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Developing the Competence of Using Tools and Materials in Learning Mathematics for 4th-Grade Students in Geometry and Measurement Content

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ABSTRACT: In Vietnam's general education program, Mathematics is a significant tool for many other subjects. Mathematics originates from practicality and serves as the "key" in most human activities, as well as in learning other subjects. In teaching Mathematics, teachers not only guide students to acquire knowledge but also form and develop students' abilities and intellectual qualities, training their critical thinking and creativity. The ability to use tools and learning materials for Mathematics is one of the five components of mathematical competence in the 2018 Mathematics curriculum for general education. This article focuses on proposing some basic measures to develop and nurture the ability of using tools and materials in learning Mathematics for fourth-grade students through teaching Geometry and Measurement content.

KEYWORDS: Capability, Tools and Means, Learning Tools, Geometry, Primary School level.

I. INTRODUCTION

Capability is an issue that has been and is being of interest to many educators. H. Gardner, a psychologist at Harvard University (USA), addresses the concept of capability by analyzing seven facets of human intelligence: language, logical-mathematical, music, spatial, bodily-kinesthetic, interpersonal, and intrapersonal. He asserts that each facet of intelligence must be manifested or expressed in an equal or highly creative form. To solve a problem in life, individuals cannot solely mobilize one facet of intelligence but must combine multiple facets of intelligence related to each other. This combination forms personal capability. According to H. Gardner, capability must be demonstrated through activities that yield results and can be evaluated or measured.

According to H. Gardner, from a psychological perspective, not everyone possesses all aspects of intelligence. A normal person can only have a few aspects of intelligence. Aspects of intelligence may change or replace each other as individuals gain more experience and accumulation or as society becomes more demanding. The relationship between aspects of intelligence and how they are possessed also varies from person to person. This shows that students need to be given opportunities to maximize the different aspects of intelligence, and schools must be places that encourage the combination of these aspects and help students adjust the combination. This is to meet the changing needs of society 2).

F. E. Weinert has defined intelligence based on the foundation of knowledge, skills, perception, and learning strategies of students, focusing mainly on assessing students' knowledge 4).

The National Mathematics Curriculum in the United States also addresses the role of using tools in teaching mathematics, especially focusing on the use of handheld calculators. The document emphasizes that mathematical tools play a crucial role in developing students' mathematical thinking at all ages. It mentions that the presence of tools and computers has made mathematics more accessible, allowing for more optimal solutions to mathematical problems 10).

Author Nguyen Chien Thang in the study "Developing the ability to use tools and learning materials for Mathematics for students through teaching Geometry content in grade 6" also proposed some measures to develop the ability to use tools and learning materials for Mathematics through teaching Geometry content in grade 6. In the study, the author affirmed that teaching the Geometry content in grade 6 contributes to developing the ability to use tools and learning materials for Mathematics, and this ability is the main capacity in teaching the content of Geometry in grade 6" 7).

Therefore, in teaching Mathematics, teaching tools help students construct mathematical knowledge. Teaching tools play an important role in developing students' mathematical thinking. Teaching Mathematics contributes to nurturing mathematical abilities and developing the ability to use mathematical tools and materials, which is the main capacity in teaching Geometry content. Developing the ability to use tools and mathematical materials will meet the goals of the 2018 Mathematics curriculum in Vietnam.

II. RESEARCH RESULTS

2.1. Some issues regarding abilities, abilities to use tools and mathematical materials

2.1.1. Competence

2.1.1.1. Viewpoints on competence

Abilities have been a topic of discussion among many scientists both domestically and internationally. According to the Vietnamese dictionary: Abilities can be understood in two ways: First, as the natural ability or condition to perform a certain activity; Second, as the psychological qualities that enable a person to complete an activity with high quality 8).

According to the philosophical dictionary, Abilities are broadly understood as the psychological characteristics of individuals that regulate their behavior and are the living conditions of individuals. In a narrow sense, abilities are all the psychological characteristics of a person that make them suitable for a specific professional activity that has developed historically. Human abilities are the product of social development, not only determined by brain activity but primarily by the level of historical development that humanity has achieved. Human abilities cannot be separated from the social labor organization and the education system that adapts to that organization 8).

According to the Educational Dictionary, Ability is the capacity that is formed and developed to enable individuals to succeed in physical, mental, or professional activities. Abilities are manifested in the ability to perform an activity, execute a task **Error! Reference source not found.**.

