in mechanics.

One way of addressing the shortage of skills problem in South Africa might be giving Grade 12 students optional topics. This might motivate students and increase the mathematics pass rate. Maybe, if Linear programming was maintained and Euclidean geometry added as an option, the Mathematics pass rate of 2014 might have been higher. Table 2.2 shows the comparison between a change in intended curriculum and a change in implemented curriculum.

Table 2.2: Change in the intended curriculum as compared to change in the implemented curriculum.

Change in intended curriculum.	**Change in implemented curriculum**
Textbook writers need more time to write new textbooks.	Textbook writers need less time to update textbooks.
Publishers need more resources to publish new textbooks for all students.	Fewer resources needed to publish fewer current edition textbooks because some students will be using the previous editions.
Need for in-service training of all educators.	Less need for in-service training of educators.
Examiners and educators need to significantly adjust to the new intended curriculum.	Examiners and educators need to slightly adjust to the new implemented curriculum.
More waste due to redundant textbooks. Encourages a throw-away culture. Need for a national plan on what to do with redundant textbooks.	Less waste. Books can be passed on for many years.
Parents and care-givers cannot properly assist students in doing homework because the new curriculum is different from what they did when they were at	Parents and care-givers can properly assist students with home work.

school.	
Need for schools and parents to buy new textbooks for everyone.	Need for schools and parents to buy few textbooks.
Short history of the new curriculum, so students have few, if any, past-examination question papers for revision. The history of the previous curriculum becomes less relevant to the student even though it is still relevant to educational planners. Students cannot use question papers of the previous syllabus for revision.	Long history of the curriculum. Many past exam question papers available for revision.
Small accumulation of educational resources.	Large accumulation of educational resources.
Partially experienced and competent educators, examiners, textbook writers and markers.	Highly competent and experienced educators, examiners, text-book writers and markers.
Does not necessarily result in a change in implemented curriculum and attained curriculum. (Words). Words mean nothing until they are used.	Result in a significant change in the attained curriculum. (Actions) Actions speak louder than words.
Easy because it is physical.	Difficult because it is objective.

(Table 2.1 was designed by the researcher)

Table 2.2 shows that a change in intended curriculum will result in many changes in the education system but does not necessarily result in a significant change in the attained curriculum. On the other hand, a change in implemented curriculum will result in fewer changes in the education system but a significant change in the attained curriculum.

Mathematics objects are mental constructs with little or no concrete referents. As a result, symbols are used to link concepts with things. Understanding is perceived as a mental process which can be achieved through cognition. The latter is the process of obtaining knowledge through experiences and senses. Content analysis focuses on three cognitive areas, namely, remembrance of factual knowledge, comprehension of conceptual knowledge, and application of procedural knowledge.

The recall of factual knowledge in the FET mathematics curriculum entails the knowledge of basic definitions, doing basic arithmetic calculations, substituting values in formulae, solving basic algebraic equations, and performing routine calculations. The comprehension of conceptual knowledge in the FET mathematics curriculum entails knowing the conceptual demands of a problem and applying them, usually in conjunction with procedural knowledge and problem-solving strategies. The focus of the current study is on the cognitive requirements of contextual word-problems.

The application of procedural knowledge involves solving mathematical problems and the performance of basic algorithms. It relates to mathematical problems in which the mathematical strategy for solving them requires more than routine procedures. The failure by a student to complete a procedural process is known as procedural breakdown. The current study intends to shed light on the type of contextual word-problems that are posed to grade 12 students.

2.6 Textual analysis

Textual analysis determines the attained curriculum and is based on five critical indicators, namely, conceptual competence, procedural competence, logic, dealing with crisis, and reflection. An argument is advanced that these indicators are also essential when solving contextual word-problems. As for textual analysis, it will focus on the nature and functions of signs. Semiotics is a system of signs and their related meanings (Saenz-Ludlow & Presmeg, 2006; Presmeg, 2008). Textual analysis is done through analyzing semiotics. The semiotic perspective is used in this study to describe the meaning-making process.

As for textual analysis, it will focus on the nature and functions of signs. Meaning is construed as the relationship between signs and mathematical objects while understanding refers to competence in the interpretation and use of semiotic functions (Presmeg, 2008). Mathematical activity is characterized by the use of semiotic functions among four types of entities- ostensive entities (notations, external, representation), extensive entities (situation problems), intensive entities (ideas, abstractions) and accusative entities (subject's actions)- which can play either the role of expression or content (Gordino et al, 2003).

Semiotics can be ascribed a representational role or can be viewed as a realistic, structural, and functional approach to mathematical objects (Saenz-Ludlow & Presmeg, 2006; Presmeg, 2008). On his part, (Radford, 2007) regards the process of using signs to express abstract mathematics in physical form, or to reflect unconscious activities, as cognition. Language is instrumental in structuring and developing mathematical thoughts and knowledge.

Deely (1990) suggests that the semiotic universe divides the content of experience into three areas, namely, the physical, the objective and the subjective. The objective is that which is experienced- implemented curriculum. Conversely, the physical is that which exists independently from experience - intended curriculum. The subjective exists only in relation to the symbiosis function - attained curriculum.

Symbiosis is when something that is objective is recognized and turned into a sign. Signs represent the relationship between two components; for example, $2 > 1$. A sign can be an object, an utterance, or a gesture which conveys meaning that has been ascribed to it by cultural consensus. In addition to representing the relationship between the signifier and the signified, signs can also be instrumental.

Indeed, since mathematics objects are mental constructs with little or no concrete referents, symbols are signs which link concepts with things. Symbols are used as a means of communication and a mode of expressing ideas in vertical mathematization and horizontal mathematization (Saenz-Ludlow & Presmeg, 2006; Presmeg, 2008).

Focusing on the role of the sign and the profile of the student might assist in understanding the meaning-making process in mathematics education. For example, focusing on the role of signs in a student's written solution to a financial mathematics problem might help in understanding how the student develops meaning in financial mathematics. Each semiotic function implies a semiotic act by which an interpreting agent constitutes knowledge.

If a question puts too much semiotic demands on a student, the latter may encounter challenges when making meaning, except in previous networks of meaning. A student needs to recognize the concept in order to be able to solve a contextual word-problem. The student's inability to recognize the concept might result in the use of trial and error. Some students try to solve a problem with a high level of semiotic demand by using a technique that involves a lower level of semiotic understanding.

More often than not, students will only be able to successfully solve contextual word-problems with a high level of semiotic demand if they have been able to figure the meaning of the involved signs at a higher level. The development of understanding is facilitated by the identification of meanings that are useful for progression, and by encouraging students to make those meanings at a higher level of semiotic demand than the one required.

In the context of this study, it is assumed that students are required to conform to a set of expectations about formal written mathematics, particularly when writing examinations. This means that examiners have to provide answers/solutions for the examination questions, which clearly indicate that students are expected to deal with the given tasks in a pre-determined way.

It can thus be deduced from this statement that it is expected of students to respond to questions in ‘standard ways’ as outlined in the curriculum statement, the examination guidelines, classroom notes, and marking scheme. It is expected that the students’ answers will be structured according to the required or an agreed pattern. Even questions which require students to write down their opinions, have constructed responses.

In mathematics, each symbol placement becomes associated with a meaning which has been attributed to it by convention. Hence, mathematics educators need to move towards a description of mathematical meaning-making that involves society, culture, communication, and context. It is hoped that delving into contextual word-problems posed to matriculates might provide some insight into this issue. It is even more important for mathematics educators to move further and investigate the role of the sign in mathematical meaning-making.

2.7 A review of related studies

There are studies on contextual word-problems that have been carried out. Some of these studies have focused on the advantages of using context in mathematics teaching and learning (e.g., Mogari, 2007; Little, 2010; Dhlamini & Mogari, 2012), while others have explored both the advantages and disadvantages of context (e.g., Sullivan, Zevenbergen & Mousley, 2003; Mogari, 2010). Yet other studies have illustrated that a change in intended curriculum does not necessarily imply a change in implemented curriculum (e.g. Usher, 2012).

Furthermore, other studies have explored alternative approaches to assessment such as comparative judgment (e.g. Jones & Inglis, 2015). Nevertheless, studies profiling questions on real-world context seems to be limited. In this regard, few studies that have done so will be closely scrutinized with a view to understanding their methodological approach, sampling techniques and findings.

Little (2010) investigated the effects of real-world contexts on the accessibility of questions, or the attitudes of students towards its usage in tasks; he used 17-year old students and the AS-level topic of sequences. Little's (2010) study considered the effect of Real-World Contextual Framing (RWCF) on AS-level examination questions. With regard to his theoretical approach, Little adopts the realistic mathematics education perspective (RME), as well as the fidelity and irrelevant variance constructs.

Questions relating to the AS-level sequence and series topics were categorized as explicit (e), algebraic (a), word-problems (w), and pattern (p) questions, (Little (2010). In this regard, (Little, 2010) gave a one-hour test and a short questionnaire to students. The test consisted of four questions on arithmetic sequences (A1 TO AIV), and four questions on geometric sequences (G1 TO GIV) (Little. 2010).

The sample was 594, students who were 17 years old from four centres which were labelled A, B, C, and D. Each centre contained one of the four question versions (e, a, w, and p), (Little, 2010). Students were then randomly allocated to one of the four centres. The questionnaire invited these students to consider six statements on pure and applied mathematics and real-world contextual problems. These students were expected to register their level of agreement, from strongly disagree to strongly agree, and then write further comments in the space provided, if necessary (Little, 2010).

This research provided strong evidence that setting sequence questions in real-world contexts does not make them more difficult. It has been established that the context has the advantage of providing a mental scaffold that helps students to use contact-specific heuristic strategies (Little, 2010). However, for the context to provide mental scaffolding, questions with RWCF need to be carefully constructed, so as to avoid unwanted distracters and ambiguities (Little, 2010).

Like the AMESA report on the 2009 NSC examinations, the study recommends the consideration of the overall length of the questions in relation to the time allowed to answer those (Little, 2010). A complex and novel context, in a timed written examination, adds to the stress of the experience (Little, 2010). The goals of the mathematical assessment are compromised when too much emphasis is placed on comprehension skills (Little, 2010).

Although contexts can be perceived as artificial, the students involved in the survey generally see real-world contexts as reinforcing the perception that mathematics is useful (Little, 2010). Girls were found to prefer algebraic questions, whereas it was established that boys prefer context-based questions. Although students link the real-world context to the applicability of mathematics, most contextualized questions have little or no practical utilitarian value for them (Little, 2008a).

It is important to emphasise that genuine mathematical modelling requires strategic thinking which is currently, impossible to test in a timed, written examination (Little, 2010). Since this study was based on sequences and series, there is a need to conduct similar studies on other topics in order to determine whether the same results are obtained.

Sullivan, Zevenbergen & Mousley (2003) article reports some data related to the use of contexts, from the first phase of a project, with a broader focus. Prior to using any contexts, educators need to make judgments about their mathematical suitability, interest or relevance to the students, potential motivational impact, and the possibility of negative effects or tendency to exclude some students (Sullivan et al, 2003). The context needs to be familiar to the students, but not to the extent that it becomes an emotive issue. For example, the context of rape might be familiar to most students but inappropriate and uncomfortable to a student who has been rapped.

In addition, the article by Sullivan et al (2003) also highlights that the very socio-cultural nature of mathematics and mathematics learning has led to a differentiation of students in terms of those who can engage with the presentations of the subject and those who are unable to do so (Dengate & Lerman, 1995). Therefore, the educator needs to ensure that no students, especially those from culturally-divergent backgrounds, are excluded by the context. High quality contexts should support mathematics and not overwhelm it; they should be real or at least imaginable; they must be varied; they have to relate to real, solvable problems; they must be sensitive to cultural, gender, and racial norms and should not exclude any group of students; and they must allow the making of models (Meyer et al, 2001).

The context of sports was found to be alienating to students who are not interested in sports. If the educator chose sports because it may be interesting to some students, he or she also needs to find a way of engaging the students who have no penchant for sports (Sullivan et al, 2003). The context of posters illustrates how contexts can add layers of complexity that need to be both anticipated and addressed (Sullivan et al. 2003). Hence, while we agree with the mainstream belief that contexts can be useful, it is clear that educators need to be sensitive and take the appropriate steps to avoid selecting contexts that have the potential to alienate, exclude, or exacerbate disadvantages (Sullivan et al, 2003).

Usher (2012) conducted a study to determine the reflection of horizontal and vertical mathermatization in textbooks produced since the 2005 National Curriculum Framework (NCF) emphasised mathematization in India. The study aimed at determining how the implemented curriculum has changed in response to the change in the intended curriculum. However, only a few chapters, such as ‘A Trip to Bhopal’, can be used by grade four educators to support horizontal mathematization, according to the National Council of Education Research and Training (NCERT) (2007:23-24) in (Usher, 2012). Requiring students to calculate the number of buses needed to transport football players is an actual problem that can motivate students (Usher, 2012).

Even though the analysis of textbooks also revealed that horizontal mathematization is supported, the same cannot be said of vertical mathematization which enjoys limited support in the new NCERT textbooks (Usher, 2012). The study further revealed that, generally, there is a collection of contexts; however, there is no paradigmatic context that can support further abbreviation of the strategies as children reflect on their informal strategies (Usher, 2012).

A change in emphasis in the intended curriculum is physical. It exists regardless of whether or not it is implemented or experienced. A change in textbook content - implemented curriculum - is objective and experienced. It must be emphasised that a change in the intended curriculum does not necessarily translate into a change in the implemented curriculum. After every change in emphasis in the intended curriculum, there is a need to workshop publishers about the implications of a change in intended curriculum emphasis on textbook content- implemented curriculum.

Another option might be for the National Department of Education to hire practicing, experienced mathematics educators to write textbooks that may sufficiently address the curriculum needs. Probably such initiative might go a long way in helping educators to cope with contextual word-problems and thus alleviate concerns raised by AMESA (see AMESA, 2013).

Jones & Ingris’ (2015) study evaluated the potential of comparative judgment for the assessment of high school mathematics. The aim of the study was to know whether an examination paper designed free of marking considerations would contain tasks that are qualitatively distinct from those typical of contemporary GCSE examination papers (Jones & Ingris, 2015). The research revealed that GCSE examiners, when briefed to put marking out of consideration, produced an examination paper that contained more open-ended, less structured questions than is typical in current

GCSE mathematics examinations (Jones & Ingris, 2015). Removing the constraint for a reliable marking scheme can free up examiners to produce more open and sustained examination questions.

It is important to emphasize that genuine mathematical modelling requires strategic thinking which is currently impossible to test in a timed, written examination (Little, 2010). Comparative judgment offers a way forward to support the assessment of problem solving and contextualized approaches to mathematics assessment (MEI, 2012) in (Jones & Ingris, 2015). Since comparative judgment aims to assess students reliably using subjective judgments, it might enable genuine mathematical modelling to be tested in a timed, written examination, in future.

There are three conditions which should be fulfilled for comparative judgment to be successful. The first condition is that the examiner needs to set a question paper without considering the marking scheme, experience and competence of the markers. The second condition is that another person besides the examiner prepares a flexible marking scheme. The third condition is that the makers need to have a high level of experience and competence in mathematics education.

In sum, it is noted that Little's (2008) research has provided evidence that, when used properly context can make mathematics easier for the student. Moreover, Sullivan et all's (2003) study and Mogari's (2010) study reveals that there are advantages and disadvantages of using context. Furthermore, Usher's study provides evidence that some textbooks greatly support horizontal mathematization but have limited support for vertical mathematization.

Moreover, Jones et all's (2015) study revealed that comparative judgment seems to represent a superior method of assessing open-ended questions that encourage a range of unpredictable responses. Comparative judgement seems to be superior because in enables subjective assessment of the subjective attained curriculum. The most important thing to keep in mind is that the disadvantages of context can be at least better managed or at most avoided.

2.8 Concluding remarks

The theory of authentic task situations specifies eight crucial aspects, whose mathematization, determine the authenticity of a mathematics contextual word problem. The eight crucial aspects are event, question, information, presentation, solution strategies, circumstances, solution requirements and factors in figurative context. The mathematization of these aspects will determine the extent of the match between solving a real world problem and a solving a mathematics contextual word problem. According to RME, mathematics teaching should be linked to reality. Mathematics contextual word problems are the evidence of the link between classroom mathematics and reality. The mathematization and significance of mathematics contextual word problems determines the strength of the link between classroom mathematics and reality.

Intended curriculum is physical, implemented curriculum is objective and attained curriculum is subjective. Intended curriculum exists but it is not necessarily experienced by students. Mathematics contextual word-problems in the implemented curriculum are objective because they are experienced by students. Even though the experience of a student – implemented curriculum, is objective, the evidence of that experience – attained curriculum, is subjective. This explains why performance in contextual word problems is subjective.

Mathematization can be horizontal, vertical or both depending on the nature of definition, symbolization and algorithmitization. Horizontal mathematization is expressing a real world problem using mathematical symbols. Vertical mathematization is movement within the mathematical field. Progressive mathematization is whereby previous solutions to mathematical word problems are used as reality for current mathematical problems. A balance between horizontal and vertical mathematization results in comprehensive mathematization. The dominance of either horizontal or vertical mathematization results in selective mathematization.

Chapter 3 – Methodology

3.1 Research Paradigm: Multi-Paradigmatic Research.

Methods and standards from the interpretive and critical paradigms were combined to create a Multi-Paradigmatic Research. There was demonstration of a critical understanding of the complexity of educational issues and development of a vision of a better way of teaching, learning and assessing mathematics.

3. 2 Research design: concurrent triangulation mixed-methods

The concurrent-triangulation mixed-methods research design was used for the research (Gay, Mills & Airasian, 2006). This is because the problem statement stresses the need to explore and explain outcomes. Exploring requires qualitative methods and explaining outcomes necessitates quantitative methods. Moreover, the research questions are posed as both quantitative and qualitative questions. The researcher simultaneously used both qualitative and quantitative methods to collect and analyse data, to integrate the findings, and to draw inferences (Tashakkori & Cresswell, 2007: 4). Data analysis revealed a convergence of data.

Qualitative and quantitative data were gathered simultaneously. They were merged using both qualitative and quantitative data analysis procedures. The results were interpreted concurrently to provide a better understanding of past examination contextual word-problems. Measures of both central tendency and dispersion were calculated. The researcher developed the results and interpretations into information that sheds light on the nature and cognitive demands of the contextual word-problems posed in the FET examinations of IEB and NSC. Results from both qualitative and quantitative methods are consistent.

Qualitative and quantitative research paradigms were given equal status (Johnson & Christensen, 2011: 435). The researcher used the strengths of the quantitative method to offset the weaknesses of the qualitative method. Similarly, the strengths of the qualitative method were used to overcome the weaknesses of the quantitative method. The purpose of these complementarities was to allow for a much stronger overall design and thus more credible conclusions.

Quantitative results enhance generalisation, whereas qualitative results help to explain context. The concurrent use of the two methods resulted in complementary results. The mixing of qualitative and quantitative methods gave the researcher a better perspective on mathematics contextual word-problems as well as an appreciation of them (Gorard & Taylor, 2004).

Jenkins did a concurrent-triangulation mixed-methods research on rural high school students' perceptions of drug-resistant difficulties (Creswell & Plano Clark, 2007: 194-203). Jenkins analysed qualitative data obtained from focus groups, and quantitative data gathered through a semi-structured questionnaire. The two data sets were merged into an overall interpretation (Punch, 2009).

In this study, the qualitative aspect of the research concentrated on exploring and analysing NSC and IEB past examination mathematics contextual word-problems, in terms of their mathematization. The exploration and analysis focused on significance, horizontal mathematization, vertical mathematization, theme, contextual subject, and the eight aspects of the real world that are crucial to its mathematization. These essential aspects include event, question, information, presentation, solution strategies, circumstances, solution requirements, and purpose in the figurative context.

The schedule for mathematization was used to gather quantitative and qualitative data. The aim was to determine the similarities and/or differences between IEB and NSC mathematics contextual word-problems in terms of significance, contextual subject, horizontal mathematization, vertical mathematization, theme and the eight crucial aspects of the theory of authentic task situations, (event, question, information, presentation, solution strategies, circumstances, solution requirements, and purpose in the figurative context).

The quantitative aspect of the research focused on the students' performance in the past examination contextual word-problems of IEB and NSC. Data analysis was based on the significance of contextual word-problems, themes, contextual subjects, horizontal mathematization, vertical mathematization, and national performance.

The theme frequency table provided qualitative data in the form of themes, and quantitative data in the form of total marks per theme. In the same vein, the contextual subjects table provided qualitative data in the form of contextual subjects and quantitative data in the form of total marks per contextual subject. The determination of the possible interrelations between achievement and context in each of the two examination bodies was done through the use of both qualitative and quantitative data analysis techniques.

The researcher collected multiple sets of data, using different approaches and methods. The resulting combination ensured complementary strengths and non-overlapping weaknesses. Qualitative data was converted into quantitative data and quantitative data was converted into qualitative data. The purpose of this was to get an insight into the nature and cognitive demands of past examination contextual word-problems. The researcher merged results from both qualitative and quantitative methods in order to triangulate the findings.

3.3 Sampling

The researcher used primary and secondary data sources produced as part of completed formal activities. This helps to minimise external influences and prevent intrusions and obstructions associated with the role and visibility of the researcher. The primary written data sources and the secondary written data sources used for the research are past examination question papers, marking scheme, and examination reports.

The population sampling, the data sampling, and the choice of instruments were deliberate. The population for the qualitative aspect of the research is all contextual word-problems included in the 2008-2013 question papers of IEB and NSC mathematics examinations. The above mentioned period was chosen because the previous NCS syllabus started in 2008 and ended in 2013. Since the whole population for the qualitative aspect of the research was collected and analysed, no sampling was required for this aspect of the research.

The population for the quantitative aspect of the research is all students who wrote the NCS examinations of 2008-2013. Once again, because the researcher used national pass rates, no sampling was required for this aspect of the research. The students' performances in the 2008-2013 final examinations were compared and possible interrelationships between their achievement and the given contextual word-problems were explored.

3.4 Data collection

The researcher used primary and secondary written sources of data. Primary sources of data are original records of events and experiences, as seen through the eyes of and as interpreted by the researcher. Primary sources of data allowed the researcher to be as close as possible to what actually happened. Examples of such include past examination question papers, and marking scheme.

Secondary sources of data are derived sources written by people who did not experience the event first hand. Secondary data sources can also be defined as existing data collected at an earlier time by a different person who had a different purpose (Johnson & Christensen, 2011) for example, examination reports. Official documents, such as past examination question papers, past examination marking schemes, curriculum guides, and examination reports were the major sources of data in this research.

3.4.1 Schedule for analysing the mathematization of real-life situations

The schedule for analysing the mathematization of real-life situations was developed by the researcher as informed by the theory of authentic task situations. It was based on contextual subjects, theme, significance, horizontal mathematization, vertical mathematization and the eight crucial aspects of the theory of authentic task situations (see section 2.2). This schedule has twelve columns. The number of rows depends on the number of contextual word-problems included in the given question paper (see Appendix 3.1.1 – 3.1.24).

The first column indicates the examination body, the year, the month, and the relevant paper (Paper 1 or Paper 2). The second column indicates the quantity of marks and the level of the contextual word-problem under consideration. A contextual word-problem that is exclusively solved through horizontal mathematization is a level-1 contextual word-problem. A contextual word-problem which is exclusively solved through vertical mathematization is a level-2 contextual word-problem. A contextual word problem that is solved through progressive mathematization is a level-3 contextual word-problem. The third column identifies the theme of the relevant contextual word-problem. The fourth column indicates the contextual subject of the given contextual word-problem.

Columns five to twelve present the eight crucial aspects of real-world problems. The fifth column indicates whether the event described in the contextual word-problem has taken place, or if it has a fair chance of occurring, or if it cannot take place in the real world. The sixth column indicates whether or not the question posed in the contextual word-problem has a fair chance of being asked in a real-world situation. The seventh column indicates the existence, as well as both the realism and specificity of the information presented in the contextual word-problem.

The eighth column indicates the way the task is conveyed to students in terms of mode and language. The ninth column indicates the role and purpose of someone solving the task in terms of availability and expanded plausibility. The tenth column mentions factors in the social context. These include the availability of external tools, guidance, consultation and collaboration, discussion opportunities, time, and implications of the success or failure to solve the task. The eleventh column indicates solution requirements. The twelfth column indicates the purpose in the figurative context.

It must be noted that one schedule for analysing the mathematization of real-life situations was completed for each question paper. One schedule was devoted to each 2008-2013 past examination question paper. Consequently, a total of twenty four schedules for analysing the mathematization of real-life situations were completed: twelve for IEB and twelve for NSC. Tables 3.1.1 to 3.1.24, in the appendix, illustrate data collected using the schedule for analysing the mathematization of real-life situations included in past IEB and NSC examination question papers.

3.4.2 Schedule for the total marks of contextual word-problems and national performance

The schedule for the total marks of contextual word-problems and national performance was developed, by the researcher, from the total marks of contextual word-problems included in past examination question papers and the national mathematics pass rate. One schedule for the total marks of contextual word-problems and national performance was completed for both IEB and NSC examinations.

The abovementioned schedule has five columns and seven rows. The first column indicates the year. The second column shows the total marks of IEB contextual word-problems for each year. The third column indicates the IEB national performance for each year. The fourth column provides the total marks of NSC contextual word-problems for each year. The fifth column provides the NSC national pass rate for each year.

The first row presents column headings. The second row indicates the year 2008. The third row represents the year 2009. The fourth row shows the year 2010. The fifth row indicates the year 2011. The sixth row represents the year 2012. The seventh row indicates the year 2013. The eighth row shows the totals. Finally, the ninth row indicates the averages. Table 3.2 shows the rows and columns of the schedule for the total marks of contextual word-problems and national performance. Table 3.2 shows the relationship between total marks allocated to contextual word problems and national performance.

Table 3.2: Schedule for the total marks of contextual word-problems and national performance

Year	Total marks of contextual word-problems (IEB)	National pass rate (IEB)	Total marks of contextual word-problems (NSC)	National pass rate (NSC)
2008	115	95.8	66	45.7
2009	104	95.5	98	46
2010	101	96.3	77	47.4
2011	74	96.6	65	46,3
2012	54	96.9	91	54
2013	61	96.8	76	59.1
Total	509	577.9	473	298.5
Average	84.8	96.3	78,8	49.8

(This schedule was developed by the researcher)

3.5. Reliability and validity

Validity and reliability issues that usually surface in both qualitative and quantitative studies were considered in this mixed-methods research. The written primary sources of data, that is, IEB and NSC past examination question papers and marking schemes, are assumed to be valid and reliable. This is because they are externally set and externally moderated. The researcher ensured item validity by selecting schedule items that are relevant to the measurement of the intended content area, for each schedule.

