Keep Calm and Carry a Pentagon

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Abstract

This MELT-in-your-mouth paper introduces a variation to the Optimising Problem Solving (OPS) pentagon. Low numeracy skills in adults are widely recognised as a significant concern. Addressing this issue is essential in Vocational Education and Training (VET). The context of this paper is numeracy skills support within the VET sector. Programs which increase numeracy skills of adults, delivered by adequately experienced and qualified practitioners, are needed. The Innovative High Achieving Template Enhancing Maths (Maths Template) was created as a tool for enhancing learning and supporting numeracy skills. Being adaptable to suit diverse environments, it has a broad range of uses. In a user-friendly, uncomplicated practical way, it provides a calm step-by-step approach to skills development. The three key concepts of the Maths Template are familiarity, confidence and competence.

Introduction

Australia has a problem with low literacy and numeracy skills in the adult population (Berghella & Molenaar 2012). Adults with low numeracy skills are less likely to be employed or to keep a job long term. This affects society, the workplace, and the individuals themselves (Berghella & Molenaar 2013; Tout 2014; Black & Yasukawa 2014). As VET are the main providers of workplace-based training, the role of increasing numeracy skills in adults through the integration of numeracy skills into assessment requirements has largely become theirs (SCOTESE 2012).

VET is competency-based. The consequence of incorporating numeracy skills into assessment requirements is that students are unable to progress in their studies until they have developed these skills. There are limited

avenues of support for students who struggle with numeracy. Vocational teachers do not necessarily have the level of understanding required to be able to help these students (Berghella & Molenaar 2013). Availability of practitioners who specialise in teaching numeracy skills is limited, with inadequate interest or options for people to train (Berghella & Molenaar 2013).

Research has shown that a flexible approach which has been contextualised to the numeracy skills of the discipline area is the most successful (Medlin 2016). The Innovative High Achieving Template Enhancing Maths has been developed with the needs of students in mind. Using the Optimising Problem Solving pentagon as a starting point, it is an adaptable discipline-specific framework. Using the example of medication administration in nursing, it will be shown that the Maths Template is easy for teachers to use and intuitive for students to learn.

Theory

The Adult Literacy and Life Skills Survey (ALLS) divides literacy and numeracy skills into five levels (The Australian Bureau of Statistics [ABS] 2008). In the ALLS survey, level 3 is considered to be the baseline necessary to cope with the demands of everyday literacy and numeracy requirements (Black & Yasukawa 2013). According to the 2006 ALLS, nearly 50% of Australians aged between 15 and 74 falls below this baseline (Tout & Mendelovits 2013).

Employers need employees who have adequate numeracy skills. The level of skills required to be considered "adequate" has increased, with changes in the way we work (Berghella & Molenaar 2012). Low Language, Literacy and Numeracy (LLN) skills in employees affect productivity. Time is wasted with incorrect calculations, misinterpreted instructions, and forms not completed accurately (Black & Yasukawa 2012; Mayer 2016; Livock 2016).

Since 2006, Australia's numeracy skills have declined (Tout 2014). Both government and industry need this to change (Black & Yasukawa 2012). In 2012, the National Foundation Skills Strategy was released (Standing Council on Tertiary Education Skills and Employment [SCOTESE] 2012). Primarily, it focuses on the workforce development of adults in numeracy and literacy skills (Black & Yasukawa 2012). Minimum targets have been set which provide benchmarks for them to work towards (Black & Yasukawa 2014; SCOTESE 2012). These targets include an increase in skilled practitioners able to provide numeracy education, and availability for support for learners to develop adequate numeracy skills (SCOTESE 2012). One target is that, 'by 2022, at least

two thirds of working age Australians will have literacy and numeracy skills at Level 3 or above.' (SCOTESE 2012).

Foundation skills are defined in the strategy as a combination of LLN skills and skills relevant to the workplace (SCOTESE 2012). Support for vocational training to effectively incorporate foundation skills into training packages is identified as a priority (Black & Yasukawa 2012). In addition, employers are placing increased pressure on VET providers to support learners with low numeracy skills (Livock 2016).