According to the 2018 General Education Program in Vietnam, Ability is a personal attribute that is formed and developed through inherent qualities and the process of learning, training, allowing individuals to mobilize a synthesis of knowledge, skills, and other personal attributes such as interest, belief, willpower, ... to successfully carry out a specific type of activity, achieve desired results in specific conditions 1).

From the above perspectives, it can be summarized that, Ability is the combination of inherent qualities and the learning, training process of learners; Ability is the integration of knowledge, skills, and other personal attributes such as interest, belief, willpower (acquired through the learning, training process), ...; Abilities are formed, developed through activities and are demonstrated in success in practical activities. Abilities can be observed and measured.

2.1.1.2. Competence Classification

Depending on the viewpoint and approach, researchers have divided competencies into different types. Researchers from the Organization for Economic Cooperation and Development have divided competencies into: Cognitive competencies and non-cognitive competencies. In which, cognitive competencies include knowledge related to each professional field. Specifically, skills in analyzing and solving problems. Non-cognitive competencies are changes in beliefs or the development of values. Non-cognitive competencies can be developed through learning in class as well as extracurricular activities organized by the school to supplement the main curriculum 5).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has divided competencies into three groups: Cognitive competencies, attitudinal competencies and vocational competencies. In which, cognitive competencies are competencies that serve the development of personal knowledge and are also important factors for us to successfully apply existing knowledge; Attitudinal competencies are behaviors, values and standards that can indicate or create high efficiency, and also show many different types of knowledge that have helped learners apply effectively; Vocational competencies are specialized knowledge about information sources, access to technology, services, management, along with the ability to systematically evaluate accurately, scientifically and apply this knowledge to perform necessary tasks to bring about expected results" 6).

The 2018 general education program in Vietnam has divided competencies into two groups: General competencies and specific competencies. In which, engeral competencies are formed and developed mainly through subjects and educational activities, including: autonomy and self-study competencies, communication and cooperation competencies, problem-solving and creativity competencies; Specific competencies are formed and developed mainly through subjects and educational activities, including: language competencies, scientific competencies, computational competencies, technological competencies, information technology competencies, physical competencies, and aesthetic competencies 1).

2.1.2. Competence in using tools and means of learning mathematics

2.1.2.1. Concept

Competence in using tools and means of learning mathematics is the ability to use learning tools and media such as pencils, paper, calculators, tablets, learning software, textbooks, instructional videos, other online resources to support effective learning of Mathematics and to know the limitations of those tools. **Error! Reference source not found.**.

Competence in using tools and means of learning mathematics includes the ability to use tools and media to solve problems, practice calculation skills, understand mathematical concepts and develop problem-solving skills in the field of Mathematics.

Indicators of competence in using tools and means of learning mathematics at primary level

Competence in using tools and means of learning mathematics	**Indicators**
– Recognize the names, functions, usage specifications, and preservation methods of common visual aids and tools, scientific and technological tools (especially those using information technology) used in learning Math.	- Name the tools and means of learning math; - State the effects and usage of simple tools and means of learning math.
– Be able to use math learning tools and means, especially scientific and technological means to explore, discover and solve math problems (appropriate to age-appropriate cognitive characteristics)	- Choose tools and means of learning mathematics suitable for the learning task. - Use tools and means of learning mathematics to perform learning tasks as well as solve simple problems in life. - Get familiar with handheld calculators and information technology tools to support learning.
– Recognize the advantages and limitations of tools and support means to use them appropriately.	- Recognize some advantages and limitations of tools and support means to have appropriate use.

2.1.2.3. Evaluation framework for assessing the competence in using tools and means of learning mathematics at primary level

TT	**Competence in using tools and means of learning mathematics at primary level**	**Đánh giá**		
		Good	**Measure**	**Needs effort**
1	Name the tools and means of learning math	Students correctly name the tools and methods of learning math.	Students name the tools and means of learning math.	Students have not yet named the tools and methods of learning math.
2	State the effects and usage of simple tools and means of learning math.	Students correctly state the effects and ways to use math learning tools and means in a documented manner.	Students state the effects and ways to use math learning tools and means but have not been able to document them.	Students do not state the effects and ways to use math learning tools and means.
3	Choose tools and means of learning mathematics suitable for the learning task.	Students can choose the right tools and means of learning mathematics that are suitable for the learning task.	Students can choose the right tools and means of learning mathematics that are suitable for the learning task with the support of the teacher.	Students have not chosen the right tools and means of learning mathematics that are suitable for the learning task.
4	Use tools and means of learning mathematics to perform learning tasks as well as solve simple problems in life.	Students are proficient in using math tools and learning aids to perform learning tasks and solve simple problems in life.	Students are able to use math tools and learning aids to perform learning tasks and solve simple problems in life with the support of teachers.	Students are not yet able to use math tools and learning aids to perform learning tasks and solve simple problems in life.
5	Get familiar with handheld calculators and information technology tools to support learning.	Students know how to use handheld computers and information technology	Students use calculators and information technology tools to support learning with	Students do not know how to use calculators and information technology