Sampling validity was achieved by selecting schedule items that adequately sample the domain of all possible items, for each schedule. The researcher also clearly identified and examined the boundaries of the various content areas to be tested before constructing schedules. The schedule for the mathematization of real-life situations and those of total marks and national performance were clearly constructed. These instruments were validated by established researchers, where they scrutinised their aspects and decided on their suitability for the purpose of the study.

Inside-outside validity was achieved by fully entering the world of the participants and that of the objective researcher. This enabled the researcher to develop a viewpoint that is based on fully-developed emic and etic perspectives (Johnson & Christensen, 2011: 274). Commensurability mixing validity was achieved by adequately mixing qualitative and quantitative viewpoints into one integrated viewpoint. Weakness minimisation validity was also achieved by combining qualitative and quantitative approaches in a manner that prevents overlapping weaknesses.

Conversion validity was achieved by quantitising, qualitative data and qualitising, quantitative data so that they yield high quality inferences. Sample integration validity was achieved by drawing appropriate conclusions, and making generalisations and inferences from the population. Multiple-validity was achieved by ensuring that all quantitative, qualitative, and mixed validities were addressed and resolved successfully.

The research was designed in such a way that the weaknesses of the quantitative method are minimised by the use of the qualitative method and the weaknesses of the quantitative set of data are minimised by the use of the qualitative set of data, and vice versa. Multiple sets of data were used to cross-validate and corroborate findings. Furthermore, multiple perspectives and theories were used in interpreting the data.

Researcher-bias was controlled by using reflexivity which is the use of self-reflection to recognise one's biases and to actively endeavour to eliminate them. Any bias inherent to a particular data source or method was more likely to be eradicated because it was used in conjunction with other data sets and methods. This resulted in convergent findings regarding the use of mathematics contextual word-problems in the FET examinations of IEB and those of NSC.

The reliability of the schedule of mathematization was determined on the basis of how it consistently generated data from the analysis of contextual word problems in various question papers.

3.6-Ethical issues

The most common ethical issues that surface in both qualitative and quantitative forms of enquiry were considered in this mixed-methods research. Since the researcher used data sources produced as part of ongoing formal activities of both the public and private schools, there was no disruption of teaching and learning. The researcher communicated the purpose of the study, which was to investigate the nature and cognitive demands of contextual word-problems posed in the FET mathematics examinations of both the IEB and the NSC.

The past examination questions considered is copyright of their respective publishers. As such, they were reproduced with permission (under the helpful policy that allows the reproduction of not more than 70% of any single question paper). The researcher obtained ethical clearance from the relevant committee at Unisia. Moreover, the researcher avoided deceptive practices and respected vulnerable populations, given her awareness of the potential power issues involved in data collection (Creswell, 2008). The researcher did not disclose any sensitive information and respected indigenous cultures.

Data was reported honestly, without changing or altering the findings to satisfy certain predictions or interest groups (Creswell, 2008). The researcher did not copy studies completed by other researchers, and credit was given for material quoted from other studies. The researcher communicated the practical significance of research findings to other educational researchers and practitioners.

Chapter 4

Data Analysis

In this concurrent-triangulation research, qualitative and quantitative data were analysed simultaneously, in an integrated fashion. Qualitative and quantitative data were combined, during the data-mixing phase, to communicate the essential characteristics of past examination contextual word-problems and student performance. Data sets were merged through a quantitative analysis of qualitative data and a qualitative analysis of quantitative data.

This was achieved through the use of both descriptive and inferential statistics. Qualitative data were represented numerically, based on the frequency of occurrence, and were subsequently used in the quantitative analysis. Statistical trends were complemented with qualitative data. Measures of both central tendency and dispersion were calculated in order to analyse the data.

Moreover, essential characteristics of contextual word-problems were conveyed by presenting the data in more interpretable forms such as frequency distributions and graphical displays. Bar graphs were constructed in order to illustrate the variance of the total marks of contextual word-problems, from one year to another and from Paper 1 to Paper 2.

Two scatter-graphs were drawn to illustrate the relationship between the total marks allocated to contextual word-problems per year and students' performance in mathematics. The first scatter-graph was drawn to illustrate the relationship between marks allocated to IEB contextual word-problems per year and national performance. The second-scatter graph was drawn to illustrate the relationship between marks allocated to NSC contextual word-problems per year and national performance. Furthermore, the data were organised into a more interpretable form, after calculating such numerical indexes as measures of central tendency and dispersion.

4.1 Total marks of contextual word problems

Table 4.1.1 shows the distribution of contextual word problems from one year to another. The purpose of the table is to illustrate the distribution of marks from one year to another and from one examination to another.

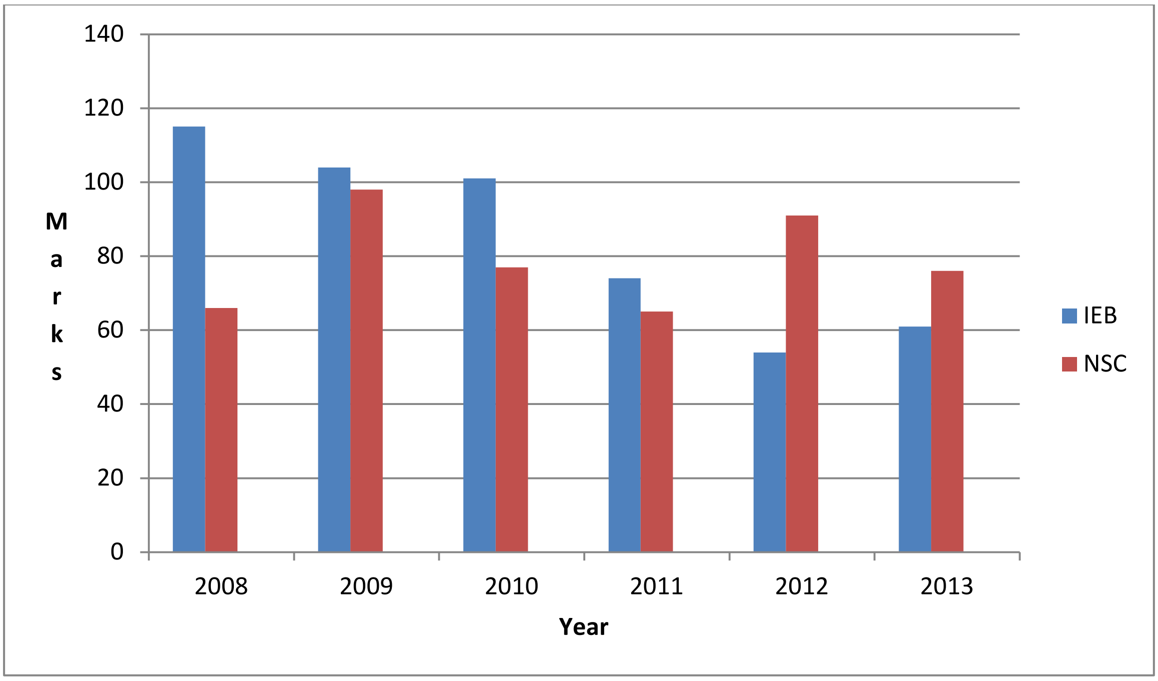
Table 4.1.1: Total marks of contextual word-problems in the respective question papers by IEB and NSC for the years 2008 - 2013

Year.	Total marks (IEB).	Total marks (NSC).
2008	115	66
2009	104	98
2010	101	77
2011	74	65
2012	54	91
2013	61	76
Total	509	473
Average	84.8	77.8

From table 4.1.1, it is clear that the total marks of IEB contextual word-problems are higher than those of NSC, except in 2012 and 2013. This implies that IEB students have a larger bank of contextual word problems as compared to their NSC peers. As a result IEB students are more likely to have more experience with contextual word problems resulting in a higher potential ability in answering contextual word problems as compared to their NSC peers.

The information in table 4.1.1 is illustrated in graph 1. The bar graph gives a clear visual impression of how the total marks are distributed from one year to another.

Graph 1: Total marks of contextual word-problems per year



Graph 1, shows that the total marks of IEB contextual word-problems have constantly declined from 2008 to 2012, but increased slightly in 2013. Conversely, the total marks of NSC contextual word-problems have fluctuated between 2008 and 2013.

Table 4.1.2A shows the total marks for contextual word-problems for each year in ascending order. The purpose of the table is to illustrate how total marks of contextual word problems are arranged from lowest to highest.

Table 4.1.2A: Total marks of contextual word-problems for the period 2008 – 2013, in ascending order

Year (IEB)	Total marks (IEB)	Year (NSC)	Total marks (NSC)
2012	54	2011	65
2013	61	2008	66
2011	74	2013	76
2010	101	2010	77
2009	104	2012	91
2008	115	2009	98

The highest IEB percentage of contextual word-problems per year was 38% (in 2008) and the lowest was 18% (in 2012). On the contrary, the NSC highest percentage of contextual word-problems per year was 32.7% (in 2009) and the lowest was 23% (in 2011). The variation of IEB contextual word-problems is greater than that of NSC contextual word-problems.

This variation in the total marks allocated to contextual word problems might have a positive relationship with the variation in total marks allocated to contextual word problems in internal examinations. This implies that both extremes of contextual word problems might be experienced by IEB students. As a result, students with the highest exposure to contextual word problems might be IEB students, as well as students with the lowest exposure to contextual word problems.

Table 4.1.2 B shows the measures of central tendency and measures of dispersion of the total marks allocated to contextual word problems each year. The purpose of the table is to illustrate central tendency and dispersion of marks allocated to contextual word problems.

Table 4.1.2B: Total marks of contextual word problems – Measures of central tendency and dispersion

Measures of central tendency/ dispersion.	IEB	Measure of central tendency/ dispersion.	NSC
Q1	61	Q1	66
Q2	87.5	Q2	76.5
Q3	104	Q3	91
IQR	43	IQR	25
Range	115-54=61	Range	98-65=33
Mean	84.8	Mean	78.8
Standard deviation	25.2	Standard deviation	13.29
Number of items within one standard deviation of the mean	4	Number of items within one standard deviation	4
Percentage of items within one standard deviation of the mean	66.7	Percentage of items within one standard deviation of the mean	66.67

Table 4.1.2B shows that the mean, range, and standard deviation of IEB contextual word-problems are greater than those of NSC contextual word-problems. For four years, the total marks of IEB and NSC contextual word-problems have been within one standard deviation of the mean.

Table 4.1.3 shows the total marks for each question paper. The purpose of the table is to illustrate the total marks allocated to each question paper.

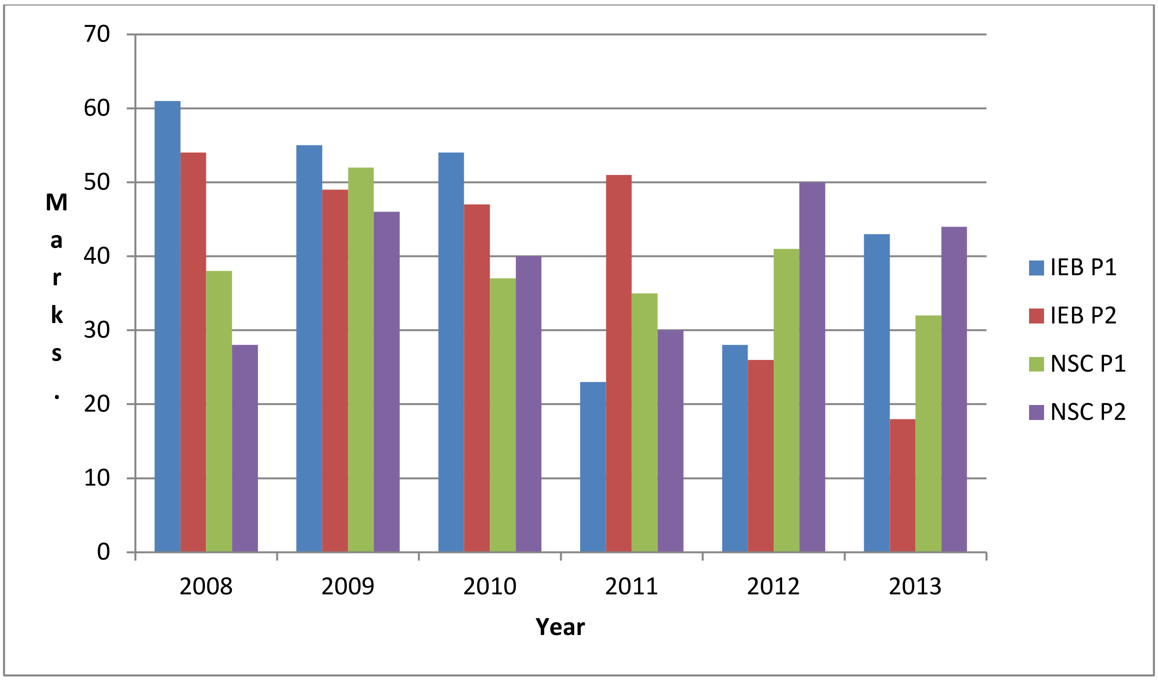
Table 4.1.3: Total marks of contextual word-problems for each question paper

Question Paper	Total marks (IEB)	Total marks (NSC)
2008 P1	61	38
2008 P2	54	28
2009 P1	55	52
2009 P2	49	46
2010 P1	54	37
2010 P2	47	40
2011 P1	23	35
2011 P2	51	30
2012 P1	28	41
2012 P2	26	50
2013 P1	43	32
2013 P2	18	44
Total	509	473
Average	42.42	39.42

Table 4.1.3 shows that the total marks of contextual word-problems for Paper 1 are generally higher than those of Paper 2, for IEB examinations. The only exceptions occurred in 2011. From 2008 to 2011, Paper 1 was having higher marks than Paper 2 for NSC examinations. Conversely, from 2012 to 2013, Paper 1 was having lower marks than Paper 2 for NSC examinations. There are a total of 264 marks for IEB Paper 1 and 245 marks for IEB Paper 2. On the other hand, there are a total of 235 marks for NSC Paper 1 and 238 marks for NSC Paper 2.

Graph 2 shows the total marks of contextual word-problems per question paper. The bar graph gives a clear visual impression of how the total marks of contextual word problems change from Paper 1 to Paper 2, from one year to another, and from one examination body to another.

Graph 2: Total marks of contextual word problems per question paper



From graph 2, it is clear that the total marks of contextual word--problems in all question papers and all examinations have been fluctuating between 2008 and 2013.

Table 4.1.4A shows the total marks for each question paper in ascending order. The purpose of the table is to show how the total marks of contextual word problems for each question paper are arranged from lowest to highest.

Table 4.1.4A: Total marks of contextual word-problems for each question paper, in ascending order

Year (IEB)	Total marks (IEB)	Year (NSC)	Total marks (NSC)
2013 P2	18	2008 P2	28
2011P1	23	2011 P2	30
2013 P1	43	2013 P2	35
2012 P2	26	2011 P1	35
2012 P1	28	2008 P1	38
2010 P2	47	2010 P2	40
2009 P2	49	2012 P1	41
2011 P2	51	2010 P1	41
2008 P2	54	2013 P2	44
2010 P1	54	2009 P2	46
2009 P1	55	2012 P2	50
2008 P1	61	2009 P1	52

The highest IEB percentage of contextual word-problems per question paper is 40.7% for 2008 P1, whereas the lowest was 12% for 2013 P2. On the contrary, the highest NSC percentage of contextual word-problems per question paper was 34.7% for 2009 P1, whereas the lowest was 18.7% for 2008 P2. The IEB variation is greater than the NSC variation. Generally, Paper 1 question papers have more contextual word problems as compared to Paper 2 question papers for IEB examinations. This might imply that IEB educators teach more of Paper 1 in context as compared to Paper 2.

Table 4.1.4B illustrates the measures of central tendency and dispersion of total marks allocated to contextual word problems from one year to another. The purpose of the table is to illustrate central tendency and dispersion.

Table 4.1.4 B. Total marks of contextual word problems per question paper-Measures of central tendency and dispersion

Measure of central tendency/dispersion.	IEB	Measure of central tendency/dispersion.	NSC
Mode	54	Mode	41
Q1	34.5	Q1	35
Q2	48	Q2	40.5
Q3	54	Q3	45
IQR	19.5	IQR	10
Range	61-18=43	Range	52-28=24
Mean	42.4	Mean	39.42
Standard deviation	14.65	Standard deviation	7.36
Number of items within one standard deviation of the mean	7	Number of items within one standard deviation	8
Percentage of items within one standard deviation of the mean	58.3	Percentage of items within one standard deviation of the mean	66.67

According to the table 4.1.4B, Q1 for IEB is less than Q1 for NSC; whereas Q2 and Q3 for IEB are greater than Q2 and Q3 for NSC. In addition, the IQR and range for IEB are greater than the IQR and range for NSC. Moreover, the mean and range for IEB are greater than the mean and range for NSC. Furthermore, seven IEB question papers are within one standard deviation of the mean whereas eight NSC question papers are within one standard deviation of the mean. The variation in the amount of marks allocated to each question paper in external assessment might have an implication on the variation of marks allocated to each question paper in internal assessment.

Table 4.1.5 shows the cumulative frequency for each year. The purpose of the table is to illustrate that, every year, IEB students has a larger bank of past examination contextual word problems to use for revision as compared to their NSC peers.

Table 4.1.5: Cumulative frequency for contextual word-problems

Year.	Cumulative frequency (IEB).	Cumulative frequency (NSC).
2008 P1	61	38
2008 P2	115	66
2009 P1	165	118
2009 P2	219	164
2010 P1	273	201
2010 P2	320	241
2011 P1	343	276
2011 P2	394	306
2012 P1	422	347
2012 P2	448	397
2013 P1	491	429
2013 P2	509	473

Table 4.1.5 shows that the cumulative frequency for IEB has been higher than that of NSC, from 2008 to 2013. This implies that IEB students always have a higher reserve of contextual word problems, for revision, as compared to their NSC peers. In addition, IEB educators seem to have a wider variety of contextual word problems to refer to when setting contextual word-problems for internal assessment as compared to their NSC peers.

4.2 Theme frequency

Table 4.2.1 shows theme frequency for IEB and NSC contextual word problems. The purpose of the table is to illustrate the themes that students are exposed to and the total marks allocated to each theme.

Table 4.2.1: Theme frequency

Theme	Theme frequency (IEB)	Theme frequency (NSC)
Sport and recreation.	41	44
Loans and investments	45	62
Academic marks	40	37
Trade (sales, purchases, and prices)	73	27
Manufacturing and production	5	71
Food and nutrition (apples, ice-cream, and vitamins)	21	N/A
Transport (airlines, airbuses, ships, hot-air balloons, satellites, cars, missiles, car accidents, blood alcohol levels and tractors)	24	67
Buildings, street lights, towers, walls, pyramids, playhouses, roller coasters and stadiums	66	32

Bridges and tunnels.	31	N/A
Age, height, weight and body mass index	40	12
Clock	4	10
Logos (SAPS emblem) and emblems (Audi logo)	16	4
Drinking glasses, cans, water tanks, soccer balls, and rectangular cardboard	8	23
Earth's orbit	7	N/A
Maps, animals and physical features (landforms and trees)	26	N/A
HIV and AIDS	13	6
Movement, distance, particle movement, water flow, time, travelling time, wheel rotation and speed	N/A	48
Planting maize and sweet potatoes.	N/A	17
Development indicators (Number of children per family, income, population, population density)	22	N/A
Battery lifespan and light bulb lifespan	6	9
Hotel bookings	15	N/A
Social networking sites	6	N/A
Recycling	N/A	4

Total	509	473
Average	509/20=25.45	473/16=29.6

Table 4.2.1 reveals twenty themes for IEB and sixteen themes for NSC. The average mark per theme for IEB is 25.45, whilst the average mark per theme for NSC is 29.6. The variety of themes in IEB examinations is greater than the variety of themes in NSC examinations. This variety of themes in external assessment might have an implication on the variety of themes used in internal assessment

Table 4.2.2A shows theme frequency in descending order. The purpose of the table is to illustrate how the total marks allocated to each theme are arranged, from highest to lowest.

Table 4.2.2A: Theme frequency, in descending order

Theme (IEB)	Total marks (IEB)	Theme (NSC)	Total marks (NSC)
1. Trade (sales, purchases and prices)	73	1. Manufacturing, machines and production	71
2. Buildings, street lights, towers, walls, pyramids, playhouses, roller coasters and stadiums	73	Transport (airlines, airbuses, ships, hot air balloons, satellites, cars, missiles, car accidents, blood alcohol levels and tractors)	67
3. Loans and investments	45	3. Loans and investments	62

4. Sport and recreation	41	4. Movement, distance, particle movement, water flow, time, travelling time, wheel rotation and speed	48
5. Age, height, weight and body mass index	40	5. Sport and recreation	44
6. Academic marks	40	6. Academic marks	37
7. Bridges and tunnels	31	7. Buildings, street lights, towers, walls, pyramids, playhouses, roller coasters and stadiums	32
8. Maps, animals and physical features	26	8. Trade (sales, purchases and prices)	27
9. Development I indicators (Number of children per family, income, population, population density)	22	9. Drinking glasses cans, water tanks, soccer balls and rectangular card box	23
10. Food and nutrition	21	10. Planting maize and potatoes	17

11. Transport (airlines, airbuses, ships, hot air balloons, satellites, cars, missiles, car accidents, blood alcohol levels and tractors)	17	11. Age, height, weight and body mass index	12
12. Logos and signs	16	12. Clock	10
13. Hotel Bookings	15	13. Battery and light bulb lifespan	9
14. HIV and AIDS	13	14. HIV and AIDS	6
15. Drinking glass, cans, water tanks, soccer balls and rectangular card box	8	15. Logos and signs	4
16. Earth's orbit	7	16. Recycling	4
17. Battery lifespan and light bulb lifespan	6		
18. Social networking sites	6		
19. Manufacturing, machines and production	5		
20. Clock	4		

Table 4.2.2A shows that a variety of themes have been used in IEB examinations and NSC examinations. For both IEB and NSC, the theme of loans and investment is number 3. In IEB examinations, this theme has been allocated a total of 45 marks whereas in NSC examinations, it has been allocated a total of 62 marks. In the same vein, the theme of academic marks is number 6 for both examinations. For IEB, a total of 40 marks have been allocated to this theme whereas in NSC examinations, a total of 37 marks have been allocated to this theme. Moreover, HIV and AIDS, is number 14 in both examinations. This theme has been allocated a total of 13 marks in IEB examinations and a total of 6 marks in NSC examinations.

Table 4.2.2B illustrates the measures of central tendency and dispersion of total marks allocated to each theme. The purpose of the table is to illustrate central tendency and dispersion.

Table 4.2.2B: Theme significance- Measures of central tendency and dispersion

Measure of central tendency/dispersion.	IEB	Measure of central tendency/dispersion.	NSC
Q1	7.5	Q1	9.5
Q2	19	Q2	25
Q3	40	Q3	46
IQR	32.5	IQR	36.5
Range	73-4=69	Range	71-4=67
Mean	25.45	Mean	29.57
Standard deviation	20.95	Standard deviation	23.04
Number of items within one standard deviation	17	Number of items within one standard deviation	10
Percentage of items within one standard deviation of the mean	85	Percentage of items within one standard deviation of the mean	62.5

Table 4.2.2B reveals that the range of IEB contextual word-problems is higher than that of NSC contextual word-problems. However, the mean and standard deviation of IEB themes are less than those of NSC themes. Furthermore, 85 % of IEB themes are within one standard deviation of the mean, against only 62.5% of NSC themes.

4.3 Contextual subjects

Table 4.3.1 shows contextual subjects. The purpose of the table is to show the contextual subjects used in past examinations and the total marks allocated to each contextual subject.

Table 4.3.1: Contextual subjects

Contextual subject	Total Marks (IEB)	Total Marks (NSC)
Statistics	135	170
Financial mathematics	100	80
Trigonometry	65	54
Functions (straight line, quadratic equations and exponential)	55	N/A
Linear programming	54	94
Transformation	11	10
Calculus	16	18
Surface area and volume	18	35
Number patterns.	39	12
Co-ordinate geometry	9	N/A
Circle geometry	7	N/A
Total	509	473
Average	509/11 = 46.27	473/8=59.13

Table 4.3.1 identifies eleven contextual subjects for IEB examinations and eight contextual subjects for NSC examinations. This might imply that IEB students are exposed to more contextual subjects in mathematics teaching, learning and assessment as compared to their NSC peers.

Table 4.3.2A shows contextual subjects in descending order. The purpose of the table is to illustrate the distribution of total marks allocated to each contextual subject from highest to lowest.

Table 4.3.2 A: Contextual subjects of texts in descending order

Contextual subject (IEB)	Total marks (IEB)	Contextual subject (NSC)	Total marks (NSC)
Statistics	135	Statistics	170
Financial Mathematics	100	Linear programming	94
Trigonometry	65	Financial mathematics	80
Functions	55	Trigonometry	54
Linear Programming	54	Surface area and volume	35
Number Patterns.	39	Calculus.	18
Surface area and volume	18	Number patterns	12
Calculus	16	Transformation	10
Transformation	11		
Co-ordinate geometry	9		
Circle-geometry	7		

Table 4.3.2A shows that statistics is the most popular contextual subject for both examinations. As a result educators and students are more likely to anticipate that statistics will be examined in context. It can be assumed that statistics is more likely

to be taught in context as compared to other topics. Topics such as financial mathematics, linear programming and trigonometry are also popular in both examinations. These topics are also, more likely to be taught in context. All contextual subjects that are found in NSC examinations are also found in IEB examinations. A total of three contextual subjects namely, circle-geometry, co-ordinate geometry and functions are exclusive to IEB examinations. As a result IEB students are more likely to learn these topics in context whilst NSC students are less likely to learn them in context.

Table 4.3.2B illustrates the measures of central tendency and dispersion of total marks allocated to contextual subjects. The purpose of the table is to illustrate the central tendency and dispersion of total marks allocated to different contextual subjects.

Table 4.3.2B: Contextual subjects- Measures of central tendency and dispersion

Measures of central tendency/dispersion.	IEB	Measures of central tendency/dispersion.	NSC
Q1	11	Q1	15
Q2	39	Q2	42.5
Q3	65	Q3	87
IQR	54	IQR	72
Range	135-7=128	Range	170-10=160
Mean	46.27	Mean	59.13
Standard deviation	34.63	Standard deviation	54.61
Number of items within one standard deviation of the mean	9	Number of items within one standard deviation of the mean	7
Number of items within one standard deviation of the mean	81.82	Number of items within one standard deviation of the mean	87.5

Table 4.3.2B reveals that the mean and standard deviation for IEB contextual word-problems are less than the mean and standard deviation for NSC contextual word-problems. Furthermore, 81.82% of IEB contextual subjects are within one standard deviation of the mean, whereas 87.5% of NSC contextual contexts are within one standard deviation of the mean.

