SMART LESSON Measuring Tree Height with the Smart Measure App

Smart Lesson Structure

MAIN DATA OF THE LESSON

Title:	*Measuring Tree Height with the Smart Measure App*
Subject:	*STEM*
Specific topic:	*Trigonometry*
Main target:	€ *Grade 3 (upper secondary school)*
Duration:	*4 hours*
Context:	€ *Inside the classroom* € *Outside the classroom*
School/Author:	*Panagiotis PAPADOPOULOS, ICT teacher, Gymnasium and L.T. Kallithea Elassonas*

LEARNING OUTCOMES

Specificy the technical competences, digital and life long learning competences which will be developed

Key Competences:	<u>*According to 8 Eu Life long learning Competences*:*</u> o *Mathematical, science, technology and engineering* o *Personal, social and learning to learn* o *Citizenship* **The digital competence is not listed below as it is already included in the previous point*
Digital Competences:	<u>*According to the DigiComp:*</u> o *Information & data literacy* o *Communication & collaboration* o *Problem Solving*
Technical Competences:	*Proficiency in app utilization, trigonometry, and applications involving similar triangles*

DIGITAL TOOLS/APPS

APPs and other IT tools	*(Brief description of the apps and of the skills/competences that are developed through each specific app)* *The students engaged in this project/lesson will leverage collaborative tools such as Google Docs to store and share their work. They will utilize search engines, like Google and merlin, to gather information from the internet. For assessment purposes, we will employ Kahoot and use quantitative and qualitative indicators to measure specific results.* *Google calendar and keep as a project management tool.* *Kahoot is an interactive learning platform that allows educators to create and play educational games, quizzes, and surveys with students. It is often used in classrooms to make learning more engaging and fun. The platform uses a game-based format, where*

participants answer questions on their devices, and scores are displayed in real-time. Students generally find Kahoot enjoyable and exciting due to its competitive and interactive nature, fostering a positive and participatory learning experience.

The Smart Measure app is a digital tool designed for measuring distances and heights using a smartphone's camera and sensors. It employs trigonometry principles to calculate measurements accurately.

A clinometer app is a mobile application that uses the sensors in a smartphone or tablet to measure angles accurately. It is commonly used for tasks such as measuring the angle of elevation or inclination of objects like trees, buildings, or slopes.

Through this apps, students develop:

1. **Mathematical Competence (STEM):**
   - *Application of trigonometric principles for distance and height measurements.*
2. **Digital Competence:**
   - *Utilization of a specialized app for a practical, real-world task.*
   - *Interpretation and application of digital measurements.*
3. **Learning to Learn:**
   - *Problem-solving skills in choosing and effectively using digital tools for specific tasks.*
   - *Adaptability in applying digital solutions to measure real-world objects.*
4. **Collaborative learning – Citizenship**
   - *Digital citizenships by collaborative activities and sharing knowledge*

DESIGN OF FHE SMART LESSON IN 4 STEPS

Step 1 – eTASK
Introduction to the digital task

(Introduction to the topic, explanation of the different learning outcomes, general introduction to the activities to be carried out: this is a brief introduction to present the topic and the activities to the students)

- o *Topic Introduction: (Brief overview of the lesson plan and its objectives.)*
  - ➢ *Problem: We aim to assess the growth progress of trees in a plantation by determining an effective method for measuring their height*
  - ➢ *Explanation of the Smart Measure app and its relevance to the lesson.*
  - ➢ *Discussion on the importance of mathematical concepts, digital skills, and problem-solving in real-world scenarios.*

➢ *A brief introduction to the subject matter, emphasizing the importance of digital skills.*

o ***Learning Outcomes Explanation****: (Explain how using these apps will contribute to achieving the specified learning outcomes.)*

1. *Mathematical, Science, Technology, and Engineering:*
   ➢ *The Smart Measure app and clinometer app involve the application of mathematical principles, particularly trigonometry, in real-world scenarios, enhancing students' understanding of geometry and measurement concepts.*
   ➢ *Utilizing search engines like Google and Merlin promotes the integration of technology in research, fostering scientific inquiry and exploration.*

