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Using Interactive Charts in a Demonstration Lesson to Help Learners of Colleges of Education Teach Measurement of Angle Properties of Parallel Lines in Basic Schools

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Abstract

The main objective of the study was to examine the efficacy of using interactive charts in a demonstration lesson to equip second year learners of both Foso College of Education and Accra College of Education with practical ways of teaching aspects of mathematics to learners in their placement schools. The topic chosen for the demonstration was measuring angle properties of parallel lines. All second year mathematics major learners in both schools were used for the study. The sample was made up of 4 ladies representing11% and 32 gentlemen representing 89% in Foso College of Education and 12 girls representing 23% and 40 gentlemen representing 77% in Accra College of Education. The data was presented using descriptive statistics. The authors, meeting at a subject based workshop seemed to have the same challenges with their elective mathematics learners in their respective schools and decided to pair and work out strategies to unearth their learners' creative potentials to teach mathematics in an interactive way. The study identified the causes of the learners' lack of creative potentials at the pre-intervention stage which was done through observation and interview as inadequate teaching learning resources at the colleges and tutors' continuous use of lecture method with little or no hands-on activities.

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Then the interactive charts designed by Benjamin Tettey were introduced as a suitable option to address the problem. The intervention procedure was carried out by the authors in each other's college, that is, Miss Mary Acquah in Accra College of Education and Mr. Benjamin Ayerkain Tettey in Foso College of Education. The new pre-tertiary lesson plan template was modified and prepared by Miss Ruby Jecty, a Teacher Professional Learning Coordinator (TPLC) in Foso College of Education, who we engaged in the preparation stage, acted as a critical friend for the observation of the enactments in both colleges and a reflective practitioner who took both tutors through a professional digital reflection to discuss the strengths and areas of improvements of the enactments. A post intervention result established that when learners are exposed to the use of interactive chart intervention activities, they became very imaginative and innovative as they can suggest other innovative ways of teaching other topics in mathematics and develop positive interest towards the teaching mathematics. The results of the study were collated by Miss Mary Acquah. Based on the pre-during and post enactment discussion with the TPLC, the recommendations were made by both tutors. The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them.

Keywords: Type your keywords here; separated by semicolons.

1. Development in almost all areas of life is based on effective knowledge of science and mathematics. There simply cannot be any meaningful development in virtually any area of life without knowledge of science and mathematics. It is for this reason that the education systems of countries that are strict about their development put great deals of emphasis on the study of mathematics

2. According to the[13]mathematics at the primary school level in Ghana emphasizes on knowledge and skills that will help the learners to develop the foundation for numeracy. The pupil is expected to be able to read and use numbers competently, reason logically, solve problems and communicate most ideas effectively to other learners. Mathematics ideas, skills and competence at this stage should enable him or her to make more meaning of his or her world and also develop interest in mathematics as an essential tool for science research and development.

3. In Ghana, traditional teaching and learning of mathematics places emphasis on rote memorization which does not provide room for student-teachers to use improvised materials and activity method to understand various forms of mathematics concepts specifically in measurement. As a result student cannot teach mathematics concepts using interactive approaches. Most student-teachers develop fear of teaching mathematics due to the way tutors in the colleges handle or teach with no improvised teaching aids and no child centered approach. These attitudes when not corrected will have a lasting effect on basic school learners' performance in mathematics as these student-teachers will graduate to become permanent teachers in the basic schools.

Mathematics has long been perceived as a difficult subject by learners. It is in this regard that [7]stated that the word mathematics generate fear in learners. He also added that others become nervous upon hearing anything about mathematics losing sight of the fact that mathematics is indispensable and that all human activities are prompted by mathematical desire. Reference [9] Stressed that one thoughts about a subject or concept makes a meaning to the subject or concept. If you have bad attitude or dislike towards a subject you will not get the meaningful understanding of the subject. Reference[18] Pointed out that we must see mathematics as a tool for development since the subject cannot be left out. Learners must be advised to change their attitude towards the

