ETL421 2014/2 ASSIGNMENT ONE – CURRICULUM THROUGH NUMERACY

TASK: (2,000 WORDS)

Document, analyse, consolidate and redirect learning while working through Module One of the Learning Materials.

EXPECTED CONTENT: The assignment (when considered as a whole) should contain:

Documentation:

- An overview of your teaching context (real or anticipated).
- Written responses to at least four of the numbered activities in Module 1.

Analysis:

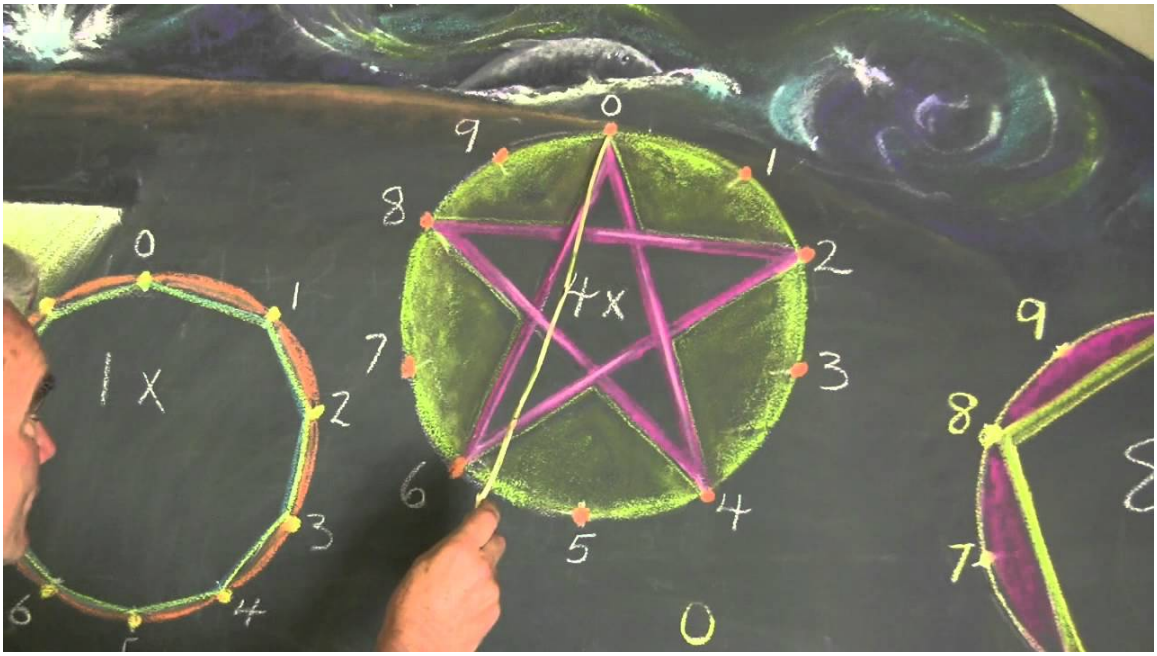
- A plausible interpretation of the school-based scenario described in Davis and Renert's opening chapter (2014, pp. 1-15).
- Suggestions on how you could harness this interpretation to better address applicable curriculum (e.g. segments of the Australian Curriculum) within your teaching context.
- Identification of a particular element of numeracy you'd like to investigate further.
- Rationale for prioritising this element of numeracy within your teaching context.

Consolidation:

- An outline of a compelling classroom activity designed to encourage your students (whether real or imaginary) to experience in context a key aspect of your prioritised element of numeracy.
- A summary of the pedagogy and/or other interactions underpinning the activity.
- A visualisation showing how your thinking links to significant themes arising in the Learning Materials, Davis and Renert (2014), and other relevant literature as applicable.

Redirection:

- A description of a surprising idea or an unanswered question that you'd like to pursue in Assignment 2 (without obligation).
- Several recommendations on how you might progress your learning from here.



