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# Appendices

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<b>Appendix A</b>	Letter of consent to the ML teachers
<b>Appendix B</b>	Letter of consent to the principals
<b>Appendix C</b>	Letter of permission to the department
<b>Appendix D</b>	Ethical clearance certificate
<b>Appendix E</b>	Observation sheet for observing ML teachers' lessons
<b>Appendix F</b>	Interview schedule 1 (Prior to lessons 2 and 3)
<b>Appendix G</b>	Interview schedule 2 (Final interview)
<b>Appendix H</b>	List of research studies for Literature Control
<b>Appendix I</b>	Analysis of discussions on Theme 1 and Theme 2
<b>Appendix J</b>	Additional information verifying Question 1
<b>Appendix K</b>	Additional information verifying Question 1
<b>Appendix L</b>	Declaration: External coder



Appendix A: Letter of consent to the ML teachers



**FACULTY OF EDUCATION**

Mrs. J.J. Botha  
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19 April 2011

Dear Ms/Mr .....

**Letter of consent to the Mathematical Literacy teacher**

You are invited to participate in a research project aimed at investigating the influence of Mathematical Literacy teachers' knowledge and beliefs on their instructional practices. This research will be reported upon in my PhD thesis conducted at the University of Pretoria.

Your participation in this research project is voluntary and confidential. It is proposed that you form part of this study's data collection phase by being observed three times when teaching your Mathematical Literacy class(es) and being individually interviewed twice. The lessons will be video recorded and the interviews will be audio-taped by me in order to have a clear and accurate record of all the activities and communication that took place.

The process will be as follows: during the third term of this year I would like to observe you teaching three Grade 11 Mathematical Literacy lessons during school hours, preferably to different Mathematical Literacy classes. I would like to conduct a short interview with you prior to the second and third lessons and another interview at the end of the three observations. The duration of the interviews prior to the lessons will not be more than 20 minutes and can be conducted during break or a free period you have. The duration of the third and final interview will take a maximum of an hour and will be scheduled at a time convenient to you. The focus of the questions is your knowledge and beliefs regarding Mathematical Literacy as subject, the teaching thereof and the Mathematical Literacy learners. The interviews will be scheduled at a place convenient to you.

Should you declare yourself willing to participate in this study, confidentiality and anonymity will be guaranteed at all times. You may decide to withdraw at any stage should you not wish to continue with your participation. Your decision to accept/decline involvement in this research will not influence your teaching career in any way, nor will your participation be reflected in your performance appraisal.

If you are willing to participate in this study, please sign this letter as a declaration of your consent, i.e. that you participate in this project willingly and that you understand that you may withdraw from the research project at any time.

Yours sincerely

.....

Researcher: Mrs. J.J. Botha

.....

Co-supervisor: Dr. G. Stols

Date: .....

Date: .....

**I the undersigned, hereby grant consent to Mrs. J.J. Botha to observe my classes and conduct interviews with me for her PhD research.**

Participant's name ..... Participant's signature ..... Date: .....

E-mail address ..... Contact number .....

Appendix B: Letter of consent to the principals



**FACULTY OF EDUCATION**

Mrs. J.J. Botha  
Natural Science Building 4-13  
Groenkloof campus, UP  
hanlie.botha@up.ac.za  
Tel: 082 475 6096

19 April 2011

Dear Dr/Ms/Mr .....

**Letter of consent to the Principal**

I hereby request permission to use your school for my research project. I would like to invite a Mathematical Literacy teacher to participate in this research project aimed at investigating the influence of Mathematical Literacy teachers' knowledge and beliefs on their instructional practices. This research will be reported upon in my PhD thesis conducted at the University of Pretoria.

Your participation in this research project is voluntary and confidential. It is proposed that the teacher forms part of this study's data collection phase by being observed three times when teaching Mathematical Literacy class(es) and being individually interviewed three times. The lessons will be video recorded and the interviews will be audio-taped by me in order to have a clear and accurate record of all the activities and communication during the lesson.

The process will be as follows: during the third term of this year, should you look favourably upon my request, I would like to observe the teacher teaching three Grade 11 Mathematical Literacy lessons, preferably to different Mathematical Literacy classes during normal school hours. I would like to conduct a short interview with the teacher prior to the second and third lessons and another interview at the end of the three observations. The duration of the interviews prior to the lessons will not be more than 20 minutes and can be conducted during break or a free period the teacher has. The duration of the third and final interview will take a maximum of an hour and will be scheduled at a time convenient to the teacher. The focus of the questions is on the teachers' knowledge and beliefs regarding Mathematical Literacy as subject, the teaching thereof and the Mathematical Literacy learners. The interviews will be scheduled at a time and place convenient to the teacher.