Training packages are designed to prepare students for work by linking learning and assessment directly with the workplace (Wheelahan 2016). They consist of units of competency grouped into skill sets or courses. Units of competency have specific requirements which must be assessed. Evidence collected for every student needs to show that the student has met all of the assessment requirements for the unit of competency (Australian Government 2017).

Foundation skills have been included in the assessment requirements for each unit of competency. Consequently, assessment tasks written for the unit must include assessment of numeracy skills. Students must be able to show understanding and application of numeracy requirements for the unit. As these assessment tasks are competency-based, students have to be able to do everything correctly, every time. There is no such thing as "50% correct".

Meeting numeracy requirements can be problematic. Many courses which previously did not require specific assessment of numeracy skills now have added requirements. Students may find these difficult to fulfil. For example, students studying horticulture, fashion design, nursing or cookery may be highly capable in their vocational area but struggle with numeracy. People with low numeracy skills who lack confidence and possibly have negative feelings about maths may struggle to meet assessment requirements. Course completion may be unachievable for those with low numeracy skills. An example of this is in nursing. A hurdle requirement is mastery of the numeracy skills. To register as an enrolled nurse, students must achieve 100% in the medication unit in the Diploma of Nursing (Livock 2016).

Tout (2014) asserts that despite increased attention and efforts to improve LLN skills in adults, numeracy is being cut short. It is not receiving the time and energy required. There is a need for more research to be undertaken in teaching and learning of numeracy (Berghella & Molenaar 2013). Availability of adequately experienced and qualified practitioners who specialise in numeracy is limited (Tout 2013).

Increasing numbers of students with low numeracy are enrolling in VET courses and undertaking assessments with compulsory numeracy requirements. Vocational teachers in the discipline areas often have not had the experience or ability to provide the assistance that these students need (Berghella & Molenaar 2013). Options for training as an LLN specialist are limited and Government funding is low. Of those who do the training, most are not interested in working in VET (Medlin 2016). The best solution may be to provide numeracy specialists with professional development, in which specialists are presented with a numeracy model suited to be used and adapted for a variety of contexts in a flexible discipline-specific way (Medlin 2016).

Broad MELT Implementation

OPS

The Research Skills Development (RSD) framework follows a constructivist theory approach, with students constructing meaning through their learning (Pretorius et al 2013). Students using the RSD are more confident in using skills that they have developed, requiring less assistance (Pretorius et al 2013; Willison 2012). Additionally, the RSD framework is easy for teachers to implement and expands their understanding of the skills they are teaching (Willison 2012).

The Optimising Problem Solving (OPS) pentagon, a simplified version of the RSD, uses the six facets of the RSD in a pentagon shape. The visually presented steps are easy to follow. Engineering students designed the OPS to help with aspects of their course that many struggled with, such as communication skills. Research findings showed that the simple yet structured systematic process involving a pentagon shape broadened students' understanding (Willison et al 2016). Being a mathematical shape with systematic logical steps, it can be adapted easily to suit a mathematics context.

Keep Calm

The Innovative High Achieving Template Enhancing Maths (Maths Template) is based on the OPS pentagon. (See Appendix 1 for the generic Maths Template). The six facets of the Maths Template can be left as is or modified. Initially, students would learn numeracy skills by following the steps of the pentagon alongside more detailed information to guide them through the process. Each of the six facets are expanded. The aim would be to involve students in the thinking behind what the function of each step is. They consider what questions need to be asked and answered as they move around the pentagon. The amount and type of information will vary

depending on the particular context; developed by those doing the learning and those doing the teaching. Three key objectives are familiarity, confidence, and competence.