teaching and learning of mathematics to be able to solve questions in mathematics especially on angle properties of parallel lines. In spite of these, the method of teaching is also a contributory factor to learners' low performance in mathematics. .As said by [1] that instruction must be fitted to the child not the child to instruction. Let the methods of teaching lessen the labor of learning, there is the need to ensure that nothing becomes a stumbling block on the path of the child in his or her quest to learn. [20]Asserted that always the method employed must be such that at the end of it all, the learner benefits greatly. Hence if at the end of the lesson the learner is not able to grasp the intended concept, the purpose of the teaching and learning has failed. This normally becomes visible in class where the learner participates passively in the teaching and learning process. A good teaching method is one that goes with teaching and learning resources. According to [10], teaching and learning resources are relevant items selected or prepared by the teacher or pupil to enhance teaching and learning. The main purpose for any teaching and learning material is to make teaching and learning more meaningful. By using teaching and learning resources, the teacher attempts to excite as many sense areas in learners as possible to involve learners in the learning situation, so that their senses will be brought to bear on the topic being treated. Learning mathematics is good for your brain. Research conducted by [16] of Stanford University indicates that learners who know mathematics are able to recruit certain brain regions more reliably, and have greater gray matter volume in those regions, than those who perform more poorly in mathematics. The brain regions involved in higher mathematics skills in high-performing learners were associated with various cognitive tasks involving visual attention and decision-making. While correlation may not imply causation, this study indicates that the same brain regions that help you to do mathematics are recruited in decision-making and attention processes.

Mathematics is the universal language. Sure, it's mostly equations, numbers, and some Greek letters, but mathematics is understood the same virtually all over the world (and who knows, maybe all over the universe)! A mathematics equation doesn't need to be translated to another language to be understood by someone on the other side of the planet. A mathematical law doesn't change because someone has a different religion from yours or speaks a different language from yours. 2 + 2 = 4 in every single place on planet Earth. Pretty cool! The universality of mathematics is one of the many things that makes it such a powerful tool and, indeed, essential life skill. Reference[19] Said that mathematics is compose of definitions, theorems, axioms, postulates, numbers and concepts that have been proven to be true across many nations. Through the symbolic representation of mathematical ideas, communication may occur and that stands to break cultural barriers and unite all people using one common language. In summary, mathematics is not only important for success in life; it is all around us. The laws of mathematics are evident throughout the world, including in nature, and the problem-solving skills obtained from completing mathematics homework can help us tackle problems in other areas of life. While many may complain that mathematics is boring or complicated, the truth is that a life devoid of mathematics means that we go around experiencing the world on a much less interesting level than we could.

1.1 Angles

An angle measures the amount of turn

Type of Angle	Description
Acute Angle	less than 90°
Right Angle	90° exactly
Obtuse Angle	i. Greater than 90° but less than 180°
Straight Angle	is 180° exactly
Reflex Angle	greater than 180°
Full Rotation	360° exactly

1.2 Positive and Negative Angles

When measuring from a line: a positive angle goes counterclockwise (opposite direction that clocks go) a negative angle goes clockwise

1.3 Parts of an Angle

The corner point of an angle is called the vertex and the two straight sides are called arms The angle is the amount of turn between each arm.

1.4 How to Label Angles

There are two main ways to label angles:

1. Give the angle a name, usually a lower-case letter like a or b, or sometimes a Greek letter like α (alpha) or θ (theta)

2. or by the three letters on the shape that define the angle, with the middle letter being where the angle actually is (its vertex).

Parallel Lines and Pairs of Angles

Supplementary Angles, Complementary Angles, Interior Angles, Exterior Angles

Geometry Index, Angles, parallel lines and transversals

Two lines that are stretched into infinity and still never intersect are called coplanar lines and are said to be parallel lines. The symbol for "parallel to" is //.

If we have two lines (they don't have to be parallel) and have a third line that crosses them as in the figure below

- the crossing line is called a transversal: If we draw to parallel lines and then draw a line transversal through them we will get eight different angles. The eight angles will together form four pairs of corresponding angles. Angles F and B in the figure above constitutes one of the pairs. Corresponding angles are congruent if the two lines are parallel. All angles that have the same position with regards to the parallel lines and the transversal are corresponding pairs. Angles that are in the area between the parallel lines are called interior angles whereas the angles that are on the outside of the two parallel lines like D and G are called exterior angles. Angles that are on the opposite sides of the transversal are called alternate angles e.g. H and B. Angles that share the same vertex and have a common ray, like angles G and F or C and B in the figure above are called adjacent angles. As in this case where the adjacent angles are formed by two lines intersecting we will get two pairs of adjacent angles (G + F and H + E) that are both supplementary. Two angles that are opposite each other as D and B in the figure above are called vertical angles. Vertical angles are always congruent.

1.5 Parallel Lines

Lines are parallel if they are always the same distance apart (called "equidistant"), and will never meet. (They also point in the same direction). Just remember:

Parallel Curves

Curves can also be parallel when they keep the same distance apart (called "equidistant"), like railroad tracks.

What Is an Interactive Angle Chart?

www.pinterest.com this mini anchor chart is a great resource to help students remember the names of the different types of angles. It is the perfect size for any interactive math journal.

