

SPANGLE



**Gifted Learners in Mathematics Project
GLIM
Lecturer: John Munro**

TEACHING PROJECT

The Garden Bed planning sheet above details all activities and strategies used in the implementation of this project. See Appendix 1

Development of the Project:

- Pre assessment using a collation of activities based on CSF11 Maths levels 4 +
- Group students according to assessment results. Identify talented students.
- Early lessons focused on:
the basic language of angles, their origins and their uses

identifying and measuring a variety of angles and naming them,
estimating and confirming predictions using a protractor

angles in real life, students choose an occupation and identify the
Maths, including the use of angles in this occupation

estimating and measuring angles in sports angles hitting the target
<http://www.hittingthetarget>

brainstorming the importance of angles in sport- represent ideas in a
mind map

using Tony Ryan's Thinking Keys – What if ? key to discuss creative
possibilities in relation to angles in sport. Make prediction

test their hypotheses in real life sporting situations
- The students were then challenged to carry out their own investigation
on angles in sport.
See appendix 3
- Some sample lessons and evaluations are included at the end.
Appendix 2
- Some examples of student's reflections are also included. Appendix 4

GARDEN BED - ANGLES IN SPORT

Learn new idea in particular cultural, social or historic contexts	Link new ideas in scientific-mathematical ways	Link emotions/feelings with new ideas
<p>Name the chosen/ favourite sport of five different cultures. Why do you think it is the favourite? Who invented each sport?</p> <p>Investigate angles and their importance in the various sports of these cultures.</p> <p>Investigate the historical aspects of <i>angles</i>. What is, who came up with the Pythagoras' theory? Find out about Archimedes and his theories. Investigate other historical figures that made an impact on this area.</p> <p>Investigate the Bermuda Triangle</p>	<p>Hypothesize about the place of angles in Sport Write some hypothetical statements to support your view that the understanding of the mathematics of angles is important to your success in this sport. <i>What If</i> questions- choose between scenarios in four sports- basketball, cricket, AFL football, tennis. Mentor (PE Teacher) invited to discuss the students <i>what if</i> questions Students make their own predictions prior to the discussion Resolve at least one of your <i>what if</i> questions. Demonstrate how you came to a solution.</p>	<p>Imagine you are a sports person whose game is down Which do you think is the easiest sport to play? Why?</p> <p>What feelings help you solve problems in maths?</p>
Draw attention to the cultural, historical aspects of ideas	Learn ideas in symbols, abstract, ideas, to think about them in a general way	The feelings attitudes linked with an idea

Ideas to be taught

Link new ideas in words, in sentences, in more abstract ways	Link new ideas in particular contexts and in images	Learn the actions that go with the new ideas
<p>Use Tony Ryan's thinking Keys E.g. Make a glossary of angles terminology</p> <p>List the topic words from A-Z</p> <p>Concept map of angles in everyday life.</p> <p>Explain the language of angles to a friend.</p>	<p>Draw diagrams to support your understanding of the words you chose or your glossary.</p> <p>Collect magazine articles/ newspaper images of sportspeople in action.</p> <p>Compare the importance of angles in two or more sports. Use visual images such as a Venn Diagram to demonstrate your comparisons.</p>	<p>Try out your predictions of the "what if" hypothetical situations.</p> <p>Choose a sport. Investigate the importance of angles in this sport. What do you think are the most important angle? What is the relationship between fixed and movement angles in this sport?</p> <p>Design a board game. Make a video, Invent a new sport.</p> <p>Present your findings creatively in any way you wish.</p>
Think about the ideas in words, paraphrase or summarize them, work on links between verbal concepts	Remind students to think about ideas in real-life contexts, visualize them	Use actions to represent ideas, to imagine the ideas changing

PLANNING SHEET FOR PERSONAL INQUIRY PROJECT

KLA: Maths

Productive Pedagogy: Intellectual Quality

1. Focus of Unit:

Reviewing formal language in relation to angles

Estimating/ measuring angles in real life

Mathematics in Sport

Discussing creative possibilities in relation to angles in Sport

2. Strategies Used:

Use of Technology

Mind Map

3. Action:

Warm up: Computer simulation of work with angles

Site: [www.http://hittingthetarget.com](http://hittingthetarget.com)

Students review their knowledge on obtuse, acute and right angles in the four sports covered- snooker, soccer, tennis, cricket

Present students with real life sports people quotes.