Linear programming represents 10.61% of IEB total marks for contextual word-problems, whereas it accounts for 19.87% of NSC total marks for contextual word-problems. Now that linear programming is not in the CAPS syllabus anymore, the implications of its absence on the total marks of contextual word-problems need to be sufficiently considered.

4.4 Horizontal mathematization and vertical mathematization

Table 4.4 shows total marks and percentages of total marks allocated to each level of contextual word problems. The purpose of the table is to illustrate the relationship between horizontal mathematization and vertical mathematization.

Table 4.4: Levels of contextual word-problems

Mathematization	Horizontal mathematization (Level 1)	Vertical mathematization and vertical mathematization. (Level 2)	Horizontal mathematization (Level 3)
IEB Total marks	$\frac{31}{509} = 6.1\%$	$\frac{142}{509} = 27.9\%$	$\frac{336}{509} = 66.0\%$
NSC Total marks	$\frac{60}{473} = 12.7\%$	$\frac{116}{473} =$ 24.5%%	$\frac{297}{473} = 62.8\%\%$

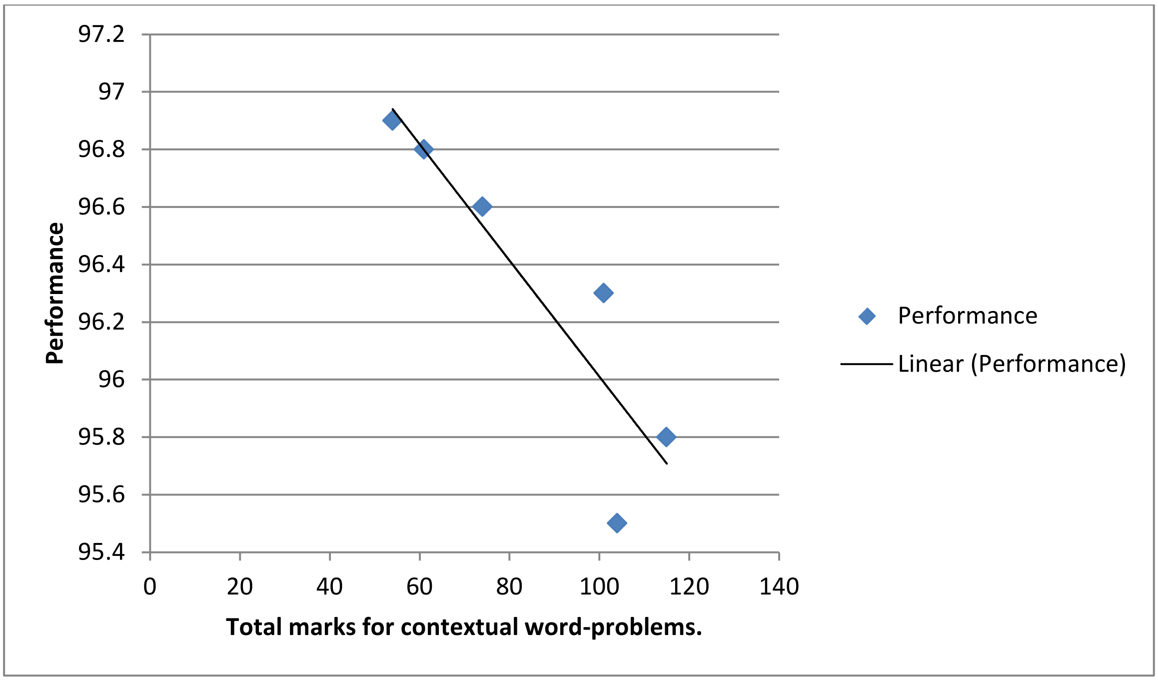
Table 4.4 reveals that, for both examinations, level 3 has the highest percentage of marks. It is followed by level 2 and then level 1. However, the percentage for NSC level 1 mathematics contextual word-problems is greater than the percentage of IEB level 1 mathematics contextual word-problems. Conversely, the percentage of IEB mathematics contextual word-problems for both level 2 and level 3 is greater than that of NSC mathematics contextual word-problems.

Table 4.4, shows desirable, positive selective mathematization in which more marks are allocated to vertical mathematization as compared to horizontal mathematization. Conversely, it is undesirable to have negative selective, mathematization in which more marks are allocated to horizontal mathematization as compared to vertical mathematization.

4.5 The relationship between national pass rate and total marks for contextual word problems.

Graph 3 shows the relationship between the mathematics, IEB national pass rate and total marks for contextual word problems. The purpose of the scatter plot is to illustrate the relationship between total marks allocated to IEB contextual word problems and the IEB national mathematics pass rate.

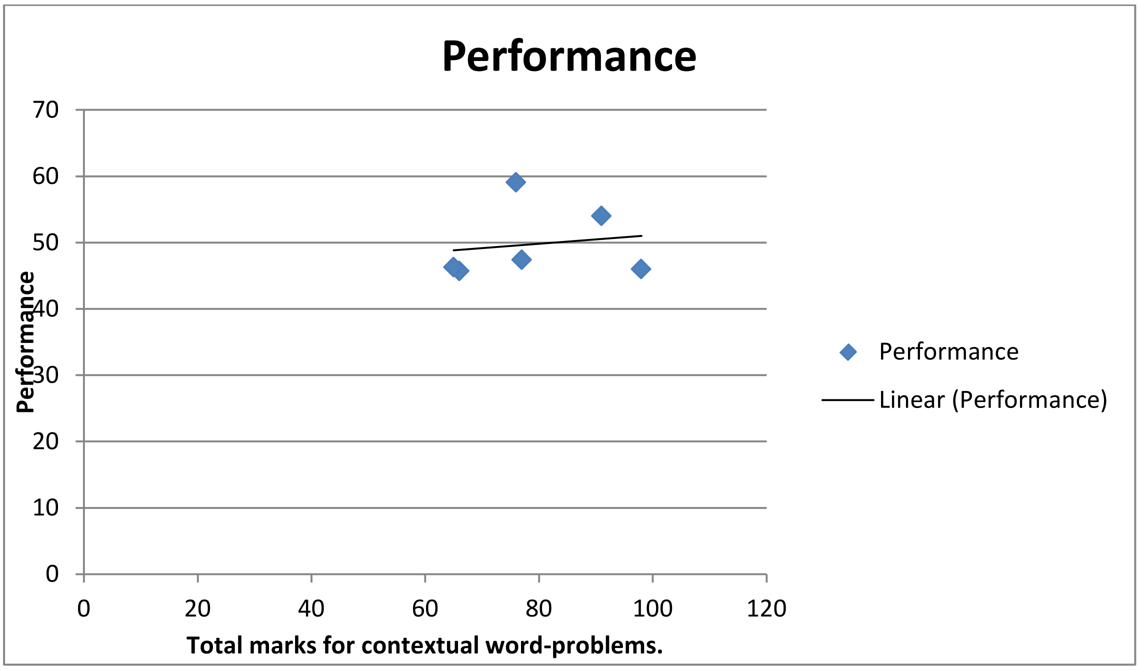
Graph 3: Scatter plot for mathematics IEB national pass rate and total marks for mathematics contextual word-problems



Graph 3 shows that there is a negative relationship between IEB average performance and total marks for mathematics contextual word-problems. The amount of marks allocated to contextual word problems have been declining whilst the IEB average performance have been increasing.

Graph 4 shows the mathematics, NSC, national pass rate and the total marks for mathematics contextual word problems. The purpose of the scatter plot is to illustrate the relationship between total marks allocated to NSC contextual word problems and the NSC national mathematics pass rate.

Graph 4: Scatter plot for mathematics NSC national pass rate and total marks for mathematics contextual word problems



Graph 4 shows that the points tend to be loosely clustered without a distinct trend or pattern that can be discerned. Drawing a 'line of best fit' through the points yields a line graph that does not perfectly represent the trend of the points. This seems to suggest a very weak positive relationship between performance in NSC and total marks for contextual word-problems, which in essence is tantamount to a negligible correlation. Generally, the amount of marks allocated to contextual word problems and the national pass rate have been gradually increasing.

4.6 Summary of research findings

Quantitative and qualitative data were obtained using the schedule of mathematization of real-life situations and the schedule of total marks of contextual word-problems and national performance, as noted in section 3.3. It was also indicated in Table 4.1.2, which is included in section 4.1, that the IEB total marks of contextual word-problems per year – in descending order – are 115 in 2008, 104 in 2009, 101 in 2010, 74 in 2011, 61 in 2013, and 54 in 2012.

On the other hand, the NSC total marks of contextual word-problems per year – in descending order – are 98 in 2009, 91 in 2012, 77 in 2010, 76 in 2013, 66 in 2008, and 65 in 2011. Clearly, IEB has the highest total mark per year of 115 in 2008, as well as the lowest total mark per year of 54 in 2012. This implies that IEB has a greater range than NSC. The quantity of marks allocated to contextual word-problems varies from one year to another and from one examination body to another.

Moreover, as shown in Table 4.1.4, presented in section 4.1, the IEB total marks of contextual word-problems per question paper – in descending order – are 61 for 2008 P1, 55 for 2009 P1, 54 for 2010 P1, 54 for 2008 P2, 51 for 2011 P2, 49 for 2009 P2, 47 for 2010 P2, 43 for 2013 P1, 28 for 2012 P1, 26 for 2012 P2, 23 for 2011 P1, and 18 for 2013 P2. Conversely, the NSC total marks of contextual word-problems per question paper – in descending order – are 52 for 2009 P1, 50 for 2012 P2, 46 for 2009 P2, 44 for 2013 P2, 41 for 2010 P1, 41 for 2012 P1, 40 for 2010 P2, 38 for 2008 P1, 35 for 2011 P1, 35 for 2013 P2, 30 for 2011 P2, and 28 for 2008 P2.

Once more, IEB has the highest mark per question paper of 61 for 2008 P1, and the lowest mark per question paper of 18 for 2013 P2. This, once again, suggests that IEB has a greater range than NSC. Generally, Paper 1 question papers have more contextual word-problems than Paper 2 question papers for IEB examinations – with the exception of the 2011 question papers.

In addition, as shown in Table 4.2.2, section 4.2, IEB themes – in descending order – are trade (73 marks), buildings (73 marks), loans and investment (45 marks), sport and recreation (41 marks), age, height and body mass index (40 marks), academic marks (40 marks), bridges and tunnels (31 marks), maps, animals and physical features (26 marks), development indicators (22 marks), food and nutrition (21 marks), transport (17 marks), logos and signs (16 marks), hotel bookings (15 marks), HIV and AIDS (13 marks), drinking glass (8 marks), earth's orbit (7 marks), battery lifespan and light bulb lifespan (6 marks), social networking sites (6 marks), manufacturing, machines and production (5 marks), and clocks (4 marks).

Furthermore, as also revealed in Table 4.2.2, section 4.2, NSC themes – in descending order – are manufacturing, machines and production (71 marks), transport (67 marks), loans and investment (62 marks), movement (38 marks), sport and recreation (44 marks), academic marks (37 marks), buildings (32 marks), trade (27 marks), drinking glass (23 marks), planting maize and potatoes (17 marks), age, height and body mass index (12 marks), clock (10 marks), battery and light bulb lifespan (9 marks), HIV and AIDS (6 marks), logos and signs (4 marks), and recycling (4 marks). IEB examinations have more themes than NSC examinations.

What is more, as shown in Table 4.3.2, section 4.3, IEB contextual subjects – in descending order – are statistics (135 marks), financial mathematics (100 marks), trigonometry (65 marks), functions (55 marks), linear programming (54 marks), number patterns (39 marks), surface area and volume (18 marks), calculus (16 marks), transformation (11 marks), co-ordinate geometry (9 marks), and circle geometry (7 marks).

Moreover, from Table 4.3.2, section 4.3, NSC contextual subjects – in descending order – are statistics (170 marks), linear programming (94 marks), financial mathematics (80 marks), trigonometry (54 marks), surface area and volume (35 marks), calculus (18 marks), number patterns (12 marks), and transformation (10 marks). IEB examinations also have more contextual subjects than NSC examinations.

Although all contextual subjects are supposed to be equal, it seems as if some, such as statistics, are given more importance. Likewise, though all themes are expected to be equal, it also seems that some, such as trade, are more important. Thus, the intended curriculum might need to specify the themes and contextual subjects that should form the basis of the contextual word-problems included in textbooks, mathematics teaching and learning activities, and mathematics examinations.

Table 4.4, section 4.4, shows that IEB level 1 questions account for 6.1% of total marks, IEB level 2 questions count for 27.9% of IEB total marks and IEB level 3 questions represent 66% of IEB total marks. Conversely, NSC level 1 questions represent 12.7% of NSC total marks, NSC level 2 questions represent 24.5% of NSC total marks and NSC level 3 questions account for 62.8% of NSC total marks. IEB examinations have a greater percentage of level 2 and level 3 questions; whereas NSC examinations have a greater percentage of level 1, questions. NSC level 1 contextual word-problems are almost double IEB level 1 contextual word-problems.

Examination-driven teaching and learning can be better exploited by setting adequate and sufficient contextual word-problems in the mathematics examinations of IEB and NSC. Educators and students use past examination question papers as inputs in their teaching and learning process. The emphasis put by examiners on contextual word-problems in previous examination question papers is reflected in the current teaching and learning process. As a result, the contextual word-problems included in the examinations of the currently implemented curriculum determine, to a large extent, the classroom activities of the future implemented curriculum.

Educators and students respond more to the action of examining in context than to the intended curriculum's call for the inclusion of context in all teaching and learning activities. It seems that IEB students are exposed to more contextual questions, more themes and more contextual subjects than their NSC peers. On the contrary, NSC students are exposed to more questions per theme and per contextual subject than their IEB counterparts.

The difference between teaching-in-context and teaching algebraically has far-reaching implications on the pass rate, drop-out rate, and university throughput rate in mathematics. The supposition that teaching-in-context results in more meaningful learning than teaching algebraically might be one of the logical explanations for the differences in pass rates and university throughput rates between IEB and NSC students.

Chapter 5

Summary of the Study, Discussions, How the data addressed the research questions, Limitations of the research topic and research approach Conclusions and Recommendations

5.1 Summary of the Study

The study was a mixed-methods research on contextual word-problems posed in the FET examinations of IEB and NSC. As noted in section 2, the theoretical framework for analysing contextual word-problems is the theory of authentic task situations, whereas the teaching and learning of mathematics is underpinned by the Realistic Mathematics Education (RME) perspective. Quantitative and qualitative data were collected simultaneously, using the schedule of the mathematization of real-life situations and the schedule of total marks and national performance, as indicated in section 3.3.

One schedule for analysing the mathematization of real-life situations was completed for each question paper. In total, 24 schedules for analysing the mathematization of real-life situations were completed. Schedules 3.1.1 to 3.1.12 are for IEB examinations, and schedules 3.1.13 to 3.1.24 are for NSC examinations, as reflected in the Appendix. One schedule for total marks and national performance was completed for both IEB and NSC examinations.

In addition to the eight crucial aspects of the theory of authentic task situations, the contextual word-problems in IEB and NSC past examination question papers from 2008 to 2013 were analysed basing on their themes, contextual subjects, level of mathematization, and quantity of marks. Qualitative data were analysed quantitatively, whereas quantitative data were analysed qualitatively, as noted in section 4. Both measures of central tendency and those of dispersion were calculated. Bar graphs and scatter graphs were used for the data illustration.

5.2 Discussions

The adoption of a mixed-methods research approach to investigate the problem of this study was largely informed by the profile of the approach as presented by (Gay, Mills & Airasian, 2006; Tashakkori & Cresswell, 2007). As indicated in Table 4.1.1, 509 marks out of 1800 were allocated to contextual word-problems in IEB examinations; whereas 473 marks out of 1800 were allocated to contextual word-problems in NSC examinations. Table 4.1.2, indicates that the range of IEB contextual word-problems, per year, is 54-115; whereas the range of NSC contextual word-problems, per year, is 65-98.

Table 4.1.4, also shows that the range of IEB contextual word-problems, per question paper, is 18-61; while that of NSC contextual word-problems, per question paper, is 28-52. The findings are consonant with the argument presented in section 4.1, that more marks are allocated to questions in IEB examinations and that there are more contextual word-problems questions in the IEB examination than in the NSC one. It is therefore claimed that IEB tend to value contextual word-problem more than NSC.

The data in tables 4.1.2 and 4.1.4 show the varying degree of emphasis being put on the contextual word-problem by each of the two examination bodies. It is thus concluded that examining more in context seems to be far more effective in motivating educators to teach in context and students to learn in context than the intended curriculum’s mere stipulation that context should be included in mathematics teaching, learning, and assessment as the documents by DoE (2006) and CAPS (2012) do. There is therefore a need to reduce the variation in the amount of marks allocated to contextual word-problems in the two examinations. Perhaps, in this regard educators, particularly those in the NSC schools, may require further training on the use of context in teaching and assessment

Generally the total marks of IEB contextual word-problems have been declining whilst that of NSC contextual word-problems has been fluctuating. In 2012 and 2013, the total marks of NSC contextual word-problems are higher than that of IEB contextual word-problems. However, the cumulative frequency of IEB contextual word-problems is always higher than that of NSC. The amount of marks allocated to IEB contextual word-problems have declined from 115 in 2008 to 54 in 2012 and then increased to 61 in 2013. Generally during the same period as IEB, the total marks of NSC have fluctuated between 65 (in 2011) and 98 (in 2009). The state of marks allocation in the two examination bodies warrants an investigation particularly that there is strong advocacy to embed content in context in order to enhance relevance and make content fun to learn (Mogari, 2007).

With regards to the low marks range (65 – 98) allocated to contextual word problems over the years in the NSC examination, it is surmised that, on one hand, the difficulty such problems pose to students (see Onabanjo, 2004; Little, 2010; Sasman, 2011) could be the reason. On the other hand, AMESA (2013) noted that educators do not pay due attention to such problems when teaching hence students find it difficult to resolve them in the examinations. Thus, it may be that there is fear among those concerned that if more marks can be given to contextual word-problems more students might be disadvantaged and perform poorly in mathematics on the overall.

The relationship between total marks for mathematics contextual word-problems and national pass rate varies from one examination body to another. There is a negative relationship between marks allocated to IEB contextual word-problems and national pass rate whilst there is an extremely weak positive relationship between total marks for NSC mathematics contextual word-problems and national performance. For IEB, the findings vindicate Little’s (2010) claim that more questions on contextual word-problems in an examination disadvantages students simply because contextual word-problems are complex and cognitively demanding.

Thus, subjecting students to more of such questions may compound the stressful experience of an examination and lead to poor performance. In the case of NSC, a similar argument may also hold. Fewer questions means few marks have been allocated to contextual word-problems in an examination and according to graph 4 students still score low. Drawing on AMESA's (2013) report it suffices to argue that most probably students would still perform poorly even if there were more of such questions in an examination. It is important to emphasize that contextual word-problems in previous examinations affects the current teaching and learning in context. Educators tend to use the questions to prepare their students for the coming examination.

The data show that there were 20 themes for IEB contextual word-problems and 16 for NSC contextual word-problems. The two numbers (i.e. 20 and 16) are significant in terms of the quantity of themes of contextual word-problems. It shows that there are attempts by the two examination bodies to comply with the issue of diversity of themes of contextual word-problems as stipulated in the documents by the DoE (2006) and CAPS (2012). This probably exposes students to a range of real life questions (see Palm, 2002; Verschafell at all, 2009) and this is in line with the authentic task situation theory (see Verschafell et al, 2009) and RME perspective of teaching and assessing mathematics in such a way that mathematics is portrayed as a human activity, as far as possible (Van den Heuvel-Panhuizen, 2003).

It is noted that context provides a mental scaffold that helps students to use contact-specific heuristic strategies to solve problems (Little, 2010), it promotes non-routine thinking (Khumalo, 2010), and it refines concepts and deepen understanding Perrira and Du Toit (2010). It is therefore argued that more themes for contextual word-problems have potential to afford students opportunity to develop more skills because they solve a range of contextual word-problems. It is also noted that IEB has more themes than NSC; it is therefore claimed that IEB tends to diversify more the selection of themes of contextual word-problems and these even advantages students more.

There are eleven contextual subjects for IEB contextual word-problems and eight contextual subjects for NSC contextual word-problems. Both examinations use a significant number of topics as contextual subjects. This is in line with the requirements set by DoE (2006) and CAPS (2012). However it would be desirable for contextual subjects to be sampled from all topics. This would minimize prediction of the topics which will be examined in context. As a result, all topics would be taught in context because educators would be anticipating contextual word-problems from any topic in examinations.

In addition, section 4.4 indicates that 6.1% of IEB contextual word-problems are level 1 whereas 12.7% of NSC contextual word-problems are level 1. On the other hand, 27.9% of IEB contextual word-problems are level 2 whereas 24.5% of NSC contextual-word problems are level 2. Moreover, 66% of IEB contextual word-problems are level 3 whereas 62.8% of NSC contextual word-problems are level 3. The findings show that IEB tends to operate more at higher levels of mathematization than NSC. It may very well be that IEB tends to comply more with the argument put forth in section 2.4.

5.3 How the data addressed the research questions

Question 1: *What are the themes of the mathematics contextual word-problems posed in the FET examinations of IEB and NSC?*

The study identified 20 themes for IEB contextual word-problems and 16 themes for NSC contextual word-problems.

As noted in section 4.2, the themes for IEB contextual word-problems are trade (sales, purchases, and prices), buildings (street lights, towers, walls, pyramids, playhouses, roller-coasters, and stadiums), loans and investments, sport and recreation, age (height and body mass index), and academic marks. Other themes include bridges and tunnels, maps, animals and physical features, development indicators (number of children per family, income, population, population density), food and nutrition, and transport (airlines, airbuses, ships, hot-air balloons, satellites, cars, missiles, and car accidents). Additional themes for IEB are blood alcohol level and tractors, logos and signs, hotel bookings, HIV and AIDS, drinking glass, cans, water tanks, soccer balls, earth's orbit, battery lifespan and light bulb lifespan, social networking sites, manufacturing (machines and production), and clock.

As also noted in section 4.2, the themes for NSC are manufacturing (machines and production), transport (airlines, airbuses, ships, cars, hot-air balloons, missiles, satellites, car accidents, blood alcohol level and tractors), and loans and investments. Other themes for NSC are movement (distance, particle movement, water flow, time, travelling time, wheel rotation and speed), sport and recreation, academic marks, and buildings (street lights, towers, walls, pyramids, playhouses, roller-coasters, and stadia). Further themes for NSC include trade (sales, purchases, and prices), drinking glass (cans, water tanks and soccer balls), planting maize and potatoes, age (height, weight and body mass index), clock, battery lifespan and light bulb lifespan, HIV and AIDS, logos and signs, and recycling.

In terms of the contextual subjects of mathematics contextual word-problems posed in the FET examinations of IEB and NSC. The study uncovered 11 contextual subjects for IEB contextual word-problems and 8 for NSC contextual word-problems.

As also noted in section 4.5, the contextual subjects for IEB contextual word-problems are statistics, financial mathematics, trigonometry, functions, linear programming, number patterns, calculus, transformation, co-ordinate geometry, circle geometry, and surface area and volume, as noted in section 4.3.

The contextual subjects for NSC contextual word-problems are statistics, linear programming, financial mathematics, trigonometry, surface area and volume, calculus, number patterns, and transformation, as also noted in section 4.3.

Question 2: *What percentage of total marks is allocated to mathematics contextual word-problems in the FET examinations of IEB and NSC?*

In IEB, 509 out of 1 800 marks, or 28.28% of the total marks, were allocated to mathematics contextual word-problems, as noted in section 4.1. Conversely, in NSC, 473 out of 1 800 marks, or 26.28% of the total marks, were allocated to mathematics contextual word-problems, as noted in section 4.1.

It was interesting to note that linear programming, which has been removed from the CAPS syllabus, enjoyed more attention in the NSC than IEB. In the sense that it was allocated 10.61% of contextual word-problems' marks in the IEB examinations as compared to 19.87% of contextual word-problems' marks allocated to it in the NSC examinations.

Question 3: *What is the balance between the vertical mathematization and the horizontal mathematization of mathematics contextual word-problems posed in the FET examinations of IEB and NSC?*

The highest amount of marks is allocated to progressive mathematization followed by vertical mathematization and then horizontal mathematization. More marks are allocated to vertical mathematization as compared to horizontal mathematization – positive selective mathematization. As a result there is positive selective, mathematization which is leaning towards vertical mathematization.

Question 4: *What are the similarities and/or differences between the mathematics contextual word-problems posed in the FET examinations of IEB and those of NSC?*

Differences relate mainly to the number of themes and contextual subjects. Other differences pertain to the amount of marks allocated to contextual word-problems.

While many themes and contextual subjects are present in IEB and NSC examinations, a few themes and contextual subjects are specific to each of these two examinations. Nevertheless, in both examinations, the highest amount of marks is allocated to level 3 mathematics contextual word-problems, followed by level 2 mathematics contextual word problems and then level 1 mathematics contextual word problems. In addition, both examinations have statistics as the contextual subject with the highest amount of marks.

NSC has 8 contextual subjects whereas IEB has 11 contextual subjects. Functions, co-ordinate geometry and circle geometry are contextual subjects only found in IEB examinations. These 3 contextual subjects are not found in NSC examinations. All the remaining 8 contextual subjects namely, statistics, financial mathematics, linear programming, transformation, calculus, surface area and volume and number patterns are common to both IEB and NSC examinations. Consequently, all contextual subjects found in NSC examinations are also found in IEB examinations.

IEB examinations have a wider variety of themes as compared to NSC examinations. IEB examinations have 20 themes whereas NSC examinations have 16 themes. In general, NSC examinations have more marks per theme as compared to IEB examinations. For NSC, the mean per theme is 29.57 whilst the mean per theme for IEB is 25.45.

There are differences in the presentation of the question papers and the presentation of mathematics contextual word problems. NSC mathematics question papers have attractive cover pages but contextual word problems are predominantly presented in black and white. On the other hand, IEB question papers have black and white cover pages but contextual word problems are presented in other colours in addition to black and white.

5.4 Limitations of the research topic and research approach

It must be noted that internal assessment varies from province to province, district to district, circuit to circuit, school to school and class to class. As a result, students writing the same examination are not necessarily exposed to the same mathematics contextual word-problems. Furthermore, even students who are in the same class are not necessarily exposed to the same amount of mathematics contextual word-problems. Indeed, some students supplement classroom activities with activities from textbooks and the Internet. This enriches their experience.