Source: *Learning Times Tables with 10 Point Circles, n.d.*

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DOCUMENTATION

AN OVERVIEW OF YOUR TEACHING CONTEXT (REAL OR ANTICIPATED)

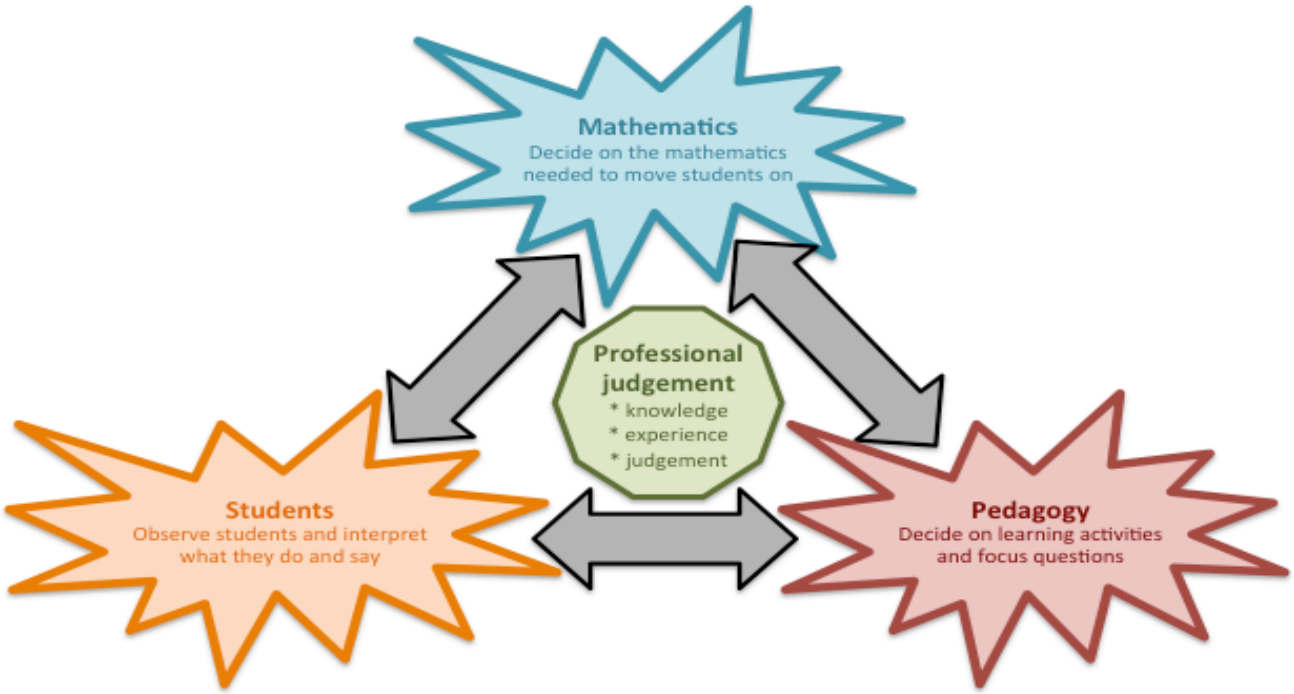
My teaching context is high school mathematics and science, Years 7 to 12. I am working across three schools. Two of these are Cooks Hill Campus (CHC) and Hunter Sports High School (HSHS), both running Big Picture Education Australia (BPEA) programs with some high school students. At HSHS I am working with Year 10, and at CHC I am working with both Year 9 and Year 10. The third school is Newcastle Waldorf School, which uses the Waldorf pedagogy and is affiliated with Steiner Education Australia (SEA).

WRITTEN RESPONSES TO AT LEAST FOUR OF THE NUMBERED ACTIVITIES IN MODULE 1 ACTIVITY 1.1

[1]Responses are given to recommendations one, eight and fifteen.

Factors most likely to affect successful implementation of the three recommendations:

- The NSW Mathematics Curriculum does not stretch outside the acquisition of mathematical routines and algorithms, no matter how well they are learned. Students need to learn mathematics in ways that enable them to recognise when mathematics might help to interpret information or solve practical problems, apply their knowledge appropriately in contexts where they will have to use mathematical reasoning processes, choose mathematics that makes sense in the circumstances.
- Action needs to be taken to ensure that there is an appropriate allocation of time for mathematics.
- Often in Australian mathematics classrooms students do low-level procedural tasks. The time, understanding and thoughtful action that deep mathematical learning requires must be acknowledged.
- The language of all subjects can include terms whose meaning lies in numerical literacy. It seems teachers of non-mathematical subjects are not able to bring this into their teaching.
- Davis proposes that there does not seem to be a correlation between the level of mathematics known or studied by the teacher and how well they are able to actually teach this to their students. It is not about being able to do advanced engineering mathematics. It is about being able to reach the students by inspiring them and making the lessons fun.
- Financial constraints and inequality in government funding across schools based on their geographical location, students with special needs, numbers of students, and socio-economic demographics.