Confidentiality and anonymity will be guaranteed at all times. Your decision to accept involvement in this research will hopefully contribute to the improvement of Mathematical Literacy teachers' practices. If you are willing to allow a member of your staff to participate in this study, please sign this letter as a declaration of your consent.

Yours sincerely

.....

Date: .....

Researcher: Mrs. J.J. Botha

.....

Date: .....

Co-supervisor: Dr. G. Stols

---

**I the undersigned, hereby grant consent to Mrs. J.J. Botha to conduct her research in this school for her PhD research.**

School principal's name .....

School principal's signature .....

Date:.....

E-mail address .....

Contact number .....



Appendix C: Letter of permission to the department



FACULTY OF EDUCATION

Mrs JJ Botha  
Aldoel Building C04  
Groenkloof Campus  
hanlie.botha@up.ac.za  
Tel: 082 475 6096

15 March 2010

GAUTENG DEPARTMENT OF EDUCATION

Dear Sir/ Madam

**Request from GDE for permission to do classroom observations and to conduct interviews**

I am currently enrolled as a doctoral student at the University of Pretoria, where I am also a lecturer in the Department of Science, Mathematics and Technology Education. The title of my proposed thesis is as follows: **The influence of Mathematical Literacy teachers' knowledge, beliefs and attitudes on their instructional practices.** ML is a valuable subject and it is crucial to attain its purpose in our country by addressing problems experienced by both teachers and learners. My research concerns the ML teacher's role in the classroom situation. It is important to determine who the ML teachers are, what knowledge they have regarding the subject and what beliefs and attitudes they hold. Furthermore I want to explore and interpret the influence of those elements on these ML teachers' instructional practices. I hope, at the end of my research, to be able to make a contribution to the improvement of pre-service training in order to perk up ML teachers' instructional practices.

In order to collect data for this project, I would like to observe and interview a purposive sample of Mathematical Literacy teachers, preferably grade 11 teachers at approximately six schools in and around Tshwane. Each teacher will be observed three times and interviewed twice. My observations will be unobtrusive.

I therefore formally request your permission to observe and interview Mathematical Literacy teachers at schools in and around Tshwane in the second term of this year. I trust that my request will meet with a favourable response.

Yours faithfully

.....  
Researcher: Mrs JJ Botha

.....  
Date

.....  
Supervisor: Dr G Stols

.....  
Date

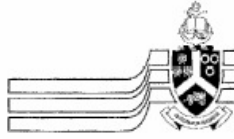
**I the undersigned, hereby grant consent to Mrs JJ Botha to conduct research for her PhD at schools in and around Tshwane.**

.....  
Departmental officer

.....  
Date



Appendix D: Ethical clearance certificate



UNIVERSITY OF PRETORIA  
FACULTY OF EDUCATION  
RESEARCH ETHICS COMMITTEE

**CLEARANCE CERTIFICATE**

**CLEARANCE NUMBER :**

SM 10/02/01

**DEGREE AND PROJECT**

PhD

**INVESTIGATOR(S)**

Johanna Jacoba Botha

**DEPARTMENT**

Science, Mathematics and Technology Education

**DATE CONSIDERED**

17 October 2011

**DECISION OF THE COMMITTEE**

APPROVED

Please note:

*For Masters applications, ethical clearance is valid for 2 years*

*For PhD applications, ethical clearance is valid for 3 years.*

**CHAIRPERSON OF ETHICS  
COMMITTEE**

Prof L Ebersohn

**DATE**

17 October 2011

**CC**

Jeannie Beukes  
Prof. J.G. Maree  
Dr G. Stols

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

**Appendix E: Observation sheet for observing ML teachers' lessons**

**OBSERVATION SHEET**

(To be used for all three observations per teacher)

Name of school	
Name of researcher	Mrs. J.J. Botha
Subject observed	Mathematical Literacy (ML)
Grade observed	
Number of learners in class list (present in class)	
Topic of the lesson	
Name of teacher	
Date of observation	
Observation number	

*Table A and Table B are based on the different dimensions of teachers' lessons. Use the indicators in Table B to complete Table A.*