Moreover, some educators and students rely predominantly on textbooks, policy documents, and the Internet; they never use past examination question papers. It must be noted that most of their classroom contextual word-problems come from textbooks. As a result, the analysis of mathematics contextual word-problems found in textbooks reveals how they implemented the curriculum more clearly than the analysis of the contextual word-problems included in past examination question papers.

Furthermore, there are some tutors who provide tuition to both IEB and NSC students. These tutors are more likely to provide the same tuition to these two types of students. It needs to be highlighted that some NSC students even use IEB past examination question papers for revision; similarly, some IEB students use NSC past examination question papers for revision purposes. As a result, these IEB and NSC students will have more or less equal exposure to contextual word-problems.

Generally, IEB examinations have more contextual word problems as compared to NSC examinations. Nevertheless, internal examinations might not necessarily reflect the same picture as external ones. In addition to past examination questions, there are other factors that influence internal examinations, notably educators' conceptions. As indicated in section 2.2, classroom assessments are contextualized and largely dependent on educators' conceptions, norms, and practices.

As a result, the amount of marks allocated to contextual word-problems in internal examinations might be significantly higher or lower than that of marks assigned to contextual word-problems in external examinations. It is also important to note that there might be some students who have not been exposed to past examination contextual word-problems. However, the majority of students are more likely to be exposed to past examination contextual word-problems because of examination driven teaching and learning.

In terms of the attained curriculum, the researcher relied on secondary sources of data, such as examination reports. The researcher did not have access to primary sources of data such as past examination answer scripts. Having access to these answer scripts would have helped in determining the relationship between mathematization and student performance per question.

5.5 Conclusions

This study identified twenty themes for IEB and sixteen themes for NSC. It also uncovered eleven contextual subjects for IEB, against eight for NSC. Generally, in terms of significance, theme frequency, and contextual subjects, it was established that IEB examinations had more mathematics contextual word-problems than NSC examinations.

This implies that, in addition to being exposed to a greater quantity of mathematics contextual word-problems, IEB students are also exposed to a wider variety of contextual word-problems, based on themes and contextual subjects. On the contrary, NSC examinations have more contextual word-problems per theme and per contextual subject, as compared to IEB. This means that NSC students are exposed to more questions per theme and per contextual subject than their IEB peers.

The study reveals that there is a variation in marks allocated to contextual word problems from one year to another, from one question paper to another, from one examination body to another, from one theme to another and from one contextual subject to another. As indicated in section 4, the range of IEB marks is greater than that of NSC marks. With regard to total marks per year and per question paper, IEB has both the highest mark and the lowest mark. The average mark per year and per question paper for IEB is greater than that of NSC.

There is need to reduce this variation because, as noted in Section 4.3, this variation might have an implication on the variation of contextual word problems in mathematics teaching, learning and internal assessment. Mathematics Paper 1 has more contextual word problems as compared to Mathematics Paper 2, for IEB examinations. The best way to encourage educators to teach Paper 2 in context and students to learn Paper 2 in context might be to allocate more marks to Paper 2 contextual word-problems.

Most but not all topics are used as contextual subjects. It will be desirable for all topics to be used as contextual subjects. Since linear programming is no longer in the CAPS syllabus, there is need to find contextual subjects that can replace linear programming. The vacuum left by linear programming should not be left empty but be completed

While an instruction explicitly reminds IEB students to put their calculators in degree mode, NSC students do not have any. NSC contextual word-problems are predominantly presented in black and white, while IEB's are highlighted in bright colours, in addition to black and white. Adding an instruction reminding NSC students to put their calculators in degree mode and illustrating NSC diagrams in other bright colours seems a good idea.

As stated in section 1.1, the 2010 NCS examinations were written by 8 285 IEB students and 537 543 NSC students; this gives a total of 545 828 students. IEB students represent 1.5% of the total of students, while NSC students account for the remaining 98.5%. Clearly, the percentage of IEB students is too small to make any significant impact in national and international tests, such as SACMEQ. As a result, the success of the South African education system depends on that of the public schooling system.

In addition to specifying the number of exercises and tests per term, it might be important to stipulate the nature and quality of the contextual word-problems to be included in these tests. More clarity on the use of context might help in improving the quantity and quality of contextual word-problems to which students are exposed.

Context has advantages as well as disadvantages. It is the responsibility of both the examiners and the educators to highlight these advantages or disadvantages through their actions. If used properly, context can do more good than harm. Conversely, if used inappropriately, context can do more harm than good. Both a proactive anticipation of the limitations of any context and the adoption of measures aimed at addressing those limitations in advance constitute one way of minimizing the disadvantages of context and maximizing its advantages. Sometimes, far from being a problem, students' failure to solve contextual word-problems might be an indicator of a problem.

For curriculum change to occur, an adjustment in intended curriculum should be followed by a change in the implemented curriculum and, by implication, the attained curriculum. A change in the implemented curriculum implies an amendment of textbook content and classroom activities. There is also a need to provide exemplars before the first examination of any new curriculum. For a change in the implemented curriculum to take place, classroom activities and textbook content need to be adjusted. In short, a curriculum change is largely dependent on the activities of educators, examiners, students, and textbook writers.

The need for standardized marking for large groups of students is the major reason why current mathematics examination papers, at least in England, require mainly short, precise answers from students, which may make valid assessment of contextual word-problems difficult (Jones & Ingris, 2015). High-stakes external examinations stimulate examination driven teaching. Be that as it may, high-stakes external examinations papers that are more closely aligned to the stated intentions of curricula to promote problem solving, creativity and sustained mathematical reasoning might positively influence teaching practice (Jones & Ingris, 2015).

An appropriate use of context might help in increasing the efficiency of the education system. Similarly, the allocation of more resources might give the education system the capacity to improve the mathematics pass rate; but, more efficiency is necessary for the creation of a positive relationship between inputs allocated to education and the mathematics pass rates, the matric pass rate, and the university throughput rate. Although it might be good or bad, context is never irrelevant to mathematics questions. It needs to be emphasized that an examination is the steering wheel of any curriculum, as well as its ultimate motivation.

5.6 Recommendations

As noted in section 2.7, the use of context has advantages as well as disadvantages. Most of the disadvantages emanate from human error which can be minimized by providing clear guidelines on how to set contextual word-problems and by adequately moderating them. Human error needs to be anticipated and addressed in order to minimize the disadvantages of contextual word-problems.

As also indicated in section 2.7, there is a need to set contextual word-problems that are universal so that they do not exclude any students, especially given that they are from diverse cultural backgrounds. In classroom situations, the educator needs to identify students who are excluded by a given context and remedy the situation. On their part, examiners need to avoid contexts that are alienating to some students. For example, the theme of a dishwasher might be alienating to some students in the rural areas who have never seen or heard about a dishwasher. They might confuse a dishwasher with dishwashing liquid.

As also, noted in section 2. 7, the context needs to be familiar to the students, but not too familiar that it becomes an emotive issue. Themes such as rape and child abuse need to be handled carefully, or avoided. This is because they might be too emotional for some students who have experienced them. An appropriate choice of words might help in making the questions less emotive.

Moreover, as also suggested in section 2.7, contexts can add layers of complexity that need to be both anticipated and addressed. Therefore, educators need to prepare students for contextual word-problems that add layers of complexity. On their part, students need to anticipate these questions and sufficiently prepare for them. As for examiners, they need to ensure that the layers of complexity are appropriate for the level of the students. Mark and time allocation also need to take into account the layers of complexity of the contextual word-problems.

Furthermore, as indicated in section 2.7, a change in assessment- implemented curriculum can have positive results without a change in intended curriculum. On the other hand, a change in intended curriculum without a change in implemented curriculum does not have any positive results. As also indicated in section 2.7, when briefed to put marking out of mind, GCSE examiners produced an examination paper that contained more open-ended, less structured questions as compared to the current GCSE mathematics examination papers (Jones & Ingris, 2015). This implies that a change in the education system can be initiated by introducing an alternative form of assessment.

In section 2.4, it was indicated that many mathematicians interested in education narrow mathematization to the vertical component, whereas many educationists turning to mathematics constrict mathematization to the horizontal component (Freudental, 1991). Hence, one way of ensuring a balance between horizontal mathematization and vertical mathematization is to balance the representation of employees who are mathematicians interested in education and those who are educationists turning to mathematics in the curriculum planning and implementation processes.

It was also noted, in section 2.4, that both horizontal mathematization and vertical mathematization have to occur to enable the development of basic mathematics concepts. As a result, there is a need to balance horizontal mathematization and vertical mathematization.

Moreover, diagram sheets need to be carefully constructed. Some diagram sheets aid students, while other diagram sheets are barriers to students' understanding of contextual word-problems, as noted in section 2.1. Mistakes on diagram sheets can result in confusion, whereas a well-constructed diagram sheet can help students. Diagram sheets need to be carefully constructed so that they do not have too little or too much information. An effective moderation of question papers will enable the spotting and rectification of these mistakes before the question paper is printed and given to students. This, in turn, will minimize mistakes on diagram sheets.

Furthermore, as indicated in section 2.2 and 2.3 the AMESA report for the 2009 National Senior Certificate examinations recommended that the examiners take the duration of the examination into consideration when setting contextual word-problems. As also noted in section 2.7, Little also recommends the consideration of the overall length of the questions in relation to the time allowed to answer them (Little, 2010). The researcher also reiterates the need to consider the length of the examination when formulating contextual word-problems that require sufficient time to be read, understood, and solved.

In addition, as stressed in section 1.2, section 2.2, section 2.3 and section 2.7, the language used in formulating contextual word-problems needs to take into account first-additional-language speakers. As also noted in section 1.2, students who have English as home language may have been able to understand the language used in the 2009, NSC, Paper 2; however, some questions – particularly 2.3, 2.4, 5.7, and 11.1 – might have been difficult to the rest of the students, because of the use of some unfamiliar words such as trend and bearing (AMESA Report, 2009).

Therefore, there is a need for examiners to anticipate the disadvantage of unfamiliar words to first-additional-language speakers; alternatively, examiners must try to use familiar words. Nevertheless, educators need to address the unfamiliar words that are likely to be used in mathematics contextual word-problems that students will be exposed to.

Moreover, as noted in section 2.2 and 2.3, collaboration between educators and researchers needs to be developed. Researchers have made some recommendations and suggestions. Some of these are addressed to educators. The latter need to know about these recommendations and suggestions so as to implement them, where necessary. Educators can also suggest areas to be explored by researchers.

The researcher also recommends the sampling of contextual subjects from all topics, in order to minimise the predictability of topics which are examined in context. This will promote the teaching of all topics in context. This study revealed that NSC has 8 contextual subjects, whereas IEB has 11. Moreover, the researcher suggests that educators include more themes in mathematics teaching and assessment.

As noted in section 5.5, NSC past examination question papers has bright cover pages, whereas contextual word-problems are predominantly presented in black and white. Conversely, IEB past examination question papers have black and white cover pages, but the contextual word-problems are presented in both bright colours and black and white. Bright colours are more likely to appeal to students as compared to black and white colours. Thus, the researcher recommends an increased use of colours other than black and white for both IEB and NSC examination question papers.

In addition, the researcher recommends the inclusion of an instruction reminding NSC students to put their calculators in degree mode for Mathematics Paper 2. Their peers writing IEB examinations were reminded to put their calculators in degree mode for 2010 P2, 2011 P2, and 2013 P2. Students tend to get nervous when writing examinations. As a result, they might forget such fundamentals as ensuring that their calculators are in degree mode. Thus, including an instruction reminding them to ensure that their calculators are in degree mode might be a good, proactive action.

As noted in section 4, there is a significant variation in the total marks allocated to contextual questions, from one year to another, from one question paper to another, from one theme to another, and from one contextual subject to another. For both NSC and IEB examinations, the researcher recommends a reduction in the variation of the total marks allocated to contextual word-problems, from one year to another, from one question paper to another, from one contextual subject to another, and from one theme to another.

Moreover, for any new curriculum, the researcher recommends the provision of exemplar question papers which should be true reflections of the actual question papers. In addition, question papers provided in textbooks need to be a true reflection of the actual question papers. If a new curriculum emphasizes the link of classroom activities to reality; then, this should be reflected by having more contextual word-problems in textbooks, exemplars as well as the final examination.

Furthermore, for any change in intended curriculum to be effective, there is a need to plan on how to change the implemented curriculum. Classroom activities, textbook content, and examination questions are the major indicators of the responsiveness of the implemented curriculum to a change in the intended curriculum. Any curriculum change needs to focus on how to revolutionize classroom activities, textbook content, and examination questions to suit the new curriculum. This implies a need to workshop educators, textbook writers, examiners, and publishers.

As also noted in section 2.7, after every change in emphasis in the intended curriculum, there is a need to workshop textbook writers about the implications of a change in intended curriculum emphasis on textbook content- implemented curriculum. Most textbooks are written by authors who are not practicing educators. It would be more convenient for the National Department of Education to hire experienced and practicing mathematics educators to write textbooks that may sufficiently address the curriculum needs. This might reduce the number of mathematics educators seeking greener pastures or retiring early.

The researcher also recommends that, where possible, the intended curriculum be more specific about how context should be included in mathematics teaching, learning and assessment. The specification can be in terms of themes, contextual subjects, and weight. Finally, the researcher recommends collaboration between IEB examiners and NSC examiners, as well as collaboration between IEB educators and NSC educators, to enable an exchange of ideas and a transfer of skills.

5.7 Recommendations for further possible studies

1. The focus of the study was on the state of contextual word problems in the IEB and NSC examinations. It would therefore be of interest to determine whether there is any relationship between teaching more in context and how students perform in contextual word-problems.

2. A study can also be undertaken to investigate why fewer marks have been allocated contextual word problems over the years. Also, it would be of interest to

determine whether the reduction of marks has not compromised the aims of teaching and learning mathematics as spelt out in the curriculum documents.

3. It might also be worthwhile to determine the educators’ beliefs and ability to teach and examine contextual word-problems.

Reference

Adler, J. (2001). *Teaching mathematics in multilingual classrooms.* Dordrecht: Kluwer.

Altum-Akbaba, S. (2006). Complexity of integrating computer technologies into education in Turkey, Educational Technology and Society, 9 (1), 176-187.

AMESA (2013). AMESA report on the 2013 Mathematics & Mathematical Literacy Examination Papers. (Downloaded from www.amesa.org.za on 2014/07/31).

Anderson, L. W. (2005). Objectives, Evaluation and the Improvements of Education. *Studies in Educational Evaluation,* 31:102-113.

Anstrom, K. (1998). *Preparing Secondary Education Teachers at Work with English Language Learners: English Language Arts*. Washington, DC.

Centre for the Study of Language and Education of the George Washington University. Arnon, and Reichel, N. (2009) Closed and Open Ended Question Tools in a Telephone Survey about “The Good Teacher”: an Example of a Mixed Method Study. *Journal of Mixed Methods Research,* 3 (2), 172-196.

Baranes, R., Perry, M., & STIEGLER, J.W. (1989). Activation of real-world knowledge in the solution of word problems. *Cognition and Instruction*, 6, 287-318.

Bates, E. T. and Wiest, L. R. (2004). Impact of Personalization of Mathematics Word Problems on Student Performance. *The Mathematics Educator*, 14(2), 17-26.

Bell, B (2003). Mother-tongue maintenance, math and science achievement: A contribution towards the formulation of multilingual language-in-education policies for South African Schools. http://und.ac.za/und/ling/archieve/bell-ol.htm.

Bishop, A.J., Clements, M.A., Keitel, C., Kilpatrick and Leung, F.K.S. (2003). *Second International Handbook of Mathematics Education*. Dordrecht: Kluwer.

Bloch, G. (2009). *The Toxic Mix: What's wrong with South Africa's schools and how to fix it?* Cape Town, South Africa: Tefelberg.

Boaler, J. (1993). The role of contexts in the mathematics classroom: Do you make mathematics more "real"? *For the learning of Mathematics*, 13(2), 12-17.

Boaler, J. (1999). Participation, knowledge and beliefs: A community perspective on mathematics learning. *Educational Studies in Mathematics*, 40 (3), 259-281.

Brand South Africa. (2012). MediaClubSouthAfrica.com. *Education in South Africa.* Retrieved from www.mediaclubsouthafrica.com/indeca&catid=34:developmentbg.

Brodie, K., Lelliot, A., and Davis, H. (2002a). Forms and substance in learner-centred teaching: Teacher's take-up from an in-service programmed in South Africa. *Teaching and Teacher Education*, 18: 541-559.

Brown, B., & Schafer, M. (2006). Teacher Education for Mathematical Literacy: A modelling approach. Pythagoras, No 64. December 2006.

Christiansen, I.M. (1997). When negotiation of meaning is also negotiation of task. *Educational studies in Mathematics, 34(10), 1-25.*

Clarke, D.J.and Helme, S. (1998). Context as construction. In O. Björkqvist (Ed.). *Mathematics teaching from constructivist point of view (pp 129-147)*. Vasa, Finland: Abo Akademi University, Faculty of Education.

Claussen-May, T. (2005). *Teaching Maths to pupils with different learning styles*. London: Paul Chapman Publishing.

Coopper. B (1992). 'Testing National Curriculum Mathematics: some critical comments on the treatment of "real" contexts for mathematics,' *in the Curriculum Journal* 3 (3): 231-43.

Cooper, B. & Dunne, M. (2000). *Assessing children's mathematical knowledge, social class, sex and problem solving.* Buckingham: Open University Press.

Creswell, J.W. & Plano Clark, V. (2007). *Designing and Conducting Mixed Methods Research.* Thousand Oaks, CA: Sage.

Creswell. J. W. (2008). *Educational Research. Planning, Conducting and Evaluation Quantitative and Qualitative Research*. USA: Pearson Education.

Deely, J. (1990). *The Basics of Semiotics*. Bloomington: Indiana University Press.

Dengate, B., & Lerman, S. (1995). Learning theory in mathematics education: Using the wide-angle lens and not just the microscope. *Mathematics Education Research Journal, 7*(1), 26–36.

Department of Education. 2006. Monitoring Evaluation Report on the Impact and Outcomes of the Education System on South Africa's Population: Evidence from Household Surveys. Pretoria: Department of Education.

Department of Education. (2008). *Education for All (EFA)-Country report South Africa*. Pretoria: Department of Education.

Department of Education. (2008). *Ministerial Report on Learner Retention in the South African Schooling System*. Pretoria: Department of Education.

Dhlamini, J. & Mogari, D. (2012). Using a context-based problem solving instruction to promote social justice in high school mathematics classrooms. (In) S. Nieuwoudt, Laubsher, D & H. Dreyer (eds). *Proceedings of the 18th National Congress of Association for Mathematics Education of South Africa*. Volume 1, pp. 108 - 119. Northwest University, Potchefstroom, South Africa.

Dossey, J.A, Mullis, L.V, Lindquist, M. Mand, Chambers, D. (1998). *Mathematics: Are we measuring up.* Washington, DE: Office of Education Research and Improvement (ERIC Reproduction Service No ED 300207).

Durkin, K. & Shire, B. (1991). *Language in Mathematics Education: Research and Practice.* Milton Keynes: Open University Press.

Dyer, C. (March 1999). Researching the implementation of educational policy. A backwards mapping approach*. Comparative Education*, 33, (1)

Earp, N.W. & Tanner, F.W. (1980) Mathematics and Language. *Arithmetic Teacher*, 28, 32-34.

Emerging Voices. (2005). *A report on education in South African rural communities*. Place of publication? Research for the Nelson Mandela Foundation by the Human Research Council, with the Education Policy Consortium.

Fischer-Hoch, H. and Hughes, S. (1996). *What makes mathematics exam questions difficult? Research and Evaluation.* , Hills Road, Cambridge CBI 2EU: University of Cambridge local examinations syndicate.

Fiske, E.B. & Ladd, H.F. (2005). *Elusive equity: education reform in post-apartheid South Africa.* Cape Town: HSRC Press.

Fitzpatrick, R. & Morrison, E.J (1971). Performance and product evaluation. In R, I. Thorndikie (Ed), *Educational measurement* (2^{nd} ed., pp. 237-270). Washington, DC: American Council of Education.

Fitzpatrick, R. & Morrison, E.J. (1997). Performance and product evaluation. In R.L. Thorndike (Ed.). *Educational measurement* (2^{nd} ed.). (pp. 237-270). Washington, DC: American council on Education.

Freudenthal, H. (1973). *Mathematics as an Educational Task*. Dordrecht: Reidel.

Freudenthal, H. (1991). *Revisiting mathematics education*. Dordrecht: Kluwer.

Freudenthal, H. (1993). *Didactical phenomenology of mathematics structures*. Dordrecht: Reidel.

Gay, L.R., Mills, G.E., and Airsian, P. (2006). *Educational Research. Competencies for Analysis and Applications.* New Jersey, USA: Pearson.

Gerdes, P. (1998). On culture, mathematics and curriculum development. Seminar Paper presented at "Mathematics and Culture" Bergen, Norway. In Mogari, D. (2010). Gender differences in the learners' learning of properties of a rectangle, African Journal of Mathematics, Science and Technology Education, 14:3, 92-109.

Glasser, B.G., & Strauss, A.L (1967). The discovery of grounded theory: Strategies for qualitative research. New York: Aldine.

Godino, J.D & Batanero, C (2003). *Semiotic functions in teaching and learning mathematics*. In, Anderson, A. Saenz- Ludlow, S. Zellweger and V.V Cifarelli (Eds), *Educational Perspectives on Mathematics as Semiosis: From Thinking to Interpreting to Knowing* (pp149-146). Ottawa: LEGAS.

Gorard, S. & Taylor, C. (2004). *Combining Methods in Education and Social Research*. Maidenhead: Open University Press. Gravemeijer, K.P.E. (1994). *Developing Realistic Mathematics Education.* Utrecht: Cdß.

Gravemeijer, K. P. E (1994). *Developing realistic mathematics education*. Utrecht. CdB Press.

Gravemeijer, K. P. E & Terwel, J. (2000). Hans Freudenthal, a mathematician on didactics and curriculum theory. *Journal of Curriculum Studies*, 32, 777-796.

Gravett, S. & Gillian, G. (2011, 14 January). Private good; public not so bad. *Mail Guardian* [online]. . retrieved from http://www.Mg.co.za/article/2011-01-14-private-good-public-not-so-bad.

Gutstein, E. (2006c). "The real world as we have seen it." Latino/parents' voices on teaching mathematics for social justice. *Mathematical Thinking and Learning,* 8: 331-358.

Hart, S. (1960). *Beyond special needs: Enhancing children's learning through innovative thinking*. London: Paul Chapman.

Hart, J.M (1996). "The Effect of Personalized Word Problem". *Teaching Children Mathematics*, Vol. 2, No.8, 504-505. NCTM Virtual Academy www.nctm.org.

Hart, L.C (1996). The Decatur Elementary Math Project. *In E. Jabuwoski (Ed.), Proceedings of the 18th annual meeting of the North American Chapter of the Psychology of Mathematics Education* (pp, 491-496). Panama City, FL.: University of Florida.

Howie, S.J. (2003). Language and other background factors affecting secondary pupils' performance in South Africa. *African Journal of Research in Mathematics Science and Technology Education*, 7:1-20.

Johnson, B. & Christensen, L. (2004). *Educational Research. Third Edition. Quantitative, Qualitative and Mixed Approaches*. Boston& New York: Pearson.

Johnson, B. Christensen, L. (2011). *Educational research: Quantitative, Qualitative, and Mixed Approaches.* (4th ed.). USA: SAGE Publications.

Jones, I. & Ingris, M. (2015). *The problem of assessing problem: can comparative judgment help?* Published online: 29 May 2015. Springer Science + Business Media Dordrecht 2015.

Kaphesi, E. (2001). *Effect of home language on pupils' performance in mathematics: A focus of IEQ/Malawi project*. Retrieved from www.ieq/pdf/Effect-Home-Language-Mathematics [pdf].

Karolia, S. (2011). IEB matric results improve by 1% in 2010. *Mail&Gurdian* [online]. Retrieved month day, year?, from http://www Mg.co.za/article/2011-01-04-ieb-mathematics.

Khumalo, L. T. N. (2010). *A context-based problem solving approach in grade 8 Natural Science teaching and learning*. Med thesis. School of Science, Mathematics, and Technology Education, Faculty of Education University of Kwazulu-Natal.

Kuchemann, D. (Ed.). (1March 2007). *Proceeds of the British Society for Research into learning Mathematics*, 27.

Leibbrandt, M., Wegner, E., and Finn, A. (2011). "*The Policies for reducing Income Inequality and Poverty in South Africa," SALDRU Working papers* 64, South Africa Labour and Development Research Unit, University of Cape Town.

Little, C. (2008a). *The functions and effects of real world contextual framing in A/AS mathematics questions: developing an evaluative framework.* Proceedings of the British Society for Research in learning mathematics 28(3), 72-77.

Little, C. (2010) (in press). *The use of Real-World Contextual Framing in UK University Entrance, Level Mathematics examinations, PhD Thesis.* University of Southampton.

Mail and Guardian (online), Sameerah Karolia. (04 January 2011). IEB matric results improve by 1% in 2010.

McCarthy, J., & Bernstein, A. (10 October 2010). The schooling system is still squandering the math and science potential of many thousands of pupils. Sunday Times. Retrieved from www.mathsexcellence.co.za/papers/%20Scince%20potenyial[pdf].

McLester, S., & McIntire, T. (2006). The workforce readiness crisis: We're not turning out employable graduates nor maintaining our positions as a global competitor-why? *Technology and learning,* 27, 22-28. In Jones, I. & Ingris, M. (2015). *The problem of assessing problem: can comparative judgment help?* Published online: 29 May 2015. Springer Science + Business Media Dordrecht 2015.

MEI. (2012). *Integrating mathematical problem solving: Applying Mathematics and Statistics across the curriculum at level 3. End of report.* London: Mathematics in education and industry. In Jones, I. & Ingris, M. (2015). *The problem of assessing problem: can comparative judgment help?* Published online: 29 May 2015. Springer Science + Business Media Dordrecht 2015.

Meyer, M., Dekker, T., and Querelle, N. (2001). Contexts in Mathematics Curriculum. *Mathematics Teaching in the Middle School, 6*(9), 522–527.

Mogari, D. (2007): The effect of teaching properties of a rectangle in a socio-cultural context on grade 9 pupils' achievement. *Journal of Educational Studies* 6(2), 215 – 225.

Mogari, D. (2010): Gender differences in the pupils' learning of properties of a rectangle. *The African Journal of Research in Mathematics, Science and Technology Education* 14(3), 95 - 112.

Mohala T (28 May 2010). *More time for learning and teaching. Mail & Guardian [online].* Retrieved from www.mg.co.za/article/2010-05-20-more time for learning-and-teaching.

Motala, S. (2006). *Educational Transformation in South Africa: The Impact of Finance Equity Reforms in Public Schooling after 1998.* PhD Thesis. University of Witwatersrand, Johannesburg.