Source: (Department of Education, Science and Training)

[1] The recommendations are provided in Appendix One.

ACTIVITY 1.2

Why is numeracy a distinct area of interest?

Numeracy should not be subsumed under literacy; it merits separate and serious attention. The demands on numeracy tend to be context-specific. Numeracy skills are needed in all subject areas. It is reported that many adults lack the numeracy skills needed to function in a maximally effective manner in their vocational, civic and personal lives.

How have definitions of numeracy changed over time? (What have the main changes been, and what has brought these about?)

The definition has expanded considerably over time. The process of change mirrors the evolution of the definition of literacy. Most recent descriptions of numeracy include reference to learner's attitudes, confidence and disposition to use numeracy skills independently.

From 2008 students' numeracy skills are being tested under the NAPLAN. All education systems across Australia have drawn up numeracy development plans.

The changes that have occurred in conceptualising numeracy tend to parallel the changes that have occurred in the past 25 years with literacy.

In what ways is it helpful (or unhelpful) to draw a comparison between numeracy and mathematics?

The mathematical underpinning of numeracy is not restricted to working with numbers, but also includes work with space, data (statistical and measurement) and formulae. Numeracy involves a combination of:

- Mathematical concepts and skill form across the discipline
- Mathematical thinking
- Numerical strategies
- Appreciation of context

To be numerate you must know some mathematics, but simply knowing some maths does not necessarily make a person functionally numerate. Mathematical competence comprises more than numeracy.

Thinking about a subject area that you know well, how does (or how could) numeracy become (better) integrated within that subject area?

As an engineer and a pre-service teacher in the areas of high school mathematics and science, numeracy is central many things. In the subject area of Stage 6 mathematics, numeracy can be included into:

- Communication: mobile phone plans; digital download and file storage
- Health: body measurements, medication; life expectancy
- Driving: costs of purchase and insurance; running costs and depreciation; safety
- Resources: water availability and usage; dams, land and catchment areas; energy and sustainability.

The rationale behind this is that mathematics is deeply embedded in modern society. From the numeracy skills required to manage personal finances, to making sense of data in various forms, to technologies in the sciences and engineering, mathematics provides the framework for interpreting, analysing and predicting, and the tools for effective participation in an increasingly complex society (Board of Studies NSW, 2012).

ACTIVITY 1.7

The placemat was made and is including in *Appendix One*. It matches up well and provides an opportunity for developing and revising my sequence through the process of examination and reflection.

All six types of mathematical activity emphasised by the L-by-D placemat

1. **Stressing and ignoring** – some features are stressed so questions are raised about those features; others are ignored.
2. **Specialising and generalising** – a natural consequence of stressing and ignoring. One or more special cases are tried to get a sense of the generality.
3. **Distinguishing and connecting** – things are distinguished so their properties and relationships between properties are identified. Their similarities and distinctive qualities can be identified (as a result of stressing and ignoring).
4. **Imagining and expressing** – patterns are imagined as continuing and gives the pattern significance; it is then expressed in words, diagrams or symbols.

5. **Conjecturing and convincing** – most things are conjecture, which may be expanded to give several conjectures; these are then established as always true, sometimes true, never true, or still conjecture.
6. **Organising and characterising** – it is natural to organise objects and then characterise them in order to reduce the effort required to remember.

Colouring is definitely therapeutic – as anyone who spends time around young children will know. I thoroughly enjoyed it, as well as the reflection and examination provided by the exercise. The colours used in this activity also help one to remember the knowledge process. The colours can later be used in sequencing and analysing designs. The only downfall was their prescription of which colours to use!