2. *Personal, Social, and Learning to Learn:*
   ➢ *Collaborative tools such as Google Docs facilitate teamwork and peer collaboration, promoting social interaction and enhancing students' ability to work effectively in groups.*
   ➢ *Kahoot provides an engaging and interactive learning experience, encouraging self-directed learning and boosting students' motivation to participate actively in their own education.*

3. *Citizenship:*
   ➢ *By engaging in collaborative activities and sharing knowledge through digital platforms, students develop digital citizenship skills, including responsible online behavior and respect for intellectual property rights.*

4. *Information & Data Literacy:*
   ➢ *Utilizing search engines helps students develop skills in information literacy, enabling them to effectively search, evaluate, and utilize digital resources to gather information and support their learning.*

5. *Communication & Collaboration:*
   ➢ *Google Docs facilitates communication and collaboration among students by allowing them to work together in real-time, share ideas, and provide feedback to one another.*
   ➢ *Kahoot encourages communication and collaboration through interactive quizzes and games, fostering a sense of community and shared learning experience among students.*

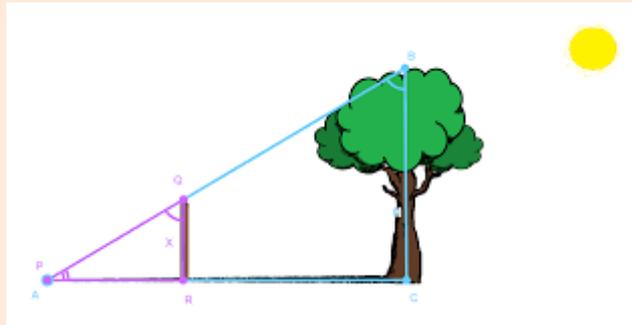|	
	6. *Problem Solving:* ➤ *Using the Smart Measure app and clinometer app requires students to apply problem-solving skills to accurately measure distances and angles, encouraging critical thinking and analytical reasoning.* ➤ *Assessing and analyzing the data collected through these apps allows students to identify and address discrepancies, fostering a systematic approach to problem-solving and decision-making.* ○ ***Activity Overview:*** *(Outline the main activities, including research, organization, and assessment tasks.)* ➤ *The activities will consist of three tasks utilizing different methods to calculate tree height and assessments* ➤ *Conducting assessments to gather prior knowledge(pre assessment), feedback (post assessment) aimed at identifying mistakes and enhancing individual and group performance.* ➤ *Researching mathematical formulas and theorems essential for accurate height calculations.* ➤ *Each activity is designed to engage students in practical applications of mathematical concepts while fostering collaboration and problem-solving skills. Through these activities, students will not only learn to apply mathematical principles but also develop strategies for error correction and continuous improvement.*
Step 2 – eEXECUTION **Digital execution of the task**	*(Execution of the task, description of the tasks/subtasks that will be carried out with the help of the apps/digital technology)* *The conventional techniques utilized for measuring a tree's height through trigonometry, utilizing only a 1-meter stick and a measuring tape* *Activities description:* *1st Activity) A pre-assessment is conducted to gauge students' prior knowledge, inform instructional planning, set learning goals, differentiate instruction, and monitor progress throughout the learning journey. It will help tailor teaching to meet diverse student needs and ensures effective and personalized instruction, ultimately enhancing learning outcomes.* *2nd Activity) The mathematical approach involves applying the principle of similar triangles to accurately calculate the height of the tree.*

3rd Activity) Utilizing a clinometer app along with a measuring tape, and employing trigonometric principles such as the tangent function to accurately determine the height of the tree.
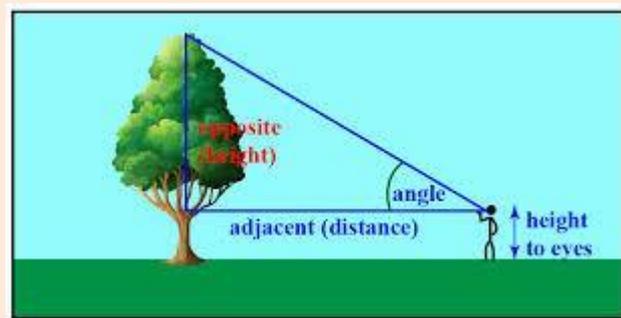
4th Activity) Students engage in a brief conversation highlighting the practical significance of **mathematical** understanding, **digital** proficiency, and **problem-solving skills**.
The discussion emphasizes how these competences collaboratively empower individuals to navigate and excel in real-world situations.