National Treasury, Republic of South Africa (2009). *Provincial Budget and Expenditure Review 2005/06-2011/12*. Pretoria: National Treasury.

Nesher, P. (1980). *The stereotyped nature of school word problems, for the learning of Mathematics*, 1. 41-48.

Newby, P. (2010). *Research Methods for Education*. London, England: Pearson.

Noyes, A., Wake, G., Drake, P., & Murphy, R. (2011). *Evaluating Mathematics pathways final report. DfE Research Report* 143. London: Department for Education. In Jones, I. & Ingris, M. (2015). *The problem of assessing problem: can comparative judgment help?* Published online: 29 May 2015. Springer Science + Business Media Dordrecht 2015.

Nyabanyanda, T., Shimizu, Y. & Heuvel-Panhuizen, M. (2004). Task Study Group 27. *Research and development in assessment and testing in mathematics education.*

OECD. (2008). *Reviews on National Policies for Education*. South Africa: OECD.

Onabanjo, C.F (2004). *A survey of some Behavioural and Attitudinal Factors Affecting Senior Secondary School Female Students' Mathematical Ability and Achievement*. A PhD Research Post-Field, Report, University of Ibadan.

Palm, T. (2002). The realism of mathematics school tasks: features and consequences. [Doctorial thesis]. Department of Mathematics. University of Umea.

Perreira, C & Du Toit, R (2010). *Access to learning-Mathematics performance in schools in Gauteng and Eastern Cape*. Create South Africa Policy Brief (2010).

Phoshoko, MM (2013). Teachers' views on the use of contexts in transition to mathematics. [Unpublished Doctoral thesis]. University of South Africa.

Pimm, David (1995), *Symbols and Meanings in School Mathematics*. London. Routledge.

Pirie, S and Kieren, T. (1994). Growth in mathematical understanding: How can we characterize it and how can we represent it? *Educational studies in Mathematics,* 26: 61-86.

Presmeg, N. (2008). Semiotic theoretical frameworks: Creativity and imaginative rationality in mathematics education. Retrieved 2014/11/18 from www.unige.ch/maths/EnsMath?Rome2008/......

Punch, K.L. (2009). *Introduction to Research Methods in Education*. London: SAGE Publisher.

Radford, L. (2007). *Ecole des Sciences de le" éducation.* Laurentian University, Sadbury, ON P3E, 2C6, Canada. Email: lradiford@laurentian.ca.

Resnick, L.B. (1987). Learning in school and out. *Educational Researcher,* 16: 13-20.

Saenz-Ludlow, A., & Presmeg, N. (2006. Semiotic perspectives in mathematics education- A PME Special Issue. *Educational Studies in Mathematics*, 61, Whole No. 1-2.

Saenz-Ludlow, A. & Presmeg, N. (2008). Semiotic perspective on learning mathematics and communicating mathematically. *Educational Studies in Mathematics*, 61: 1 – 10.

Sapa. (2011-02-15). *More now have access to education: Nzimande*. Retrieved from http:// www.m.news24.com/fin24/education-Nzimande-20110215.

Sasman, M. (2011). *Insights from NSC Mathematics examinations.* 17th Annual AMESA National Congress, 11 July 2011, Johannesburg, Gauteng. Volume 1.

Saville-Troike, M. (1991). Teaching and testing for academic achievement: the role of language development. http://www.ncela.gwu.edu/pubs/focus/focuss.htm.

Schoenfeld, A.H. (1991). On mathematics as sense making: An informal attack on the unfortunate divorce of formal and informal mathematics, In J.F. Voss, D. N. Perkins, and J.W. Segal (Eds.), *Informal reasoning and education*. Hillsdale, NJ: Erlbaum.

Sickens, C. (2010). *T0068e math and science performance of South Africa's public schools.* The Centre for Development and Enterprise.

Snoek, M., & Wielenga, D. K(2001). Teacher Education in the Netherlands; Change of Gear. Contribution to the UNESCO-CEPES project *"Institutional Approaches to Teacher Education [Within higher education] in the Europe Region: Current Models and New Developments*.

South African Government Information [online]. *Chapter 2- Bill of rights.* Retrieved from http://www.infor.gov. za/documents/constitution.

Sosu, E., McWilliams, A., & Gray, D. (2008). ` The Complexities of Teachers' Commitment to Environmental Education. *Journal of Mixed Methods Research,* 2 (2), 169-189.

Spaull, N. (2011). *a Preliminary Analysis of SACMEQ 111 South Africa*. Stellenbosch: WORKING PAPERS 11/11.

Stillman, G. (1998). Engagement with task context of application tasks: Student performance and teacher beliefs. *Nordic Studies in Mathematics Education*, 6 (3-4), 51-70.

Sullivan, P., Zevenbergen, R., & Mousley, J. (2003). The Contexts of Mathematics Tasks and the Context of the Classroom: Are We Including all Students? Mathematics Education Research Journal. Vol 15. No 2. 107-121.

Tashakkori & Cresswell, J.W A: Developing publishable mixed methods research. J. Mix. Methods. Res. (2007b). 10.1177/1558689806298644.

Taylor, N. (1989). "Let them eat cake"- Desire, cognition and culture in mathematics learning. In C. Keitel, P. Damerow, A. Bishop and P. Gerdes(Eds.), *Mathematics, education and society* (pp.161-163). Paris: Division of Science Technical and Environmental Education, UNESCO.

Taylor, N., Fleischer, B., & Shinder, J. (2008). Changes in Education since 1994. *Fifteen Year Review.* Pretoria: Office of the Presidency.

Third International Mathematics and Science Study- Repeat (TIMSS-R): What has changed in South African pupils' performance in Mathematics from 1995-1998. In

Howie, S.J. (2003). Language and other background factors affecting secondary pupils' performance in South Africa. *African Journal of Research in Mathematics Science and Technology Education*, 7:1-20.

Treffers, A. (1987). *Three dimensions. A model of goal and theory description in mathematics education: The Wiskobas project.* Dordrecht: Kluwer Academic Publishers.

Umalusi. *Investigation into the senior certificate examination*. Summary report on the evaluation of the senior certificate examination (August 2004).

Usher, M. Jodo Gyan, India. 2012. *Mathematization – horizontal and vertical.* Episteme 5.

Van der Berg, S. (2007). Apartheid's enduring legacy: Inequalities in education. *Journal of African Economies* (pp 1-32). University of Stellenbosch, South Africa.

Van der Berg, S (2008). How effective are poor schools: poverty and educational outcomes in South Africa. *Studies in Educational Evaluation*, 34(3): 145-154.

van den Heuvel-Panhuizen, M. (2001). R*ealistic Mathematics Education as work in progress.* In. Lin, F.L.(Ed).*Common Sense in Mathematics Education*. 1-43. Available at www.staff.science.uu.nl/~heuve108/download/vdHeuvel_2001_RME%20as%20work-in-progress.pdf

Van den Heuvel-Panhuizen, M. (2003). The didactical use of models in realistic mathematics education: An example from a longitudinal trajectory on percentage. Educational studies in Mathematics, 54, 9-35. http://dx.doi.org/10.1023/B:EDU.000005212.03219.dc

Van de Walle. J. A. (2004). *Elementary and middle school mathematics: teaching developmentally*. USA. Pearson Education.

Van de Walle, J. A., Karp, K.,S.,& Bay-Williams, J,. M. (2010). *Elementary and Middle School Mathematics* (7th ed). Boston: Allyn & Bacon. Van de Walle. J. A., Karp. K. S., and Bay-Williams. J. M. (2011). *Elementary and middle school mathematics: teaching developmentally*. USA: Pearson Education.

Van de Walle, J. A., Karp. K. S., & Bay-Williams. J. M. (2013). *Elementary and middle school mathematics: teaching developmentally*. USA: Pearson Education.

Van de Walle, J., Karp, K., Lovin, L. & Bey-Williams, J. (2013). Teaching Student Centred Mathematics: Developmentally Appropriate Instruction for Grades (3-5) (Volume 11). Pearson.

Vanska, R. and Roberts, V. (2011). *Mathematics education in South Africa via cell phones and the web*. Issue 58-E learning.

Verschaffel, L., Greer, B., Van Dooren, W. & Mukhopadhyay, S. (2009). *Words and Worlds. Verbal Descriptions of Situations*. Sense Publishers. Rotterdam.

Weiner, B. (1980). The order of affects in rational (attribution) approaches to human motivation*. Educational Research*, 19: 4-11.

Wryer, S.R. (2010). *APOS Theory as a Conceptualization for Understanding Mathematical Learning.* Department of Mathematics and Computer Science. Ripon College.

Appendix.

Tables (3.1.1 – 3.1.24) - Analysis of the mathematization of real-life situations

Table 3.1.1: Schedule for analyzing the mathematization of real-life situations – IEB November 2008 P1

Question number.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism, specificity).	Task presentation.	Solutions strategies.	Circumstances.	Solution requirements.	Purpose in figurative context.
2008 IEB November P1. 3a1.	2. Level 2.	Buying a new car.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Depreciation is 12, 5% per year.	Reducing balance depreciation.	Value of car after 3 years.
2008	5	Buyin	Fin	Can	Ca	Exist,	Word	Av	Valu	Redu	Length

IEB November P1. 3a2.	Level 3.	g a new car.	ancial mathematics.	take place.	n be asked.	realistic and specific.	s and numbers.	ailable.	e of the car is R100 000.	cing balance depreciation.	of time to the nearest year.
2008 IEB November P1. 3b.	4 Level 3.	Buying a new car.	Financial mathematics.	Can take place.	Can be asked.	Exist, specific and realistic.	Words and numbers.	Available.	Depreciate to half its original value in 6 years.	Reducing balance.	Calculate depreciation rate.
2008 IEB November P1. 3c.	7 Level 2.	Bank loan to cover university costs.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	14, 75% p.a interest compounded monthly.	12 equal monthly instalments starting one month	Calculate monthly payment.

										after receiving loan.	
2008 IEB November P1. 6a.	4 Level 3.	Vitamins A, B1 and B2.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	8x+2y ≥ 16. x + y ≥5 2x+7y ≥ 20. x>0 y>0	Shade the feasible region.	Draw the constraints.
2008 IEB November P1. 6b.	1 Level 3.	Vitamins A B1 and B2.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	Represent the cost of the daily requirement of vitamin.	State.	Objective function.
2008 IEB Nove	4 Level	Vitamins A, B1an	Linear pro	Can take plac	Can be	Exist, realistic	Words, table,	Available	Minimize	Within the feasi	Determine minimu

mber P1. 6c.	3.	d B2.	gramming.	e.	asked.	and specific.	numbers and inequalities.	e.	the daily cost.	ble region.	m cost using x and y.
2008 IEB November P1. 6d.	3 Level 3.	Vitamins A, B1 and B2.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	Brand Q decreased price to 40c per tablet.	Determine the new minimum.	Calculate the new minimum.
2008 IEB November P1. 6e1.	1 Level 1.	Vitamins A, B1 and B2.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	Vitamin B1 requirement is 6 units.	Change vitamin B1 requirement to 6 units.	Rewrite the constraints.
2008 IEB November P1. 6e2.	1 Level 3.	Vitamins A, B1 and B2.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and	Available.	Draw the constraint	Label the drawn graph “New	Draw the constraint.

			ng.				inequalities.		on the graph used in a.	vitamin B1”.	
2008 IEB November P1. 6e3.	2 Level 3.	Vitamins A, B1 and B2.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	Use the objective function in b.	Use the new vitamin B1 graph.	Determine the new optimal solution.
2008 IEB November P1. 8a1.	2 Level 3.	Bloukrans river bridge.	Quadratic equations.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	$y = \frac{-x^2}{240} + 210$.	Substitute x = 0 to solve for y.	Show that the road is 216m above the bottom of the bridge.
2008 IEB November P1. 8a2.	4 Level 3.	Bloukrans river bridge.	Quadratic equations.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities	Available.	The concrete arc has a spa	Substitute x = 136 m to solve for y.	Determine the height of the longest pillars between the

							.		n of 272 m.		bridge and Type equa the arc.
2008 IEB November P1. 8b.	5 Level 3.	Bloukrans river bridge.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	At full stretch, the bungee rope is 160 m long.	Find S_∞.	Calculate the total distance covered by a jumper before they are hoisted back to the platform.
2008 IEB November P1. 9a1.	5 Level 3.	BMA tunnel and bridge.	Cubic functions.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	$\gamma=2x^3-17x^2+35x$ $0\le x\le 5$	Giving answers to the nearest meter.	Determine the length of the tunnel.
2008 IEB November P1. 9a2.	1 Level 3.	BMA tunnel and bridge.	Cubic function.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and	Available.	$\gamma=2x^3-17x^2+35x$ $0\le x$	Giving answers to the neare	Determine the length of the bridge.

							inequalities.		≤5	st meter.	
2008 IEB November P1. 9b.	7 Level 3.	BBMA tunnel and bridge.	Cubic function.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	γ =2 x^3- $17x^2$ +35 x 0≤x ≤5	Above the tunnel.	Calculate the height of the top of the mountain.
2008 IEB November P1. 9c.	3 Level 3.	BMA tunnel and bridge.	Cubic function.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, numbers and inequalities.	Available.	γ = x^3 - $17x^2$ +35 x 0≤x ≤5	*Solve for x by equating* $\frac{dy}{dx}$ *to 0*	Calculate the deepest drop from the bridge to the valley below.
Total.	61										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.2: Schedule for analyzing the mathematization of real life situations- IEB 2009 Paper 1

Question number.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Circumstances.	Solution requirements.	Purpose in figurative context.
2009 IEB November P1. 3a.	7 Level 1.	Head of a new missile.	Parabola and straight line.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, equation and diagram.	Available.	Triangular shaft coated with another material forming a parabola.	Write down the domain of h.	Determine the straight line and parabolic equations.
2009 IEB November P1. 4a1.	5 Level 3.	House loan.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and diagrams.	Available.	Interest 15, 5% per annum compound	Fully repay the loan over 20	Determine monthly payment.

									ed monthly.	years.	
2009 IEB November Paper 1. 4a2.	2. Level 1.	House loan.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and diagrams.	Available.	Interest 15,5% compounded monthly.	Fully repay the loan over 20 years.	Determine total amount of interest she will pay.
2009 IEB November P1. 4b1.	4 Level 3.	Investment.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Interest 5,8% compounded monthly.	Give the answer to the nearest year.	How long it will take for the investment to be worth R500 000.
2009 IEB November P1. 4b2	2 Level 3.	Investment.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Interest 5,8% compounded monthly.	Correct to one decimal digit.	Determine the effective interest rate.
2009	2	Inves	Fina	Ca	Ca	Exist,	Word	Av	Intere	Nu	Compar

IEB November P1. 4b3.	Level 3.	tment.	ncial mathematics.	n take place.	n be asked.	realistic and specific.	s, equation and numbers.	ailable.	st = 5, 8% compounded monthly.	mber of years = 72 ÷ r.	e rule of 72 with b1 answer.
2009 IEB November P1. 4c.	5 Level 2.	Cost price and marked price.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and percentages.	Available.	Adds 25% to cost price give customers a discount and make a profit of 5%.	As a % of marked price.	Determine discount.
2009 IEB November P1. 6b1	1 Level 3.	Toy manufacturer (cars and boats)	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words diagrams and equations.	Available.	$P = c_{1x} + c_2y$.	In terms of c_2.	Write down profit at point K.

2009 IEB November P1. 6b2.	1 Level 3.	Toy manufacturer (cars and boats).	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams and equations.	Available.	$P=c_1x+c_2y$.	Identify the point in the feasible region.	Maximize profit.
2009 IEB November P1. 6b3.	3 Level 3.	Toy manufacturer (cars and boats).	Linear programming.	Can take place.	Can be asked.	Exist, specific and realistic.	Words, diagrams and equations.	Available.	$P=c_3x+c_2y$.	Profit on each car increasing to c_3.	Maximize profit.
2009 IEB November P1. 7a1.	3 Level 1.	Swimming and running.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams and numbers.	Available.	Arithmetic sequence with a= 100 and d=50.	In terms of n.	Determine the distance that Alex swims.
2009IEB November	3 Level 1.	Swimming and runni	Number patt	Can take	Can be as	Exist, realistic and	Words, diagrams,	Available.	Geometric sequ	In terms of n.	Determine the distance that

P1. 7a2		ng.	erns.	place.	ked.	specific.	numbers and percentages.		ence with r=3, 5.		Alex runs.
2009 IEB November P1. 7b.	5 Level 3.	Swimming and running.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages, numbers and diagrams.	Available.	Arithmetic sequence for swimming and geometric sequence for running.	On the set of axis provided.	Plot points for each type of exercise.
2009 IEB November P1. 7c.	1 Level 3.	Swimming and running.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and diagrams.	Available.	Arithmetic sequence for swimming and geometric sequence	Use your graphs.	Compare swimming distance and running distance.

									for running.		
2009 IEB November P1. 8b1.	2. Level 1.	Stack of cars.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams and numbers.	Available.	Arithmetic sequence with a =30 and d=1.	Pattern continues.	Determine T_n.
2009 IEB November P1 8b2	4 Level 3.	Stack of cars.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams and numbers.	Available.	Arithmetic sequence with a=30 and d=1.	Pattern continues.	Determine maximum number of canc.
2009. IEB. November Paper 1. 10a.	5 Level 3.	Company profit.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	$P(x) = 50\sqrt{x} - 0,5x - 500$.	Maximize.	Calculate the number of units that need to be produced.
Total	55										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.3: Schedule for analyzing the mathematization of real life situations - IEB November 2010 P1

Question number.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information.	Take presentation.	Solution strategies.	Circumstances.	Solution requirements.	Purpose in figurative context.
2010 IEB November P1. 3a.	4 Level 3.	HIV survey results.	Exponential functions.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers, diagrams and equations.	Available.	$A=P(1+i)^n$.	As a percentage.	Annual rate of increase.
2010 IEB November P1. 3b.	5 Level 2.	Exchange rate.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and b specific.	Words, numbers and diagrams.	Available.	R10, 285 to one Euro and R10, 516 to one Euro.	Change accommodation price and exchange rate.	Percentage increase for accommodation.
2010	4	Inve	Fina	Can	Can	Exis	Wor	Av	I = 8,	After	Calcu

IEB November P1. 3c1.	Level 2.	stment.	ncial mathematics.	take place.	be asked.	t, specific and realistic.	ds and numbers.	ailable.	5% p.a compounded monthly.	30 years.	late final amount.
2010 IEB November P1. 3c2	5 Level 2.	Investment.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available,	I = 8,5% p.a compounded monthly.	To the nearest whole number.	Calculate the number of years.
2010 IEB November P1. 8a.	6 Level 1.	Selling South African flags.	Linear programming.	Can take place.	Can be asked.	Exist, specific and realistic.	Words, diagrams and inequalities.	Available.	Y = mx + c.	Involving boundary lines for the feasible region.	Determine three constraints.
2010 IEB November P1. 8b.	1 Level 3.	Selling South African flag	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, inequalities and diag	Available.	All the constraints.	Comply with all the constraints	Maximize.

		s.					rams.			.	
2010 IEB November P1. 8c.	5 Level 2.	Selling South African flags.	Linear programming.	Can take place.	Can be asked.	Exist, specific and realistic.	Words, equations, inequalities and diagrams.	Available.	Corner points of the feasible region.	P= 8x+4y.	Determine the maximum profit.
2010 IEB November P1. 8d.	6 Level 2.	Selling South African flags.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, equations, inequalities and diagrams.	Available.	Reduction in search line gradient from -2 to -1.	Determine 3 pairs in coordinate form.	Maximize profit.
2010 IEB November P1. 10a.	7 Level 3.	Roller coaster.	Parabola and straight line.	Can take place.	Words and equations.	Exist, realistic and specific.	Words and equations.	Available.	$F(x)=1/2450(x-50)(x-100)^{2}$. $40\leq x$	In coordinate form.	Determine the highest point.

									≤90.		
2010 IEB November P1. 10b.	6 Level 2.	Roller coaster.	Parabola and straight line.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers, equations and diagrams.	Available.	$Y= ax^2 + bx$. $Y=m_1x+c$. $Y=m_2 x=c$	$M_1=2$. $M_2=3$. At point R on the parabola, x=20.	Determine values of a and b.
2010 IEB November P1. 11a.	5 Level 2.	Speed.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	She drove to the stadium at 165km m^{-1} and drove from the stadium at 110km m^{-1}	It is not 137,5 km.h^{-1} Maybe 'Is it not 137,5km.h^{-1} could have been more appropriate.	Calculate average speed for the whole trip.
Total	54										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.4: Schedule for analyzing the mathematization of real life situations - IEB 2011 November P1

Question number.	Marks and level.	Theme.	Contextual subject.	Event.	Information.	Question.	Task presentation.	Solution requirements.	Circumstances.	Solution requirements.	Factors in figurative context.
2011 IEB November P1. 5a.	4 Level 2	Buying a new computer.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific	Words, numbers and diagrams.	Available.	Depreciation from R12 000 to R7 500 over three years.	Reducing balance depreciation.	Calculate rate of depreciation per year.
2011 IEB November P1.	4 Level 2.	Buying a new computer.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific	Words, percentages and numbers.	Available.	I=10% p, a compounded monthly.	R110 400 loan to be paid over 60	Calculate the value of his monthly

5b.						.				months.	payment.
2011 IEB November P1. 5c1.	1 Level 2.	Buying a car as a present.	Financial mathematics.	Can take place.	Can be asked.	Exist, specific and realistic.	Words, percentages and numbers.	Available.	Buy a car costing R120 000 at her 21^{st} birthday.	8% deposit.	Determine deposed amount.
2011 IEB November P1. 5c2.	2 Level 1	Buying a car as a present. .	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers, percentages and diagrams.	Available.	Interest changing from 8, 5% p.a compounded monthly to 12% p.a compounded quarterly.	Invest birthday money in a savings account.	Use a time line to summarize given information.
2011 IEB November	5 Level 3.	Buying a car as a present.	Financial mathematics.	Can take plac	Can be asked.	Exist, realistic and spe	Words, numbers, percentage	Available.	8, 5% p.a compounded monthly	Withdrew R1 200 towards a	Determine whether Ayanda

P1. 5c3.				e.		cific.	s and diagrams.		interest changing to 12% p.a compounded quarterly.	holiday.	was able to supply the deposed.
2011 IEB November p1. 7b.	7 Level 3.	Buying a car as a present.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, equations and diagrams.	Available.	$Y = x^2/10 + 3$. $Y = 2x/15 + 7/2$	Give your answer to the nearest centimetre.	Difference in height above the road of two points A and B.
Total	23.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.5: Schedule for analyzing the mathematization of real life situations - IEB 2012 P1

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information.	Task presentation.	Solution strategies.	Circumstances.	Solution requirements.	Purpose in figurative context.
2012 IEB P1. November 5a.	4 Level 2	Valuation of a car.	Financial mathematics.	Can take place.	Can be asked.	Exist. Realistic and specific.	Words, numbers and percentages.	Available.	R130 000 valued cars depreciates at 15% per annum reducing balance.	Round of your answer to the nearest thousands rands.	Determine the value of the car 5 years ago.
2012 IEB P1. November 5b.	6 Level 2.	Saving.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and percentages.	Available.	R300 monthly deposit for 10 years.	Interest of 8, 5% compounded monthly.	Calculate the amount of money after

											20 years.
2012 IEB P1. November 5c.	4 Level 2.	Saving.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and percentages.	Available.	R130 000 final amount after 10 years.	Interest 8, 5% compounded monthly.	Calculate the amount of money to be saved every month.
2012 IEB P1. November 5d.	2 Level 3.	Saving.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages and numbers.	Available.	Emily paid R36 0 00 in total.	Interest is 8, 5& per annum compounded monthly.	Calculate how much Yerma paid in total.
2012	2	Heig	Nu	Can	Can	Exist,	Word	Avai	The	Give	Calc

IEB P1. November. 7a1	Level 2.	ht of a building.	mber pattern.	take place.	be asked.	realistic and specific.	s, picture and numbers.	lable.	button has been clicked eight times.	your answer to the nearest meter.	ulate the height of the building.
2012 IEB P1 November. 7a2.	4 Level 3.	Height of a building.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture and numbers.	Available.	First term is 50mm and common ratio is 1, 2.	The height of the building should be more than 400mm.	Determine the least number of times the button must be clicked.
2012 IEB P1. November. 9	6 Level 2.	Basketball player practicing	Parabola.	Can take place.	Can be asked.	Exist, realist and specific.	Words, diagram and numbers.	Available.	Each throw follows the path of a parabola.	Find the horizontal distance between	Determine how far Tashmira is

		shooting.								Tashmira, s hand and the rim.	from the rim.
Total.	28										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.6: Schedule for analyzing the mathematization of real life situations - IEB 2013, Paper 1

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information.	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements.	Purpose in figurative context.
2013. IEB P1. Novemb	2 Level 2.	Number of me	Number patter	Can take pla	Can be aske	Exist, realistic and	Numbers and wor	Available.	Geometric sequence, a=1, r=2.	Find term 12.	Calculate the number of member

er. 2b1.		members of a social networking site.	ns.	ce.	d	specific.	ds.				s that were on day 12.
2013. IEB P1. November. 2b2.	4 Level 2.	Number of members of a social networking site.	Number patterns.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers and words.	Available.	The site earns half a cent per member per day.	Give your answer to the nearest rand.	Calculate the amount of money earned in the first 12 days.
2013. IEB P1. Nov	3 Level	Running.	Number pat	Can take	Can be as	Exist, realistic	Numbers and	Available.	Arithmetic sequence with	$T_n=a+(n-1)d$	Calculate the distance that

ember. 2c1.	2.		terns.	place.	ked	and specific.	words.		a=1000m and d=750m.		Gina will run on the 9th Sunday.
2013. IEB P1. November. 2c2.	2 Level 2.	Running.	Number patterns.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers and words.	Available.	Arithmetic sequence with a=1000m and d=750m. After reaching 10km, the distance will remain constant.	Find n.	Determine on which Sunday Gina will first run 10km.
2013. IEB P1. November. 2c3.	4 Level 2.	Running.	Number patterns.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers and words.	Available.	N=24.	Find the sum.	Calculate the total distance that Gina will run over the first 24 Sundays.
2013. IEB	2 Le	Investi	Finan	Can	Can	Exist,	Numbe	Availabl	Joe invested	Use inter	Calculate the

P1. November. 4a1..	vel 2.	ng.	cial mathematics.	take place.	be asked	realistic and specific.	rs, words and percentages.	e.	R50 000 in a bank.	est rate of 6% per annum compounded annually.	amount at the end of 15 years
2013. IEB P1. November. 4a2	1 Level 3.	Investing.	Financial mathematics.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers, words and percentages.	Available.	Joe invested R50 000 in a bank.	Total value minus investment.	Determine the financial gain.
2013. IEB P1. November. 4b1.	4 Level 2.	House loan.	Financial mathematics.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers, words and percentages.	Available.	Joe .R850 000 loan for 30 years.	Interest of 8% per annum compounded monthly.	Show that her monthly instalment was R6 237

2013. IEB P1. November. 4b2.	3 Level 3.	House loan.	Financial mathematics.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers, words and percentages.	Available.	Joe .R850 000 loan for 30 years.	Interest of 8% per annum compounded monthly.	Calculate the outstanding balance on end of the first year.
2013. IEB P1. November. 4b3.	3 Level 3.	House loan.	Financial mathematics.	Can take place.	Can be asked	Exist, realistic and specific.	Numbers, words and percentages.	Available.	Joe .R850 000 loan for 30 years.	R74 844 was paid during the first year.	Calculate the amount paid towards the interest.
2013. IEB P1. November. 5a.	7 Level 3.	Hotel accommodation bookings.	Linear programming.	Can take place.	Can be asked	Exist, realistic and specific.	Words and inequalities.	Available.	$x \geq 1$ $y \geq 2$ $x+y \geq 5$ $X+3y \leq 18$.	Clearly indicate the feasible region.	Draw the constraints.
2013. IEB	1 Le	Hotel	Linear	Can	Can	Exist,	Words	Availabl	$x \geq 1$ $y \geq 2$	Use the	Write down

P1. November. 5b.	vel 3.	accommodation bookings.	programming.	take place.	be asked	realistic and specific.	and inequalities.	e.	$x+y \geq 5$ $X+3y \leq 18$.	feasible region.	the minimum values of x and y.
2013. IEB P1. November. 5c.	3 Level 2.	Hotel accommodation bookings.	Linear programming.	Can take place.	Can be asked	Exist, realistic and specific.	Words and inequalities.	Available.	$x \geq 1$ $y \geq 2$ $x+y \geq 5$ $X+3y \leq 18$.	Profit of R500 for each type of room.	Calculate their maximum possible profit.
2013. IEB P1. November. 5d.	4 Level 3.	Hotel accommodation bookings.	Linear programming.	Can take place.	Can be asked	Exist, realistic and specific.	Words and inequalities.	Available.	$x \geq 1$ $y \geq 2$ $x+y \geq 5$ $X+3y \leq 18$.	$P= 200x +600y$.	Maximize the profit.
Total.	43										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.7: Schedule for analyzing the mathematization of real life situations - IEB 2008 Paper 2

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Circumstances.	Solution requirements.	Purpose in figurative context.
2008 IEB P2 November. 3h.	3. Level 2.	Streetlight.	Trigonometry-heights and distan	Can take place.	Can be posed in real life.	Exist, real and specific.	Words, numbers, angles and diagrams.	Available.	PQ= 5m. RP= 2m. PRQ =101,2^0.	Correct to the nearest tenth of a m.	Find PQ.

			ces.								
2008 IEB P2 November. 4. a.1.	4. Level 3.	Examination marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and cumulative frequency curve.	Available.	Use frequency curve.	In answer booklet.	Complete the frequency table.
2008 IEB P2 November. 4. a.2.	1. Level 3.	Examination marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and cumulative frequency curve.	Available.	Use the cumulative frequency curve.	40% students failed.	Find pass mark.
2008 IEB P2 November. 4.	4 Level 3.	Sizes of apples.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and table.	Available.	Use finding of the investigation of	On a grid inside the answer bookl	Draw a scatter diagram.

b.1.									size of apples in 2kg bags.	et.	
2008 IEB P2 November. 4. b.2.	1 Level 3.	Sizes of apples.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and table.	Available.	Information from the table and scatter diagram.	Choose 1 between linear, quadratic and exponential.	State the type of relationship.
2008 IEB P2 November. 5.a.	6 Level 3.	Heights of basketball player.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, heights and picture.	Available.	Heights of team A are given. For team B Mean =199.	Showing all working by using a given table.	Calculate standard deviation.

