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Time, turns and angles: A real-world approach to learning mathematics

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Abstract: This report documents a lesson study conducted with Year 6 students at Għarb Primary School, Gozo, as part of the INSOLVU project focused on teaching mathematics through problem solving. The lesson explored the concepts of angles, time, and turns by embedding them in a real-life problem involving a cooking timer. Through an engaging outdoor activity using a large protractor and clock-face simulation, students visualised angles as physical rotations, measured them, and linked degrees with time. The lesson aimed to bridge abstract and concrete understandings, improve spatial awareness, and foster collaborative learning. Observations revealed that hands-on, contextualised experiences significantly enhanced student engagement and reasoning, although some struggled to articulate the lesson's mathematical focus. Post-lesson reflections identified the importance of scaffolding and inclusive strategies to support all learners. The report concludes with recommendations for refining group dynamics, encouraging individual accountability, and building a classroom culture that embraces challenge and exploration.

Keywords: Angles; measurement; problem-solving; real-world contexts; spatial reasoning

Introduction

Understanding angles and turns is a core component of geometry, yet for many primary students, these concepts remain abstract and disconnected from everyday experience. In traditional classroom settings, angle measurement is often introduced through diagrams and static tools, which may limit students' ability to visualise rotation and apply angle knowledge meaningfully. In this context, the present lesson study, conducted as part of the INSOLVU project, sought to develop and

trial a research lesson that supports students in making sense of angles through a real-world, problem-solving approach.
The lesson was implemented in a Year 6 class at Għarb Primary School in Gozo, a small rural school committed to providing inclusive, creative, and engaging learning opportunities. The teacher team included classroom educators, the head of department for mathematics, a support teacher, and members of the school's senior leadership. Collaboratively, they designed a research lesson centred around the use of a cooking timer as the context for estimating, measuring, and reasoning about angles and time.

The research lesson aimed to achieve several learning goals, including helping students define and represent angles as measures of turn, relate angles to fractions of a full rotation, estimate and measure angles up to 180°, and connect angle measurement to time using real-world scenarios. A significant part of the lesson involved moving the activity outdoors, where students used a large protractor, laminated number cards, and string to simulate clock movements and explore angular turns physically.

The research lesson

The lesson addresses the abstract nature of angle measurement by connecting it to real-life contexts, improving students' spatial awareness and ability to apply angle knowledge meaningfully.

The lesson aimed to help students to:

- Define and illustrate that an angle is a measure of a turn
- Recognise that a full turn equals 4 right angles and a half turn equals 2 right angles.
- Estimate, sort, measure, and draw angles up to 180° using a protractor (with a margin of error of ±5°).
- Deduce that angles on a straight line add up to 180° and calculate missing angles in such contexts.
- Master hands-on strategies for teaching and evaluating angles.
- Learn to simplify complex problems involving angles and time.

The lesson study context

The school

The lesson study was conducted at Għarb Primary School, which is part of the Gozo College network. The school is in the village of Għarb on the western side of Gozo and currently accommodates 107 students (57 girls and 50 boys). The school comprises nine classes: three in the Early Years (one Kinder 1 class and two Kinder 2 classes) and six primary classes, one class per year group, from Year 1 to Year 6.

The vision of Għarb Primary school is to provide students with alternative opportunities to learn, grow and attain success. The school believes that growth occurs when students feel safe, respected and appreciated. The commitment is to prepare students to move forward with a strong sense of self confidence into a life filled with promise.

The school's mission is to promote a positive school ethos that seek the holistic development of every student. Għarb primary believes in a trusting, caring environment where diversity is honoured and respected. Students learn in a variety of ways and are viewed as individuals evolving into their own identities. Positive relationships are the main priority of Għarb Primary School's success.

The students

The research lesson was implemented in a Year 6 class composed of 16 students: 11 girls and 5 boys.

The team members

Name	Role at school	Role in lesson study
Sarah Camilleri Dimech	Head of Department (Maths)	Facilitator
Antoinette Grech	Maths Support Teacher	Facilitator
Daniela Said	Teacher	Team member + taught the lesson
Sharon Muscat	Teacher	Team member
Marion Vella Muscat	Deputy Head of School	Team member
Marthese Attard	Head of School	Team member