Andrew Gaze – Melbourne Tigers Basketball Team

Brendan Fevola – AFL Footballer

David Ginola- Soccer Player

Tim Henman Tennis Player

Activity:

Part 1: Students are asked to choose one of the sportspeople quotes.

They are asked to brainstorm in pairs the importance of angles in this sport.

They represent their ideas in the form of a concept or mind map.

Student Feedback:

Productive Pedagogies Evaluation

Date: 03/05/04

Focus of Lesson:

Reviewing formal language in relation to angles
 Estimating/ measuring angles in real life
 Mathematics in Sport
 Discussing creative possibilities in relation to angles in Sport

Intellectual Quality	
Higher-order thinking	I found I had to actively listen to what pairs of students were saying and prod them with questions which were more open ended in order to elicit a deeper level of conversation.
Deep knowledge	the mind maps they produced were of high quality in information and a reasonably deep understanding and knowledge of the topic
Deep understanding	I suppose the insecurity I felt was related to the fact that I need to have a more in depth knowledge of this area myself in order to be able to facilitate the conversations effectively.
Substantive conversation	Because the students were the producers of the knowledge, the challenge was to guide them through appropriate dialogue. The dialogue was continuous
Knowledge as problematic	
Meta-language	
Supportive Classroom Environment	
Student direction	I probably need to free myself to allow them to guide most of the conversation in future as they are highly able students.
Social support	The interactions between the students themselves and between me and the students were characterized by active listening and sharing.
Academic engagement	The students showed enthusiasm and keen interest in this activity.
Explicit quality performance criteria	
Self-regulation	Students were self-motivated and fully focused
Recognition of Difference	
Cultural Knowledge	I noticed that the boys chose sports that they played, but the girls chose soccer, which they do not play.
Inclusivity	
Narrative	
Group identity	The girls preferred to work in groups separate from the boys when doing their mindmaps, but were later fully interacting as a whole when engaged in discussion
Active citizenship	
Connectedness	
Knowledge integration	The use of students own knowledge, computer technologies, real life scenarios using a variety of sports people
Background knowledge	The use of computer technology to explore angles in sport through games was a good introduction
Connectedness to the world	See knowledge integration
Problem -based curriculum	The scenarios using different sportspeople provided interesting problem-based thinking activities

PLANNING SHEET FOR PERSONAL INQUIRY PROJECT

KLA: Maths: Name of unit is SPANGLE- sports/ space angles

Productive Pedagogy: Intellectual Quality

1. Focus of Unit:

Mathematics in Sport

Discussing creative possibilities in relation to angles in Sport

2. Strategies Used:

Questioning skills Ryan's What if? key.

3. Action:

Review real life sports people quotes and mind maps done by the students at the last lesson.

Andrew Gaze – Melbourne Tigers Basketball Team

Brendan Fevola – AFL Footballer

David Ginola- Soccer Player

Tim Henman Tennis Player

Activity:

Part 1: Students look back at their mind map and share the ideas they came up with last week. Discussion about their ideas

Write some ***what if*** questions about angles in sport in relation to these sportspeople
What would these players be saying in their minds?