*Table C and Table D are based on the teachers' pedagogical content knowledge (PCK) and beliefs. Use the indicators in Table D to complete Table C.*

**Table A. ASSESSING TEACHERS' INSTRUCTIONAL PRACTICES THROUGH OBSERVATIONS**

(Videotape lesson and make field notes during observations)

LESSON DIMENSIONS	COMMENTS (Support with examples)
Tasks	
Modes of representation	
Motivational strategies	
Sequencing/difficulty level	
Discourses	
Teacher-learner interactions	
Learner-learner interactions	
Questioning	
Learning environments	
Social/intellectual climate	
Modes of instruction/pacing	
Administrative routines	
Other	
Mathematical content knowledge	
Contextual knowledge	

*Evaluation scale:* Table A: Description of the scale. 3 = commendable (strong presence of indicator); 2 = satisfactory (indicator is somewhat present); 1 = needs attention (there is very little presence of indicator); N/O = not observed or not applicable.

**Table B. EVALUATING TEACHERS' PCK AND BELIEFS THROUGH OBSERVATIONS AND INTERVIEWS**  
(Videotape lesson and make field notes during observations; audio-tape the interviews)

TEACHERS' PCK AND BELIEFS	COMMENTS (Support with examples)
PCK AND BELIEFS	
Mathematical content Knowledge	
Content and learners	
Content and teaching	
Curriculum	
BELIEFS	
Nature of mathematics	

*Evaluation scale:* Table B: Description of the scale. 3 = commendable (strong presence of indicator); 2 = satisfactory (indicator is somewhat present); 1 = needs attention (there is very little presence of indicator); N/O = not observed or not applicable.

**Appendix F: Interview schedule 1 (Prior to lessons 2 and 3)**

**INTERVIEW SCHEDULE 1**  
**Semi-structured interview**

**GENERAL INFORMATION**

Name of school	
Name of researcher	Mrs. J.J. Botha
Name of teacher	
Date of interview	
Teacher's qualification	
Level of Mathematics education	
Number of years teaching Mathematics	
Number of years teaching ML	
Courses attended on teaching ML	

Based on the lesson that you are about to present and your preparation for the lesson, please answer the following questions:

1. What is the topic of the lesson you are going to present?
2.
  - a) What mathematical content do you predict the learners will understand?
  - b) Why do you think they will comprehend this content?
3.
  - a) What mathematical content do you predict the learners will not understand?
  - b) Why do you think they will not understand this content?
4.
  - a) Tell me about the context to which the mathematical content is applied in today's lesson.
  - b) Is the context familiar or unfamiliar to the learners?
  - c) If unfamiliar, how do you plan to make it comprehensible to the learners?
5. How did you plan to approach the lesson in order to bring the learners to understand the content and context?
6.
  - a) Tell me about the task(s) you are going to give them.
  - b) In which way, in your opinion, will the learners approach these task(s)?
7. What prior knowledge is needed by the learners to enable them to understand today's new work?
8. What alternative or preconceptions do you believe the learners could have that may serve as misconceptions?



Appendix G: Interview schedule 2 (Final interview)

**INTERVIEW SCHEDULE 2**  
**Open-ended and semi-structured interview**

**GENERAL INFORMATION**

Name of school	
Name of researcher	Mrs. J.J. Botha
Name of teacher	
Date of interview	

This interview consists of three sections. The **first section** (Section A) is an open discussion based on the lessons presented and focuses on the teacher's demonstrated PCK and beliefs. The purpose is to give the teachers the opportunity to reflect on their lessons and to identify justification for their behaviour in the classroom. The **second section** (Section B) is a discussion according to a set of predetermined questions on the teacher's beliefs regarding the nature of mathematics as discipline, ML as subject, the ML learners, the teaching of ML and the curriculum. The **third section** (Section C) consists of questions regarding the NCS and CAPS and should be answered in writing.

**SECTION A**  
**Oral questions based on the observed lessons**

Questions will be compiled once the observations have been done and will most probably vary from teacher to teacher. The questions will be based on incidents where PCK was identified during the lessons. Clips from the video recordings will be used as probes. Possible questions are the following:

1. Tell me about your positive experiences regarding
  - a) the learners
  - b) your teaching of the lesson
2. Tell me about your negative experiences regarding
  - a) the learners
  - b) your teaching of the lesson
3. I noticed that you used ... (lecturing, group work, discussion etc.) in today's lesson.  
Why did you choose this teaching strategy for the lesson?