5th Activity) Subsequently, they will utilize the Smart Measure app to gauge the height of a tree. Through this hands-on application of theoretical concepts, students gain a practical understanding, solidifying the relevance of these principles beyond academic boundaries and fostering a forward-looking perspective

6th Activity) A post-assessment to evaluate student learning and mastery of content after instruction, providing feedback on the effectiveness of teaching strategies and informing future instructional decisions.

- o **Individual Research and Learning**: *(Students use the educational resource app to learn about a specific topic and take notes.)*
  Each student will engage in online research to create a document highlighting the significance of the problem. This document will be stored on Google Docs and made accessible to

all peers. The content will encompass the formulas and theorems utilized to tackle the problem.

- o **Task Organization**: *(Using the project management tool, students plan and organize their learning activities and timelines.)*
  Students can leverage Google Workspace's calendar and Keep apps, integrating them to harness the combined power of various Google project management tools, thereby obtaining the required functionality
  Using the calendar, students can schedule their activities and set reminders, while utilizing Google Keep to store all essential notes and questions for further processing

- o **At-Home Execution:** *(Encourage students to engage in these tasks at home, promoting a comfortable and self-paced learning environment.)*
  The teacher can provide help for at-home execution by:
  - ➤ *Offering clear instructions and guidance on how to approach the tasks.*
  - ➤ *Providing resources or references for further learning.*
  - ➤ *Being available for questions and assistance through email, online platforms, or virtual office hours.*
  - ➤ *Offering feedback on completed tasks to reinforce learning and provide guidance for improvement.*
  - ➤ *Encouraging students to reach out if they encounter difficulties or need clarification.*
  - ➤ *Suggesting additional exercises or challenges to extend learning beyond the initial tasks.*

Step 3 – eCORRECTION **Digital correction of the task**	*(Describe the different options: self-correction, digital correction with the teacher and with the classroom)* o **Self-Correction**: *Students use digital tools (like grammar checkers or fact-checking websites) to review their work.* **Students could use following sites for self-correction** https://topdrawer.aamt.edu.au/Geometric-reasoning/Big-ideas/Similarity/Similar-triangles https://study.com/academy/lesson/tangent-in-trigonometry-definition-lesson-quiz.html o **Teacher Feedback**: *(Teachers provide feedback digitally, focusing on content comprehension and digital skill application.)*

➤ clear understanding of trigonometric principles demonstrated.

➤ Accurate application of formulas and theorems evident in height calculations.

➤ Provide students with the correct heights measured each time with the different method and let them compare their findings with the correct ones. What do they conclude?

➤ Proficient use of digital tools such as the Smart Measure app, clinometer showcased.

➤ Effective integration of Google Workspace apps for project management tasks.

➤ Organization and clarity of digital submissions and communication demonstrated

o **Classroom Interaction:** *(Incorporate opportunities for students to share their work with peers digitally, encouraging collaborative learning and peer assessment)*

➤ Organize group discussions or presentations where students can showcase their work to their peers.

➤ Implement online platforms or discussion boards for students to post their work and receive feedback from classmates.

➤ Encourage collaborative projects where students can work together to solve problems or complete tasks.

➤ Facilitate peer review sessions where students provide constructive feedback on each other's work.

➤ Utilize online polling or voting tools to allow students to anonymously vote on the quality of their peers' work.

