UNIVERSITY OF JOHANNESBURG

FACULTY OF EDUCATION

NOVEMBER EXAMINATION 2015

UNIVERSITY OF JOHANNESBURG

PROGRAMME: M Ed by coursework – TAKE HOME SUBMISSION

MODULE: (RESEARCH ON) ISSUES IN MATHEMATICS EDUCATION

CODE: IMS9X20

TIME: Students submit on the 11th of November at 08:30

MARKS: 200

EXAMINER: Prof Gerrie J Jacobs

MODERATOR: Prof DCJ Wessels (University of Stellenbosch)

(This paper consists of **seven (7)** pages and **two (2)** questions)

INSTRUCTIONS

1. You are expected to answer **both** questions, on your own, in English or in Afrikaans.

2. You should present your 'hard copy' (**printed**) and clearly labelled 'answers' to the examiners in the examination venue.

3. **Ring-bind** your submission and insert it in a folder or file (so that it can be easily paged). Print it on just one side of a page.

4. Candidates are free to exit the examination venue, as soon as the submissions of all candidates have been collected by the examiners.

5. Provide **structure** to your answers by using appropriate headings and sub-headings. Make use of the numbering system of this paper.

6. You should provide a **reference list** at the end of each of your answers.

7. Use the **American Psychology Association's (APA) technique** to refer to consulted sources, both in the text and in the reference list.

8. A **marking framework** is supplied in respect of each question. Aspects like a scientific writing style, appriopriate language usage and proper referencing form part of the assessment criteria.

9. All **articles** and **e-documents** prescribed for the questions below, are available on Ulink (in the module's sub-folder *Exam literature 2015*) for your access and utilisation. You are encouraged to also use other relevant sources of literature, if appropriate.

QUESTION 1

> Research on issues related to numeracy and number sense in
> Mathematics teaching and learning

Sources of literature provided [in the Ulink folder: **Exam literature 2015**]

Bennison, A. (2015). Developing an analytic lens for investigating identity as an embedder of numeracy. *Mathematics Education Research Journal, 27(1)*, 1–19.

Muir, T. (2012). What is a reasonable answer? Ways for students to investigate and develop their number sense. *Australian Primary Mathematics Classroom (APMC), 17(1)*, 21–28.

Sengül, S. (2013). Identification of number sense strategies used by pre-service elementary teachers. *Educational Sciences: Theory & Practice, 13(3)*, 1965-1974.

Wagner, D. & Davis, B. (2010). Feeling number: Grounding number sense in a sense of quantity. *Educational Studies in Mathematics, 74*, 39–51.

1.1 Mathematics educators who possess an adequate level of numeracy or number sense and who can develop it in their learners, are increasingly regarded as a fundamental key to mathematics learner success in South African schools. The Australian researcher, Tracy Muir (2012, p. 21), defines number sense as "*...a good intuition about numbers and their relationships*" and "*to have a 'feel' for the relative size of numbers and to make reasonable estimations.*" Wagner & Davis (2010) argue that mathematics teachers have an obligation to let their learners develop a so called quantity sense, which they link to number sense. In their article, "*Feeling number: Grounding number sense in a sense of quantity*", they advocate mathematics classroom experiences that can help learners "feel the weight of numbers", which includes a sense of what numbers are and what they can do.

By using the articles of Muir (2012), Sengül (2013) and Wagner & Davis (2010), but also several other relevant sources of literature, conceptualise **number sense**, clearly distinguishing it from other related concepts like **numeracy**, **quantitative literacy**, **number knowledge** and **a sense of quantity**. Provide relevant corresponding and/or contrasting literature views, clearly outlining the

underlying elements or constructs of these five concepts and eventually also provide your own working definition of them. (25)

1.2 Via a careful exploration of relevant and relatively recent (since the year 2000) research that has been published (or reported on) in respect of the development of the numeracy (number sense or sense of quantity) of mathematics learners/students and/or teachers/educators at school or at higher education level, interrogate **three (3) research studies** that have been conducted with the intention of developing mathematics learners/students or teachers'/educators' number sense. Give a critical account of each study's:

(a) purpose (aim or goal) or research question

(b) participants and institution(s) involved

(c) data collection instrument(s) used

(d) main findings

(e) recommendations for further research and/or implications for Mathematics Education research

[Number your answers as 1.2.1, 1.2.2 & 1.2.3 and write maximum two pages on each]

(30)

1.3 In her article, titled "*Developing an analytic lens for investigating identity as an embedder-of-numeracy*" the Australian researcher Anne Bennison (2015), proposes a conceptual framework in respect of the identity of teachers in the role that (she is of the opinion that) they should ideally fulfil, namely as **embedders-of-numeracy**. Her framework is based on two premises, namely that:

(1) numeracy involves mathematical knowledge, contexts, dispositions, tools and a critical orientation and

(2) all teachers need to embed numeracy into the subject(s) they teach.

Provide your own (and literature-supported) critical views on:

1.3.1 the validity and relevance of the *rationale* underlying her study

1.3.2 her opinion(s) on embedding numeracy *across the curriculum*

1.3.3 her description of and opinions on *teacher identity*

1.3.4 the five suggested *domains of influence*, which according to her framework, might greatly impact on a teacher's identity as an embedder-of-numeracy and

1.3.5 the potential *applicability* of her study to the identity of effective mathematics teachers/educators in South Africa.