## SECTION B

### Oral questions based on the teacher's beliefs

#### The nature and value of mathematics and ML:

1. How do you view mathematics as discipline?
2. Complete the sentence: Mathematics is .....
3. How do you view ML as subject?
4. What do you believe is the value of mathematics?
5. What do you believe is the value of ML?
6. What is your role as teacher in your ML classroom?

#### ML learners:

1. Describe your Grade 11 ML learners in terms of their
  - a) mathematical abilities
  - b) motivation
2. Give me a description/profile of your ML learners.
3. How can you improve your learners' appreciation of the subject ML?
4. How can you improve your learners' participation in the lesson?
5. What is your belief about the way learners proficiently learn new work?

#### Teaching of ML:

1. How do you feel about teaching ML?
2. Describe the ideal ML classroom in terms of
  - a) instructional strategies used
  - b) discourse
  - c) learning environment
3. How does this ideal classroom compare with your own class?
4. What are your goals in teaching ML?
5. To what extent is mathematical content knowledge a prerequisite to teach ML?
6.
  - a) Does the teaching approach of ML differ to that of Mathematics?
  - b) If you experience a difference, tell me about your experiences in teaching Mathematics versus ML.



## SECTION C

### Written questions based on the teacher's knowledge regarding the curriculum

1. How does the Department of Education define Mathematical Literacy?  
\_\_\_\_\_  
\_\_\_\_\_
  
2. What is the purpose of Mathematical Literacy according to the Department of Education?  
\_\_\_\_\_  
\_\_\_\_\_
  
3. Which contexts does the Department of Education suggest you should use in teaching Mathematical Literacy? \_\_\_\_\_  
\_\_\_\_\_
  
4. Write down what you know about the new Curriculum Assessment Policy Statement (CAPS) for Mathematical Literacy. \_\_\_\_\_  
\_\_\_\_\_
  
5. a) Which topic are you currently teaching? \_\_\_\_\_  
b) Name the instructional materials you use for your lessons on this topic.  
\_\_\_\_\_  
c) Comment on the availability and usefulness of the instructional materials. \_\_\_\_\_  
\_\_\_\_\_
  
6. a) Which textbook(s) are you using? \_\_\_\_\_  
b) Which other material do you use? \_\_\_\_\_  
c) In your opinion, what are the strengths of these books and materials?  
\_\_\_\_\_  
d) In your opinion, what are the weaknesses of these books and materials?  
\_\_\_\_\_
  
7. Are you aware of the curriculum content being studied by your learners in other subjects that integrate with Mathematics/ML? If yes, tell me about it.  
\_\_\_\_\_

8. a) Which departmental documents exist that you know of?

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b) Which of these departmental documents do you find useful and valuable? \_\_\_\_\_

---

9. What are the learning outcomes for Mathematical Literacy?

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10. A list of concepts and content to be covered in grade 10, 11 or 12 are provided per Learning Outcome in the following table. Indicate in which grade the specific concept/content is introduced. (*Only complete the Learning Outcomes applicable to the observed lessons*)

**Table E: Concepts and content per learning outcome (DoE, 2003a; p. 38-42)**

CONCEPTS AND CONTENT PER LEARNING OUTCOME	Grade		
	10	11	12
<b><i>LEARNING OUTCOME 1</i></b>			
Cost price and selling price			
Complex formulae			
Currency fluctuations			
Direct proportion			
Financial and other indices			
Fractions, decimals, percentages			
Inverse proportion			
Positive exponents and roots			
Profit margins			
Rate			
Ratio			
Ratio and proportion			
Simple and compound growth			
Simple formulae			
Square roots and cube roots			
Scientific notation			



Taxation			
The associative, commutative and distributive laws			
<b><i>LEARNING OUTCOME 2</i></b>			
Cartesian co-ordinate system			
Compound growth			
Formulae depicting relationships between variables			
Graphs depicting the relationship between variables			
Graphs showing the fluctuations of indices over time			
Inverse proportion			
Linear functions			
Maximum and minimum points			
Simple linear programming (design and planning problems)			
Simple quadratic functions			
Solution to linear, quadratic and simple exponential equations			
Solution to two simultaneous linear equations			
Rates of change (speed, distance, time)			
Tables of values			
<b><i>LEARNING OUTCOME 3</i></b>			
Angles ( $0^\circ$ - $360^\circ$ )			
Basic transformation geometry, symmetry and tessellations			
Circles			
Compass directions			
Conversion of measurements between different scales and systems			
Conversion of units within the metric system			
Floor plans			
Location and position on grids			
Measurement in 3D (angles included, $0^\circ$ - $360^\circ$ )			
Measurement of length, distance, volume, area, perimeter			
Measurement of time (international time zones)			
Polygons commonly encountered (triangles, squares, rectangles that			
Properties of plane figures and solids in natural and cultural forms			
Scale drawings			
Scale models			
Sine rule, cosine rule, area rule			