Activity 1.8

Some narratives from *What Works* (Department of Education, Science and Training)*:*

- Numeracy the poor cousin of literacy. Many don't know what numeracy means. Connotations of being numerate don't spring readily to mind and many can't separate numeracy as being distinct from mathematics.
- Students do not appreciate the numerous and very diverse ways in which their mathematical understanding s and skills might, and must, be applied in daily life.
- Many disadvantaged students learn better when presented with verbal rather than written instruction and they are able to manipulate resources and use games to establish and reinforce concepts.
- Recognise the significance language has in mathematics learning, and encourage language-rich environments in mathematics classrooms.
- Language and thought are close relatives – they are both products of experience. New ideas are best assimilated when they can be easily connected to experience.
- Students who have had bad experiences with mathematics may more quickly and easily understand numeracy.
- Mathematics is full of new language which must be learnt

Analysis

A plausible interpretation of the school-based scenario described in Davis and Renert's opening chapter (2014, pp. 1-15)

What a fantastic description of a very healthy and whole way to teach mathematics. The students are allowed to explore a simple question to the depth and in the direction or directions that they feel the need to go.

The marked difference between the classes lies in the difference between the knowledge of mathematics held by each of the teachers. Mathematics for teaching must be seen, heard and felt. *Head, heart, hand* is a motto used by both SEA and BPEA and refers to the holistic intention of both pedagogies. The 'head' refers to cognitive knowledge, the 'heart' to emotional and spiritual learning, and the 'hand' to practical and physical shills as explained in Social pedagogy (n.d., Principles). Educate the whole child.

Instead of a tightly organised and controlled classrooms concerned with facts, the classroom that was about engaging with the world through posing questions, identifying patterns, expressing observations, varying the questions, contriving explanations, defending interpretations and so on.

Not 'what' teachers know but 'how' they know it. What mathematics do teachers need to know in order to teach mathematics? They need to know how to teach.

Suggestions on how you could harness this interpretation to better address applicable curriculum (e.g. segments of the Australian Curriculum) within your teaching context

A skill to be developed by a student at Stage 3 Science in NSW includes students investigating by posing testable questions, making predictions and then gathering data in order to draw an evidence-based conclusion, then developing explanations (Board of Studies NSW, 2009).

A way of addressing the attainment of this skill is to firstly ask the class what they think science is and what is the purpose of studying science. I would talk about the differences between Waldorf and mainstream

science. Before performing a science experiment, for example an Optics experiment appropriate for Year 8, I would talk about the importance of coming to theory through careful observations, as opposed to starting with the theory (York, 8th Grade Physics Lesson Plans, 2012)

Identification of a particular element of numeracy you'd like to investigate further

I would be interested to research the influence that different levels of numeracy have on different careers and professions. For instance, Numeracy (n.d., para 1) states that low numeracy distorts risk perception towards health decision and may negatively affect economic choices. Greater numeracy has been associated with a person's ability to respond to the mathematical demands of life.

Rationale for prioritising this element of numeracy within your teaching context

My rationale for prioritising this element of numeracy within any teaching content is supported by this being one of the many 'real' applications of numeracy for everyone. Developing and maintaining a good level of numeracy and integrating this into our lives has far reaching benefits. Conversely, not having these skills can be detrimental to one's overall health and wellbeing.

Consolidation

An outline of a compelling classroom activity

A compelling classroom activity designed to encourage my students to experience in context a key aspect of numeracy follows (York, 7th Grade Algebra & Geometry Main Lesson, 2012). It describes different ways of looking at a task, and where this can lead, in contrast to sitting and learning by rote how to add a sequence of numbers together. It is aimed at Year 7 level.

The class is asked how they would go about adding all the numbers from one to 100 together. This seems like an enormous and time consuming task and should result in an interesting class discussion.

I would then tell them the story of a man who is thought to be one of the greatest mathematicians ever. Carl Freidrich Gauss was alive in the late 1700s to early 1800s. When he was about 10 years old, he went to a very poor school in Germany. One day his teacher Herr Büttner asked the class to sum all the numbers from one to 100, which was just what we had been talking about.

Instead of putting the numbers in order i.e. 1 + 2 + 3 + 4 + ……. + 99 + 100, Carl did it differently. He actually did it in his head in a matter of minutes, wrote down the answer and handed it to his teacher! I would ask the class if they could guess his secret, and tell them that the answer is 5050.

