

Proportional Compass: An Interactive Geometry Exploration

I n t e r a c t i v e	21st Century Theme: Critical Thinking and Problem-Solving		
	Concepts for STEAM Disciplines	Mathematics Proportions and ratios Measurement of angles and distances	Arts Design Proportions and ratios
		Technology GeoGebra	Science Education -
o n	Prerequisite Knowledge		
	<p>Mathematics Basic knowledge of geometry, such as shapes and angles. Understanding of proportions and how they apply in everyday life, such as in recipes or scale drawings. Ability to work with fractions and percentages.</p> <p>Information Technologies Students are able to use GeoGebra in a basic way.</p> <p>Arts Understanding of the importance of proportions in art, such as how incorrect proportions can make a drawing look "off" or disproportionate. Ability to use basic drawing tools, such as a pencil and ruler.</p>		
	Learning Outcomes		
	<p>Grade Level: 12 year old Duration: 180 minutes</p> <p>Learning Outcomes for Mathematics Understand the concept of proportion and its application in geometry and art. Learn to find the proportion between two figures using a proportional compass. Understand the differences and similarities between similar figures.</p> <p>Learning Outcomes for Information Technologies Students improve their GeoGebra skills</p> <p>Learning Outcomes for Arts Develop practical skills Improve students' drawing and design skills</p>		
R e a l	Problem Situation		
	An artist wants to create a replica of a painting in a different size, but does not have a tool to help them proportionally scale the painting. By constructing a proportional compass, the artist can accurately measure the dimensions of the original painting and scale them proportionally to create a faithful replica in the desired size.		
L i f e	Materials		
	<ul style="list-style-type: none"> ● A thumbtack or pushpin ● Ruler ● A small piece of paper or cardboard ● Computer 		
S i t u a t i o n	Preparation for the lesson		
	<p>Answers will be sought to the following questions:</p> <ul style="list-style-type: none"> ● What does it mean for two line segments to be proportional? ● What are two similar figures? ● What is the relationship between the sides of two similar figures? ● What is the relationship between the areas of two similar figures? 		

	<p>Resources https://www.geogebra.org/m/se5xtm7p</p>
<p>S T E M A c t i v i t Y</p>	<p>Ask The lesson begins by brainstorming. Students are asked the following questions:</p> <ul style="list-style-type: none"> • What are some of the benefits of using proportion when resizing an object or creating a scaled version of something? • What are some techniques we can use to ensure that the proportionality of an object is maintained when it is resized? • What techniques do artists use to maintain proportion when creating a larger or smaller version of an artwork? <p>Research Students should work on the Geogebra activity provided (https://www.geogebra.org/m/se5xtm7p) It is necessary for students to become familiar with how the compass works in GeoGebra. Some recommendations:</p> <ul style="list-style-type: none"> • Place point O at one end of the segment to be measured. • Move points N and P to locate the other end of the segment. • When selecting point N, the entire compass remains fixed and can be moved without modifying it. • Align points M and R with those of the new figure. <p>In this Geogebra activity, students will have the opportunity to explore the concept of proportionality in geometry. The activity is designed to guide them in using a compass of proportions to create figures that maintain their proportional relationships even as they are scaled up or down.</p> <p>By working through the activity, students will be able to discover the underlying principles of proportionality and apply them to different geometric figures. They will also gain hands-on experience using the compass of proportions</p> <p>Imagine The teacher will use the following questions as a guideline to start a discussion on the mathematical principles behind the proportional compass:</p> <ul style="list-style-type: none"> • What is a proportion and can you give an example of one? • How would you define the ratio between two segments and how does this relate to the use of the proportional compass? • Can you explain how the proportional compass can be used to construct triangles with precise measurements and provide a concrete example? <p>By using these questions, the teacher can encourage students to think critically about the fundamental mathematical concepts that underlie the use of the proportional compass. The questions are designed to foster discussion.</p> <p>Plan The teacher will begin by explaining the mathematical principles behind the proportional compass, including the definition of proportion, the ratio between two segments, and how to use the proportional compass to construct precise measurements, including triangles. The teacher will also introduce the concept of similarity in triangles, and how it relates to the use of the proportional compass.</p> <p>Once the students have a solid understanding of these concepts, they will begin to design their own proportional compasses, selecting the ratio of proportion that they desire. During this activity, the teacher will guide students in applying their knowledge of proportion and similarity to construct precise measurements and triangles using their custom-designed compasses.</p>
	<p>Create Once the students have the pre-made design, they use it as a guide to drawing the two pieces of their proportional compass onto the cardboard. Using the ruler and pencil, they measure and mark the correct lengths for the pieces. Carefully, students then use scissors to cut out the two pieces of their proportional compass. After that, they use the thumbtack or pushpin to punch a hole through the center of each piece. Finally, students use the thumbtack or pushpin to join the two pieces of their proportional compass together.</p>
	<p>Test After creating their own proportional compass, students will use it to enlarge or reduce geometric figures. Examples of possible figures to enlarge or reduce could include triangles, squares, rectangles, and circles. This exercise helps to reinforce the understanding of proportions and the use of the proportional compass in practical applications.</p>

	<p>Improve</p> <p>To improve the activity, teachers may consider adding questions to the GeoGebra activity that can help reinforce the concepts covered in class. This could include questions about proportions, ratios, and the use of the proportional compass in geometric constructions.</p> <p>Another option for extending the activity is to have students design their proportional compass in GeoGebra and then print it using a 3D printer. This would allow students to create a more precise and detailed version of their proportional compass, while also exploring the technology of 3D printing.</p>
M a t h e r i a l s	<p>Computer</p> <p>3D printer</p> <p>Filament</p>