1.6 Different Types of Graphs and Charts for Presenting Data

To better understand each chart and how they can be used, here's an overview of each type of chart.

1. Column Chart

A column chart is used to show a comparison among different items, or it can show a comparison of items over time. You could use this format to see the revenue per landing page or customers by close date.

2. Bar Graph

A bar graph, basically a horizontal column chart, should be used to avoid clutter when one data label is long or if you have more than 10 items to compare. This type of visualization can also be used to display negative numbers.

3. Line Graph

A line graph reveals trends or progress over time and can be used to show many different categories of data. You should use it when you chart a continuous data set.

4. Dual Axis Chart

A dual axis chart allows you to plot data using two y-axes and a shared x-axis. It's used with three data sets, one of which is based on a continuous set of data and another which is better suited to being grouped by category. This should be used to visualize a correlation or the lack thereof between these three data sets.

5. Area Chart

An area chart is basically a line chart, but the space between the x-axis and the line is filled with a color or pattern. It is useful for showing part-to-whole relations, such as showing individual sales reps' contribution to total sales for a year. It helps you analyze both overall and individual trend information.

6. Stacked Bar Chart

This should be used to compare many different items and show the composition of each item being compared.

7. Mekko Chart

Also known as a marimekko chart, this type of graph can compare values, measure each one's composition, and show how your data is distributed across each one. It's similar to a stacked bar, except the mekko's x-axis is used to capture another dimension of your values -- rather than time progression, like column charts often do. In the graphic below, the x-axis compares each city to one another.

8. Pie Chart

A pie chart shows a static number and how categories represent part of a whole -- the composition of something. A pie chart represents numbers in percentages, and the total sum of all segments needs to equal 100%.

9. Scatter Plot Chart

A scatter plot or scattergram chart will show the relationship between two different variables or it can reveal the distribution trends. It should be used when there are many different data points, and you want to highlight similarities in the data set. This is useful when looking for outliers or for understanding the distribution of your data.

10. Bubble Chart

A bubble chart is similar to a scatter plot in that it can show distribution or relationship. There is a third data set, which is indicated by the size of the bubble or circle.

11. Waterfall Chart

A waterfall chart should be used to show how an initial value is affected by intermediate values -- either positive or negative -- and resulted in a final value. This should be used to reveal the composition of a number. An example of this would be to showcase how overall company revenue is influenced by different departments and leads to a specific profit number.

12. Funnel Chart

A funnel chart shows a series of steps and the completion rate for each step. This can be used to track the sales process or the conversion rate across a series of pages or steps.

13. Bullet Graph

A bullet graph reveals progress toward a goal, compares this to another measure, and provides context in the form of a rating or performance.

14. Heat Map

A heat map shows the relationship between two items and provides rating information, such as high to low or poor to excellent. The rating information is displayed using varying colors or saturation.

Topics:

Data Visualization 101: How to Choose the Right Chart or Graph for Your Data

Types of Charts to Use for Your Data Column Chart Bar Graph Line Graph Dual Axis Chart Area Chart Stacked Bar Graph Mekko Chart Pie Chart Scatter Plot Chart Bubble Chart Waterfall Chart Funnel Chart...Read more

1.7 An Introduction to Data Visualization: How to Create Compelling Charts & Graphs [Ebook]

Your data is only as good as your ability to understand and communicate it. Effective marketers aren't only able to understand and analyze the numbers, but also to effectively communicate the...Read more

2. Conclusion

Reference [10] says that the main objective for using teaching and learning resources is to whip up learners interest in mathematics. Teachers who solely rely on oral presentation find out that learners frequently are unable to relate well with any new learning topics. The use of pictures ,posters, drawings or sketches will assist not only in focusing attention on the topic but also in providing sufficient energy to carry the learners under his or her momentum to do further reading. In summary, mathematics teaching and learning becomes a subject of interest to learners and even teachers when appropriate teaching materials are used. This can be achieved

through the use of teaching and learning resources as recommended by various scholars.