Surface areas and volumes of right pyramids and right circular cones and spheres			
Surface area and volumes of right prisms and right circular cylinders			
Theorem of Pythagoras			
Trigonometric ratios: $\sin x$ , $\cos x$ , $\tan x$			
Views			
<b><i>LEARNING OUTCOME 4</i></b>			
Bivariate data			
Compound events			
Construction of questionnaires			
Contingency tables			
Cumulative frequencies			
Histograms			
Intuitively-placed lines of best fit			
Line and broken-line graphs			
Mean, median, mode			
Ogives (cumulative frequency graphs)			
Percentiles			
Pie charts			
Populations			
Probability			
Quartiles			
Relative frequency			
Scatter plots			
Selection of a sample			
Selection of samples and bias			
Single and compound bar graphs			
Standard deviation (interpretation only)			
Tables recording data			
Tally and frequency tables			
Tree diagrams			
Variance (interpretation only)			

**END OF INTERVIEW**

### Appendix H: List of research studies for Literature Control

AUTHOR AND YEAR	TITLE OF ARTICLE	PARTICIPANTS	SOURCE	APPLICABILITY	
				IP	PCKB
Bansilal, S. (2008)	An exploration of teachers' difficulties with certain topics in Mathematical Literacy	In-service teachers in ACE (ML) programme	Proceedings of AMESA 2008	Tasks: TSL	MCK; PCK Curr: C7
Bansilal, S., Mkhwanazi, T. & Mahlaboratoryela, P. (2010)	Mathematical Literacy teachers' engagement with contexts related to personal finance	In-service teachers in ACE (ML) programme	Proceedings of SAARMSTE 2010	Discourse: DTL	Curr: C7
Bowie, L. (2009)	Critical issues in school mathematics and science: pathways to progress	Theory	Proceedings of an Academy of Science of South Africa Forum	N/A	
Fransman, J.S. (2011)	Exploring the practices of teachers in mathematical literacy training programmes in South Africa and Canada	In-service teachers in ACE (ML) programme	Unpublished dissertation for the degree Master of Education	Learning environment: LEC, LESP	MCK; PCK (I); Curr: C1, C3, C4, C5, C8
Frith, V. (2009)	A framework for understanding the quantitative literacy demands of higher education	Theory	Journal: South African Journal of Higher Education	N/A	
Frith, V. (2010)	How to make every graph a straight line (or not!)	Mathematics	Learning and Teaching Mathematics	N/A	
Frith, V. (2011)	Towards understanding the quantitative literacy demands of a first year medical curriculum	University students	African Journal of Health Professions Education	N/A	
Geldenhuys, J., Kruger, C. & Moss, J. (2009)	Grade 10 learners' experience of Mathematical Literacy	190 Grade 10 learners from three types of schools	Proceedings of SAARMSTE 2009	Learning environment: LESP	Curr: C1, C7
Glover, H. & King, L. (2009)	The subject knowledge levels of some Mathematical Literacy teachers	In-service teachers in ACE (ML) programme	Proceedings of SAARMSTE 2009		MCK