									$\sum h2 =]475$ $\sum h = 2\ 38$		
2008 IEB P2 November. 5.b.	4 Level 3.	Heights of basketball player.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and variance formula.	Available.	Use the variance formula.	Correct to one decimal place.	Find standard deviation.
2008 IEB P2 November. 5.c.	1 Level 3.	Heights of basketball player.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and letters.	Available.	Based on answers obtained in 5a and 5b.	In the differed teams.	Make a valid comment about the dispersion of heights.
2008	2 Lev	SAPS	Co -	Can	Can	Exist, realistic	Words,	Available.	Y is a	By	Calc

IEB P2 November. 6.b.1.	el 3.	Emblem.	ordinate Geometry.	take place.	be asked.	and specific.	letters, photographs and diagrams.		point on the y axis.	inspection.	ulate size of AOY.
2008 IEB P2 November. 6.b.2.	3 Level 3.	SAPS Emblem.	Co-ordinate Geometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams, photograph and letters.	Available.	A(-3,Y)	To one decimal place.	Show that y=7.2
2008 IEB P2 November. 6.b.3	4 Level 3.	SAPS Emblem.	Co-ordinate Geometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, letters, photographs and diagrams.	Available.	Point A and B lies on the emblem.	Correct to one decimal place.	Calculate the co-ordinates of B.
2008 IEB P2 November. 7.	5 Level 2.	Sphere shaped buildin	Surface area and vol	Can take place.	Can be asked.	Exist, realistic and specific.	Words, pictures, letters, diagrams	Available.	P, Q, A and B are in the sam	ATO=90°.	Show that $r \approx 26,25$

c.1.		gs.	ume.				and angles.		e horizontal plane.		
2008 IEB P2 November. 7. c.2.	2 Level 3.	Sphere shaped buildings.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, letters, diagrams and angles.	Available.	Surface area = 4∏r^2.	Sphere radius=26,25m.	Calculate the surfaces area S.
2008 IEB P2 November. 7. c.3.¡	3 Level 1.	Sphere shaped buildings.	Surface area and volume,	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams, pictures, angles and letters.	Available.	S=2∏rh. V=∏r2h-∏h3/3.	H=18m.	Show that V = 2/3 ∏r3 +18 ∏r2-1944∏
2008 IEB P2 November. 7.c.3 ¡¡	4 Level 3.	Sphere shaped buildings.	Surface area and volum	Can take place.	Can be asked.	Exist, realistic and specific.	Words, letters, pictures, angles and	Available.	H=18m R=26,25m	In m^2.	Calculate the amount of stee

			e.				diagrams.				l require to build the surface of the building.
2008 IEB P2 November. 8.a.1.	3 Level 3.	Audilogo.	Circle geometry.	Can take place.	Can be asked.	Exist, realistic and specific.		Available.	$x^2-12x+y^2=64$ and $(x-20)^2+y^2=r^2$.	Find the radius.	Find the value of r.
2008 IEB P2 November. 8.a.2.	2 Level 3.	Audilogo.	Circle geometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, letters and diagram.	Available.	A, B, C, D, E, F, G and H lie on the same horiz	Find the co-ordinates of the centre and	Write down the equation of the circl

									ontal line.	the length of the radius.	e with diameter AC.
2008. IEB. P2. N0vember. 8a3.	2. Level 3.	Audilogo.	Circle geometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, letters and diagram.	Available.	BC= DE= FG.	Use of the equations of the circles.	Determine the length of BC.
Total.	54										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.8: Schedule for analyzing the mathematization of real life situations - IEB 2009 Paper 2

Question paper.	Marks and	Theme .	Contextual subject.	Event.	Question.	Information (existenc	Task presentation.	Solution strategies.	Factors in social	Solution requirements.	Purpose in figurative context

	level.					e, realism and specificity).			context.		.
2009 IEB P2 November. 3.a.2.	4 Level 2.	Vertical lift bridge.	Trigonometry – heights and distances.	Can take place.	Can be asked.	Exist, real and specific.	Word, diagrams letters and angles.	Available.	AE=BK=25m. AEK=BKE=75^0	Give your answer correct to two decimal digits.	Determine the length of AB.
2009 IEB P2 November. 3.b.1.¡	4 Level 2.	Airbus A380.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, diagram, letters and numbers.	Available.	DE=79,8m. DR=ER=43,4m.	Round to one decimal digit.	Size of angle DRE.
2009 IEB P2 November.	3 Level 3.	Airbus A380.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, diagram, letter	Available.	DE=79,8m. DR=ER=43.4m.	Round off to 1 decimal digit.	Area of ∆DRE.

3. b.1.ii							s and numbers.				
2009 IEB P2 November. 3. b.2.i	2 Level 3.	Airbus A380 in a hanger.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Word, diagrams, letters and numbers.	Available.	$S=2\prod rh$	Round off to two decimal digits.	Determine the surface area of the dome.
2009 IEB P2 November. 3. b.2.ii	2 Level 3.	Airbus A380 in a hanger.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams, letters and numbers.	Available.	Total cost $\approx$ $R160$	Round off to two decimal digits.	Determine cost per square kilometre.
2009 IEB P2 November. 4.a.1	1 Level 3.	Age of South Africa national team squad mem	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture and cumulative frequency curve.	Available.	Use the cumulative frequency curve.	Read the y-value corresponding to the x-value of 39.	Number of players.

		bers.									
2009 IEB P2 November. 4.a.2	1 Level 3.	Age of South African national team squad members.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture and cumulative frequency curve.	Available.	Use the cumulative frequency curve.	Read the y-value corresponding to the x-value of 30.	Number of players below or equal to 30.
2009 IEB P2 November. 4.a.3	1 Level 3.	Age of South Africa National football squad members.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and cumulative frequency curve.	Available.	Use the cumulative frequency curve.	Subtract the x-value corresponding to 27 from the x-value corresponding to 30.	Estimate how many players are older than 27 but not older than 30.
2009 IEB P2 Nov	1 Level 3.	Age of South Africa	Statistics.	Can take pl	Can be asked.	Exist, realistic and	Words, picture and cumu	Available.	Use the cumulative	Subtract the x-value correspondin	Estimate how many players are

ember. 4.a.4		n National football squad members.		ace.		specific.	lative frequency graph.		frequency curve.	g to the y-value of 30 from the y-value corresponding to the x-value of 39.	older than 30.
2009 IEB P2 November. 4.b	4 Level 3.	Stadia for Fifa world cup and their capacities.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, table, Fifa 2010 world cup logo picture and box and whisker diagram.	Available.	The names of the stadiums and their capacities are given in the table.	Find the lower quartile, median, upper quartile and highest value.	Determine the values of b, c, d and e.
200	1	Wall	Trigo	Ca	Can	Exist	Word	Avai	Rea	Find	How

9 IEB P2 November. 7.b.1	Level 3.	clock.	nometry-sine graph.	n take place.	be asked.	, realistic and specific.	s, clock diagram and trigonometric graph.	lable.	d the h and the angle from the trigonometric graph.	the hypotenuse of the right-angled triangle.	long in centimetres is the minute hand.
2009 IEB P2 November. 7.b.2	1 Level 3.	Wall clock.	Trigonometry-sine graph.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, clock diagram and trigonometric graph.	Available.	Use the given trigonometric graph.	Write down h in terms of $\boldsymbol{\theta}$.	Write down the equation of the trigonometric graph.
2009 IEB P2 November. 7.	2 Level 3.	Wall clock.	Trigonometry-sine graph.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, clock diagram, and trigonometr	Available.	Use the clock to find the value of	Find the y-value corresponding to 72 ° degree	Determine the value of h when the time is exactly

b.3.							ic graph.		x and then use the trigonometric graph to find the value of y.	s in the x-axis.	12 minutes past the hour.
2009 IEB P2 November. 7.c.1	4 Level 2.	Tree opposite a river.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram, lengths, angles.	Available.	RT= 12m RTE = 46° ERT = 39°	Rounded to one decimal digit.	Determine the height of the tree.
2009 IEB P2 November. 7.c,2	3 Level 3.	Tree opposite a river.	Trigonometry-solving triangle.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, angles, lengths and diagram.	Available.	Assume that R, E and T are points on	Rounded to one decimal digit.	Determine the width of the river.

									the banks of a river and that the width is constant.		
2009 IEB P2 November. 8.a.1	1 Level 3.	Mathematics and life sciences marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter plot.	Available.	Use the scatter plot.	Count the number of dots.	How many students are in this group?
2009 IEB P2 November. 8. a.2.i.	1 Level 3.	Mathematics and life sciences marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter plot.	Available.	Scatter plot on mathematics marks	State whether it is true or false.	In general, the higher the mark for life sciences the higher

									and life sciences marks.		the mark for mathematics.
2009 IEB P2 November. 8.a.2.ii	1 Level 3.	Mathematics and life sciences marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter plot.	Available.	Scatter plot on mathematics marks and life sciences marks.	State whether it is true or false.	The student that got the lowest mark for mathematics also got the second lowest mark for life sciences.
2009 IEB P2 November. 8.a.2iii	1 Level 3.	Mathematics and life sciences marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter diagram.	Available.	Scatter plot on mathematics mar	State whether it is true or false.	The median mark for mathematics is lower than the

									ks and life sciences marks.		median mark for life sciences.
2009 IEB P2 November. 8.a. 2¡v	1 Level 3.	Mathematics and life sciences marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter diagram.	Available.	Scatter plot on mathematics marks and life sciences and marks.	State whether it is true or false.	The range for the mathematics mark is lower than the range for the life sciences mark.
2009 IEB P2 November.	1 Level 2.	Data for a statistics test.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, standard deviation of 8	Available.	The teacher decided to incr	For the new set of marks.	Write down the mean.

8.b.1							and mean of 72.		ease marks by adding 5 to each person's mark.		
2009 IEB P2 November. 8.b.2	1 Level 3.	Data for statistics test.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, standard deviation of 8 and mean of 72.	Available.	The teacher decided to increase marks by adding 5 to each person's	For the new set of marks.	Write down the standard deviation..

									mark.		
2009 IEB P2 November. 10	8 Level 2.	Soccer ball.	Trigonometry-rotation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and picture of a ball.	Available.	Use the rotation formula.	Rounded to one decimal place.	Determine the coordinate of G^1.
Total	49										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.9: Schedule for analyzing the mathematization of real life situations - IEB 2010 Paper 2

Question in paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements.	Purpose in figurative context.
2010 IEB P2 Nov	7 level 3	Obstacle course	Statistics.	Can take place.	Can be asked.	Exist, specific and realis	Words, frequency table,	Available.	Obstacle course time.	Use a cumulative	Represent data.

ember. 3.a		completed by 30 children.				tic.	diagram and numbers.			frequency curve.	
2010 IEB P2 November. 3.b.1	1 Level 3.	Obstacle course completed by 30 children.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, frequency table, numbers and diagram.	Available.	Cumulative frequency curve.	Show on the cumulative frequency curve using letter A.	Number of children who took less than 135s.
2010 IEB P2 November. 3.b.2	1 Level 3.	Obstacle course completed by	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagrams, frequency table and numb	Available.	Cumulative frequency curve.	Show on the cumulative frequen	Value of t if 60% of the children took less than t s

		30 chil dren.					ers.			cy curv e usin g lette r B.	
201 0 IEB P2 Nov emb er. 3.b. 3	1 Le vel 3.	Obs tacl e cour se com plet ed by 30 chil dren.	Stati stics.	Can take plac e.	Can be ask ed.	Exist, realis tic and specif ic.	Word s, numb ers, frequ ency table and diagr am.	Avai labl e.	Cumul ative freque ncy curve.	Sho w on the cum ulati ve freq uen cy curv e usin g lette r C.	The 75th pe rcentile.
201 0 IEB P2 Nov emb er. 5.a. 1	1 Le vel 3.	Lea ning Tow er of Pisa.	Trig ono metr y- heig hts and dist anc es.	Can take plac e.	Can be ask ed.	Exist, realis tic and specif ic.	Word s, pictur e, diagr am, letter s, lengt hs	Avai labl e.	Sum of angles in a straigh t line and triangl e.	Use wor ds.	Explai n why DAC= $10,8^0$.

							and angles.				
2010 IEB P2 November. 5.a.2	3 Level 3.	Leaning Tower of Pisa.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, diagram, letters, lengths and angles.	Available.	Sine rule.	Give your answer correct to 2 decimal places.	Determine the straight line distance AD.
2010 IEB P2 November. 5.a.3	3 Level 3.	Leaning Tower of Pisa.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, diagram, letters, lengths and angles.	Available.	AB is not vertical.	Correct to 2 decimal places.	Determine the length of tower AB.
2010 IEB P2	4 Level 3.	Leaning Tower of	Trigonometry-	Can take place.	Can be asked.	Exist, realistic and	Words, picture,	Available.	H is a point vertically	In degrees.	Calculate ABH.

November. 5.a.4		Pisa.	heights and distances.			specific.	diagram, length, letters and angles.		above B.		
2010 IEB P2 November. 5.b.1	1 Level 3.	Play house for children.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, specific and realistic.	Word, shapes and lengths.	Available.	Regular pentagon.	Show that QRS=108^0.	Solve for QRS.
2010 IEB P2 November. 5.b.2	2 Level 3.	Play house for children.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, shapes and lengths.	Available.	Regular pentagon with side=3m.	Correct to 2 decimal places.	Determine the area of QRS.
2010 IEB P2 Nov	2 Level 3.	Play house for chil	Trigonometry-heig	Can take place.	Can be asked.	Exist, realistic and specif	Words, shapes and	Available.	Area of ΔPSQ =6,92 m$^{2.}$	Correct to 1 cubic	Find the volume of the prism.

ember. 5.b.3		dren.	hts and distances.			ic.	lengths.			meter.	
2010 IEB P2 November. 7.a.1	3 Level 3.	Body mass index.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, box and whisker diagram and equation.	Available.	Normal body mass index between 20,1kg/m^2 kg/m^2 and 25	Show all necessary calculations.	Determine whether Portia"s mass index is normal.
2010 IEB P2 November. 7.a.2	3 Level 3.	Body mass index.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, box and whisker diagram and equations.	Available.	Dino is the shortest student and has normal mass index.	Show all necessary calculations.	Determine Dion's maximum weight.
2010 IEB P2 November	3 Level 3.	Earth's orbit around the	Trigonometry-heights	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and equat	Available.	D=149,6(1-0.0167 cosα).	In millions of kilometr	Determine the distance from Q to

er. 9.b.1		sun.	and distances.				ions.			es.	the sun.
2010 IEB P2 November. 9.b.2	4 Level 3.	Earth's orbit around the sun.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and equations.	Available.	D=150 million km.	In degrees.	Determine ∝.
2010 IEB P2 November. 10.a	2 Level 2.	Monkey and duck.	Trigonometry-rotation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and coordinate.	Available.	PQ is the diameter of the circle centre origin.	Anticlockwise rotation	Write down the coordinates of Q.
2010 IEB P2 November. 10.b	6 Level 3.	Monkey and duck.	Trigonometry-rotation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and coordinate.	Available.	Duck rotes 25^0 per second whilst duck rotate 85^0 per second	Anticlockwise rotation.	Determine the coordinates of point where P and Q will meet.

									.		
Total.	47.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.10: Schedule for analyzing the mathematization of real life situations - IEB 2011 Paper 2

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism specificity).	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements.	Purpose in figurative context.
2011 IEB P2 November. 2.a.1	2 Level 3.	Outline of Africa.	Translation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, outline of Africa, letters and coordinates.	Available.	Transformation in the y-axis.	Write it in the form (x,y) →…	Identify the transformation from A to B.

2011 IEB P2 November. 2.a.2	2 Level 3.	Outline of Africa.	Translation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, outline of Africa, letters and coordinates.	Available.	90^0 anticlockwise rotation.	Write it in the form (x,y) →…	Identify the transformation from A to C.
2011 IEB P2 November. 2.a.3	2 Level 3.	Outline of Africa.	Translation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, outline of Africa, letters and coordinates.	Available.	180^0 rotation.	Write it in the form (x,y) →…	Identify the transformation from A to C.
2011 IEB P2 November. 2.b.1	1 Level 1.	Outline of South Africa.	Translation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, letters, coordinates and outline of South Africa	Available.	R (-4,4)→ R^1 (-12,12).	K is a scale factor.	Write down the value of k.

							.				
2011 IEB P2 November. 2.b.2	Level 1.	Outline of South Africa.	Translation.	Can take place.	Can be asked	Exist, realistic and specific.	Words, letters, coordinates and outline of South Africa.	Available.	Perimeter of the smaller outline is x units.	Area of image shape is k^2 x area of original shape.	Write down perimeter of the larger outline.
2011 IEB P2 November. 2.b.3	Level 3.	Outline of South Africa.	Translation.	Can take place.	Can be asked.	Exist, realistic and specific. Factor instead of scale factor.	Words, letters, coordinates and outline of South Africa.	Available.	The factor is 3.	The numerator is area of smaller outline and the denominator is area of larger outline.	Write down the value of Area of smaller outline / Area of larger outline.
201	2	Outl	Transl	Ca	Can	Exist	Word	Avai	Further	In	Find T

1 IEB P2 November. 2.b.4	Level 3.	ine of South Africa.	ation.	n take place.	be asked.	, realistic and specific.	s, letters, coordinates and outline of South Africa.	lable.	enlargement by a factor of 2.	coordinate form.	given $T^{11}(-30,6)$.
2011 IEB P2 November. 5.a	7 Level 3.	Weights of 100 chickens.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, frequency polygon, histogram, picture and numbers.	Available.	Weights of 100 chicken shown in a frequency polygon and histogram.	On the grid provided.	Draw a cumulative frequency curve.
2011 IEB P2 November. 5.b.1	1 Level 3.	Weights of 100 chickens.	Statistics.	Can take place.	Can be asked.	Exist realistic and specific.	Words and intervals.	Available.	Intervals [1;1,2) [1;2,1;4) [1;4,1;6) [1;6,1;8)	Interval notation.	Write down lower quartile position.

									[1;8,2)		
2011 IEB P2 November. 5.b.2	1 Level 3.	Weights of 100 chickens.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and intervals.	Available.	Intervals [1;1,2) [1;2,1;4) [1;4,1;6) [1;6,1;8) [1;8,2)	In interval notation.	Write down median position.
2011 IEB P2 November. 5.b.3	1 Level 3.	Weights of 100 chickens.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and intervals.	Available.	Intervals [1,1;2) [1;2,1;4) [1;4,1;6) [1;6,1;8) [1;8,2).	In interval notation.	Find the upper quartile position.
2011 IEB P2 November. 5.b.4	1 Level 3.	Weights of 100 chickens.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and intervals.	Available.	Intervals [1,1;2) [1;2,1;4) [1;4,1;6) [1;6,1;8) [1;8,2)	In interval notation.	Find 90^{th} percentile position.

2011 IEB P2 November. 5.c	2 Level 3.	Weights of 100 chicken s.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and box and whisker diagram.	Available.	The box and whisker plot is not correct.	In words.	Give two reasons why the plot is not correct.
2011 IEB P2 November. 6.a	3 Level 3.	Statistics test marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table for class A marks.	Available.	Use a calculator.	Give your answer to two decimal places.	Determine the mean and the variance from the mean,
2011 IEB P2 November. 6.b.1	1 Level 3.	Statistics test marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Equations for class B marks and words.	Available.	$\sum_{n=1}^{22} xn = 1320.$ $\sum_{n=1}^{22} (xn - 60)2 = 1012$	Use variance and summation of marks.	Find the number of student in class B
2011 IEB P2 November.	1 Level 3.	Statistics test marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	$\sum_{x=1}^{22} xn = 1320$	Use summation of marks and numb	Determine the mean mark for class B.

6.b.2										er of students.	
2011 IEB P2 November. 6.b.3	2 Level 3.	Statistics test marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	From the mean of class B.	Correct to three decimal digits.	Determine the standard deviation.
2011 IEB P2 November. 6.c	2 Level 3.	Statistics test marks.	Statistics.	Can take place.	Can be asked.	Explain which class, A or B in your opinion did better might have been clearer.	Words.	Available.	Compare class A and class B.	Justify your answer.	Explain which class A or B did better.
201	2	Stat	Statist	Ca	Can	Exist	Word	Avai	All	Leave	Find

1 IEB P2 November. 6.d	Level 2.	istics test marks.	ics.	n take place.	be asked.	, available and specific.	s.	lable.	students who obtained a mark of 60 in class A were moved to class B.	your answers correct to two decimal digits.	the new variance for class B.
2011 IEB P2 November. 10.b1	2 Level 3.	Vertical wall.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist realistic and specific.	Words, lengths, letters and diagram.	Available.	QRST is a vertical wall of height h on level ground.. P is a point on the ground in front of the wall. TP=2, 25metres. QP=6 metres	In terms of h.	Express tan β and tan2β

									.		
2011 IEB P2 November. 10.b.2	4 Level 3.	Vertical wall.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	$\frac{\tan 2\beta}{\tan \beta} = \frac{2}{1-\tan 2\beta}$	Use the given equation.	Show that $\tan^2\beta = \frac{1}{4}$
2011 IEB P2 November. 10.b.3	2 Level 3.	Vertical wall.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, lengths, angles and equations.	Available.	$\tan^2 \beta = \frac{1}{4}$	Correct to two decimal places.	Hence determine the value of β
2011 IEB P2 November. 10.b.4	8 Level 3.	Vertical wall.	Trigonometry-heights and distances.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, lengths, angles, equations and diagram.	Available.	SPR=120^0. β=26,6^0.	SR is the length of the wall.	Determine SR.
Total.	51.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.11: Schedule for analyzing the mathematization of real life situations - IEB 2012, Paper 2

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information.	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements.	Purpose in figurative context.
2012. IEB P2. November. 5a1.	3 Level 3.	Number of children per family.	Statistics.	Can take place.	Can be asked	Exist, realistic and specific.	Table, numbers and words.	Available.	Show that the mean is 2,2.	On the diagram sheet provided.	Complete the table provided.
2012. IEB P2. Nov	4 Level 3.	Number of children per	Statistics.	Can take	Can be asked.	Exist, realistic and	Table, numbers	Available.	Find the missing	Follow the proc	Determine the value

ember. 5a2.		family.		place.		specific.	and words.		values in the given table.	ess of finding variance.	of a, b, c and d.
2012. IEB P2. November. 5a3	1 Level 3.	Number of children per family.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	$\sum f($	Give your answer correct to 1 decimal digit.	Find the standard deviation.
2012. IEB P2. November. 5b1	2 Level 3.	Battery lifespan.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and two cumulative frequency curves.	Available.	The graphs indicate the percentage of batteries that die after t minutes of usage.	For each type of battery.	Give the median lifespan.

