

## Look Who's Talking- Incorporating oral presentations into mathematics

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*“By learning you will teach, by teaching you will learn.” – Latin Proverb*

**Abstract** The essence of this proverb can be used to illustrate the educational benefits of oral presentations in tertiary level foundation mathematic units. Currently most educators will explore a variety of mediums to teach mathematical concepts, though only use written assessments to test students' understanding. A common form of written assessment is the traditional test, which evaluates a student's comprehension of a specific component relating to a mathematical concept, whereas the oral presentation assesses a student's understanding of an entire concept, beyond rote-learning and applying formulae. This paper will examine the unique elements of oral presentations including; two-way communication, general understanding, and incorporation of mathematics into the chosen field of study. The importance of oral presentations is primarily found with students of non-mathematical majors who require broad knowledge rather than a deep theoretical comprehension of mathematical curriculum.

### Introduction

Assessment of students' mathematical ability will always be a subject of research and debate. Which assessments are the fairest methods to both students and tutors? Which method accurately depicts students' mathematical ability? Many aspects of assessment have been discussed by researchers, Holton, Houston, and Challis in relation mainly to students who have chosen to study mathematics at undergraduate level [1-2]. The student cohort of this paper will complete no more than three units of mathematics at university. These compulsory mathematics units are viewed by some students as an endurance rather than enjoyment. Few tertiary institutions in Western Australia contain an oral component as part of the assessment in mathematics service units.<sup>1</sup> This exploratory paper will discuss how oral presentations for non-mathematical majors may be incorporated into first year service courses showing the roles of brain-based learning and multiple intelligences.

Recent research studies by Kågesten and Engelbrecht [3], Jardine and Ferlini [5], and Dennis [6] have explored the use of oral presentations in mathematics learning with engineering and mathematics undergraduate students and Fan and Yeo with secondary students [3-6]. The teacher-based style of education allows little time for the learner to consider how he/she learns. Personal and educational reflection can provide students with powerful tools that will give all skills necessary for true learning to happen [7-9]. Students participating in service units need a broad understanding of mathematics rather than a deep theoretical mathematical approach. Communication through conversation is ubiquitous from that friendly greeting in the morning, the obligatory ordering of coffees, the quick call to check lecture time, to the catch-up on “what I

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<sup>1</sup> A sessional staff member initiated the introduction of an oral assessment component for four semesters whilst employed as a lecturer; other similar units taught at the institution did not have such a component. This staff member is currently a tutor at the same institution where oral assessment does not occur in any first year mathematics service units.

have missed” moments. These all flow effortlessly as idle banter imparting the necessary relevant information. The intention of any lecture is to explain and demonstrate concepts that will enable further study and research via examples and questions leading to comprehension. Each lecture has a conversational aspect as material is conveyed orally and visually (overheads, gestures, and body language). Tertiary educators primarily use this vocal mode to impart facts yet assess students’ knowledge mainly in the written mode. Why not give students, especially those of non-mathematical majors, a chance to express orally their mathematical insight?

### **Theoretical framework**

Although very clichéd, “I am not mathematically minded” or “I have not got a mathematical brain” are phrases that mathematics educators often hear from first year students during the course of service units. There may be an element of truth to these beliefs as perhaps educators are too restrictive in assessing students’ mathematical knowledge with reference to brain function. The brain continues to fascinate researchers by the delicate workings that make each individual’s thinking unique. The brain has two complementary hemispheres, left and right, with an interface allowing the flow of information. Reading, writing and logical functions occur in the left hemisphere whilst the right hemisphere deals with the intuitive, emotional and holistic functions [10-11]. So, while the left side copes with scholastic duties, the right side imagines the ‘what can be’ new ideas.

Traditional education is directed towards the orderly left hemisphere rather than the creative territory of the right hemisphere. Most testing procedures used at school assess the recollection of facts and algorithm use giving the left side plenty of activity whilst the right side is rather underused. Recent research studies, involving music and music with mathematics, have found evidence to suggest that many areas in both brain hemispheres are activated by music. If both hemispheres are stimulated by music then perhaps other activities may behave in a similar manner such as mathematics [12-14]. It may be beneficial, during the teaching process, to promote the use of the right hemisphere’s creativity in assessing mathematics knowledge rather than relying on the left hemisphere’s ‘rule following’ procedures.

The use of multiple intelligences by Gardner when applied in teaching at any level gives both hemispheres the opportunity to be active and thereby develop. There appears to be an unwritten perception that mathematical ability is linked positively with intelligence. Yet, according to Gardner, intelligence has many different aspects as diverse as spatial, linguistic to interpersonal and intrapersonal. Logical-Mathematical intelligence is only one domain [15-16]. There is an educational need to address the equilibrium between the hemispheres. This may be achieved by teaching to all intelligences. Many strategies of multiple intelligences are utilised in early childhood and primary education, these could be adapted to university level without any loss of quality [17-18].