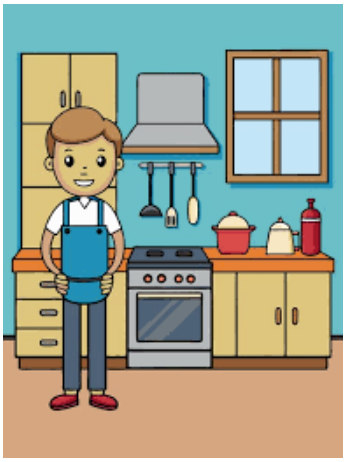
The lesson study process

The meetings

Date	Points discussed
14/11/2024	• Identify gaps in teaching and learning mathematics • Discuss and choose topic and the lesson focus • Discuss possibility of an outdoor learning activity • Brainstorm real-life links for a problem-solving task
26/11/2024	• Work on the learning outcomes • Develop the lesson plan • Develop the resources needed • Focus on the lesson structure
16/01/2025	• Complete the lesson plan • Create student survey • Prepare resources and other teaching materials
22/01/2025	• Create the observation sheet • Assign roles for observers • Revise lesson plan • Go through all the resources

The problem-solving task

A mother needs to run an errand and leaves instructions for her son John about cooking dinner.
She tells him to switch on the oven by turning the knob of the timer 210˚ clockwise.
John turns the knob at 11:15 a.m. but he is not sure if the timer of the oven is working properly.
What is the **cooking time in minutes** for the food to be ready? Explain your reasoning.
What **time** should the oven **switch off?**



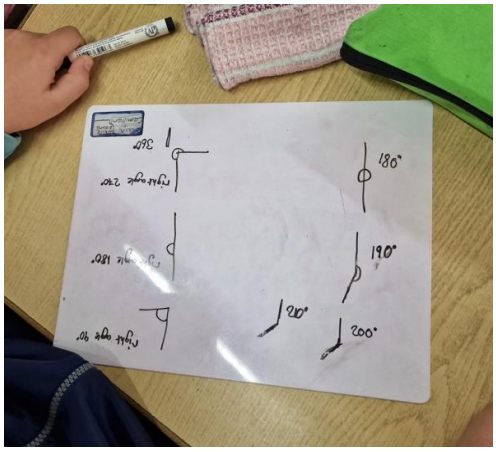
The lesson outline and plan

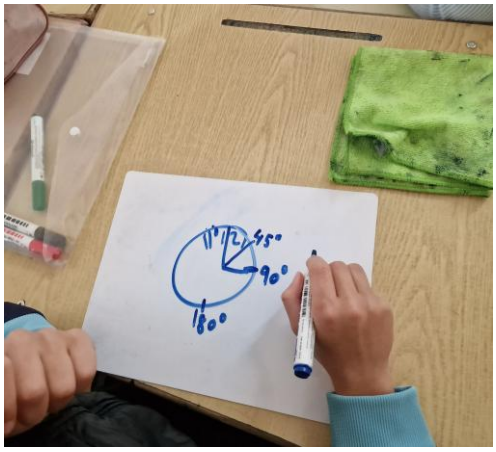
Lesson outline

The teacher kick started the lesson by showing students a cooking timer knob. Then, the teacher asked students what the knob is and what they think it is used for. Students then engaged with a real-life scenario in which a mother instructs her son to turn the oven knob 210˚. Unsure if the oven timer is functioning correctly, the son attempts to determine the correct cooking time. Following a discussion where students shared their interpretations, they headed outdoors to explore turns and angles in a hands-on way, connecting these concepts to the clock face.

A large protractor was placed in the middle of the ground. The laminated numbers were spread in a large circle around protractor to represent the clock face. A group of students held a string from side to side. One of the sides was on the middle of the protractor and the other on the number 12. Students were asked the following questions for investigation:

- Move to the number 3 of the clock face. What angle did you turn?
- Now go back to the initial position and move to the number 6. What angle did you turn?
- If you turn to the number 9 of the clock face, what angle will you turn?
- What about if you turn a whole turn? What angle is this?





The exercise was repeated but this time students measured other angles which are not right angles. The exercise proceeded but this time students were given the angle, and they needed to measure the time. For example, the string is the minute hand, turn 60˚ clockwise. How many minutes did the minute hand turn? Repeat with other angles.

Students must figure out what the fraction of a right angle is. For example, turn 10 minutes clockwise, what fraction of a right angle is that? Turn 30˚ clockwise, what fraction of a right angle is that?