e.g. What if I

Student Feedback/ reflective journals

Productive Pedagogies

Date: 10/05/04

Focus of Lesson: Mathematics in Sport

Discussing creative possibilities in relation to angles in Sport

Intellectual Quality	
Higher-order thinking	
Deep knowledge	Deep knowledge needs to be explored much further, therefore a lesson/lessons needs to be developed the for exploration of the language of angles (metalanguage) so that the students will have the necessary vocabulary and understanding of it in order to be able to undertake discussion at a much higher level.
Deep understanding	
Substantive conversation	My skill in leading the students to explore the possibilities through dia needs further focus. I need to step back more and allow them to take more of a lead, to listen actively and know the right times to intervene.
Knowledge as problematic	The students produced very creative what if questions, thinking outside the square.
Meta-language	
Supportive Classroom Environment	
Student direction`	The next step will need to be to get an expert/mentor (physical education teacher) to further explore the what if questions and then to help the students to investigate or try out the possibilities.
Social support	The students became quite competitive in trying to think of questions which were different/creative. All what if questions were accepted no matter how different.
Academic engagement	The students were fully engaged and needed no encouragement to keep on task.
Explicit quality performance criteria	The students and I agreed to accepting all possibilities prior to starting.
Self-regulation	
Recognition of Difference	
Cultural Knowledge	
Inclusivity	The student's cooperative interactions were impressive particularly in the girls group who were focused and attentive to the task.
Narrative	
Group identity	
Active citizenship	
Connectedness	
Knowledge integration	There was a high level of knowledge integration -the use of Tony Ryan's <i>What if</i> Questions, integrating areas of motion, weather, force in science with mathematical concepts
Background knowledge	The students who had some knowledge of the sports used this to support and explore <i>what if</i> questions.
Connectedness to the world	
Problem -based curriculum	Exploring <i>what ifs</i> made today's lesson problem based

PLANNING SHEET FOR PERSONAL INQUIRY PROJECT

KLA: Maths: Name of unit is SPANGLE- sports/ space angles

Productive Pedagogies: Intellectual Quality and Connectedness

1 Focus of Unit:

Mathematics in Sport

Discuss creative possibilities in relation to angles in Sport

2 Strategies Used:

Questioning skills Ryan's What if? key. Cooperative pair and group work, use of a mentor.

3 Action:

Use the "what if" questions formulated by the students in the last lesson. Discuss predictions. Discuss possible outcomes with an expert- David Rushmore our Physical Education teacher.

Activity:

Re-read the **what if** questions composed at our last lesson in relation to angles in sport.

In pairs or threes choose one or two **what if** questions.

The students make predictions and discuss in depth the possible answer to these questions.

David, our PE teacher then helps us to confirm these predictions and to pose further questions.

Student Feedback/ reflective journals

Productive Pedagogies

Date: 16/07/04

Focus of Lesson: Discuss creative possibilities in relation to angles in Sport
Questioning skills Ryan's What if? key.
Cooperative pair and group work, use of a mentor.

Intellectual Quality	
Higher-order thinking	The ability of the students to "think outside the square" The creativity of thinking demonstrated by all students.
Deep knowledge	The activity chosen was intellectually challenging for the students Not having enough knowledge in each of the sports we discussed- personally
Deep understanding	The deep level of reflection by the students.
Substantive conversation	The high quality and depth of the discussion. Allowing the students to carry on the discussions with minimum interruptions from me.
Knowledge as problematic	<i>What if</i> questions supported this
Meta-language	<i>There is a need to develop the student's meta-language, particularly technical vocabulary needed to discuss the issues we are investigating.</i>
Supportive Classroom Environment	
Student direction	Inviting David to be part of the lesson was an important determining factor to the depth of discussion. See reflective journals.
Social support	The cooperative nature of the activity enabled the students to extend their thinking, and build their deep knowledge- promoting improved collective understanding of the topic.
Academic engagement	The high level of student engagement. Both boys and girls.
Explicit quality performance criteria	
Self-regulation	Clear directions given
Recognition of Difference	
Cultural Knowledge	
Inclusivity	
Narrative	
Group identity	One child did not enter into the discussion and David informed me that sport isn't of interest to him. We encouraged him to relate what we were discussing to other every day activities
Active citizenship	
Connectedness	
Knowledge integration	The activity was relevant to their current topic and so was easily integrated into their topic.
Background knowledge	
Connectedness to the world	Real life situations were explored
Problem -based curriculum	<i>What if</i> questions supported this

PLANNING SHEET FOR PERSONAL ENQUIRY PROJECT

KLA: Maths – Name of unit is SPANGLE: sports/space angles

Productive Pedagogies: Intellectual Quality and Connectedness

1. Focus of Unit:

Mathematics in Sport

The focus of this session is to allow students the opportunity to test their ideas and hypothesis from the previous lesson. Students will be guided through a practical activity in which they must develop a suitable 'experiment' to test their theories on angles in sport. Appropriate materials will be provided.

2. Strategies used:

Self discovery, guided learning, open ended questioning, group work and use of a mentor.

3. Action:

Students to test their theories which were discussed in class last week. By adopting a 'visual' / hands on approach, it is hoped that key concepts related to angles will be reinforced.