In order to explain use of the Maths Template, consider medication administration in nursing. The steps of the Maths Template remain unchanged. An example of additional information required in a nursing context has been provided in Appendix 2 and discussed below. The seven steps for medication administration, commonly used by nurses, are applied to each of the facets in the Maths Template (these are my suggestions; however, they could easily be modified by each student to something which they may find helpful.)

The goal is to break a process comprising calculations of medication dosage into manageable steps. Users of the Maths Template start in the centre. Before doing anything, they need to be clear about what it is that they are setting out to do. Keeping calm at the start is the key; no rushing into a task without thinking.

a. **Embark and clarify** – What is the task? It is to follow the seven steps for medication administration. Right Medication. Right Patient. Right Dosage. Right Route. Right Time. Right Reason. Right Documentation.

b. **Find and generate** – State or write down what you need to find out for each of the seven steps.

c. **Evaluate and reflect** – Go through the seven steps and state or write down what you know.

d. **Organise and manage** – Arrange the information for each of the seven steps using what you do know to find what you don't know. Do any calculations.

e. **Analyse and synthesise** – How do you feel about each of the steps? Are you ready to continue or do you need to go back to *a. Embark and Clarify*?

f. **Communicate and apply** – Are you ready? Write down the final information at each of the seven steps.

Students repeat the seven steps as they work their way around the pentagon. They refer to both the Maths Template and the expanded steps. The process is repeated using different scenarios, allowing students to become familiar with the process. As their confidence and ability increases, students become familiar enough to keep calm during the process and demonstrate high achievement while carrying a pentagon shape in their hand. The expanded information which they used at the start is no longer required. Pointing to each side around the pentagon, they are able to recollect what they need to do.

Familiarity with the seven steps for medication administration and familiarity with the steps of the Maths Template provides experience and understanding. Students question what makes sense. Their anxiety is reduced, and their focus and concentration are improved. Performing calculations and understanding how to administer medicine becomes a positive experience, and students achieve competency.

Familiarity, confidence, competence.

Methodology

Over the past several months, I have explored the MELT and the OPS, through workshops, VIC MELT focus group meetings and reading of literature. Conducting field research in the workplace has provided opportunity for the development of the Maths Template. This has enabled me to test and modify the Maths Template through receiving instant feedback. Being involved in the VIC MELT has provided me with the opportunity to learn from others and brainstorm ideas which I can then take back as a new iteration.
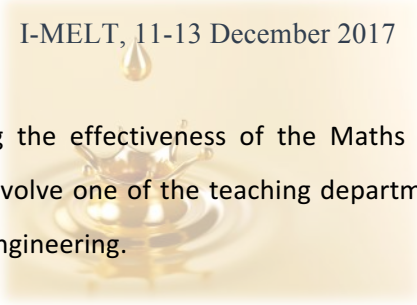
Initially, I presented a Maths Template within a nursing context to the leadership of the nursing department. It was well received, but its use has not yet gone any further.

I spent some time working with coordinators and teachers involved in assessment design of VET accounting courses. We looked at the steps involved in checking whether their assessment tasks met all of the unit assessment requirements. A Maths Template adapted to this context worked perfectly as a systematic reminder of the process (see Appendix 3).

Thirdly, I discussed my PhD thesis plan with my supervisor. I realised how well it fitted into the Maths Template (see Appendix 4).

Work in Progress

Outcomes of numeracy support programs have proven to be much more successful when the teacher delivers them with a friendly, relaxed, flexible approach which adapts according to the learning needs of each individual (Medlin 2016). The Innovative High Achieving Template Enhancing Maths model combines a relaxed, flexible group learning approach with a model that can be adapted specifically to the discipline area.

Ideally, the next step in testing the effectiveness of the Maths Template is within a project. A relatively straightforward project would involve one of the teaching departments that has numeracy requirements. For example, nursing, electrical, or engineering.

The project could involve mixed methods research with interviews of teachers and numeracy support staff, and student surveys completed in class. A unit of competency with a high level of numeracy skills content could be chosen. One class could be taught using the Maths Template and another taught following more traditional methods. All students would be given the same assessment tasks and learning materials. One class simply learns with the added assistance of the pentagon. There is a range of ways the Maths Template can be introduced and used by the students.

