

Lesson Details	Lesson Study Group
Name of lesson: Step by Step	School Name & address: Ardee
Topic: derivation of the cosine rule	Community School, John St, Ardee,
Year group: 5 th year	Co Louth
Level: higher level	Associate: Emma Tormey
	Link Advisor: Marilyn O'Riordan
	Teachers: Emma Kane and Emma
	Tormey

Research Theme

Teachers view collaboration as a means to improve student learning and also to enhance their own professional learning. They engage in constructive collaboration practice and in collaborative review of their practice.

Students apply critical thinking and problem-solving skills in their approach to their learning and develop as autonomous learners. Students demonstrate an enquiring and open-minded attitude towards themselves and those around them.



Background & Rationale

The rationale behind the development of this lesson is to encourage students' conceptual understanding, adaptive reasoning and strategic confidence. Students will further develop on critical and creative thinking skills learnt at Junior Cycle. They will be able to develop their communication skills through presentation of their work. And although working with others they will have to be personally effective in problem solving.

In the Junior Cycle students learnt how to problem solve using right-angle triangles, this content incorporates students' prior learning and builds on it to problem-based discovery of the cosine rule in a non-right angle triangle.

Traditionally students find Trigonometry difficult conceptually and the Cosine rule tricky algebraically. Our hope is that, through the use of active manipulation of physical props, students can confidently approach the task to develop an understanding of relationships in a non-right-angle triangle.

Over the year we have identified that students struggle and are often uncomfortable with trigonometric problem-solving questions. Our aim is that by creating a real-life experience where students derive the Cosine rule themselves that they will have a better understanding of both its derivation and application.

Prior Learning	Current Learning	Future Learning
	-	-
Labelling right angle	Students can appreciate how	Identifying
triangles	algebra can be used to solve	unknowns and
Trigonometric ratios in a	real life problems.	known quantities
right-angle triangle		Using the 5 rules to
Pythagoras Theorem	Learn how to work with right	solve for an
Algebraic manipulation	angle triangles	unknown in a right
Geometric construction	Learn about degrees and	angled triangle
of triangles	radians, reference angles	Rearranging a
Problem solving with	Trigonometric functions	formula to isolate an
right-angle triangles	Special angles	unknown
Similar triangles	Solving trigonometric equations	
Constructions and	Sine Rule and Cosine Rule	
Theorems of right-angle	Use and deriving proofs and	
triangles	identities	
	Area of a triangle	
	3D problems	

Relationship of the Unit to the Syllabus



Goals of the Unit

Feel confident using trigonometry to solve a problem.

Learn that they can attempt to solve a problem using trigonometry without

necessarily knowing all the steps at the start.

Understand that there may be more than one way to solve a problem.

Appreciate that attempting to solve a problem is a satisfying achievement in itself

Assist others in a caring, open minded manner.

Communicate clearly with each other and the class.

Unit Plan	
Lesson	Brief overview of lessons in the unit
1	right angled triangles
2	Practical problems
3	Unit circle
4	Trigonometric graphs
5	Special angles
6	Trigonometric equations
7	Sine rule. Revision of right angled triangles
8	Research lesson: derivation of cosine rule
9	Using the cosine rule
10	Area of a triangle
11	Area of sector, length of arc
12	3D problems



13	Derivation of trig formulae
14	Application of formulae

Goals of the Lesson	
٠	Communicate with each other in a clear open manner
•	Develop confidence in their ability to attempt to solve a problem
•	Comprehend that proofs and derivations are not memory tests but rather a
	development of understanding.
•	Reduce dependence on teachers to always supply answers, and become
	independent learners in the process.
•	Label an unknown compound triangle

- Use Pythagoras theorem And other trigonometric ratios.
- Equate two equations
- Manipulate these to get a statement we want
- Understand that they do not have to learn a proof or derivation off by heart.

Cognitive and developmental goals:

- Students will become active self motivators to guide their own learning.
 Thus gaining confidence in their own ability and skills.
- Students will demonstrate effective communication by actively listening and clearly explaining their ideas.
- Students will justify their statements by demonstrating mathematical rigor.



Flow of the Lesson		
Timing, activities,	Teacher support,	Assessment, questions,
steps, resources,	activity	comments, strategies
problems		
Introduction:	Using a previously solved	Students will have an
	problem the teacher	opportunity to clarify
	revises prior knowledge	ideas and ask questions.
	and poses the task	
Posing the task	Students use A3 whiteboards, A2 pages and draw the triangles they constructed. They note ideas on the whiteboards and pages and used their tables and formulae books when appropriate. Students should communicate their ideas and thoughts clearly to the others in the group, either to justify or explain what they are doing. Groups who have reached differing levels of success or used novel constructions or methods will be invited to come to the top of the room to present their work to the whole class	Teachers stand back and observe how students communicate initial ideas to each other. If students arrived at a stage that it becomes obvious that there is no progress, the observing teacher is instructed to furnish them with a hint card. Students will be clear on what they did and why they did it. They should present their work clearly and confidently.





Evaluation of Lesson

The post lesson meeting was incredibly productive and full of discussion. As a group we agreed that the scaffolded discovery worksheet worked well. We did





however agree that when applying this to future classes we would provide each student with their own worksheet and individual whiteboards.

To increase a sense of achievement by all students we decided we would include a box so students can mark off when they have completed a section.

We feel that in a habitual class setting students would benefit from having the teacher read through the worksheet either at the beginning of the lesson or at set times, and that supplying coloured markers may further assist learners.

The final part, which was the student development of a problem in which the cosine rule can be embedded, was postponed until the next lesson due to time constraints.

By using careful wording of the evaluation and observation sheet we were able to see how this lesson could be further developed in the future. All questions were worded so as the worksheet, strategies and future planning were the focus. This led to a rich discussion where there was no fear of offending, and suggestions were taken as learning moments.

Summary of Key Learning	
Meetings	Having LAOS 2022 as our starting point really helped us to focus
	on what we wanted our outcomes to be. We very early decided that
	our main goals were to help students to develop as independent
	learners, gaining confidence through discovery and effective
	communication. We also decided that the area of deriving a formula
	is problematic for students and that they would benefit from seeing
	how to do it rather than learn a proof.
	Although Lesson Study is usually embedded in a structured
	problem to solve, we felt it would be interesting to attempt to allow
	students to participate in a scaffolded discovery lesson that leads to
	mathematical rigor.





 We struggled to complete a worksheet that was completely hands off from a teacher standpoint, but we knew this is an essential part of the research. We worked on the actual lesson for a large amount of time so that we could be confident that no student would be left unable to complete any work. We also felt it was important to create a lesson where every student could achieve some measure of success in their learning. The plan was to ask students to create a problem which could be solved by the use of this newly derived knowledge, but time got away from us. When creating the observation and reflection sheet, we decided to be very specific in our questioning, especially with respect to future development. Instead of asking, "how we could improve the lesson?" we asked: How can the worksheet be improved? How can this worksheet be applied in a class? What strategies did you observe or not observe that could be used when planning a class? What did you learn / observe that can be applied to future teaching and learning? Any other learning for teachers? 		
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Final Reflection

By carefully considering words and phrases used, students can be led to become more fully rounded learners. This same sentiment also applies to teachers in any Professional Learning Community.



We look forward to our continuing collaboration as a department and to participating in the next round of Lesson Study.