Activity:

We will start off by reading over the student's reflections from the previous lesson which will lead to further discussion of their ideas.

We can then discuss as a group how these ideas can be tested using the given materials outdoors. Students with guidance from their teachers must agree to the best method.

Students will then identify different 'spots' on the court from which they are going to measure the angle to the goal. From this, they draw conclusions from their findings and thus prove or discount their hypothesis.

Finally, students will attempt to kick goals from the various points to see if there is any correlation between the size of the angle and the success of scoring,

Productive Pedagogies

Date:23/07/04

Focus of Lesson: The focus of this session was to allow students the opportunity to test their ideas and hypothesis from the previous lesson. Students were guided through a practical activity in which they developed a suitable ‘experiment’ to test their theories on angles in sport.

Intellectual Quality	
Higher-order thinking	Having two teachers oversee the activity allowed for effective open-ended questioning. Students responded well to this with well thought out answers.
Deep knowledge	This was a very successful lesson as the teachers led the students to prove their hypothesis correct from the previous lesson.
Deep understanding	The activity was suitable to their knowledge and understanding of angles in sport and provided adequate intellectual challenge.
Substantive conversation	The teachers supported the students in questioning each other, asking for justification of certain ideas – this further demonstrated the student’s understanding.
Knowledge as problematic	The teachers provided the students with an opportunity to develop their understanding of angles in sport through practical application
Meta-language	Without prompting, students tried to use appropriate technical language which was pleasing given that this had been a focus during an earlier lesson.
Supportive Classroom Environment	
Student direction	
Social support	The students worked well as a team and allowed everyone to have an opinion.
Academic engagement	The teachers ensured that all students engaged in the activity and contributed to discussions.
Explicit quality performance criteria	
Self-regulation	On completion of the lesson, the students once again completed a personal reflection which clearly demonstrated what they had got from this session.
Recognition of Difference	
Cultural Knowledge	
Inclusivity	
Narrative	
Group identity	
Active citizenship	
Connectedness	
Knowledge integration	Students commented on how the physical action of trying out their hypothesis made ‘things clearer’, and helped them to visualize the role that angles played in sport.
Background knowledge	



“Angles play an important role in our daily lives. They are a crucial aspect of any sport. Professional athletes instinctively apply the concept of angles to achieve optimum outcomes in their sport.”

Prove this statement by carrying out the following investigation:

Criteria:

As a background to your presentation and for your own information and depth of knowledge, find out about **some of these:**

- favourite sports in different **cultures**, the importance of the knowledge of angles in these sports,
- the **history** of your chosen sport, who invented it etc., the **history** of angles, e.g. what is the Pythagorus' theory
- interesting facts e.g what is the Bermuda Triangle?
- a Venn diagram comparing two sports.
- describe the relationship between fixed angles and movement of angles in sport.
- which is the easiest sport for you to play? Why?

Your presentation **must** include the following:

- Describe your chosen sport and some of its rules.
- Investigate a sportsperson who plays your chosen sport. What makes this person talented in this sport?
- The correct **language** of angles?
- “What if questions” or problems which you have posed (related to angles in sport) and possible answers or solutions to some of these. Demonstrate how you came to a solution.

Present your findings creatively in any way you wish.

STUDENT REFLECTIONS

“I learnt that angles are very important in sport and we use them all the time but we don't realise.”

“ After my experience in Spangle I have realised how much angles are used in sport. I think it will help me in real life.”

“ During the whole experience of Spangle, I have learnt that in games like soccer and football when you are on smaller angles it is harder to kick at!”

” After the Spangle project I have learnt so much more about angles in sport. I never realised there were so many angles in sport.”

“In Spangle I learnt a lot about angles and sport. I learnt that the closer you are to a soccer goal and if you are right in the front, the easier it is to score.”

When in spangle I learnt about the angles that are involved when being a goalie, a defender, shooting for goals, etc. I didn't think there was so much maths in sport.

The whole spangle group really opened my brain to think about all the angles and things that deviate the ball really amazed me. Now when I go out to bat I will look at all the deviating things.

“After being in the spangle group, I have really learnt more about angles in sport. I have thought about things that I probably never would of.”

The spangle students were an absolute pleasure to work with. They were highly engaged and enthusiastic in exploring and testing their “what if” higher order thinking questions.