➤ Upload students findings and conclusions on school's website for further dissemination and exploitation

➤ Encourage students to compare their findings and engage in discussion regarding any discrepancies observed, identifying potential areas for improvement and strategies for refining their measurements

Step 4 – eASSESSMENT **Evaluation of the digital task**	*(describe how to measure the achievement of the learning outcomes, evaluate the lesson with regard to the 3 different learning outcomes, optimize the lesson -* Please, propose some examples of questions for each of the 3 levels) o **Measuring Learning Outcomes**: *(assess if the 3 different types of competences (technical, digital, life-long learning have been achieved)* I. *Assessing Technical Competence:* *Level 1 (Knowledge): Ask students to describe the mathematical concepts involved in measuring tree height using the similar triangle theorem and tangent method.*

Example Question: "Can you explain the fundamental principles of trigonometry applied in calculating tree height with the similar triangle theorem?"

Level 2 (Application): Present students with a scenario where they must choose the appropriate method (similar triangles or tangent) to measure the height of a tree based on given parameters.

Example Question: "Given a specific tree and available tools, which method would you use to calculate its height, and why?"

Level 3 (Analysis): Require students to compare and contrast the accuracy and limitations of using the similar triangle theorem versus the tangent method for measuring tree height.

Example Question: "Evaluate the advantages and disadvantages of using the similar triangle theorem and the tangent method for measuring tree height. How do these methods differ in accuracy and ease of application?"

II. Assessing Digital Competence:

Level 1 (Knowledge): Inquire about students' familiarity with digital tools such as smartphone apps and their understanding of how these tools are used in measuring tree height.

Example Question: "Can you describe how smartphone apps like Smart Measure aid in measuring tree height? How does this digital tool utilize trigonometric principles?"

Level 2 (Application): Task students with using the Smart Measure app to measure the height of a tree and interpreting the results obtained.

Example Question: "Utilize the Smart Measure app to determine the height of a nearby tree. How do you ensure accuracy in your measurements, and how reliable do you find the app's readings?"

Level 3 (Analysis): Prompt students to critically evaluate the advantages and limitations of using digital tools versus traditional methods (similar triangles and tangent) for measuring tree height.

Example Question: "Compare and contrast the effectiveness of using digital tools like the Smart Measure app versus traditional methods such as the similar triangle theorem in accurately measuring tree height. How do these approaches differ in terms of precision, ease of use, and accessibility?"

III. Assessing Life-long Learning Competence:

Level 1 (Knowledge): Inquire about students' understanding of the importance of continuous learning and adaptation in mastering new skills such as tree height measurement.

Example Question: "Why is it important for individuals to adapt to new technologies and methodologies, such as using smartphone apps for tree height measurement?"

Level 2 (Application): Challenge students to reflect on their learning process and identify areas where they can improve their proficiency in measuring tree height.

Example Question: "Reflect on your experience in measuring tree height using different methods. What challenges did you encounter, and how do you plan to overcome them in future applications?"

Level 3 (Analysis): Encourage students to explore potential advancements in technology and mathematical techniques for more accurate and efficient tree height measurement in the future.

Example Question: "Investigate emerging technologies or mathematical advancements that could revolutionize the field of tree height measurement. How might these innovations impact the way we approach this task in the future?"

o ***Evaluating Lesson Effectiveness****: (assess how effectively the lesson facilitated and improved the learning experience of students.)*

o

. *Engagement and Participation:*

Level 1: Were students actively engaged in the lesson activities?

Example Question: "To what extent were students actively participating in the tasks and discussions throughout the lesson?"

Level 2: Did students demonstrate enthusiasm and interest in learning about tree height measurement methods?

Example Question: "How would you rate the level of student engagement and enthusiasm during the lesson activities? Were there any notable moments of interest or curiosity?"

Level 3: How effectively did the lesson foster a sense of excitement and curiosity among students regarding the application of mathematical concepts in real-world scenarios?

Example Question: "Reflect on the extent to which the lesson sparked students' curiosity and excitement about using mathematical principles to solve practical problems, such as measuring tree height."

II. *Understanding and Mastery of Concepts:*

Level 1: Did students demonstrate basic comprehension of the mathematical concepts and techniques involved in measuring tree height?

Example Question: "To what extent did students exhibit understanding of the mathematical principles used in calculating tree height with the provided methods?"

Level 2: Were students able to apply the learned concepts to effectively measure tree height using different methods?

Example Question: "How proficient were students in applying the mathematical concepts and techniques learned during the lesson to accurately measure tree height with various methods?"