3. Methods and Materials

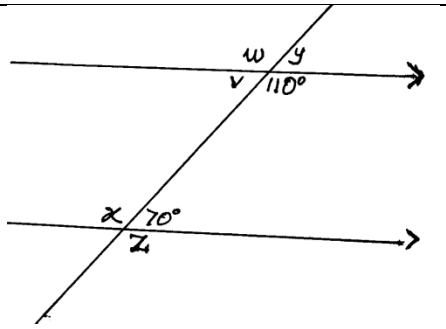
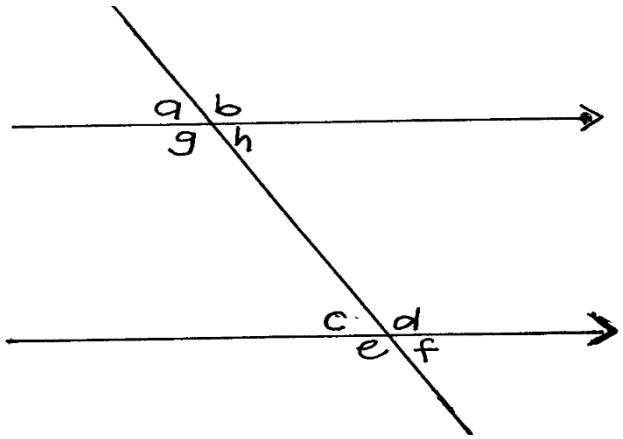
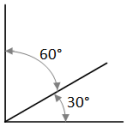
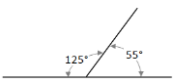
The authors prepared a lesson plan using the new template to teach angle properties of parallel lines in Junior High School Two learners.

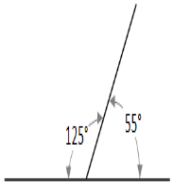
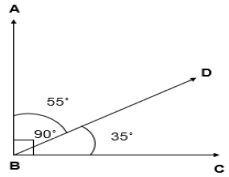
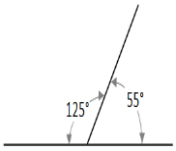
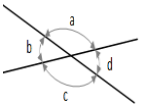
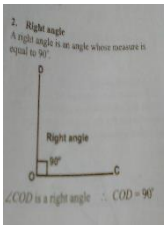
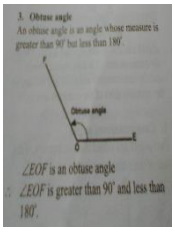
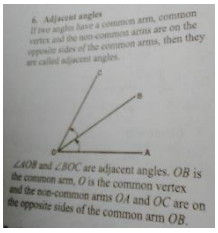
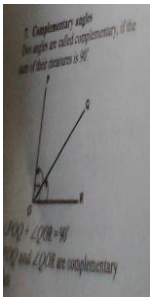
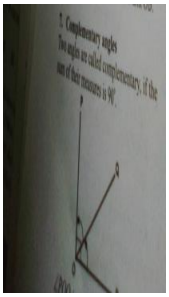
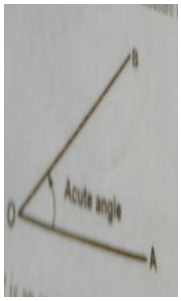
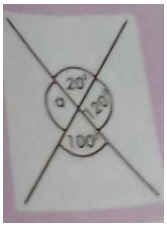
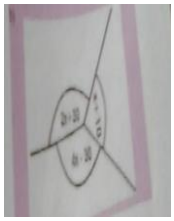
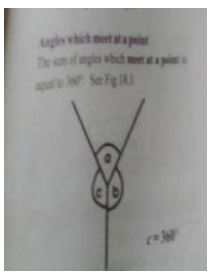
Date: 7th May 2019 Period: 3rd **Time: 6:30-8:30 a.m.** **Class JHS 2 Class size: 36, 52**	**Subject: Mathematics** **Strand: Angles** **Sub-strand: Angle Properties of Parallel lines**
Content standard **B7.2.1.1:** Learners draw and identify angles **B7.2.1.2:**. Learners discuss properties of each angle **B7.2.1.3.** learners take accurate measurements of angle properties in parallel lines.	**Lesson 4 of 6**
By the end of the lesson, every learner should be able to	

Learning Outcomes	**Learning Indicators**
1.Demonstrate in depth knowledge of measurements and angles	1.1 Give simple definitions to measurements and angles 1.2 Identify the different types of angles shown them. 1.3 Give accurate descriptions of angles they observe.
Demonstrate understanding of parallel lines, angle properties and interactive charts.	2.1 Discuss what parallel lines are. 2.2 Identify how parallel lines determine corresponding and alternate angles 2.3 Explain angle properties 2.4.Design interactive charts and use discuss
Demonstrate application of knowledge and understanding in measuring angle properties of parallel lines	3.1 use interactive charts to measure properties of angles. 3.2

Performance indicator: learners identify types of angles and measure them using interactive charts.	**Core competencies and subject specific practices:** critical thinking and problem solving skills, leadership and entrepreneurship, creativity and innovation and independent study and personal development
Key Words: Angle properties, parallel lines, data visualization	