I will apply for human ethics research approval when appropriate.

Conclusion

I will continue to develop contextualised maths templates for use in the workplace. Using the template as a teaching tool for explaining different aspects of regulatory requirements has proved very useful. I expect to find many uses for it in the future. I do see a huge opportunity for a project using this Maths Template model as a tool to increase numeracy skills, and will continue to seek an opening in pursuit of this.
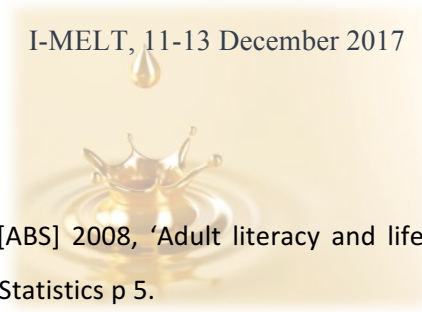
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Appendix 1 – Maths Template
Innovative High Achieving Template Enhancing Maths

When in doubt, return to the centre

f. Communicate & apply
How do we relate?
What can we conclude? What do our results mean?
How can we apply this to other problems?

b. Find & Generate
What do we need?
What are the unknowns?
What do we need to find?

a. Embark & Clarify
What is the purpose?
What is the task/calculation to be solved?

e. Analyse & Synthesise
What does it all mean?
Explain results.
Have all the necessary calculations been made or do we need to return to the centre?

c. Evaluate & Reflect
What do we trust?
What do we know?
What knowledge can we draw upon?

d. Organise & Manage
How do we arrange?
How can we manage pre-existing knowledge in this particular context?
What calculations can we do?

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Appendix 2 – Nursing Example.

a. Embark and clarify

What am I trying to do?

Follow 7 steps for medication administration, including

1. Conversion of measurements (e.g. micrograms to milligrams)
2. Calculate of the correct amount of medicine to be given to this patient.

b. Find and generate

What do I need to find out?

1. Right Medication. Has the patient taken this before? Does the order make sense?
2. Right Patient. Does the patient name match the name on the medication order? What identification checks will need to be conducted?
3. Right Dosage. Will I need to do any calculations to determine the correct dose?
4. Right Route. Is this method for medication administration safe and appropriate for the patient?
5. Right Time. Is now the correct time of day to give this medication?
6. Right Reason. Why was this medication ordered?
7. Right Documentation. Do I have enough information to be able to complete the documentation?

c. Evaluate and reflect

What do I know that will help me?

1. Right Medication. I know what medication was ordered and whether I have received it.
2. Right Patient. The name on the order matches.
3. Right Dosage. Do I need to convert the measurements to be in the same format? What format is the stock strength measured in? (micrograms, milligrams etc.).
4. Right Route. Check instructions on medication and on the order.
5. Right Time. What conditions are there regarding when this medication can be administered? Check with the patient and in the documentation whether the conditions have been met such as with food, not within 2 hours of eating, not more than once a day.
6. Right Reason. What is this medication usually used for? Ask whether this medication makes sense for this patient. If in doubt, speak to someone.

d. Organise and manage
What information is useful?

Compare what I know, to what I do not know. What steps can I now ✓ as complete?

1. Right medication. Does the medication match the order?
2. Right Patient. Do the names match? What other identification checks have been made?
3. Right dosage. Use the Calculation table. to do any calculations
    Reflect-
    a. Dose the dosage prescribed make sense?
    b. Does the frequency seem suitable?
4. Right Route. Have I explained to the patient how the medication will be administered and asked them if they have any questions?
5. Right Time. Check with the patient and in the documentation whether the conditions for administering this medication have been met.
6. Right Reason. Ask the patient if they have any questions about the reason for this medication.
7. Right documentation. Am I certain about what documentation I need to complete?

e. Analyse and synthesise
Am I ready?