It was very exciting to work with these motivated students. By incorporating different areas of the curriculum the students were very enthusiastic and the ‘overcomes’ were great. An enjoyable experience for all involved!!!

I really enjoyed working with the Spangle group and was very impressed with the extremely high level of productive conversation and presented conclusions the children arrived at. What a talented and creative group!!

Web Resources

Resources Focusing on Gifted Education

identification of gifted students

http://www.sofweb.vic.edu.au/futures/bf_id&ass.htm#ability

national quality schooling project

<http://www.nqsf.edu.au/>

Productive Pedagogies

<http://education.qld.gov.au/corporate/newbasics/html/pedagogies/intellect/int.html>

John Munro literacy intervention site

<http://webraft.its.unimelb.edu.au/476696/pub>

Victorian Association for the Gifted and Talented

<http://www.vagtc.asn.au>

Resources Focusing on Angles in Sport

angles

http://www.bbc.co.uk/schools/revisewise/maths/shape/15_act.shtml

angles sport kick boxing

<http://w3.blackbeltmag.com/bbkids/features/angles/angles.asp>

angles hitting the target

<http://www.hittingthetarget>

maths sport

<http://www.sasked.gov.sk.ca/docs/midlmath/sports.html>

angles sport

<http://www.sctev.org/ntti/lessons/1998lessons/anglesangles.html>

top jobs sport

<http://www.sctev.org/ntti/lessons/1998lessons/anglesangles.html>

angles glossary

<http://mathcentral.uregina.ca/RR/glossary/middle/>

archimedes angles

<http://www.cut-the-knot.org/pythagoras/archi.shtml>

history maths

<http://www-gap.dcs.st-and.ac.uk/~history/Indexes/HistoryTopics.html>

NQSF Resources on Demand

The NQSF website, professional reading on school improvement strategies, using the productive pedagogies and VIT Professional Teaching Standards were used as frameworks for this project.

The following is a list of resources from the NQSF website that relate to the project.

Title: Raising the Standard of Boys' Achievement in Literacy

URL: <http://www.scre.ac.uk/spotlight/spotlight81.html>

Concerns about the differences between the achievements of boys and girls, especially in terms of literacy led to an action research project by a teacher-librarian in a Scottish secondary school. This brief report explores the reading habits of a sample of boys and girls in early secondary years and describes how the findings led to the establishment of an out-of-school support scheme. Report available at <http://www.scre.ac.uk/spotlight/spotlight81.html>

Title: Promoting Boys' Achievement

URL: <http://www.ero.govt.nz/Publications/pubs2000/promoting%20boys%20achmt.htm>

This article by the Education Review Office in New Zealand deals with the issues relating to underachievement of boys, systems for identifying groups that are underachieving, barriers to achievement and programs in place to remove these barriers or encourage underachieving students to achieve to their full potential. Examples are included of schools promoting boys' achievement. The publication can be found at <http://www.ero.govt.nz/Publications/pubs2000/promoting%20boys%20achmt.htm>

Title: Exploring the Relationship Between Staff Development and Improvements in Student Learning

URL: http://www.nsd.org/library/jsd/f_gusky.html

In this article Thomas Guskey and Dennis Sparks describe a model for exploring the complicated and multidimensional relationship between staff development and improvements in student learning. Their purpose is to bring clarity to discussions of the complexities of this relationship and to investigations of those complexities. Second, they hope the paper stimulates and challenges all those involved in staff development to explore this relationship more thoughtfully. The article was originally published in the Journal of Staff Development, Fall 1996 (Volume 17, Number 4).

Title: Evaluating Professional Growth and Development

URL: <http://www.ncrel.org/sdrs/areas/issues/educatrs/profdevl/pd500.htm>

This web article is underpinned by the statement that the ultimate worth of professional development for teachers is the essential role it plays in the improvement of student learning. The article, with useful links to other pages, discusses issues associated with evaluating professional development. It makes the point that each professional development effort should be accompanied by a well-designed evaluation plan for determining its effectiveness. Because of the complexity of current changes in education.