What Carl realized, was that he could pair the numbers working from either end of the scale, so that each pair added to 101. He added 1 + 100, 2 + 99, 3 + 98 and so on to 50 + 51. This gave him 50 pairs of numbers with a value of 101, so to find the final answer he multiplied 50 by 101 to get 5050. And isn't 5050 an interesting answer when we found it by looking at 50 pairs of numbers?

To finish the lesson I would ask the class to see if they could come up with the formula for this.

A summary of the pedagogy and/or other interactions underpinning the activity

The pedagogy underpinning this activity is the educational philosophy developed by Rudolf Steiner and known as the Waldorf pedagogy or Steiner education. The activity described above is in contrast to much of today's mainstream pedagogies. Too often today education appears to concentrate on superficial results and fails to support the hidden potential of childhood. The education movement in Australia is often pressured, mechanized and devoid of imagination and compassion. It tends to focus on memory rather than the development of understanding. Steiner education is designed to be a health-giving education, nurturing and balancing the human faculties of thinking, feeling and will (Steiner Education Australia, n.d.).

Main lessons in a Steiner high school aim to take students on a rich cultural and pictorial journey to provide a base for ongoing studies at a higher level. The activity above shows how the lesson on the formula developed by Gauss and used to find the sum of a series is done in a way that challenges, excites and allows students to explore and discover.

The Steiner curriculum is on which connects with the student to themselves, to others, to the natural world, to cultural heritage, to the past, the present and the future.

REDIRECTION

As I have completed pre-service teaching in three different schools, I have found it surprising that although all three schools are teaching the NSW curriculum appropriate to the levels being taught, it would seem to me that there is quite a lot of room for interpretation. The NSW Board of Studies, Teaching & Educational Standards (BOSTES) list outcomes for each year level, but the amount or level of difficulty in the material taught, in mathematics Stage 5, for example varies enormously between schools. This is an area I would like to pursue in Assignment 2.

Going forward to progress my learning as a teacher, I aim to make sure that students have positive learning experiences, particularly early on in their schooling. Time needs to be devoted to numeracy, particularly acknowledging that it is not mathematics. Assessments need to be made fun and to serve the main purpose of encouraging the students to keep trying and keep learning. Material needs to be linked to the real world, using as many outdoor and practical activities as possible. The contexts and backgrounds of students need to be considered and included in activities also. I want students to be so engaged in and enjoying their learning that they forget that they are actually learning.

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SEA – ***see*** Steiner Education Australia

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APPENDIX ONE – QUESTIONS AND TASKS (EXCLUDED FROM WORD COUNT)

DOCUMENTATION

ACTIVITY 1.1

Recommendation 1:
That all systems and schools recognise that, while mathematics can be taught in the context of mathematics lessons, the development of numeracy requires experience in the use of mathematics beyond the mathematics classroom, and hence requires an across the curriculum commitment. Both pre- and in-service teacher education should thus recognise and prepare all teachers as teachers of numeracy, acknowledging that this may in some cases be 'subject specific numeracy'.

Recommendation 8:
That the language and literacies of mathematics be explicitly taught by all teachers of mathematics in recognition that language can provide a formidable barrier to both the understanding of mathematics concepts and to providing students access to assessment items aimed at eliciting mathematical understandings.

Recommendation 15:
That structured programmes be implemented to support teachers to develop the knowledge and skills necessary to exercise effective leadership roles in numeracy and mathematics within schools.

ACTIVITY 1.7

Follow the instructions to make the placemat and then try to map your numerate sequence (as it stands) onto the placemat. How well does it match up, and what opportunities does this alternative framework provide for developing or revising your sequence? Some further questions:

- what types of mathematical activity is the L-by-D placemat emphasising (see the Mason and Johnston-Wilder chapter)?
- what role are the coloured pencils playing within this activity?

The placemat is shown below in Figure A-1

ACTIVITY 1.8

Try to articulate some of the narratives you feel are present in the *What Works* material. Is the *What Works* material telling us anything we need to be (re)considering in our 'quality' teaching and learning practices, and in our assessment and reporting practices? And are there any clear messages concerning curriculum and its relation to social capital?