(35)

1.4 Provide your list of references for literature sources used in the answering of this question (in APA format) and write your answer to this question in accordance with the protocol for scientific writing and language use (10)

(100)

MARKING FRAMEWORK FOR QUESTION 1

No.	Assessed item	Marks
1.1	Conceptualisation of number sense, numeracy, quantitative literacy, number knowledge and a sense of quantity	25
1.2	Interrogation of *three (3) research studies* that have been conducted with the intention of developing mathematics learners/students or teachers'/educators' number sense	30
1.3	Critical review of Bennison's conceptual framework in respect of the identity of teachers in the role that they should ideally fulfil as *embedders-of-numeracy*	35
1.4.1	Reference list for literature sources utilised in this question (in APA format) and in-text referencing	7
1.4.2	Scientific writing and language usage	3
Total marks for QUESTION 1		100

QUESTION 2

> Research on issues related to teaching and learning Mathematics through problem solving

Sources of literature provided [in the Ulink folder: ***Exam literature 2015***]

Cai, J. (2003). What research tells us about teaching mathematics through problem solving. In F. Lester Jr. (Ed.), *Teaching mathematics through problem solving – Prekindergarten – Grade 6,* (pp. 241–254). Reston, VA: National Council of Teachers of Mathematics.

English L., & Sriraman B. (2010). Problem solving for the 21st century. In B. Sriraman & L. English (Eds.), *Theories of Mathematics Education: Seeking new frontiers.* New York: Springer (pp. 263–290). Springer: Berlin, Germany.

Kang, O-K., & Noh, J. (2012). Teaching mathematical modeling in school mathematics, 12th International Congress on Mathematics Education (ICME), 8–15 July, Seoul, Korea. http://www.icme12.org/upload/submission/1930_f.pdf

Lewin, T. (2006). As Math scores lag, a new push for the basics, *New York Times*, 14 November 2006. Available from: http://www.nytimes.com/2006/11/14/education/14math.html?pagewanted=all&_r=0

2.1   "*There has been a **noticeable decline** in the amount of problem-solving research that has been conducted in the past decade. Recent literature that has its main focus on problem solving, or concept development through problem solving, has been **slim***" (English & Sriraman, 2010, p. 266). The two authors identify four so-called **limiting factors**, which caused research on problem solving in mathematics teaching and learning to be neglected since the turn of the century.

2.1.1   By utilising English & Sriraman's chapter, Lewin's November 2006-article in the New York Times, and other relevant sources, provide your motivated view of the role that high-stakes international mathematics testing, such as PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) might have played (and

potentially continue to play) in the '*back to the basic skills in mathematics*' movement. (10)

2.1.2 Provide a research-based overview of the **other three factors**, which, according to English and Sririman, might have limited research on problem solving in mathematics teaching and learning. (10)

2.2 In a chapter in a book published by the USA National Council of Teachers of Mathematics (NCTM) in 2003, Jinfa Cai attempts to provide satisfactory answers to four questions on the teaching and learning of mathematics through problem solving. He regards all four questions as **burning issues**.

2.2.1 Having interrogated Cai's chapter, as well as other relevant sources of literature, write an **essay of maximum 4,000 words**, in which you provide research-based 'answers' to Cai's four questions, namely:

a) Are young mathematics learners really able to explore problems on their own and arrive at sensible solutions?

b) How can mathematics teachers (and educators) learn to teach through problem solving?

c) What are mathematics learners' (and students') beliefs about teaching through problem solving?

d) Will mathematics learners (and students) sacrifice basic skills if they are taught mathematics through problem solving?

(44)

2.2.2 Draw a **conclusion** (of *maximum one page*) on the contribution that Cai's chapter, in your view, might have made (if appropriate) to research on the teaching of mathematics through problem solving. (6)

2.3 Mathematical modelling and the teaching of modelling in school mathematics have received increasing attention lately from mathematics researchers and educators (compare Kang & Noh (2012) and others). Provide your literature-supported response to the following statement: '*Mathematical modelling contributes to mathematics learners/students problem solving abilities, while at the same time generating a number of other potential learner/student dividends*'.

Your response should be in the form of a **structured essay** of maximum three pages. (20)

2.4 Provide your list of references for literature sources used in the answering of this question (in APA format) and write your answer to this question in accordance with the protocol for scientific writing and language use (10)

(100)

MARKING FRAMEWORK FOR QUESTION 2

No.	Assessed item	Marks
2.1.1	Motivated view of the role that **high-stakes international mathematics testing**, such as PISA and TIMSS might have played (and potentially continue to play) in the *'back to the basic skills in mathematics'* movement	10
2.1.2	Overview of the **other three factors**, which, according to English and Sririman, might have limited research on problem solving	10
2.2.1	Essay of maximum 4,000 words, in which you provide research-based 'answers' to **Cai's four questions**.	44
2.2.2	**Conclusion** on the contribution of Cai's chapter to research on the teaching of mathematics through problem solving	6
2.3	Literature-supported response to the statement on **mathematical modelling**	20
2.4.1	Reference list for literature sources utilised in this question (in APA format) and in-text referencing	7
2.4.2	Scientific writing and language usage	3
Total marks for QUESTION 2		100

TOTAL: 200

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