### **Introduction of discussion**

Simply speaking, the problem is we are not speaking. The solution is true collaboration by both student and mathematics educator which may require a radical change in the administration of tutorials. This change is required for true two-way conversation to take place. Students need to be aware that the first step to mathematical comprehension is talking about mathematical concepts rather than a written solution. Public speaking is enemy number one in mathematics sessions as students would gladly attempt endless written questions rather than have to find words to explain their mathematical ideas. To overcome fear and shyness, students must be

introduced slowly to the idea of discussing concepts instead of solutions. Emotions play a major part in learning, especially in mathematics, so a top priority is to create a friendly social atmosphere from day one where students employ their interpersonal and linguistic intelligences [19-20]. Both tutor and student need to adapt to this social aspect not as an 'add-on' component but as an integral enhancement to learning. The following comments from students of first year service units echo the importance of that sense of belonging:

I just come from your tutorial for math 137, I just thought I would start the lines of communication here because I am 100% sure math is not my strong suit. I just wanted to say your friendly approach to today's tutorial made me feel better about getting through the maths in my course outline.... Thanks being so optimistic in class today.

An e-mail from first year student 2008

She always makes me feel like part of the class and she is always eager to listen to our opinions.

Independent university evaluation comment from first year student 2007

Expressing mathematical opinions can be eased with students forming small groups where the tension and dread of mathematics may be alleviated. Students will grow in confidence and become accustomed to hearing their voice, pronouncing mathematical terms and annunciating ideas. These seemingly innocent tasks will help make the final oral presentation appear less daunting. Tutors need to have the ability to blend into the groups so they interact rather than observe as an outsider. Tasks that encourage discussion may be as simple as name five important facts in algebra or some special qualities of zero. Simple 'question and answer' challenges can provide unique mathematical moments without too much stress for student or tutor. This oral-based tutorial uses both brain hemispheres incorporating the fact-based of the left with the holistic social perspective of the right side. Support for tutors includes regular meetings and communication. Tutors will need to employ the art of listening and patience not to interrupt students' explanations rather than just test mathematical ability.

### **Teamwork incorporating multiple intelligences**

There are many reasons why students and educators hold negative attitudes to group work. These range from student participation issues, time restrictions, syllabus issues to extra work for the tutor. If 'team work' is substituted for 'group work' perhaps educators and students may be willing to capture the true spirit of learning. Small teams give students an alternative view of learning from the familiar teacher-centred approach. This peer tutoring has many advantages as it happens in an environment evolved by the students for the students. This is not necessary as tutors may envisage the tutorial scenario but it may allow some students the opportunity to participate [21-22]. Erlauer proposes that 'When students can share their knowledge and skills with others, not only do the 'receivers' gain because they learn something new, but the student who is acting as the teacher will solidify his or her knowledge teaching it to others' [23]. It is important for students to share ideas reinforcing that mathematics is a synthesis of creativity, intuition and facts. Students may explore many diverse ways of communicating and engaging with mathematical concepts using both brain hemispheres rather than just completing tutorial questions [24]. It is important that students can produce comprehensive explanations concerning mathematical issues as it may be an essential skill required for future employment [1-2]. It should not be unusual to see the following in tutorials:

- Constructions with pens, bags etc... , drawings (Visual-Spatial intelligence),
- Rhymes, mnemonics or acronyms (Musical and Linguistic Intelligence),
- Gestures, arm waving and other body movements (Bodily-Kinaesthetic Intelligence)
- Interactions between students (Interpersonal Intelligence).

Former students appear to agree with Erlauer's sentiments:

The oral presentation unit encourages group work and cooperation. However, I do feel that the oral presentation encourages group debate which can arouse ideas and stimulate thinking. Moreover, presenting your ideas across and iterating them allows crystallization and maturing of ones' thoughts and thinking processes. It also encourages student to be confident about their ideas, and the ability to put them across.

First year student 2006

I will have to learn about the chapter, understand it, prepare some notes then be able to explain it. This whole process leads to a thorough understanding of the chapter.... To some extent it enables class discussion or dialogue with other students. For instance, if someone has some questions or maths problems in a particular chapter I've talked about, he asks for my help and we have a look at the questions and vice versa. This creates an atmosphere of team spirit

First year student 2006

### **Oral expression versus written expression**

Students may convey a better indication of mathematical knowledge through conversation than in a written solution. No matter how well educators have designed an examination paper, it is not always possible to determine whether the student knew the concept or followed a set of rules blindly. This presents a quandary to an educator who is assessing the mathematical competence and using the grade as a descriptor [1, 20, 25]. Students may not memorise speeches as knowledge of concepts will be required for the question session. Although the oral presentation is a scary prospect in the beginning, students realise that this is a unique opportunity. They can share their knowledge in a personalised way with peers rather than answer specific questions in an examination for one marker. Students worry about how the assessment will be graded whilst tutors worry about how to grade. Fortunately many rubrics and additional information are available for both students and tutors. Students are aware of the marking scheme in contrast to a written paper where the mark allocation is unknown beforehand. This knowledge is used to prepare their talk [3, 5, 6]. The successful scaffolding of communication from simple dialogue in partner work via answering questions in small groups through to final oral presentation makes the students more confident in their mathematical ability and communication skills.