		tools to support learning.	the support of teachers.	tools to support learning.
6	Recognize some advantages and limitations of tools and support means to have appropriate use.	Students can use tools and means to learn math effectively. Recognize the advantages and limitations of each type of tool and means to use them appropriately.	Students can use tools and means. Recognize the advantages and limitations of each type of tool and means according to the teacher's instructions to use them appropriately.	Students do not recognize the advantages and limitations of each type of tool and means to use them appropriately.

2.2. Teaching Geometry and Measurement to 4th Grade Students towards developing the competency to use tools and means of learning mathematics

2.2.1. Some orientations when designing teaching activities towards developing the competency to use tools and means of learning mathematics

2.2.1.1. Teaching activities meet the objectives and requirements of the lesson

The objectives and requirements to be achieved in the lesson are the goals that teachers set out to achieve in the teaching process. The objectives and requirements to be achieved in the lesson help determine the knowledge, skills, abilities and quality products that students need to achieve after completing the lesson. Teaching activities are designed to help students proactively explore new knowledge, apply new things to solve problems in new problems and problems in real life.

Developing the competency to use tools and means of learning mathematics is not outside the goal of developing mathematical capacity in the 2018 General Education Program. Students who have the ability to use tools and means of learning mathematics will help their friends explore, the field of knowledge and the ability to apply mathematical knowledge in practice flexibly and effectively. This helps them develop creative skills, logical reasoning and effective problem solving abilities.

2.2.1.2. Teaching activities must be suitable for students' cognitive characteristics

Primary school seniors are in the process of comprehensive development in terms of physiology, psychology and society. Students often easily adapt and learn new things but also lack high concentration. Their ability to remember and concentrate is not yet well developed, they remember quickly and forget quickly. Therefore, when designing teaching activities, they must be suitable for the level and cognitive ability of students. Teaching activities must not be too easy or too difficult, must ensure the right level of difficulty in the process of students acquiring knowledge. If the teaching activities are too easy or too simple, students will easily overcome them and will quickly become bored and will not create cognitive needs in them. In the case of activities that are too difficult for their cognitive ability, students will not be able to do them, leading to them easily giving up and losing interest in learning.

The use of images, models, tools and practical activities will help primary school students grasp knowledge more easily and effectively. Therefore, the use of teaching tools and methods must be suitable for students' cognitive characteristics, helping developers develop comprehensively and effectively in the learning process.

2.2.1.3. Teaching activities focus on developing the competency to use tools and means of learning mathematics

Designing teaching activities should aim to develop students' qualities and competencies according to the orientation of the 2018 smart general education program. Learning activities are designed to help students actively explore new architectures, apply learned knowledge to solve problems in new situations or in real life.

To develop the competency to use academic tools and means effectively, the construction of teaching tools needs to clearly define the goals and skills that students need to develop through the use of tools and means of learning mathematics. It is necessary to guide students' work to be able to use learning tools and means effectively.

2.2.2. The process of designing teaching activities towards developing the competence to use tools and means of learning mathematics.

To design teaching activities towards developing the competency to use tools and means of learning Mathematics, teachers need to follow the following process:

Step 1: Determine the requirements of the topic/lesson

The 2018 General Education Program for Mathematics has clearly identified the topics and requirements of the topic. Therefore, when designing a lesson plan, teachers need to carefully study the topic, determine the requirements, and the minimum goals that students must achieve after the teaching process of the topic/lesson. This determination helps teachers stay on track and complete the set progress goals.

Step 2: Research the teaching content, choose the form, method and means of teaching

From the research of the requirements of the topic/lesson, teachers determine the teaching content and plan the form, method and techniques of teaching to develop students' learning capacity. Teachers determine the teaching means suitable for the lesson content, the reality of the school, locality and the cognitive characteristics of students. Step 3: Design teaching activities, create opportunities for students to develop the ability to use tools and means of learning mathematics

Based on the teaching content, form and teaching method, teachers design teaching activities in the direction of developing qualities and abilities. In particular, focus on developing the ability to use tools and means of learning mathematics. At that time, students need to do the following:

* Students identify learning tasks

Students must recognize learning tasks, recognize the content that requires the use of tools and means of learning to explore and solve problems.