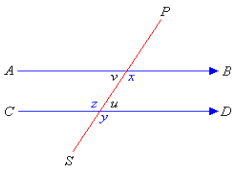
Stages/Figure	**Learner Activities**	**Resources**
Figure 1: Starter (preparing the brain for learning	Learners were given the following questions to solve in twelve minutes.	**Writing materials, projector,**

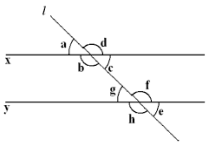
20 mins	 1. What is the value of V? 2. What is the value of W? 3. What is the value of x? 4. What is the value of y? 5. What is the value of z? Use this diagram to answer question 6 to 10. How will you facilitate a lesson to assist your JHS 2 pupils to answer the following:  What property is involved in the following? 6. a = c 7. e = d =180° 8. d = g 9. c + g = 180° 10. f = h Exercises were collected and shared among the learners. Answers were discussed and scored. Learners discuss learning outcomes and indicators, strategies to be used and core competencies to be developed in the lesson Learners form groups of 5 and each group draws lines to meet at certain points. The group which finishes first shouts BINGO and goes to the board to draw. Learners are made to indicate points where the lines meet. Learners establish that angles are formed when two or more lines meet at a point. Learners draw more angles in their notebooks.   Learners volunteer to demonstrate other ways of introducing angles in a JHS 2 class	
Figure 2: Main (new	**Activity 1 (10 mins)**	

learning including assessment) **90 mins**	Learners watch a video on angles and are asked to draw one angle they remember seeing in the video and describe them in their groups for presentation. (https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.mathplanet.com)/  Adjacent  Complementary  Supplementary  opposite Using questions to support learning, a whole class discussion follows on the types of angles projected..        **Angles which meet at a point.**    **Activity 2 : (5 mins)**	

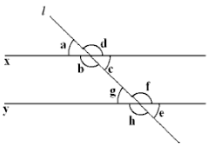
Learners browse for uses of angles on phones and discuss.
There are many uses of angles. One of them is architecture. If you want a rectangular room and walls that are straight, you need angles. Another use is in bearings. These are 3 digit angles (005, 097, 233) used to locate ships and aeroplanes using radars.
Another use is in fitting certain items example sofas into your home. You do not want to buy a sofa and realize it cannot fit the wall so you need angles. Also, to make sure doors do not hit objects and walls, you need to use loci which are a type of angle.
You can use a part of mathematics called trigonometry to find out how tall buildings are. Simply measure how far you are from the base of the building and measure the angle that you have to look up from the ground to see the top of the building. You can use this data to find out the height of big structures, example the Eiffel Tower. Furthermore, companies that use regular polygons as designs can use angles to be able to design a pattern with a hexagon and many more shapes

Activity 3 (15 mins)
Parallel Lines.
Parallel lines are lines that have the same distance along their length or two or more lines that will never meet upon extension.
Property is an object or a character that belongs to something or someone.





Alternate



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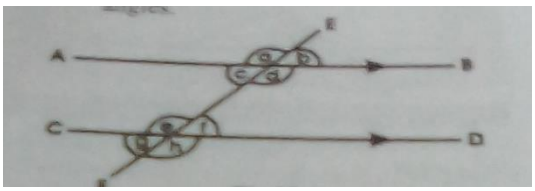
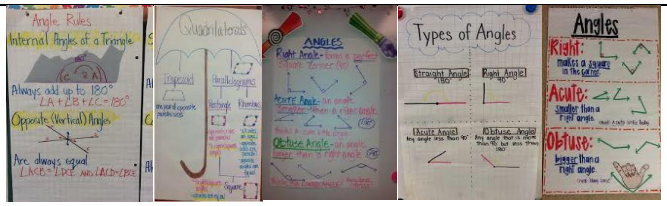
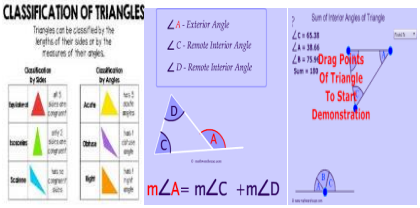


AB and CD are two parallel lines. They are crossed by a slanting or oblique line EF, called a transversal since it cuts parallel lines. This gives rise to ≤

Activity 4 (25 mins)
i. Description of the Interactive Angle Chart
Learners observe different interactive charts shown them on the screen.





Individual learners describe what they see. The answers gathered from the learners summed up as;
An interactive chart consists of a worksheet or drawing paper with angles of different shapes and sizes drawn colourfully on them.