### **Written grade versus oral grade**

One may be knowledgeable about a topic but just cannot complete the examination question whether due to stress, time, or 'just one of those days'. A grade may be awarded that both student and tutor are aware does not reflect the true comprehension. Students of non-mathematical majors may complete one or two mathematics units in preparation for future course-related mathematical content. The written examination associated with these units predominately tests imitative reasoning i.e. reproducing examples covered in course or algorithms. A good memory can be a bonus to a student obtaining a high grade rather than mathematical knowledge. The broad knowledge required by these students is not really tested, only procedures involved in solving questions [25]. These procedural skills are important to

solve test questions but may be very different to future real life situations. The oral presentation allows students to explore topics to involve all aspects of their chosen course.

### **The oral assessment**

The following schedule gives a brief insight into the administration of the oral assessments during its use over four semesters. These presentations are conducted before fellow students (about twenty-five) during the tutorial in weeks nine, ten and eleven of a twelve week semester. In week four, the marking scheme and criteria for presentations are discussed with students so they have some ownership of the process. Students are asked to produce a written version of their presentation to be submitted along with overheads or PowerPoint slides. The presentation must include a worked example (not one from notes) with background information. Students are informed that they will contribute by completing a peer evaluation. The diversity and strengths of the cohort will determine how the tutor and students develop the selection of groups and topic choices. The course outline will provide the basis for topic selection. This happens in week five. In ensuing weeks, advice and examples are offered during the regular tutorials to increase familiarity with this format. The style of presentation may take any form and is a decision of the group. The creativity will lead to diversity of formats for communication of mathematical concepts. These presentations allow students the freedom to incorporate multiple intelligences such as:

Linguistic	Stories, peer-related explanations
Logical-mathematical	Display their mathematical knowledge
Spatial -Bodily Kinaesthetic	Homemade props, gestures and movement
Musical	Songs, rhymes and even rap
Interpersonal	Audience engagement and participation
Intrapersonal	Relaying personal memory tricks
Naturalist	Flowers, rocks, etc...according to course

This assessment task allows students to view mathematics from a very different perspective to a written question. Students may gain a personal sense of inner achievement and enjoyment by revealing their particular perception of a mathematic topic. The research performed serves as revision that may lead students to a deeper level of understanding than the revision before the written component. This sentiment is echoed in a former student's recollection of an oral presentation:

Oral Presentations allows more interaction between students and their fellow peers. They are more of a fun because it's a different way to learn math. It also gives us a chance to see different ways of interpreting math and hence, increasing our awareness. I would like to have some form of oral presentations incorporated into part of the assessment part because they are also easier to get good marks in. I guess it's because there's no definite black and white answers when giving an oral presentation.

First year student 2007

### **Creating the balance**

Student and tutor both need to adapt to this new assessment that differs completely from the traditional approach of written exercises and tests. The 'rote learning' or 'algorithmic' approach cannot be employed as the invisible helper in this instance as questions may be asked that require a lateral reply. Written communication of mathematical ideas will always be part of the

assessment just not the only style. Educators are concerned about completing course content, time restrictions and whether learning is taking place when considering the introduction of oral presentations. Addressing these concerns:

- Oral work is integrated into tutorials with written work which may require extra effort at first by educators but the rewards are worthwhile.
- Comparability meeting are needed to ensure that tutors know the key elements required in the presentations.
- The oral presentations are conducted at tutorial sessions so the total number of students taking the course has no effect.
- Lecture time is unaffected by the change of assessment.
- Presentations may have a duration of ten to fifteen minutes, the total time required, based on twenty five students in groups of two or three, is approximately two and half hours. This can be spread over three or four weeks in order to reserve time to cover current topics.
- The proof is in the pudding when the presentations take place whether learning has been achieved

### **Conclusion**

It is important to consider the merits of oral presentations in mathematics service units as students' educational needs are diverse. Reaching parts of the brain that usual educational methods don't reach may be the answer to those poor students who do not have a 'mathematical brain'. The theory of multiple intelligences and brain-based learning may be the tool that will aid these students to be more confident about their mathematical ability. A broad knowledge and appreciation of mathematics is required. So examination questions that are easily solved by rote-learning and algorithms will not have any educational advantage to these students in their chosen field. Oral presentations provide all students with a chance to display their knowledge in fun and creative ways. The interest aroused when researching the topic may give rise to a new curiosity about mathematics. With the declining numbers of students wishing to study mathematics perhaps an injection of creativity in service units may spark an interest in mathematics in these and other students.

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