Teachers need to assist students appropriately with mathematical knowledge that requires the use of tools and means of learning. If necessary, teachers can give specific instructions or model for students.

* Students operate on tools and means of learning mathematics

Teachers organize teaching activities so that all students can operate directly on learning tools and means to solve tasks. Each student thinks independently to find answers to the requirements. Then they can discuss and exchange with group members about their results.

The teacher provides timely instructions to support students in discovering knowledge, stimulates students to learn, and creates conditions for students to have the opportunity to use math learning tools and means.

* Students present the results of the task.

After students complete the learning task, the teacher organizes for them to share the results. Note that the teacher needs to ask students to present how to use learning tools and means to solve problems.

2.2.3. Illustrative example

Example 1. Design teaching activities to recognize “Acute angles, obtuse angles, and flat angles”.

** Identify requirements to be achieved*

Students need to achieve the following requirements:

- Recognize acute angles, obtuse angles, and flat angles.
- Solve some practical situations related to acute angles, obtuse angles, and flat angles.
- Students have the opportunity to develop mathematical communication skills, the ability to use tools and means of learning mathematics

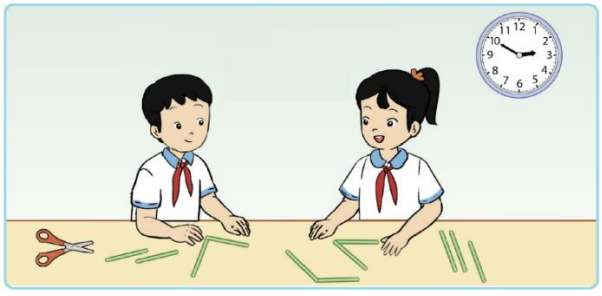
** Prepare teaching tools, means, and software*

- On the teacher's side: Teachers prepare illustrations for angles, prepare a two-hand clock face made of cardboard or wood, a folding ruler, a fan, a compass, and Sketchpad software.
- On the student's side: Students prepare a fan, a compass.

** Design teaching activities:*

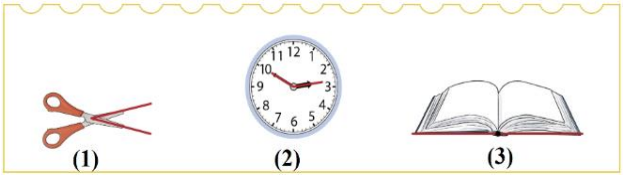
Activity 1. Recognize acute angles, obtuse angles, and flat angles:

- Teachers introduce situations related to right angles and non-right angles for students to recognize:



Students need to predict the angles created by the counting sticks of the two children in the picture, which child can form a right angle? Which child can form an angle that is not right?

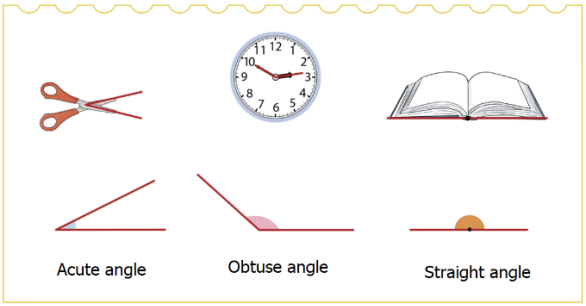
- Next, the teacher uses practical images to help students recognize acute angles, obtuse angles, and straight angles.



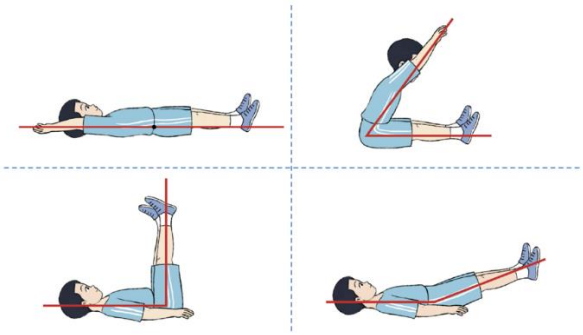
(1) When the two blades of scissors are opened, they form an acute angle.

(2) On the face of a clock, the short hand points to 3 and the long hand points to 10, so the two hands form an obtuse angle.

(3) When an open book is opened, the two edges of the cover form a straight angle.