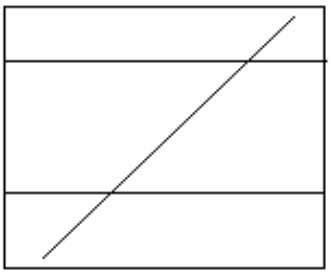
Learners are shown a facilitator-made interactive chart of two parallel lines and a transversal to cut through them. The angles are labelled A to H. these angles are cut and pasted on the chart such that it can be removed and compared with to find out concepts.

ii. Materials and Tools Used to construct Interactive Charts

Learners have a whole class discussion on the materials and tools used for interactive charts with the learners.
Learners form expect grouping and each new group is challenged to construct an interactive chart in twenty minutes using the 2 cardboards, cello tape, Marker and pencil, Blade, Ruler and a pair of Compasses through creativity and imagination and following steps

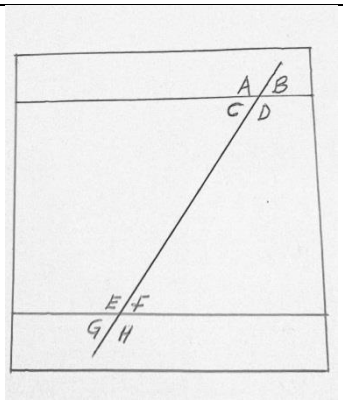
Step 1

Take the cardboard labelled 1 and draw two parallel lines to match the breadth of the cardboard and a transversal line drawn to cut through them using a pencil



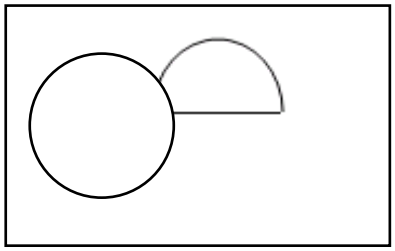
Step 2

With the help of the pair of compass indicate the angles formed and label them from A to H.



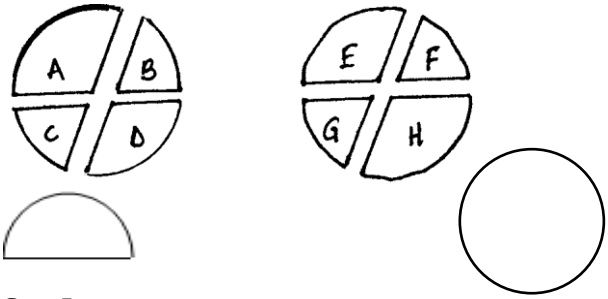
Step 3

The cardboard 2 and divide into two. On one draw a circle and a semicircle as shown below.



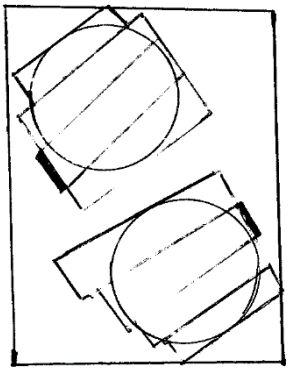
Step 4

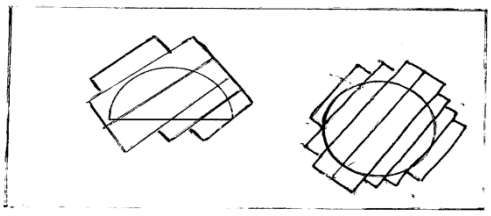
Cut out all the angles formed on the cardboards with the use of the blade.



Step 5

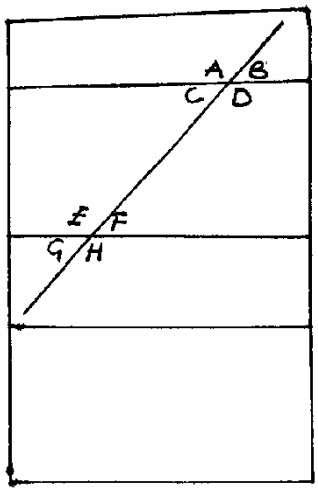
With the use of the cello tape turn to the back of the cardboard and cello tape all the portions left after cutting and the cut out angles from A to H.

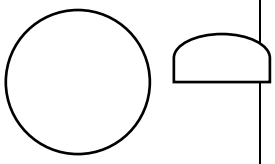




Step 6

Again with the help of the cello tape join the two cardboards and paste angles A to H on the cardboard leaving the cut out circle and semicircle.