Does the dose I intend to give match what was ordered?

Does the dosage calculated make sense?

Have I missed anything? Does something feel wrong?

Do I know how to complete all of the documentation? Do I need to ask any questions – the patient, another staff member?

If more information is still missing, return to the centre, a.*Embark and Clarify.*

f. Communicate and apply
What can I conclude?

1. Right medication.   Medication is:
2. Right Patient.   Patient name and patient number is:
3. Right Dosage.   The dose I am giving is:
4. Right Route.   The medication is in the form of (liquid/tablet)
                               and will be administered via …...
5. Right Time.   The current time is:
6. Right Reason.   I am clear that the reason makes sense
7. Right Documentation.   I have a working pen and am ready to fill it in.

Is there anything I would do differently next time?

Calculation Table

Conversion check

Check whether that the medication strength and dosage are of the same kind

$$\longleftrightarrow$$

μg (smallest) - - - mg - - - g(largest)

$1 mcg = 1.0\ mcg = 1\mu g = 1\ microgram$
$1 mg = 1.0 mg = 1\ miligram$
$1 mg = 1000 mcg = 1000\mu g = (1\ 10^3)\mu g$
$1\mu g = 1 mcg = 0.001 mg = (1x10^{-3})mg$
$1 g = 1.0\ g = 1000 mg$
$0.1 g = 100 mg$
$0.001 g = 10 mg$
$1 L = 1000 ml$
$0.1 L = 100 ml$
$0.001 L = 10 ml$

> Micrograms to milligrams:
> ➢ divide by 1000
> ➢ Shift decimal point 3 spaces to the left
>
> Milligrams to micrograms:
> ➢ multiply by 1000.
> ➢ Shift decimal point 3 places to the right
>
> Litres to millilitres: multiply by 1000

Number of tablets = dosage given divided by the strength of the stock

If d is the dosage prescribed and s is the strength, the amount to be given, N is

$$N = \frac{d}{s}$$

Reflect -Check whether the calculations are correct. Multiply the amount to be given, N by the strength. The answer should be equal to the dosage prescribed.

$$d = N \times s$$

Daily dose. If T is the total amount to be given in one day, and the patient is to be given medication x times in a day, then the amount to be given each time, N, is

$$N = \frac{T}{x}$$

Reflect - Check whether the calculations are correct. Multiply the amount to be given by the number of times in a day, x

$$T = N \times x.$$

Appendix 3 – Assessing Competency Example.

Note that the wording in the text boxes has been modified slightly. Same principle but adapted to this context.

When in doubt, return to the centre

f. Communicate & apply
What works?
What are the problems?
How can this approach be used elsewhere?

b. Find & Generate
What does competency look like?
Unit application, Assessment requirements, Principles of Assessment.

a. Embark & Clarify
What are the goals?
To design assessment tasks – useable, time efficient, demonstrating competency

e. Analyse & Synthesise
Clear information – what is required for satisfactory completion.
Marking guide, instructions to students, unit outline.

c. Evaluate & Reflect
Assessment mapping; how to assess knowledge and performance.

d. Organise & Manage
Number of assessments, methods used.

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Appendix 4 – Research Thesis Example

When in doubt, return to the centre

f. Communicate & apply
How do we relate?
Where to from here?
What conclusions can be drawn from the research?
What future directions can we take now?
How can this information be used?

b. Find & Generate
What do we need?
What information do we need to find out?
What are our unknowns?

a. Embark & Clarify
What is our purpose?
What are we trying to achieve?
What is our goal?

e. Analyse & Synthesise
What does it mean?
When we analyse the information, what trends appear? What can we conclude? Do we need to ask more questions? If so – return to the centre.

c. Evaluate & Reflect
What do we trust?
What information do we know?
What do we have?
What can we use?

d. Organise & Manage
How do we arrange?
How can we use what we know to help us with what we don't know?
What do we need to do?
How are we going to collect the information

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