2012. IEB P2 November 5b2.	1 Level 3.	Battery lifespan.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and two cumulative frequency curves.	Available.	Use the cumulative frequency curves.	Find the range of the two batteries.	Which of the two batteries has a range which is more than 30?
2012 IEB P2. November. 5b3	1 Level 3.	Battery lifespan.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and cumulative frequency curves.	Available.	Use the cumulative frequency curves.	Find the interquartiles for the two types.	Which of the two types has an interquartile range which is less than 10.
2012 IEB P2. November. 5b4.	2 Level 3.	Battery lifespan.	Statistics.	Can be asked.	Can be asked.	Exist, realistic and specific.	Words and cumulative frequency curve	Available.	The photographer uses the above	Rather than type A batteries.	Give two reasons why he would

							s.		information to decide which battery to purchase.		choose type B batteries.
2012 IEB P2 November. 10a1.	3 Level 3.	Learner performance in Mathematics.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages and box and whisker diagrams.	Available.	Use the box and whisker diagram.	Give your answer to the nearest whole number.	Calculate the highest possible end of year mark.
2012 IEB P2. November. 10a2	2 Level 3.	Lerner performance in Mathematics.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages and box and whisker diagrams.		Consider the results in the portfolio.	Explain why?	Determine the greater range.

2012 IEB P2 November. 10a3.	2 Level 3.	Learner performance in Mathematics.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages and box and whisker diagrams.	Available.	Use the box and whisker diagrams.	Explain.	Can one conclude that the lowest final mark for the learner was 20%?
2012 IEB P2 November. 10a4.	5 Level 2.	Learner performance in Mathematics.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentage and box and whisker diagrams.	Available.	A learner retook the examination and got 86%.	Give your answer correct to 1 decimal digit.	Calculate the overall mean mark for the group.
Total.	26										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.12: Schedule for analyzing the mathematization of real life situations - IEB 2013 P2

Ques	M	The	Cont	Ev	Que	Infor	Tas	Solu	Facto	Solutio	Purpos

tion paper.	arks and level.	me.	extual subject.	ent.	stion.	mation.	k presentation.	tion strategies.	rs in social context.	n requirements.	e in figurative context.
2013. IEB P2. November. 1a1.	2 Level 3.	Area and population estimate for each province.	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, map and table.	Available.	The population for the nine provinces is given.	To the nearest whole number.	Determine the mean population size per province.
2013. IEB P2. November. 1a2.	1 Level 3.	Area and population estimate for each province.	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, map and table.	Available.	The total population for all provinces was found in 1a1.	Divide total Gauteng population by total Gauteng area.	On average how many people live per square kilometre in Gauteng.
2013. IEB P2.	1 Level	Area and popu	Statistics,	Can tak	Can be ask	Exist, realistic	Words, ma	Available.	The total popul	Give your answer	Express Gauten

November. 1a3.	3.	lation estimate for each province.		e place.	ed	and specific.	p and table.		ation for all provinces was found in 1a1.	to one decimal digit.	g population as a percentage of the whole country's population.
2013. IEB P2. November. 1b1.	1 Level 3.	Income and population estimate for each province.	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, numbers and table.	Available.	Population of Gauteng is 12 272 263	Use the information in the table.	Estimate the number of people that are unemployed.
2013. IEB P2. November. 1b2.	1 Level 3.	Income and population estimate for	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, numbers and table.	Available.	Use the information in the table.	In Gauteng.	What percentage earn at least R140 000.

		each province.									
2013. IEB P2. November. 1b3i.	2 Level 3.	Income and population estimate for each province.	L	Can take place.	Can be asked	Exist, realistic and specific.	Words, numbers and table.	Available.	Use the information in the table.	The table is a cumulative frequency table.	Complete the table below.
2013. IEB P2. November. 1b3ii.	4 Level 3.	Income and population estimate for each province.	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, numbers and table.	Available.	Use the information in the table.	For people earning less than R140 000.	Draw a cumulative frequency curve.
2013. IEB P2. November	1 Level 3.	Income and populatio	Statistics,	Can take pla	Can be asked	Exist, realistic and speci	Words, numbers	Available.	Use the cumulative frequ	For people earning less than	Read off median annual income

. 1b4i.		n estimate for each province.		ce.		fic.	and table.		ency curve.	R140 000.	.
2013. IEB P2. November. 1b4ii.	1 Level 3.	Income and population estimate for each province.	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, numbers and table.	Available.	Use the cumulative frequency curve.	Including those for people earning at least R140 000.	Read off the mean income.
2013. IEB P2. November. 9b1	2 Level 3.	Race time.	Statistics,	Can take place.	Can be asked	Exist, realistic and specific.	Words, numbers and table.	Available.	Use the box and whisker plot.	Including those for people earning at least R140 000.	Give two reasons why the girls did the best.
2013. IEB P2.	2 Level	Race time.	Statistics,	Can tak	Can be ask	Exist, realistic	Words, nu	Available.	Use the box	Including those	Give two reason

November. 9b2	3.			e place.	ed	and specific.	mbers and table.		and whisker plot.	for people earning at least R140 000.	s why the girls did the best.
Total	18										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.13: Schedule for analyzing the mathematization of real life situations - NSC 2008 P1

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question	Information.	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements.	Purpose in figurative context.
2008 NSC P1 No9vember. 7.2.1	3 Level 2.	Tractor.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	A new tractor costing R80000 is to be replaced after 5	Replacement cost is expected to increase by 8% per	How much will the farmer need to pay?

									years when its trade-in-value is R200 000.	annum.	
2008 NSC P1 November. 7.2.2	6 Level 2.	Tractor.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and percentages.	Available.	A monthly payment of x rands for 60 months with 12%p.a compounded monthly.	Monthly payment starts one month after purchasing the tractor.	Calculate the monthly deposited.
2008 NSC P1 November. 7.2.3	4 Level 2.	Tractor.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and percentages	Available.	Withdrawal of R5 000 every	If he makes 5 such withdrawal	What will the new monthly

							ntages.		12 months after purchasing the tractor.	s.	deposit be?
2008 NSC P1 November. 10.1	2 Level 2.	Drinking glass.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and realistic.	Words, diagram, numbers and equation.	Available.	A drinking glass in the shape of a cylinder must hold 200ml of water when full.	Express h in terms of volume, radius and π.	Show that the height of the glass can be expressed as $h=\frac{200}{\pi r2}$
2008 NSC P1 November. 10.2	2 Level 2.	Drinking glass.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers, diagram and equati	Available.	$h=\frac{200}{\pi r2}$	Use Surface Area = π r + $\pi r^2 h$	Show that the surface area of the glass can

							ons.				be expressed as S(r)= π r^2 + $\frac{400}{r}$
2008 NSC P1 November. 10.3	5 Level 3.	Drinking glass.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers, diagram and equations.	Available.	S(r)= π r^2+ $\frac{400}{r}$.	Equate the differential of S(r) to 0 and solve for r.	Hence determine the value of r for which the total surface area of the glass is a minimum.
2008 NSC P1 November. 11.1	3 Level 1.	Cellular phones.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and realistic.	Words and numbers.	Available.	Let x represent the number of Acuna cell phones	In terms of x and y.	Write down the constraints that represent the given

									and y represent the number of Matata cell phones.		information.
2008 NSC P1 November. 11.2	5 Level 3.	Cellular phones.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Constraints obtained in 11.1.	Graphically.	Represent the constraints.
2008 NSC P1 November. 11.3	1 Level 3.	Cellular phones.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Straight line graphs obtained in 11.3.	By shading it.	Indicate the feasible region.
2008 NSC P1 November. 11.4	1 Level 1.	Cellular phones.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Profit on one Acuna phone is R200 and profit	Write down the profit in terms of x and y.	Write down the expression that will represent the

									on one Matata phone is R250.		profit, P, on the cellular phones.
2008 NSC P1 November. 11.5	3 Level 3.	Cellular phones.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Assume that the cellular phones are sold out.	Using a search line.	Determine the number of Acuna and Matata phone that will give the maximum profit.
2008 NSC P1 November. 11.6	3 Level 3.	Cellular phones.	Linear programming.	Can take.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	P= 180x+240y.	Give a reason for the answer.	Would there be any difference in the optimal

											solution.
Total.	38.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.14: Schedule for analyzing the mathematization of real life situations - NSC 2008 P2

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements.	Purpose in figurative context.
2008 NSC P2 November. 9.1	2 Level 3.	Race.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and number.	Available.	Time taken by 10 runners is given.	Divide the sum time taken by 10.	Calculate the mean time taken

											to complete the race.
2008 NSC P2 November. 9.2	4 Level 3.	Running race.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and number.	Available.	Use the formula on the formula sheet.	Use the mean obtained in 9.1	Calculate the standard deviation of time taken to complete the race.
2008 NSC P2 November. 9.3	2 Level 3.	Running race.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Mean ± one standard deviation.	Count the number of runners within one standard deviation of the	How many runners completed the race within one standard devia

										mean.	tion of the mean.
2008 NSC P2 November. 10.1	3 Level 3.	Sales.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and histogram.	Available.	Histogram showing daily sales.	On diagram sheet 3.	Complete the cumulative frequency table for the sale over November and December.
2008 NSC P2 November. 10.2	3 Level 3.	Sales.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and histogram.	Available.	Use the cumulative frequency table obtained in 10.1.	On diagram sheet 3.	Draw an Ogive for the sales over November and December.

2008 NSC P2 November. 10.3	1 Level 3.	Sales.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and histogram.	Available.	Use your Ogive.	Explain how you obtain your answer.	Determine the median value of daily sales.
2008 NSC P2 November. 10.4	2 Level 3.	Sales.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and histogram.	Available.	Use the histogram.	In interval notation.	Estimate the interval of the upper 25% of the daily sales.
2008 NSC P2 November. 11.1	2 Level 3.	Parachute jumping.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Use the information given in the table.	On diagram sheet 4.	Draw a scatter plot for the above informatio

											n.
2008 NSC P2 November . 11.2	1 Level 3.	Parachute jumping.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Use the scatter plot.	Draw the curve of best fit.	Describe the curve of best fit.
2008 NSC P2 November . 11.3	1 Level 3.	Parachute jumping.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Height above ground and time taken is given in the table.	Use the scatter plot.	Estimate the height of the parachutist 5,5 minutes after he has opened his parachute.
2008 NSC P2 November .	2 Level 3.	Test scores.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and two bow and whisk	Available.	Use the two box and whisker diagrams.	Use the five number summ	Describe the features in the

12.1							er diagrams.			ary for each class.	scores that are the same for both classes.
2008 NSC P2 November. 12.2	2 Level 3.	Test scores.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and two bow and whisker diagrams.	Available.	Use the box and whisker diagram for class B.	Subtract Q_1 from Q_3.	Calculate the interquartile range for class B.
2008 NSC P2 November. 12.3	3 Level 3.	Test scores.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and two box and whisker diagrams.	Available.	Mr Jack says there is no significant difference in the performance of the two classes after consider	Support your answer with reasons.	Is Mr Jack's conclusion valid?

									ing the median of each class.		
Total.	28.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.15: Schedule for analyzing the mathematization of real life situations -NSC 2009 P1

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Circumstances.	Solution requirements	Purpose in the figurative context
2009 NSC P1 November. 2.1	3. Level 2.	Cycling race.	Number pattern.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	To find Tn given a and d.	To find the day.	Find the day of cyclic 100km
2009	3.	Cycli	Numb	Ca	Can	Exist	Word	Avai	To find	Find	Find

NSC P1 November. 2.2	Level 2.	ng race.	er patterns.	n take place.	be asked.	, realistic and specific.	s and numbers.	lable.	Sn given a, d and n.	total distance.	total distance travelled in 14 days.
2009 NSC P1 November. 2.3	2. Level 2.	Cycling race.	Number patterns.	Can take place.	Can be asked.	Exist, realistic and specific.	Words.	Available.	Comment on diminishing returns.	Interpreted the rate of increase.	Apply the law of diminishing returns.
2009 NSC P1 November. 8.1	3 Level 2.	Cellphone purchase.	Financial mathematics,	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	25%p.a depreciation.	Use reducing balance.	Determine the depreciation on value.
2009 NSC P1 November. 8.2.1	6 Level 2.	Bank loan.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Repayment one month after the loan.	Determine the number of payments.	Settle the loan,
2009 NSC	5 Le	Bank	Financial	Can	Can be	Exist,	Words and	Available	Payment less	Calculate	Calculate

P1 November. 8.2.2	vel 3.	loan.	mathematics.	take place.	asked.	realistic and specific.	numbers.	.	than R5 000.	balance after paying the last R5 000.	balance outstanding.
2009 NSC P1 November. 8.2.3	2 Level 3.	Bank loan.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Fixed interest of 17%.	Calculate value of final payment.	Settle the loan.
2009 NSC P1 November. 8.2.4	1 Level 3.	Bank loan.	Financial mathematics.	Can take place.	Can be asked.		Words and numbers.	Available.	18% interest compounded monthly.	Total amount repaid to the bank.	Calculate total amount repaid.
2009 NSC P1 November. 11.1	5 Level 1.	Cutting a card board.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and diagrams.	Available,	$A= lb$ $A= \prod r_2$ $P= 2(l+b)$ $C= 2\prod r$	Calculate area.	Prove the value of A.
2009 NSC P1 Nov	3 Level	Cutting a card boar	Surface area and	Can take	Can be asked.	Exist, realistic,	Word and diagrams.	Available.	$A= lb.$ $A=\prod r_2$ $P=2(l+b)$	Find the dimensions	Maximize area of

ember. 11.2	3.	d.	volume.	place.		specific.			C=2∏r	of the rectangle.	shaded region.
2009 NSC P1 November. 11.3	2 Level 3.	Cutting a card board.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic, specific.	Words and diagrams.	Available.	A=lb A=∏r_2 P=2(l+b) C=2∏r.	Maximize the shaded region.	Calculate the total area of circles.
2009 NSC P1 November. 12.1	6 Level 1.	Planting maize and planting sweet potatoes.	Linear programming.	Can take place.	Can be asked.	Exist, realistic specific. numbers.	Words and numbers.	Available.	7 hectares, R72 000 AND 24 h.	2 h for x and 4 h for y. X costs R12 000 and y costs R6 000.	Write down the constraints.
2009 NSC P1 November. 12.2	3 Level 3.	Planting maize, planting sweet potat	Linear programming.	Can take place.	Can be asked.	Exist, realistic, specific.	Words, numbers and diagram sheet.	Available.	Use attached graph paper.	Represent graphically.	Represent the constraints.

		oes.									
2009 NSC P1 November. 12.3	1 Level 3.	Planting maize, planting sweet potatoes.	Linear programming.	Can take place.	Can be asked.	Exist, realistic, specific.	Words, numbers and diagram sheet.	Available.	Use attached graph paper.	Shade the feasible region.	Indicate the feasible region.
2009 NSC P1 November. 12.4	2 Level 1.	Planting maize, planting sweet potatoes.	Linear programming.	Can take place.	Can be asked.	Exist, realistic, specific.	Words and numbers.	Available.	Use the given profits.	Profit is R30 000 for x and R30 000 for y.	Express profit in terms of x and y.
2009 NSC P1 November. 12.5	2 Level 3.	Planting maize, planting sweet potatoes.	Linear programming.	Can take place.	Can be asked.	Exist, realistic, specific.	Words and numbers.	Available.	Use the given constraints.	Find number of hectares of x and y.	Maximize profit.

2009 NSC P1 November. 12.6	3 Level 2.	Sowing meal time, planting sweet potatoes.	Linear programming.	Can take place.	Can be asked.	Words and numbers.	Words, numbers.	Available.	Same constraints. Same profit for x	Decrease of 2/3 on y profit.	Calculate maximum profit after some changes.
Total.	52.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.16: Schedule for analyzing the mathematization of real life situations - NSC 2009 P2

Question Paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (exist, realistic and specific).	Task presentation	Solution strategies.	Circumstances.	Solution requirements.	Factors in figurative context.
2009 NSC	5. Le	Vertical	Trigonomet	Can	Can be	Exist,	Words,	Available	Use the	Use the	Determine

P2 November. 7.1.1	vel 1.	building. .	ry.	take place.	asked.	realistic and specific.	equations and diagram.	.	Given information.	sine rule in ΔQRS.	QR in terms of sinα and cosα.
2009 NSC P2 November. 7.1.2	5 Level 3.	Vertical building.	Trigonometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, equations and diagram.	Available.	Use the given information and diagram.	Use your answer to 7.1.1	Show that PQ = 6 + $6\sqrt{3}$ $\tan\alpha$
2009 NSC P2 November. 7.1.3	3 Level 3.	Vertical building.	Trigonometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, equations and diagram.	Available.	Use the given information.	PQ= 23m	Calculate α.
2009 NSC P2 November. 7.2	4 Level 2.	Yield sign.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, numbers and diagram.	Available.	A yield sign consist of two equilateral triangles.	The inner triangle has sides 50cm long and the	Comment on the spread of rainfall for the year.

										outer triangle has sides 80cm long.	
2009 NSC P2 November. 9.1	3 Level 3.	AIDS epidemic.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Use the information given in the table.	Use the graph paper provided on diagram sheet 2.	Draw a scatter plot for the data.
2009 NSC P2 November. 9.2	1 Level 3.	AIDS.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Use the scatter plot in 9.1.	Use words.	Describe the trend that is observed in the estimates.
2009 NSC	2 Le	AIDS.	Statistics.	Can	Can be	Exist,	Words and	Available	Use the	In word	Give two

P2 November 9.3	vel 3.			take place.	asked.	realistic and specific.	table.	.	scatter plot.	s.	possible reasons for this trend.
2009 NSC P1 November. 10.1	2 Level 3.	Travelling time.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Use the given number	Add all the numbers and divide the sum by 20.	Calculate the mean time.
2009 NSC P2 November. 10.2	2 Level 3.	Travelling time.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Use the given numbers.	Calculate manually or use the calculator.	Calculate the standard deviation.
2009 NSC P2 November. 10.3	2 Level 3.	Travelling time.	Statistics.	Can take place.	Can be asked.	Exist, realistic and spec	Words and numbers.	Available.	Use the mean and standard	Give a reason for your	Do all learners take about the

						ific.			deviation.	answer.	same time to go to school.
2009 NSC P2 November. 11.1	4 Level 3.	Price of petrol.	Statistics.	Exist, realistic and specific.	Can take place.	Can be asked.	Words and table.	Available.	Use the information given in the table.	Find the five number summary.	Determine the median, lower quartile and upper quartile.
2009 NSC P2 November. 11.2	2 Level 3.	Price of petrol.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Use the five number summary.	On diagram sheet 2.	Draw a box and whisker diagram.
2009 NSC P2 November. 11.3	2 Level 3.	Price of diesel.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, and box and box and whisker	Available.	Use the information given in the box and whiske	Use the position of the data points.	How many data points are there strictest betwe

							diagram.		r diagram.		en 600 and 800.
2009 NSC P2 November. 12.1.1	1 Level 3.	Lifetime of electric light bulb.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and ogive.	Available.	Use the information given in the ogive.	Read from the cumulative frequency curve.	How many light bulb were tested.
2009. NSC. P2 November. 12.1.2	2. Level 3.	Lifetime of electric light bulb.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and ogive.	Available.	Use the information given in the cumulative frequency curve.	Read from the cumulative frequency curve.	Determine the median lifetime of electric light bulb tested.
2009. NSC. P2. November. 12.1.	2. Level 3.	Lifetime of electric light	Statistics.	Can take place.	Can be asked.	Exist, realistic and spec	Words and ogive.	Available.	Use the information given in the	Upper quartile – lower	Determine the inter-quartile

3		bulb.				ific.			cumulative frequency curve.	quartile.	range.
2009. NSC. P2. November. 12.1.4	2. Level 3.	Lifetime of electric light bulb.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and ogive.	Available.	Use the information given in the cumulative frequency curve.	Read from the ogive.	Determine the number of electric light bulbs with a lifetime of between 1 750 and 2 000hours.
2009. NSC. P2. November. 12.2	2. Level l 3.	Lifetime of electric light bulb.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and ogive.	Available.	Use the information given in the cumulative frequency curve.	Read from the ogive.	Determine the amount spent on purchasing light bulbs

											that lasted longer than 2500 hours.
Total	46										

(This schedule was developed by the researcher on the theory of authentic task situations).Table 3.1.17: Schedule for mathematization of real life situations - NSC 2010 Paper 1

Question Paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information.	Task presentation.	Solution strategies.	Circumstances.	Solution requirements.	Purpose in figurative context.
2010 NSC P1 November. 7.2.1	2 Level 2.	Buying furniture.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Timothy borrows the money on 1 February 2010	On 1 July 2010.	Calculate the total amount owing to the financial institution.

2010 NSC P1 November. 7.2.2	4 Level 3.	Buying furniture.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Timothy agrees to pay monthly instalments of R450.	Interest is charged at 9,5% p.a.	How many months will it take Timothy to pay back the loan.
2010 NSC P1 November. 7.2.3	3 Level 3.	Buying furniture.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Timothy starts to pay equal monthly instalments from 1 August 2010.	Immediately after Timothy has made the 25th payment.	What is the balance of the loan.
2010 NSC P1 November. 10.1	3 Level 1.	Satellite.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, diagram and equations.	Available.	Volume of the cylinder $r = \frac{\pi}{6}$	Make h subject of the formula.	Show that $h = \frac{1}{6r2} - \frac{4r}{3}$
2010 NSC P1	3 Leve	Satellite.	Surface area	Can ta	Can be ask	Exist, realis	Words and equat	Available.	A cylinder is	Add outer surfac	Show that $S = \frac{4\pi r2}{3}$

November. 10.2	l 1.		and volume.	ke place.	ed.	tic and specific.	ions.		constructed in the shape of a cylinder with a hemisphere at each end.	es area of an open cylinder to that of two hemispheres.	$+\frac{\pi}{3r}$
2010 NSC P1 November. 10.3	6 Level 3.	Satellite.	Surface area and volume.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and diagram.	Available.	S= $\frac{4\pi r2}{3}+\frac{\pi}{3r}$	Differentiate S with respect to r.	Calculate the minimum outer surface area of the satellite.
2010 NSC P1 November. 11.1	4 Level 1.	Braai stands production.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	If the factory produces x Type A and y Type B	In terms of x and y.	Write down the relevant constraints.

									braai stands on a particu lar day.		
2010 N NSC P1 Nov emb er. 11.2	3 Le ve l 3.	Braa i stan ds prod uctio n.	Linear progr ammi ng.	Ca n ta ke pl ac e.	Can be ask ed.	Exist , realis tic and speci fic.	Word s and numb ers.	Avai labl e.	Indicat e the feasibl e region by shadin g it.	On graph paper provid ed on diagra m sheet 2.	Repre sent the constr aints.
2010 NSC P1 Nov emb er. 11.3. 1	1 Le ve l 3.	Braa i stan ds prod uctio n.	Linear progr ammi ng.	Ca n ta ke pl ac e.	Can be ask ed.	Exist , realis tic and speci fic.	Word s and numb ers.	Avai labl e.	Within the feasibl e region.	Write down the co- ordina tes of the corne r points .	Deter mine the larges t numb er of Type 1.
2010 N NSC P1 Nov emb er.	1 Le ve l 3.	Braa i stan ds prod uctio n.	Linear progr ammi ng.	Ca n Ta ke pl ac e.	Can be ask ed.	Exist , realis tic and speci fic.	Word s and numb ers.	Avai labl e.	Within the feasibl e region.	Write down the co- ordina tes of the	Deter mine the larges t numb er of

11.3.2										corner points	Type b.
2010 NSC P1 November. 11.4	2 Level 3.	Braai stands production.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	The factory to produce the maximum number of braai stands.	Find the co-ordinate that will give the largest sum.	Determine how many Type A and Type B braai stands that should be manufactured each day.
2010 NSC P1 November. 11.5	5 Level 2.	Braai stands production.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	If the demand of Type A stands is at least as large as the deman	Maximize x + y	Calculate the largest number of braai stands that can be

									d for Type B stands.		manufactured in one day and the machine-time require in this case.
Total.	37.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.18: Schedule for analyzing the mathematization of real-life situations – NSC November 2010 P2

Question Paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, reality and	Task presentation.	Solution strategies	Factors in the social context.	Solution requirements	Purpose in figurative context.

						specificity).					
2010 NSC P2 November. 1.1	4 Level 3.	Mathematics marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, marks and box and whisker diagram.	Available.	Marks of 25 learners are given.	In %.	Write down the five number summary for class A.
2010 NSC P2 November. 1.2	2 Level 3.	Mathematics marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, marks and box and whisker diagram.	Available.	Use the five number summary.	On diagram sheet 1. Clearly indicate all relevant values.	Draw a box and whisker diagram that represent class A marks.
2010 NSC P2 November	3 Level 3.	Mathematics marks.	Statistics.	Can take pl	Can be asked.	Exist, realistic and	Words, marks and box	Available.	Use the two box and	Give reason for your concl	Compare the two class

er. 1.3				ace.		specific.	and whisker diagram.		whisker diagrams.	usion.	es.
2010 NSC P2 November. 2.1	2 Level 3.	Statistics examination scores.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and histogram.	Available.	Histogram on scores in introductory Statistics.	On diagram sheet 2.	Complete the cumulative frequency table.
2010 NSC P2 November. 2.2	5 Level 3.	Statistics examination scores.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and histogram.	Available.	Cumulative frequency table.	On grid provided on diagram sheet 2.	Draw an Ogive.
2010 NSC P2 November. 2.3	1 Level 3.	Statistics examination scores.	Statistics.	Can take place.	Can be asked.	Exist, specific and realistic.	Words, histogram and percentages.	Available.	Examination scores for 200 learners.	Use the Ogive.	Estimate how many learners scored 75 % or more.
2010	2	Ice-	Statist	Ca	Can	Exist	Word	Avai	Avera	Find	Calcu

NSC P2 November. 3.1	Level 3.	cream sales.	ics.	n take place.	be asked.	, realistic and specific.	s and table.	lable.	ge sales for 12 days given.	the mean of the averages.	late the mean number of litres sold during the festival.
2010 NSC P2 November. 3.2	3 Level 3.	Ice-cream sales.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Average sales for 12 days given in the table.	Use the mean.	Calculate the standard deviation of the given information.
2010 NSC P2 November. 3.3	2 Level 3.	Ice-cream sales.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Average sales for 12 days given in the table.	Within one standard deviation of the mean.	Find the maximum number of litres of ice-crea

											m that the owner can stock per day.
2010 NSC November. 4.1	1 Level 3.	Lost airline luggage.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter plot.	Available.	Information is on the scatter plot.	State the airline.	Identify the airline with the worst record for on-time arrival.
2010 NSC P2 November. 4.2	1 Level 3.	Lost airline luggage.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter plot.	Available.	Information is on the scatter plot.	Motivate the answer.	State whether the given statement is true or false.
2010	2	Lost	Statist	Ca	Can	Exist	Word	Avai	Inform	Justifi	State

NSC P2 November. 4.3	Level 3.	airline luggage.	ics.	n take place.	be asked.	, realistic and specific.	s and scatter plot.	lable.	ation is given in the scatter plot.	cation of the answer.	whether the data confirm the researcher's suspicions.
2010 NSC P2 November. 4.4	2 Level 3.	Lost airline luggage.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and table.	Available.	Information is given in the scatter plot.	Giving a reason for the answer.	Choose the most preferred airline.
2010 NSC P2 November. 11.1	3 Level 2.	Moses Mabhida soccer stadium.	Trigonometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, diagram, lengths and angles.	Available.	PQ=100m. PC=32m AC is perpendicular to PC MCA=64,75^0.	In meters.	Determine AC.
2010	3	Mose	Trigon	Ca	Can	Exist	Word	Avai	PQ=1	In	Calcu

NSC P2 November. 11.2	Level 2.	s Mabhida soccer stadium.	ometry.	n take place.	be asked.	, realistic and specific.	s, picture, diagram, angles and lengths.	lable.	00m. PC=32m. MCA=64,75. AC is perpendicular to PC.	degrees.	late PAC.
2010 NSC P2 November. 11.3	4 Level 3.	Moses Mabhida soccer stadium.	Trigonometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, picture, diagram, lengths and angle.	Available.	A camera is positioned at D, 40m directed below A.	In meters.	Calculate the distance from D to C.
Total.	40.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table3.1.19: Schedule for analyzing the mathematization of real-life situations – NSC November 2011 P1

Que	Mark	The	Cont	Ev	Que	Infor	Task	Sol	Facto	Soluti	Purpos

stion.	s and level..	me.	extual subject.	ent.	stion.	mation (existence, realism and specificity).	presentation.	utilon strategies.	rs in social context.	on requirements.	e in figurative context.
2011 NSC P1. November. 7.2	6 Level 2.	Investment.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages and numbers.	Available.	Thandi receives an interest of 8% per annum compounded quarterly. Radesh receives 8,5% per	Justify your answer with appropriate calculations.	Who will have a bigger investment after 5 years.

									annum simple interest and a bonus of 5% of the principal amount at the end of 5 years.		
2011 NSC P1 November. 7.3	6 Level 2.	Savings account.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, percentages and numbers.	Available.	The account earns an interest of 15% per annum compound	Immediately after her last payment was made.	Determine the amount that should be in her savings account.

									ed monthly.		
2011 NSC P1 November. 11.1	1 Level 3.	Water flowing in a tank.	Calculus – rate of change.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	V(t)=100-4t.	Substitute t=0.	What is the initial volume of the water in the tank.
2011 NSC P1 November. 11.2	3 Level 3.	Water flowing in a tank.	Calculus – rate of change.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	V(t)=100-4t.	Differentiate V with respect to t.	Write down two different expressions for the rate of change of the volume of water in the tank.
2011 NSC P1 November.	2 Level 3.	Water flowing in a tank	Calculus – rate of chan	Can take place.	Can be asked.	Exist, realistic and speci	Words and equations.	Available.	V(t)=100-4t.	Find the rate at which water	Determine the value of k.