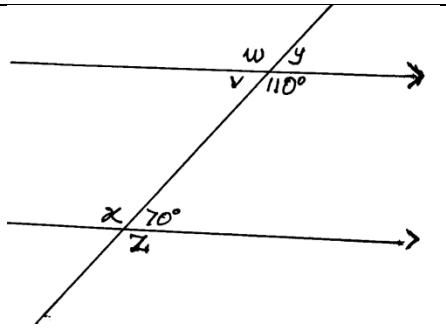


Activity 4 (30 mins)

Assessment as learning

(Learners still in their expert grouping of five.) The ten questions which were tested on content answers were written on pieces of papers with at most two questions on each paper and learners balloted for them. The test item was designed in a way that learners were to apply pedagogic content knowledge to describe and demonstrate how skilful they would be at teaching JHS 2 learners angle properties of parallel lines to find the variables given in the test. Student teachers were given fifteen (10) minutes to describe the process on flip charts and twenty minutes for each group to demonstrate. The questions were as follows:

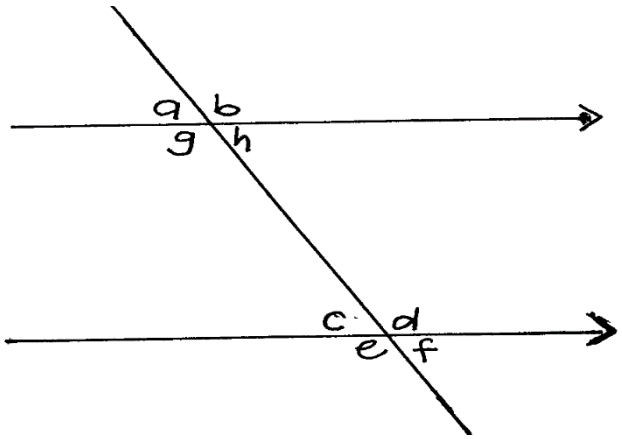
Observe the diagram below. Describe how you as a facilitator in a JHS 2 class will assist your pupils to find the following:



1. What is the value of V?
2. What is the value of W?
3. What is the value of x?
4. What is the value of y?
5. What is the value of z?

Use this diagram to answer question 6 to 10.

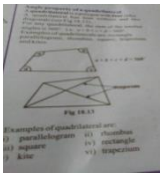
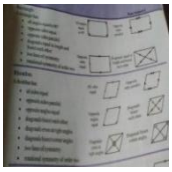
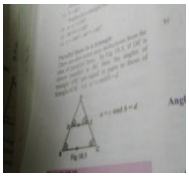
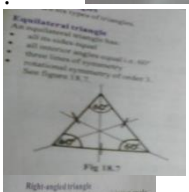
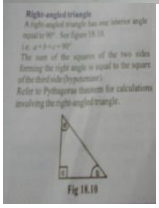
How will you facilitate a lesson to assist your JHS 2 pupils to answer the following:

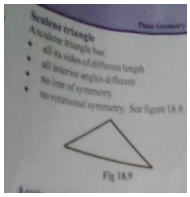


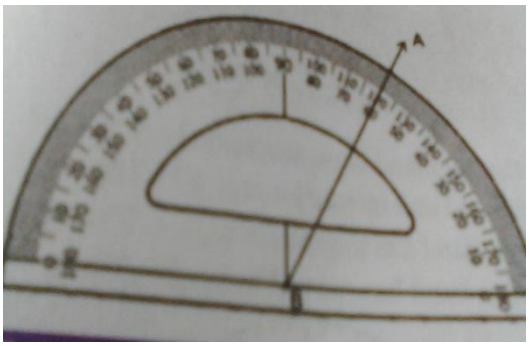
What property is involved in the following?

6. a = c
7. e = d =180°
8. d = g
9. c + g = 180°
10. f = h

A whole class discussion on the various properties of parallel lines one after the other and learners verify properties on their charts.

	Learners remove and compare angles with their interactive charts.  **Protractor: Instrument used to measure angles.** **Assignment** **Use the new lesson plan template and prepare a lesson for JHS 2 pupils on angle properties of parallel lines.**	
Figure 3: Plenary/reflections (teacher and learner) 10 mins	**Authors assist learners to reflect on the lesson.** **1. How were the core competencies developed in the lesson?** **2. Which part of the lesson did you enjoy most and why?** **3. Which part of the lesson didn't you enjoy and why?** **4. What new thing have you learnt?** **5. How will you modify the strategies to develop your practice in a JHS 2 class?**	

4. Results and Discussion

Table 1 shows the performance of the learners in the content exercise. Out of ten (10) questions administered to thirty six (36) learners in Foso College of Education, none of them scored 0 to 6 marks giving 0%, score 7 attracted 2 learners forming 5.6%, 5 learners representing 14% scored 8 marks , 10 learners forming 28% scored 9 marks and marks 10 saw 19 learners representing 53% scoring it. In Accra College of Education, a similar trend was recorded. Score 1 to 7 attracted no learner at all. Score 8 pulled down 3 learners forming 6%, sore 9 attracted 11 pupils forming 21%, and finally score 10 was tallied by 38 forming 73%. The high marks scored by the students in each college, evidently seen in the mean scores of 9.2 in Fosco and 9.6 in Accra are reflective of the high content knowledge possessed by college tutors imparted to the learners. There was nothing so remarkable about elective college mathematics students scoring these high marks in concepts formulated for JHS pupils.