Title: Engagement & Motivation in Reading

URL: <http://www.readingonline.org/articles/handbook/guthrie/index.html>

In this article John T Guthrie discusses engaged reading and its consequences. The particular focus is on student motivation. Instructional contexts that foster reading engagement and motivation are described. Teachers create contexts for engagement when they provide prominent knowledge goals, real-world connections to reading, meaningful choices about what, when, and how to read, and interesting texts that are familiar, vivid, important, and relevant. Teachers can further engagement by teaching reading strategies. A

Title: Nothing Left to Chance

URL: <http://www.thenetwork.sa.edu.au/nltc/index.htm>

Describes the experiences of high achieving, disadvantaged schools and the improvement of their students' literacy and numeracy outcomes, and includes a set of five characteristics which assist schools to construct success for their students in literacy and numeracy coherent classroom fuses these qualities.

Title: Reciprocal Teaching

URL: /uploads/2003-08-19_09-21-00_96.pdf

This resource provides a brief description of reciprocal teaching and includes an overview of reciprocal teaching strategies. The resource includes advice on implementing reciprocal teaching as well as links to useful websites.

Title: Successful Programs and Strategies for Children with Learning Difficulties

URL: <http://www.detya.gov.au/schools/literacy&numeracy/publications/mapping/brochu...>

This report outlines some of the findings of the research project, Mapping the Territory Primary Students With Learning Difficulties: Literacy and Numeracy. The report focuses on the elements of programs and strategies that were identified by the researchers as assisting students who were experiencing difficulty with literacy and numeracy learning. Details for obtaining a copy of the full report are included. The report summary is available at <http://www.detya.gov.au/schools/literacy&numeracy/publications/mapping/brochure-text.htm>

Title: Survey of Early Learning Assessment Tools

URL: http://www.tki.org.nz/r/assessment/research/stocktake_11_e.php

Description: Review of 12 assessment tools for Reading, Writing and Mathematics for students aged 5 to 9. Review undertaken for New Zealand Ministry of Education. Most of the tools reviewed are available in Australia. May be downloaded as pdf file from http://www.tki.org.nz/r/assessment/research/stocktake_11_e.php.

Title: The Intelligent Gaze: Leadership, Lead Learners and Individual Growth

URL: <http://www.ncsl.org.uk/mediastore/image2/kenning-the-intelligent-gaze-summary...>

UK Research associate report reflecting on the need for significant changes to the learning process in our schools (Summary Report) Also see Full Report.

Title: The Literacy Leadership Tools

URL: http://www.tki.org.nz/r/literacy_numeracy/professional/leader/lead_tools_e.ph...

Tools to support the planning and implementation of literacy initiatives within schools, including pro formas to guide the establishment of a literacy vision, school action plans and classroom initiatives. Emphasise the importance of gathering data to evaluate initiatives...

Title: The Literacy Program Evaluation Tool

URL: <http://www.ncrel.org/literacy/eval/>

This site provides a step-by-step process for evaluating your school's literacy programs, covering such topics as building a knowledge base, collecting and analysing data, and provides links to relevant other sites and literature summaries about best practices.

Title: Inquiry & Problem Solving In Maths and Science

URL: <http://www.enc.org/topics/inquiry>

Description: Classroom focused articles on inquiry and problem solving in mathematics and science. From a US organisation concerned with curriculum resources for K-12 mathematics and science. Available at <http://www.enc.org/topics/inquiry>.

Title: Providing Hands-On, Minds-On, and Authentic Learning Experiences in Mathematics

URL: <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/math/ma300.htm>

Learning does not mean simply receiving and remembering a transmitted message; instead, "educational research offers compelling evidence that students learn mathematics well only when they construct their own mathematical understanding" (Mathematical Sciences Education Board, 1989, p. 58). When educators begin to see learning as knowledge construction, they change their thinking about curriculum, instruction, and assessment, developing more powerful approaches to connecting thinking and mathematics and designing more mathematically significant instructional learning experiences. This website of the North Central Regional Educational Laboratory explores these themes further, particularly with reference to hands-on, minds-on, and authentic learning experiences

Title: Meeting the Needs of Able Learners through Flexible Pacing

URL: <http://ericec.org/digests/e464.html>

Flexible pacing includes programs in which students are taught material that is appropriately challenging for their ability and allows them to move forward in the curriculum as they master content and skills. This article from the ERIC Clearinghouse on Disabilities and Gifted Education is based on from successful programs in the US.

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