11.3		.	ge.			fic.				flows out of the tank.	
2011 NSC P1 November. 12.1	6 Level 1.	Bus transport for a trip.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Red buses are represented by x and blue buses are represented by y.	In terms of x and y.	Write down all constraints.
2011 NSC P1 November. 12.2	4 Level 3.	Bus transport for a trip.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Clearly indicate the feasible region.	On the attached diagram sheet.	Represent the constraints graphically.
2011 NSC P1 November. 12.3	1 Level 1.	Bus transport for a trip.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Cost of hiring a red bus is R600 and	add the product of x and R600 to the	Write down the total transport cost.

									cost of hiring a blue bus is R300.	product of y and R300.	
2011 NSC P1 November. 12.4.1	3 Level 3.	Bus transport for a trip.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Cost is minimized at the corner points.	Write down the coordinates of the corners points	Determine all possible values of x and y so that the cost will be minimum.
2011 NSC P1 November. 12.4.2	2 Level 3.	Bus transport for a trip.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Substitute the coordinates of the corner points in the	Find the lowest cost.	Calculate the minimum cost of hiring the buses.

									cost function.		
2011 NSC P1 November. 12.5	1 Level 3.	Bus transport for a trip.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Exactly 12 buses are to be used.	X+y=12.	Determine the values of x and y that will minimize the cost.
Total.	35.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.20: Schedule for analyzing the mathematization of real-life situations – NSC November 2011 P2

Question paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (event, realism and specificity).	Task presentation.	Solution strategies.	Factors in social context.	Solution requirements	Purpose in figurative context.
201	1	Scor	Stati	C	Ca	Exis	Word	Avai	Points	Arran	Determ

1 NSC P2 November. 1.1	Level 3.	es of basketball players.	stics.	an take place.	n be asked.	t, realistic and specific.	s and number.	lable.	scored by 15 players are given.	ge the scores in ascending or descending order.	ine the median of the given data.
2011 NSC P2 November. 1.2	3 Level 3.	Scores of basketball players.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Points scored by 15 players are given.	Q_3- Q_2	Determine the inter quartile range of the data.
2011 NSC P2 November. 1.3	3 Level 3.	Scores of basketball players.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Use the answers obtained above.	Use your own scale.	Draw a box and whisker to represent this data.
2011 NSC	2 Level	Scores of basketball	Statistics.	Can take	Can be ask	Exist, realistic	Words and numbers.	Available.	Use the box and whisker diagram.	Use words and/o	Comment on the words

P2 November. 1.4	3.	players.		place.	ed.	and specific.				r numbers.	scored by the player.
2011 NSC P2 November. 2.1	2 Level 3.	Scores for gofers.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Scores of 8 golfers.	Add the 8 score and divide the sum by 8.	Calculate the mean score.
2011 NSC P2 November. 2.2	2 Level 3.	Scores for golfers.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers	Available.	Use the mean above.	Find the variance and then the square root of the variance.	Calculate the standard deviation of the data.
2011 NSC P2 Novemb	2 Level 2.	Scores for golfers.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	$mean \pm one\ sta$	Count the scores outside one	Find the number of golfers that lie outside

er. 2.3										standard deviation.	one standard deviation of the mean.
2011 NSC P2 November. 3.1	1 Level 1.	Relationship between watching TV and test scores..	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter graph.	Available.	Scatter graph on the relationship between watching TV and marks.	Read it from the scatter graph.	Find the lowest test score.
2011 NSC P2 November. 3.2	2 Level 3.	Relationship between watching TV and test scores..	Statistics.	Can take place.	Can be asked.	Exist, specific and realistic.	Words and scatter graph.	Available.	The relationship between watching TV and marks.	Justification of the answer.	State whether the relationship is linear, quadratic or exponential.
201	1	Relat	Stati	C	Ca	Exis	Word	Avai	Scatter	In	Draw a

1 NSC P2 November. 3.3	Level 3.	ionship between watching TV and test scores.	stics.	an take place.	n be asked.	t, realistic and specific.	s and scatter graph.	lable.	graph on watching TV and marks.	words and/or numbers.	conclusion on watching TV and marks obtained.
2011 NSC P2 November. 3.4	2 Level 3.	Relationship between watching TV and test scores.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and scatter graph.	Available.	Using the scatter plot.	Use 35 on the x-axis to find the test score on the y-axis.	Predict the performance of a learner who watches TV for 35 hours.
2011 NSC P2 November. 4.1	3 Level 3.	Time taken to answer mathematics ques	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and frequency table.	Available.	Use the frequency table.	Add the frequencies below the upper boun	Construct a cumulative frequency table.

		tions.								dary.	
2011 NSC P2 November. 4.2	4 Level 3.	Time taken to answer mathematics questions.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and frequency table.	Available.	Use the cumulative frequency table.	On the grid provided on diagram sheet 1.	Draw a cumulative frequency table.
2011 NSC P2 November. 4.3	2 Level 3.	Time taken to answer mathematics questions.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and frequency table.	Available.	A gifted learner answers the question correctly in less than 4 minutes.	Find the number of gifted learners and express it as a percentage of all learners.	Estimate the percentage of gifted learners in the group.
Total.	30.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3,1,21: Schedule for analyzing the mathematization of real-life situations – NSC November 2012 P1

Question Paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, reality and specificity).	Task presentation.	Solution strategies	Circumstances.	Solution requirements.	Factors in figurative context.
2012 NSC P1 November. 3.2	4 Level 2.	Water tank volume.	Number patterns.	Can take place.	Can be asked.	Exist, real and specific.	Words and cylinders.	Available.	Solve the question without dimensions.	Compare the volume of tanks.	Find differences or similarities.
2012 NSC P1 November. 7.1.1	3 Level 2.	Machine.	Financial mathematics.	Can take place.	Can be asked.	Exist, real and specific.	Words and numbers.	Available.	Find scrap value given t, I and Pv.	Find scrap value.	Find scrap value.
201	3	Machi	Finan	Ca	Can	Exist	Word	A	Determi	Use	Replac

2 NSC P1 November. 7.1.2	Level 2.	ne.	cial mathematics.	n be asked.	take place.	, real and specific.	s and numbers.	vailable.	ne cost of machine in 5 years.	constant inflation.	e the machine.
2012 NSC P1 November. 7.1.3	5 Level 2.	Machine.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers,	Available.	Sinking fund for R90 000 at 8,5% interest compounded monthly.	First payment will be made immediately and last payment at the end of the 5 yea	Calculate monthly payment for a sinking fund.

										r period.	
2012 NSC P1 November. 7.2	6 Level 2.	Retirement lump sum investment.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	R900 000 invested at 10,5% interest compounded monthly.	R18 000 with drawn every month starting from the end of the first month.	Calculate the number of months left for the investment.
2012 NSC P1 November. 10.1	3 Level 3.	Distance moved by a particle.	Rate of change.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, inequalities and equations.	Available.	$s(t)=2t^2-18t+45$ $t \geq 0$	Velocity is the rate of change of	Calculate the particle's initial velocity.

										distance.	
2012 NSC P1 November. 10.2	1 Level 3.	Distance moved by a particle.	Rate of change.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, equations and inequalities.	Available.	$s(t)=2t^2-18t+45$ $t\geq 0$	At t seconds.	Determine the rate of velocity change.
2012 NSC P1 November. 10.3.	2 Level 3.	Distance moved by a particle.	Rate of change.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	$s(t)=12t^2-18t+45$ $t\geq 0$	Time in seconds.	After how many seconds will the particle be closest to the fixed point?
2012 NSC P1 November. 11.1	1 Level 3.	Calculator manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and inequalities diagram.	Available.	Feasible region given in the diagram.	Motivation of the answer.	Determine whether (15,5) is possible to manufacture.
201	6	Calcul	Linea	Ca	Can	Exist	Word	A	The	In	Write

2 NSC P1 November. 11.2	Level 1.	ator manufacturing.	r programming.	n take place.	be asked.	, realistic and specific.	s and inequality diagram.	vailable.	straight lines representing the inequalities are drawn.	algebraic form.	down all the inequalities.
2012 NSC P1 November. 11.3.1	1 Level 3.	Calculator manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and inequality diagram.	Available.	Q=x + 3y where Q is profit in rands.	Use only A, B, C or D.	Identify the point at which the profit is maximum.
2012 NSC P1 November. 11.3.2	2 Level 3.	Calculator manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and inequality diagram.	Available.	The dotted line on the graph is a search line associated with the profit function. P(30,5) is shown on the dotted line.	If it exists.	Write down the coordinates of a point on the dotted line at which the profit is greater than the profit at P.

2012 NSC P1 November. 11.3.3	4 Level 3.	Calculator manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and inequality diagram.	Available.	Q = a x +by (a>0;b>0)	The profit is a maximum at B.	Determine the maximum value of $\frac{a}{b}$
Total.	41.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.22: Schedule for analyzing the mathematization of real life situations – NSC November 2012 P2

Question Paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Factors in social context.	Solution strategies.	Purpose in figurative context.
2012 NSC P2 Nov	1 Level	Age of boys.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific	Words and scat	Available.	Scatter plot showing age	Use the scatter	Determine the average

emb er. 1.1	3.					c.	ter plot.		and height.	plot .	height of a 7 - year - old.
2012 NSC P2 Nov emb er. 1.2	1 Le ve l 3.	Age of boys.	Stat istic s.	Can take plac e.	Can be ask ed.	Exist, realisti c and specifi c.	Wor ds and scat ter plot.	Av ail abl e.	Given scatter plot.	In wor ds and /or nu mb ers.	Describ e the trend in the scatter plot.
2012 NSC P2 Nov emb er. 1.3	3 Le ve l 3.	Age of boys.	Stat istic s.	Can take plac e.	Can be ask ed.	Exist, realisti c and specifi c.	Wor ds and scat ter plot.	Av ail abl e.	Betwee n the ages of 2 and 15 years.	App roxi mat e.	Find the approxi mate increas e in the averag e height per annum.
2012 NSC P2 Nov emb er. 1.4	1 Le ve l 3.	Age of boys.	Stat istic s.	Can take plac e.	Can be ask ed.	Exist, realisti c and specifi c.	Wor ds and scat ter plot.	Av ail abl e.	Given scatter plot.	Law of dimi nish ing retu rns.	Explain why the given trend cannot continu e indefinit ely.
2012	2	Crick	Stat	Can	Can	Exist,	Wor	Av	Numbe	Fin	Determ

NSC P2 November. 2.1	Level 3.	et.	istics.	take place.	be asked.	realistic and specific.	ds and numbers.	ailable.	rs of runs scored by Abe in 8 games are given.	d the sum of the 8 scores and divide by 8.	ine the average runs scored by Abe..
2012 NSC P2 November. 2.2	2 Level 3.	Cricket.	Statistics.	Can take.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Given scores and mean obtained in 2.1	Student to choose the method.	Determine the standard deviation of the data set.
2012 NSC P2 November. 2.3	2 Level 2.	Cricket.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	First three scores for the next 8 games are 22, 35 and 2.	In words and /or numbers.	Describe the effect of his performance on the standard deviatio

											n of this larger set having 11 data points.
2012 NSC P2 November. 2.4	3 Level 2.	Cricket.	Statistics.	Can take place.	Can be asked.	What should his minimum average in the last 5 games so that he may reach his goal might have been more appropriate.	Words and numbers.	Available.	Abe hopes to score an average of 20 runs in the first 16 games.	Find average for the last 16 games that will enable Abe to reach his goal.	Find the average in the last five games that will enable Abe to reach his goal? Maybe minimum average is more clear.
2012 NSC P2	1 Leve	Mathematics	Statistics.	Can take plac	Can be ask	Exist, realistic and	Words and	Availabl	Marks for 60 learner	In interval	Write down the

November. 3.1	l 3.	and Physical science marks.		e.	ed.	specific.	box-and-whisker diagram.	e.	s given in the box-and-whisker diagram.	notation.	range of marks scored in the Physical Sciences examination.
2012 NSC P2 November. 3.2	4 Level 1.	Mathematics and Physical science marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Minimum mark=30. Range =55. Upper-quartile =70. Inter quartile range= 30. Median =55.	Draw on Diagram sheet 1.	Use the information given to draw a box-and-whisker diagram.
2012 NSC P2 November. 3.3	2 Level 3.	Mathematics and Physical scien	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Minimum mark=30. Range =55. Upper	Find the number of	How many learners scored less than

		ce marks.							quartile =70. Inter quartile range= 30. Median =55.	learner.	70% in the Mathematics examination.
2012 NSC P2 November. 3.4	2 Level 3.	Mathematics and Physical sciences marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words numbers and box-and-whisker diagram.	Available.	Mathematical and Physical science marks.	Justification of the answer.	Is Joe's claim valid.
2012 NSC P2 November. 4.1	1 Level 3.	Collecting newspapers for recycling.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and cumulative frequency graph.	Available.	Cumulative frequency graph showing the weight of newspapers collected by 30 learner	Use the cumulative frequency graph.	Determine the modal class of the weight of the newspapers collected.

									s.		
2012 NSC P2 November. 4.2	1 Level 3.	Collecting newspapers for recycling.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Word and cumulative frequency graph.	Available.	Cumulative frequency graph showing total weight of newspapers collected by 30 learners.	Use the cumulative frequency curve.	Median weight of the newspapers collected by 30 learners.
NSC November 2012 P2. 4.3	2 Level 3.	Collecting newspapers for recycling.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and cumulative frequency curve.	Available.	Cumulative frequency graph on total weight of newspapers collected by 30 learners.	Use the cumulative frequency curve.	How many learners collected more than 60kg of newspaper.
2012 NSC P2	5 Leve	Hot air ballo	Trigonomet	Can take plac	Can be ask	Exist, realistic and	Words, leng	Availabl	CDB=2x. CBD=9	Find CB	Show that CB=2k

November. 12.1	l 2.	on.	ry – solving triangles.	e.	ed.	specific.	ths, angles , equations and diagram.	e.	0^0 –x. The distance between C and D is k meters.	in terms of k and x.	sinx.
2012 NSC P2 November. 12.2	3 Level 1.	Hot air balloon.	Trigonometry – solving triangles.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, lengths, angles, equations and diagram.	Available.	CB=2k sinx.	Show that the hypotenuse is equal to 2ktanx.	Hence, show that the length of rope HC is 2ktanx.
2012 NSC P2 November. 12.3	4 Level 3.	Hot air balloon.	Trigonometry – solving triangles.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, lengths, angles, equation and	Available.	K=40m $X=23^0$ HD=31,8m.		Calculate θ the angle between the two ropes.

							diagram.				
2012 NSC P2 November. 13.1	6 Level 2.	Clock.	Trigonometry-rotation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, coordinates and diagram.	Available.	P(2;4) → P(a;b) after 37 minutes.	Find the coordinates of the image.	Determine the value of a and b.
2012 NSC P2 November. 13.2	4 Level 3.	Clock.	Trigonometry-rotation.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, coordinates and diagram.	Available.	OD is the position of the hour hand when the minute hand is at P and OD^1 is the position of the hour hand when the minute	Calculate the angle of rotation.	Calculate the angle between OD and OD^1.

									hand is at P[1].		
Total.	50.										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.23: Schedule for analyzing the mathematization of real-life situations NSC November 2013 Paper 1

Question Paper.	Marks and level.	Theme.	Contextual subject.	Event.	Question.	Information (existence, realism and specificity).	Task presentation.	Solution strategies.	Factors in social context.	Solution strategies.	Purpose in figurative context.
2013 NSC P1 Novemb	2 Level 2.	Investment.	Financial mathematics.	Can take pla	Can be asked.	Exist, realistic and	Words and numbers.	Available.	P,A and nominal inter	Use P,A and nominal	Calculate the effective

er. 7.1.1				ce.		specific.			est per annum are given.	interest per annum to calculate effective interest rate.	interest rate.
2013 NSC P1 November. 7.1.2	5 Level 2.	Investment.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	P,A and nominal interest per annum are given.	Use the effective annual interest rate.	Determine the value of k.
2013 NSC P1 November. 7.2.1	1 Level 2.	Home loan.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	The maximum monthly payment is one	Find one third of R18 840.	Calculate the monthly repayment.

									third of monthly salary.		
2013 NSC P1 November. 7.2.2	4 Level 2.	Home loan.	Financial mathematics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	×,n and I are given.	Use the present value formula.	Calculate P.
2013 NSC P1 November. 10.1	3 Level 3.	Water flow.	Calculus.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	R= - $0.2t^2$ + 10t.	Equate the first differential to 0 and solve for t.	After how long will the water be flowing at the maximum rate?
2013 NSC P1 November. 10.2	3 Level 3.	Water flow.	Calculus.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and equations.	Available.	R= - $0.2t^2$ + 10t.	Substitute r=0.	After how many seconds does the

											water stop flowing?
2013 NSC P1 November. 11.1	4 Level 1.	Shirt manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	The conditions are given.	Use the given conditions to write down the constraints.	Write down the constraints.
2013 NSC P1 November. 11.2	5 Level 3.	Shirt manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	Use the constraints.	On diagram sheet 1.	Sketch the inequalities.
2013 NSC P1 November. 11.3.1	1 Level 1.	Shirt manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	The profit is given.	Use the given profit.	Write down the profit function.
2013 NSC	2 Le	Shirt manuf	Linear progra	Can	Can be	Exist,	Words and	Available.	Use the	Use the	Maximize

P1 November. 11.3.2	vel 3.	acturing.	mming.	take place.	asked.	realistic and specific.	numbers.		diagram on diagram sheet 1.	search line or substitute the corner points.	the profit.
2013 NSC P1 November. 11.4	2 Level 3.	Shirt manufacturing.	Linear programming.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and numbers.	Available.	P=ax + by.	P is maximized at each value of y between 100 and 160.	Determine $\frac{a}{b}$.
Total.	32										

(This schedule was developed by the researcher on the theory of authentic task situations).

Table 3.1.24: Schedule for analyzing the mathematization of real-life situations- NSC November 2013 Paper 2

Quest	Marks	Theme.	Context	Event	Question	Informatio	Task presen	Solution	Factors in	Solution	Purpose

ion Paper.	and level.		ual subject.	.	.	n (existence, realism and specificity).	tation.	strategies.	social context.	strategies.	in figurative context.
2013 NSC P2 November. 1.1	2 Level 3.	Height of trees.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and box and whisker diagram	Available.	Box and whisker diagram showing the five number summaries.	Use the box and whisker diagram.	Determine the interquartile range
2013 NSC P2 November. 1.2	2 Level 3.	Height of trees.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and box and whisker diagram.	Available.	Box and whisker diagram showing the five number summ	Use the box and whisker diagram.	What percentage of plants has a height in excess of 53cm

									aries.		?
2013 NSC P2 November. 1.3	2 Level 3.	Height of trees.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and box and whisker diagram.	Available.	Box and whisker diagram showing the five number summaries.	Explain.	Between which quartiles do the heights of trees have the least variation?
2013 NSC P2 November. 2.1	3 Level 3.	Blood alcohol level and car accident risk.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and box, table and percentages.	Available.	Use the information given in the table.	On diagram sheet 1.	Draw a scatter plot.
2013 NSC P2 No	1 Level 3.	Blood alcohol level	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and box, table and percen	Available.	Use the information given in the	On diagram sheet 1.	Draw a line (or curve) of best

ve mb er. 2.2		and car acci dent risk.					tages.		table.		fit.
20 13 NS C P2 No ve mb er. 2.3	1 Lev el 3.	Bloo d alco hol leve l and car acci dent risk.	Stat istic s.	Ca n tak e pla ce.	Can be aske d.	Exist, realis tic and specif ic.	Words and box, table and percen tages.	Avail able.	Use the inform ation given in the table.	In word s and/o r numb ers.	Descr ibe the trend of the data.
20 13 NS C P2 No ve mb er. 2.4	2 Lev el 3.	Bloo d alco hol leve l and car acci dent risk.	Stat istic s.	Ca n tak e pla ce.	Can be aske d.	Exist, realis tic and specif ic.	Words and box, table and percen tages.	Avail able.	The legal limit of the blood alcohol level is 0, 05%.	Whe n one's blood level is 0, 18%.	Estim ate the proba bility of havin g a car accid ent.
20 13 NS C P2	2 Lev el 3.	Tim e take n to leav	Stat istic s.	Ca n tak e pla	Can be aske d.	Exist, realis tic and specif	Words and ogive.	Avail able.	Use the ogive.	Estim ate.	The numb er of peopl e

November. 3.1		e an auditorium.		ce.		ic.					who took more than 15 minutes.
2013 NSC P2 November. 3.2	2 Level 3.	Time taken to leave an auditorium.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and ogive.	Available.	Use the ogive.	Estimate.	The number of people who took between 8 and 12 minutes.
2013 NSC P2 November. 3.3	1 Level 3.	Time taken to leave an auditorium.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and ogive.	Available.	Use the ogive.	Write down.	Find the modal class.
2013	2 Lev	Term	Statistic	Can	Can be	Exist, realis	Words and	Available.	Use the	Give a	Find the

NSC P2 November. 4.1	el 3	test marks.	s.	take place.	asked.	tic and specific.	normal distribution curve.		normal distribution curve.	reason for your answer.	schools whose results are more widely spread around the mean.
2013 NSC P2 November. 4.2	1 Level 3.	Term test marks.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and normal distribution curve.	Available.	Use the normal distribution curve.	Compare school A and school B.	What is the difference in the spread around the respective mean marks
2013 NS	2 Lev	Term test	Statistics.	Can tak	Can be aske	Exist, realistic	Words and normal	Available.	Use the normal	Compare scho	Explain how

C P2 No ve mb er. 4.3	el 3.	mar ks.		e pla ce.	d.	and specif ic.	distrib ution curve.		distrib ution curve.	ol A and scho ol B.	mark s of scho ol A can be adjus ted to matc h mark s of scho ol C.
20 13 NS C P2 No ve mb er. 4.4	2 Lev el 2.	Ter m test mar ks.	Stat istic s.	Ca n tak e pla ce.	Can be aske d.	Exist, realis tic and specif ic.	Words and normal distrib ution curve.	Avail able.	Use the normal distrib ution curve.	Expla in the effect on the mean and stand ard devia tion of scho ol C.	Expla in the effect of loweri ng each mark in scho ol C by 10%\\
20 13 NS C	5 Lev el 2.	Rot atin g a whe	Stat istic s.	Ca n tak e	Can be aske d.	Exist, realis tic and	Words , fractio ns,	Avail able.	Clock wise rotatio n.	Rotat e from T to	Show that θ =

P2 November. 9.1		el.		place.		specific.	surds and diagram.			W.	195.
2013 NSC P2 November. 9.2	5 Level 3.	Rotating a wheel.	Statistics.	Can take place.	Can be asked.	Exist, realistic and specific.	Words, fractions, surds and diagram.	Available.	Clockwise rotation from T to W.	In revolutions per minute.	Calculate the speed at which the wheel is rotator.
2013 NSC P2 November. 13.1	3 Level 3.	Built pyramid. Level 2.	Trigonometry.	Can take place.	Can be asked.	Exist, realistic and specific.	Words and diagram.	Available.	The pyramid is square based.	Calculate CEB.	Calculate the size of the apex angle.
2013 NSC P2	6 Level 3.	Built pyramid.	Trigonometry.	Can take pla	Can be asked.	Exist, realistic and specif	Words and diagram.	Available.	EF is perpendicular to AB.	Calculate EFG.	Calculate the angle each

November. 13.2				ce.		ic.					face makes with the base,
Total	44										

(This schedule was developed by the researcher on the theory of authentic task situations).