Govender, V.G. (2008)	Lessons learnt from the 2007 GMSA foundation Mathematical Literacy Olympiad	ML Olympiad	Proceedings of AMESA 2008	N/A	
Govender, V.G. (2011)	An investigation into learners' approaches to solving problems in mathematical literacy	12 Grade 12 learners from 1 school	Proceedings of AMESA 2011	Learning environment: LESP	Curr: C7
Govender, V.G. (2011)	University students' experiences of a mathematics service module: Numerical Skills for Nursing	University students	Proceedings of SAARMSTE 2011	N/A	
Graven, M. & Venkat, H. (2009)	Mathematical Literacy	Theory	Book: Chapter 4 in Critical issues in mathematics education	Tasks: TMS; Learning environment: LEC; LESP	Curr: C7
Graven, M. (2011)	Mathematical Literacy in South Africa: Increasing access and quality in learners' mathematical participation both in and beyond the classroom	Theory	Book: Chapter 35 in Mapping equity and quality in mathematics education	Do not have the book	
Graven, M. (2011)	Creating new mathematical stories: Exploring potential opportunities within Maths Clubs	Maths Clubs	Proceedings of AMESA 2011	Discourse; Learning environment: LEC; LESP	
Hechter, J. (2011)	Analysing and understanding teacher development on a Mathematical Literacy ACE course	In-service teachers in ACE (ML) programme	Unpublished thesis for Master of Science	Tasks; Discourse: DTL; Learning environment	Beliefs
Hechter, J. (2011)	Case studies of teacher development on a mathematical literacy ACE course	In-service teachers in ACE (ML) programme	Proceedings of AMESA 2011	Tasks: TMS; TSL; Discourse: DQ; Learning environment: LEC	Curr: C7 Question 4
Mthethwa, T.M. (2009)	An analysis of Mathematical Literacy curriculum documents: cohesions, deviations and worries	Theory	Proceedings of AMESA 2009	N/A	



Nel, B. (2011)	Investigating the transformation of teacher identity of participants in an Advanced Certificate in Education in Mathematical Literacy (Reskilling) programme at a South African University	In-service teachers in ACE (ML) programme	Proceedings from SAARMSTE 2011		Beliefs Question 4
North, M. (2008)	The great Mugg and Bean mystery	Theory	Journal: Learning and Teaching Mathematics	Learning environment: LESP	
North, M. (2008)	Progression in Mathematical Literacy	Theory	Proceedings of AMESA 2008		Curr: C7
North, M. (2010)	How mathematically literate are the matriculants of 2008?	Grade 12 performance	Proceedings from AMESA 2010	N/A	
Rughubar-Reddy, S. (2010)	Beyond Numeracy: Values in the Mathematical Literacy classroom	5 Grade 10 learners from 1 school	Proceedings of SAARMSTE 2010	Learning environment: LEC	
Sidiropoulos, H. (2008)	The implementation of a mandatory mathematics curriculum in South Africa: The case of mathematical literacy	Two Grade 10 ML teachers from 2 different schools	PhD thesis	Learning environment: LESP	Curr: C1,C7, C8 Beliefs PCK (T/C) Q.3
Venkat, H. (2008)	Senior certificate examinations for mathematical literacy: findings from a small study	Grade 12 results	Journal: Learning and Teaching Mathematics	N/A	
Venkat, H. & Graven, M. 2008	Opening up spaces for learning: Learners' perceptions of Mathematical Literacy in Grade 10	All Grade 10 ML learners in 1 school	Journal: Education as Change	Tasks: TMS; Discourse: DLL; Learning environment: LEC,LESP,LEA	
Venkat, H., Graven, M., Lampen, E. & Nalube, P. (2009)	Critiquing the Mathematical Literacy assessment taxonomy: Where is the reasoning and the problem solving?	Theory	Journal: Pythagoras	Learning environment: LESP Problem solving	

Venkat, H., Graven, M., Lampen, E., Nalube, P. & Chitera, N. (2009)	'Reasoning and reflecting' in Mathematical Literacy	Theory Assessment tasks	Journal: Learning and Teaching Mathematics	Tasks: TSL; Discourse; Scaffolding	
Venkat, H. (2010)	Exploring the nature and coherence of mathematical work in South African Mathematical Literacy classrooms	1 Grade 11 ML teacher	Journal: Research in Mathematics Education	Tasks: TMS; Discourse	Curr: C7
Vithal, R. (2008)	Mathematical power as political power – the politics of mathematics education	Theory	Book: Chapter in Critical issues in mathematics education	N/A	
Vithal, R. (2008)	Mathematical Literacy and globalization	Theory	Book: Chapter 1 in Internationalisation and globalization in mathematics and science education	N/A	
Zengela, C. (2008)	Turning myself around – Experiences of teaching Mathematical Literacy	1 Grade 12 teacher	Learning and Teaching Mathematics		Curr: C1, C7

## Appendix I: Analysis of discussions on Theme 1 and Theme 2

An analysis of discussions on Theme 1 and Theme 2 produced the following tables:

**Table: Findings of my study listed according to a Teacher and Learner-centred approach**

Teacher-centred (Monty and Alice)	Learner-centred (Denise and Elaine)
<b><i>Instructional practices</i></b>	
Did not point out the value of mathematics to the learners	Pointed out the value of mathematics to the learners (Not Denise)
Did not determine or appropriately use learners' prior knowledge	Lessons were build on learners' prior knowledge
Did not encourage learner participation and did not require learners to explain their answers	Involved learners through class discussions and learners working on the board where learners could also explain and/or demonstrate their work
Instead of providing scaffolding, either re-explained the work or solved the problem for them	Provided scaffolding to support learner understanding
Insufficient knowledge of oral questioning in class	Asked various types of oral questions on different levels (Not Denise)
Created a formal atmosphere where focus was on mastering the content	Created a class atmosphere where learners were comfortable and confident
Used direct instruction as instructional strategy	Used class discussions and learners working on the board as instructional strategies
Board work were incomplete and disorganised	Board and transparency work were organised and no errors were made
<b><i>PCK and beliefs</i></b>	
Superficial knowledge regarding learners. Believed learners come to understanding by looking at several examples and through much practice	Specific knowledge regarding learners. Believed learners come to understanding by being involved through sharing their ideas and where the teacher build on their prior knowledge
Superficial knowledge regarding the teaching of ML. Believed the teaching of ML is the same as that of teaching Mathematics	Specific knowledge regarding the teaching of ML. Believed ML teaching differs from teaching Mathematics

## Appendix J: Additional information verifying Question 1

I found that two of the four instructional practices of the ML teachers in my study can be described as being exclusively teacher-centred, one teacher's practice can be described as a combination of learner- and teacher centred, leaning more towards learner-centred, while the fourth teacher's practice could be described as exclusively learner-centred.

### The practices of Monty and Alice

Monty and Alice's instructional practices can be described as teacher-centred where they believed their role as teachers was to transmit mathematical content, demonstrate procedures for solving problems, and explain the process of solving sample problems. This finding is in accordance to the findings of Artzt et al. (2008). From the observations and interviews prior to the observed lessons I realised that their focus was on transmitting mathematical content and not on the needs of the learners to develop conceptual understanding. Their practices are characterised by (according to the three lesson dimensions):

- Tasks: Not pointing out the value of mathematics so that the learners could appreciate the mathematics learned; tasks being illogically sequenced; tasks being too easy or too difficult or excessive; selecting tasks only from Level 1 of the ML Assessment Taxonomy;
- Discourse: An absence of monitoring learners' understanding; Instead of providing scaffolding, solving the problems for the learners; expressing irritation with learners' wrong answers; no constructive learner-learner interaction; low level questioning with inappropriate wait times to engage and challenge learners' thinking;
- Learning environment: Formal atmosphere where the focus was on mastering the content; using direct instruction as instructional strategy; learners being passive recipients of information.

There were differences between Monty and Alice's practices: Alice's practice was largely dysfunctional, with inattentive learners and ineffective teaching. She did not connect the learners' prior knowledge with the new mathematical situation. As both Monty and Alice are novice teachers, a plausible hypothesis seem to be the following: The difference between their practices could be attributed to the fact that Alice had no formal mathematics education training, but Monty completed a BEd with Mathematics and Methodology of Mathematics as major subjects. It is interesting to note that the teacher-centred approach can serve as a mask for teachers who do not possess full knowledge of the content, students and pedagogy (Artzt et al., 2008, p. 35). Compared to Franke et al.'s (2007) view of a productive practice being a practice where the teacher creates ongoing opportunities for learning, the

practices of Monty can be described as somewhat unproductive, where Alice's practice was unproductive.

## The practices of Denise and Elaine

Denise's instructional practice can be described as a combination of learner- and teacher-centred, leaning more towards being teacher-centred, while Elaine's instructional practice can be characterised as teacher-centred. Their purpose was that learners should develop both procedural and conceptual understanding of the content. Using a learner-centred approach to teaching requires the teacher to create opportunities for learners to come to understanding by being actively engaged with one another and the problem solving process (Artzt, et al., 2008). Their practices are characterised by (according to the three lesson dimensions):

- Tasks: Lessons being built on learners' prior knowledge; representations contributing to the clarity of the lessons; tasks being logically sequenced and at a suitable level of difficulty;
- Discourse: Encouraging learner participation; meaningful discourse between the teacher and the learners; providing scaffolding to support learner understanding; recognising learners' misunderstandings and misconceptions;
- Learning environment: Having the ability to create learning environments that contributed to proficient learning; having positive attitudes towards the subject and the learners; involving learners through class discussions and learners working on the board; effective managing of time to maximise learners involvement; board and overhead projector work being organised and no errors were made.