- Teachers use visual images to help students recognize acute angles, obtuse angles, straight angles, and right angles:



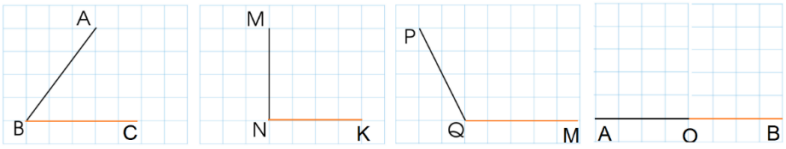
Activity 2. Practice creating acute angles, obtuse angles, right angles and straight angles:

- The teacher divides the class into groups and asks students to use learning tools: a fan, a cardboard clock to create acute angles, obtuse angles, straight angles and right angles. In addition, the teacher also asks students to use a ruler to draw acute angles, right angles, obtuse angles and straight angles.

For example, using a palm fan to create acute angles, right angles, obtuse angles and straight angles:

Use two hands of a clock to create acute angles, right angles, obtuse angles and straight angles:

Using a ruler to draw acute angles, right angles, obtuse angles and straight angles:



Through the use of tools to create angles (acute angles, right angles, obtuse angles and straight angles), students have the opportunity to develop their competency to use and learn math tools.

Example 2. Design teaching activities to recognize "Unit of angle measurement. Degree (°)".

* *Identify the requirements to be achieved*

Students need to achieve the following requirements:

- Recognize the unit of angle measurement is degree (°);
- Use a ruler to measure and draw angles.
- Solve some practical problems related to unit angle measurement.
- Students have the opportunity to develop math communication skills, the ability to use math tools and means.

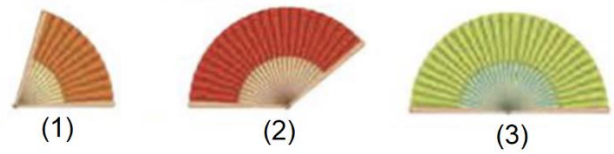
** Prepare teaching tools, means, software*

- On the teacher's side: Teachers measure dimensions, illustrated angles with specific measurements, angle measurement tables, Sketchpad software.

- On the student's side: Prepare students to measure degrees, pencils, compasses, and a fan.

** Design teaching activities:*

Activity 1: Compare the size of angles - The teacher introduces the problem, the picture of three fans opened differently:

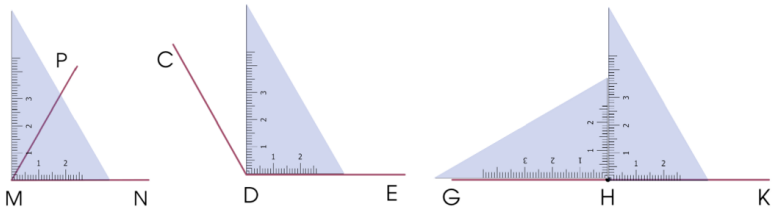


The teacher asks students to predict which angle is larger among the angles created by the fan? Which angle is smaller? And how can the size of the angle be measured? The angles in figures (1), (2) and (3) are in the form:

The teacher organizes students to discuss in pairs, asking students to use a square ruler to determine which angle is a right angle? Which angle is not a right angle? Which angle is smaller than a right angle? Which angle is larger than a right angle?

The teacher explains exactly how to use the square ruler: Place one side of the square ruler on one side of the angle. If the other side of the square ruler coincides with the other side of the angle, the angle is a right angle; If the other side of the square ruler does not coincide with the other side of the angle, the angle is not a right angle.

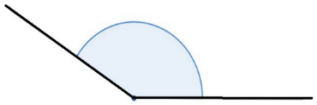
The results of measuring the angles are as follows:



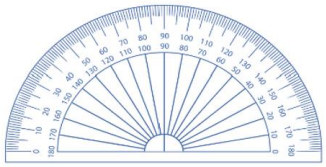
From the measurement results, students discuss to make comments: An acute angle is smaller than a right angle, an obtuse angle is larger than a right angle, and a straight angle is equal to two right angles.

Activity 2. Determine the angle measure

The teacher forms a symbol of the size of the angle by drawing a curve from one side of the angle to the other.