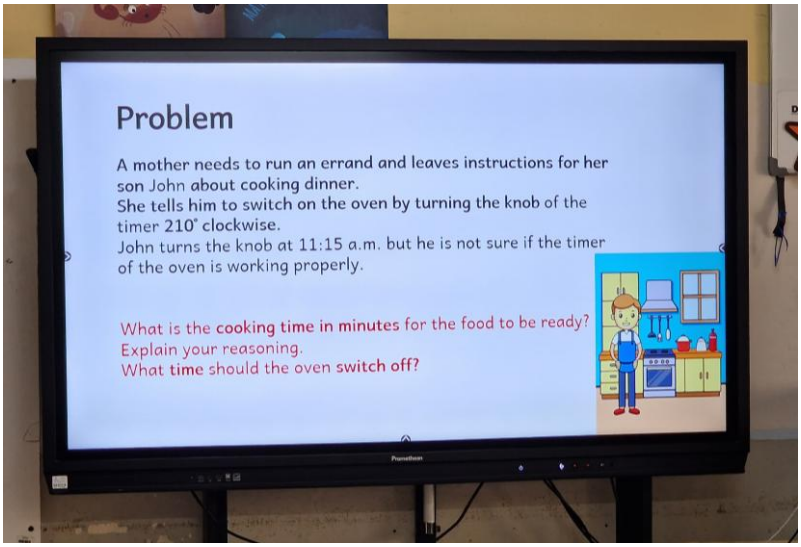
Students were divided into four groups. One group was the one that turns according to the instructions by the other groups (this group will also turn and ask the other groups to describe the turn), one group will be the minutes, the other group angles (in degrees) and the fourth group right angles. Each group gave different instructions.

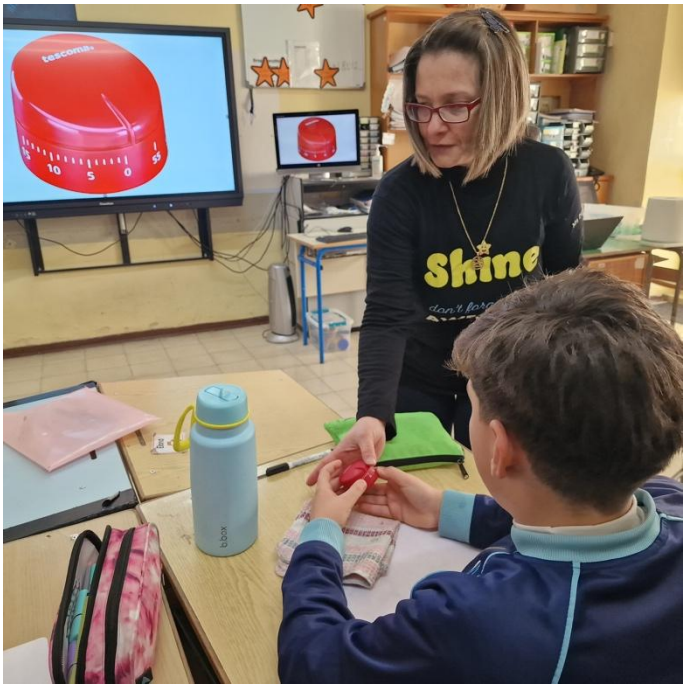

Finally, students went back in class and were given a clock face with hours, minutes and angles. They were encouraged to answer the initial

prompt in groups. Students then presented their work. In case where students presented same work (in groups), the teacher rephrased students' work to make sure they understood and posed another problem related to time and angles.

For homework students were encouraged to create one real-life problem related to angles and turns. This lesson was designed to address the challenge of students perceiving angles and turns as abstract, enhancing their spatial awareness and helps them understand the application of angles in various contexts.

The lesson plan

<table>
<tr><td colspan="2">Phase 1: Introduction</td></tr>
<tr><td>How will the lesson be introduced? What will you say and/or do to get them interested?</td><td>The teacher presents the following problem to the whole class.
 
</td></tr>
<tr><td>What difficulties might students encounter?</td><td>• Difficulties in visualising the Knob Difficulties in relating the concepts of angles, time and direction.
• Understanding angles requires the ability to visualize rotations and turns, which can be difficult without concrete examples or hands-on activities.
• Interpreting the circular movement of clock hands in terms of angles can be confusing.
• Students may struggle to see how angles, time, and direction interconnect in real-life applications like reading maps, solving puzzles, or planning routes.
• Terms like clockwise, anticlockwise, degrees, quarter turn, and right angles might be confusing, especially if students lack prior experience with these words in context.</td></tr>
</table>

	• Relating the movement of clock hands to changes in direction (e.g., "3 o'clock corresponds to a 90° turn") involves multitasking between systems. • Interpreting angular turns (e.g., making a "right angle" turn to the right or left) requires spatial awareness. • Students who struggle with orientation may have difficulty visualizing and applying these concepts.
How do you intend to address these difficulties?	 Later, the students will continue the lesson in the school ground. They will use a string, a large protractor and laminated number cards to represent the clock face to experience angles and turns in a concrete way.
Phase 2: Students' work	
How will students work? Will they be involved in individual work? Or will they be asked to work in pairs or within a small group of 3 or 4 students? Explain how this will be done.	Following a discussion where students share their interpretations they will head outdoors to explore turns and angles in a hands-on way. A large protractor is placed in the middle of the ground. The laminated numbers will be spread in a large circle around protractor to represent the clock face. A group of students will hold a string from side to side. One of the sides must be on the middle of the protractor and the other on the number 12. Students will be asked: • Move to the number 3 of the clock face. What angle did you turn? • Now go back to the initial position and move to the number 6. What angle did you turn? • If you turn to the number 9 of the clock face, what angle will you turn? • What about if you turn a whole turn? What angle is this?