Level 3: How well did students grasp the underlying principles and nuances of each measurement method, and were they able to critically evaluate their effectiveness?

Example Question: "Evaluate the depth of students' understanding of the mathematical concepts underlying each tree height measurement method. How effectively did they analyze and assess the strengths and weaknesses of each approach?"

III. *Problem-Solving and Critical Thinking:*

Level 1: Did students demonstrate basic problem-solving skills in completing the assigned tasks?

Example Question: "To what extent were students able to solve problems encountered during the measurement tasks, such as interpreting measurement readings or adjusting for potential errors?"

Level 2: How effectively did students apply critical thinking skills to identify and address challenges encountered during the measurement process?

Example Question: "Evaluate the extent to which students demonstrated critical thinking skills in analyzing measurement data, identifying discrepancies, and proposing solutions to improve accuracy."

Level 3: How proficient were students in evaluating the effectiveness of different measurement methods and proposing innovative solutions for optimizing the tree height measurement process?

Example Question: "Assess the depth of students' critical thinking skills in evaluating the efficiency and accuracy of various tree height measurement methods. How creatively did they propose improvements or innovations for enhancing measurement techniques?"

o **Optimization for Future Lessons***: Gather student feedback to refine and enhance future digital lessons.*

. Feedback Collection:

Level 1: Implement a simple feedback form or survey to gather students' overall impressions of the lesson and their satisfaction with the learning experience.

Example Question: "How would you rate your overall satisfaction with the digital lesson on tree height measurement?"

Level 2: Solicit specific feedback on the effectiveness of different learning activities, digital tools, and measurement methods used in the lesson.

Example Question: "What did you find most helpful or engaging about the lesson activities and digital tools used for measuring tree height?"

Level 3: Encourage students to provide constructive criticism and suggestions for improvement, focusing on areas where the lesson could be optimized for future iterations.

Example Question: "Reflecting on your experience, what suggestions do you have for enhancing the effectiveness and engagement of future digital lessons on similar topics?"

II.   Data Analysis:

Level 1: Compile and analyze quantitative feedback data, such as satisfaction ratings and completion rates, to identify broad trends and areas for improvement.

Example Question: "Based on the feedback received, what are the main areas of strength and areas for improvement in the digital lesson?"

Level 2: Analyze qualitative feedback to gain deeper insights into students' perceptions, preferences, and challenges encountered during the lesson.

Example Question: "What recurring themes or patterns emerge from the qualitative feedback provided by students regarding their learning experience?"

Level 3: Use data analysis techniques to identify correlations between specific teaching strategies, digital tools, and student learning outcomes, informing targeted improvements for future lessons.

Example Question: "How can we leverage the feedback data to refine our approach to digital lesson design and delivery, with the goal of maximizing student engagement and learning outcomes?"

III.   Iterative Improvement:

Level 1: Implement minor adjustments based on student feedback to address immediate concerns or issues identified during the lesson.

Example Question: "What immediate changes can be made to address any challenges or shortcomings identified in the feedback received from students?"

Level 2: Develop a plan for iterative improvement, incorporating ongoing feedback mechanisms to continuously refine and enhance future digital lessons.

Example Question: "How can we establish a feedback loop to systematically gather, analyze, and act upon student feedback to iteratively improve future digital lessons?"

Level 3: Foster a culture of innovation and experimentation, encouraging collaborative efforts among teachers and students to co-create and refine digital learning experiences.

Example Question: "How can we empower students to actively participate in the design and optimization of digital lessons, leveraging their insights and expertise to drive continuous improvement?"

o   *How confident the students feel in using mobile devices/apps in the classroom and in self-study?*
The confidence of students in using mobile devices and apps in both classroom settings and self-study can be evaluated through a combination of feedback collection, data analysis, and iterative improvement strategies. By soliciting feedback on students' experiences with digital lessons, analyzing their responses, and incorporating their suggestions for enhancement, educators can assess and enhance students' confidence in utilizing mobile devices and apps for learning purposes. Additionally, providing opportunities for collaborative learning, guided practice, and ongoing support can further bolster students' confidence and proficiency in leveraging technology for educational purposes.