There are some differences between the practices of Denise and Elaine. The following are characteristics of only Elaine's practice:

- Tasks: Exploring contexts using mathematical content; pointing out the value of mathematics in everyday-life situations to the learners; selecting tasks from Level 1-4 of the ML Assessment Taxonomy;
- Discourse: Having learners demonstrate and explain their answers; asking various types and different levels of oral questions;

Elaine's practice can therefore be described as a productive instructional practice as she created ongoing opportunities for learning to occur (Franke et al., 2007) while Denise's can be described as somewhat productive.

## Appendix K: Additional information verifying Question 2

The MCK of the four participants are described in the verification of question 2.

- **PCK and beliefs of two novice teachers**

**Knowledge and beliefs of ML learners:** Monty and Alice believe that learners learn best by receiving clear information transmitted by a knowledgeable teacher, a finding Artzt et al. (2008) also found where teachers used a teacher-centred approach. They could not predict what content the learners would and would not understand; how they would come to understanding; and what possible misconceptions the learners might have.

**Knowledge and beliefs of ML teaching:** Once Alice introduced tasks that caused confusion for her and the learners, she did not know how to adjust - a phenomenon that is according to Artzt et al. (2008) typical of teachers in the initial phase of teaching. Monty and Alice could not predict the prior knowledge that should have been present in the lesson for the learners to understand the new content and could not choose appropriate instructional strategies to use in their teaching of ML. They furthermore used examples too basic or too complex throughout the lesson presentations. They believed the teaching of ML is different to the teaching of Mathematics and that group work and discussions should be used in teaching ML.

**Knowledge and beliefs of the ML curriculum:** Monty and Alice had no knowledge of other subjects integrating with ML, although they did have some knowledge about the definition, purpose and learning outcomes of ML, but not of the various departmental documents. Most importantly they taught content in the absence of contexts and did not adhere to the DoE's (2008b) aim to develop in learners [t]he ability to use basic mathematics to solve problems encountered in everyday life and in work situations (p. 8), although they believe real-life scenarios should be used. They believe mathematics as a constructivist discipline which is logical and that ML is valuable to learners. According to Monty, ML is a unique subject, but Alice believes that ML is a lower level of Mathematics.

- **PCK and beliefs of two experienced teachers**

**Knowledge and beliefs of ML learners:** Denise and Elaine have specific knowledge of learners' prior knowledge, experiences and abilities. They could predict what learners would and would not understand; how they would come to understanding; and what misconceptions learners have and typical errors the learners make. They believe the learners should be active participants in their own learning by explaining the work to each other in small groups.

**Knowledge and beliefs of ML teaching:** Since they understand how learners learn mathematics, they knew how to select appropriate instructional strategies and could adjust their teaching when required. They predicted and integrated the prior knowledge needed to enable the learners to understand the work and chose appropriate instructional strategies. They believed their role as teacher is facilitating learners' learning through selecting appropriate tasks and leading the discussions in class. They furthermore believed that teachers should provide opportunities where learners can discover and construct their own meaning through meaningful communication.

**Knowledge and beliefs of the curriculum:** Only Elaine knew about other subjects that integrate with ML, and she knew the definition and learning outcomes. Denise and Elaine knew the purpose of ML and were familiar with various departmental documents. Only Elaine taught the mathematical content in context where all her tasks were based on applicable real-life scenarios (DoE, 2003a). Denise taught content only although she believes a teacher should use contexts. Both these teachers believe mathematics is a flexible and logical discipline and that ML is a unique subject and valuable to the learners.



## Appendix L: Declaration: External coder

28 September 2011

Hiermee verklaar ek, Barbara Posthuma, dat ek as eksterne kodeerder opgetree het by die kodering van data vervat in Hanlie Botha se tesis.

Ek verklaar dat ons na toepaslike beraadslaging ooreengekom het oor temas en subtemas wat gebruik is tydens dataontleding.

Ek verklaar verder dat hierdie temas en subtemas toepaslik en op wetenskaplik-gefundeerde wyse bepaal is en die tendense wat in die data voorkom, na my mening so akkuraat weergegee is as wat moontlik is met die kwalitatiewe wyse van analise wat onderneem is.

Die uwe

B. Posthuma