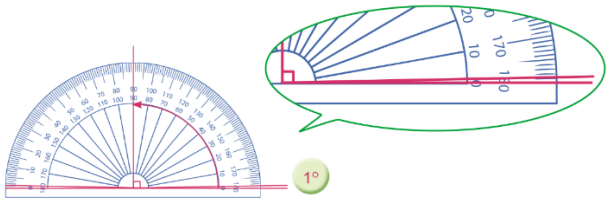


Teacher introduces angle measuring tool:

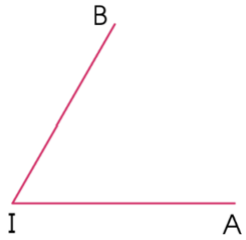


The teacher introduces the unit of angle measurement: Degree is the unit of angle measurement, the symbol is ^{o}, read as "degree".

Next, the teacher introduces the angle with a measure of one degree (1^{o}): dividing a right angle into 90 equal parts, each part is one degree, the symbol is 1^{o}.



The teacher organizes for students to discuss and find ways to use a ruler to determine the size of an angle. From there, apply it to determine the measure of the vertex angle I, sides IA and IB.

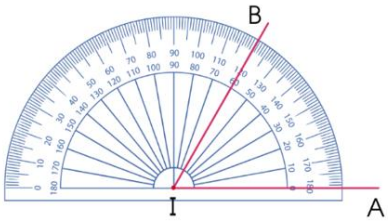


The teacher organizes students to share the results. The teacher gives the results:

+) How to use the protractor:

- Step 1: Place the protractor so that the center of the protractor coincides with the vertex I of the angle. The 0 mark of the protractor is on the edge IA.

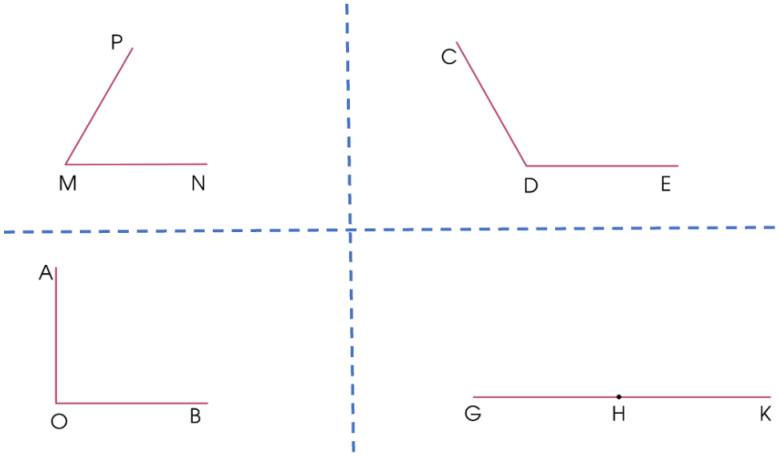
- Step 2: Determine which graduation line the edge IB passes through, that is the measurement of the angle.



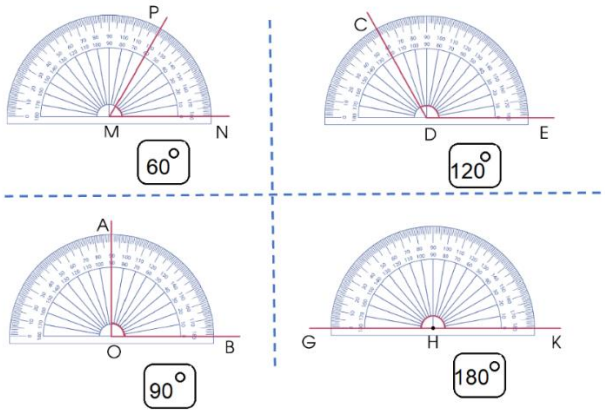
The vertex angle I of sides IA and IB has a measure of 60°.

Activity 3. Practice measuring angles.

The teacher organizes for students to use a protractor to determine the size of each angle:



The teacher organizes for students to share the results, students present how to use a ruler to measure angles in each case. The measurement results are as follows:



By using squares and protractors to compare angle measurements and determine the measure of each angle, students have the opportunity to develop their competency to use tools and means of learning mathematics.

III. CONCLUSIONS

Thus, teaching aids support teachers and students in the teaching process to achieve teaching objectives. Teaching aids have the function of arousing, transmitting and enhancing the strength of the teacher and student's activities towards the objects being taught. Developing the competency to use learning tools is a prerequisite for developing the ability to use tools and means of learning mathematics for students. Fostering and developing the competency to use tools and means of learning mathematics for students does not have to be done independently but is closely related to other components of learning competency. However, when teaching Geometry and Measurement to students, this competency is the main one that needs to be fostered for students when teaching that content.

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