	• Repeat the exercise above but this time students must measure other angles which are not right angles [Note: Start with 1 so the students understand that between a number and another there is 5 minutes but 30˚]. Proceed the exercise but this time they are given the angle, and they need to measure the time. For example, the string is the minute hand, turn 60˚ clockwise. How many minutes did the minute hand turn? Repeat with other angles. Following that (sometimes give the angle and sometimes the minutes) and students must figure out what the fraction of a right angle is that. For example, turn 10 minutes clockwise, what fraction of a right angle is that? Turn 30˚ clockwise, what fraction of a right angle is that? Students will be divided into 4 groups. One group will be the one that turns according to the instructions by the other groups (this group will also turn and ask the other groups to describe the turn), one group will be the minutes, the other group angles (in degrees) and the fourth group right angles. Each group will give different instructions. • Group A Turns • Group B Angles • Group C Time • Group D Fractions
What difficulties might students encounter with the set task/s as they start working on it?	• Understanding the protractor scale. Since the protractor typically has two scales – one for measuring angles from 0° to 180° in one direction, and another for measuring angles in the opposite direction, students may confuse these scales. • Identifying the centre of the protractor, where the midpoint of the base lines intersects with the curved edge. These must align with the vertex of the angle. The struggle is the proper alignment. • Rotation of the protractor when measuring angles. Sometimes the protractor needs to be rotated to read angles bigger than 180°.
How do you intend to address these difficulties? What kind of help do you intend to provide?	• Providing a large protractor will help since the scale is clearer. • At the beginning clear instructions will be provided on how to use a protractor emphasizing on the importance of aligning it • correctly with the angle. • Practising with different angles, both acute and obtuse will build up students' confidence.
Phase 3: Summary and closure	
How do you intend to bring the lesson to a closure?	Finally, students will go back in class and be given a clock face with hours, minutes and angles. Students will be asked to present their work. In case of similar work, the teacher will rephrase the work presented to be sure that they understood the problem. Following that the teacher will present another problem related to angles and time to assess their understanding. For homework

	students are encouraged to create one real-life problem related to angles and turns. This lesson is designed to address the challenge of students perceiving angles and turns as abstract, enhancing their spatial awareness and helps them understand the application of angles in various contexts.
What difficulties might students face during this phase of the lesson?	• Change in focus: moving from the freedom of the outdoor environment to the structure of the classroom can disrupt a student's focus. • Can lead to chaotic transition.
How will you try to address these difficulties?	• Planning the transition carefully, allowing time for students to settle into the classroom and adjusting their mindset. • We can use icebreakers or short reflective activities to help students re-focus after the outdoor lesson. For example, we can ask them to share one key observation they made when they were doing their outdoor activity.

Post-lesson reflections

Key outcomes

1. The initial problem scenario successfully engaged students and triggered deeper thinking,
2. Outdoor activities made the abstract concept of angles tangible and relatable,
3. One unexpected finding was that students struggled to independently identify the lesson's focus on angles, despite previous exposure, and
4. Active problem-solving was more effective when scaffolded by direct teacher questioning and support.

Main takeaways

1. Challenging problems at the start of the lesson increased student motivation and collaboration.
2. Real-world contexts helped students connect mathematical concepts to everyday life.
3. Problem-solving resilience was enhanced through opportunities to struggle and reason through complexity.
4. Scaffolding through questioning played a critical role in students' ability to discover solutions.

Despite the lesson's success in engaging most students, two remained consistently disengaged. These students typically struggle to participate in regular classroom activities.

Recommendations by the Senior Leadership Team

1. *Increase Individual Accountability*
   Reduce reliance on group work by integrating more individual tasks with self-reflection prompts.
2. *Strategic Pairing*
   Pair passive students together to promote ownership of learning and eliminate dependency on more active peers.
3. *Direct Teacher Support*
   Implement regular check-ins and targeted questioning using strategies such as 'no opt-out' and the use of whiteboards or journals.

Way forward

- Continue initiating lessons with real-world, open-ended problems.
- Cultivate a classroom culture where mistakes and struggle are embraced.
- Use reflective journals, peer teaching, and structured discussions to deepen reasoning and understanding.
- Focus on inclusive strategies that engage all learners, especially those prone to passive behaviour.

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