Table 1: Pre- intervention content scores

Foso College of Education: 36				**Accra College of Education: 52**			
Scores (x)	Fx	∑fx	%	Scores (x)	fx	∑fx	%
1	0	0	0	1	0	0	0
2	0	0	0	2	0	0	0
3	0	0	0	3	0	0	0
4	0	0	0	4	0	0	0
5	0	0	0	5	0	0	0
6	0	0	0	6	0	0	0
7	2	14	5.5	7	0	0	0
8	5	40	13.9	8	3	24	6
9	10	90	27.8	9	11	99	21.
10	19	190	52.8	10	38	380	73
Total	36	334	100 .0	Total	52	503	100

Mean = $\frac{\sum fx}{\sum f} = \frac{334}{36} = 9.2$ Mean = $\frac{\sum fx}{\sum f} = \frac{503}{52} = 9.6$

The new curriculum designed for ITE institutions requires that facilitations in the B.Ed. lecture theatre should be concurrent. This means that both content and pedagogy should be taught together for the student-teachers to be equipped with both at the delivery of each sub-strand. This informed the authors to test the learners in both colleges to give a step by step process of how they would assist JHS 2 pupils to arrive on the desired answers for the questions given them. The **'how to make what you know as a facilitator your pupils"** was a challenge to the learners. This is apparent in the results on the table. For Foso College of Education, mark 1 was scored by 8 learners constituting 22\% 2 scored by 9 learners forming 25%, 3 by 5 learners representing 14%, 4 by 6 pupils making up 17 %, 5 by 4 pupils representing 11 %, and finally 6 by 4 pupils representing 11 %. From marks 7-10, no learner from the college scored it. The mean mark for the distribution is 3.02 which signifies a poor performance of learners in the pedagogy test. From this, it could be observed that learners' performance was very low and not encouraging. Learners could not demonstrate knowledge, understanding and application of facilitating to help JHS 2 pupils calculate angle properties of parallel line. In Accra College of Education, score 1 attracted 10 learners constituting 19%, score 2 attained by 12 learners making 23% while score 3 attracted 14 learners making up 27 %. A total of 36 learners constituting 69% of the population failed in the pedagogy exercise. Below average score of 4 was scored by 7 learners forming 10 % and the average score of 5 attracted 5 learners constituting supply 13 %. Score 6 attracted just 3 learners forming 6 % and disappointedly only 1 learner constituting 2% Scored 7. Scores 8, 9 and 10 had no learner scoring it making 0%. What could have accounted for these poor performances in the pedagogy exercise? Learners revealed that tutors did not use teaching and learning resources during lesson deliveries and even in their methodology lessons, they were told how to teach in abstraction with little or no demonstrations to buttress the processes discussed. Mathematics concepts, especially, the concept of angle properties they said, were not related to real life situations so as students, their focus is just to master the content and pass their examinations instead of thinking of its benefits and strategizing how to teach it to benefit JHS pupils who perceive mathematics as a difficult subject. Also key words in concepts taught them in the college theatres like alternate, vertical, correspond, are not taken advantage of to help learners draw a clue from the concept as related to learning mathematics. Tutors on the other hand are

not ready to purchase or improvise teaching and learning resources from their meager salaries and even if they are, college activities are so demanding that they do not have enough time to do these. Two, It was realized that some tutors do not bother to use teaching and learning resources in lesson deliveries because these were not tested in students' examinations.

T**able 2:** Pre-intervention pedagogic scores

Foso College of Education: 36				**Accra College of Education: 52**			
Scores (x)	Fx	∑fx	%	Scores (x)	fx	∑fx	%
1	8	8	22	1	10	10	19
2	9	18	25	2	12	24	23
3	5	15	14	3	14	42	27
4	6	24	17	4	7	28	13
5	4	20	11	5	5	25	10
6	4	24	11	6	3	18	6
7	0	0	0	7	1	7	2
8	0	0	0	8	0	0	0
9	0	0	0	9	0	0	0
10	0	0	0	10	0	0	0
Total	36	109	100	Total	52	147	100

Mean = $\frac{\sum fx}{\sum f} = \frac{109}{36} = 3.02$

Mean = $\frac{\sum fx}{\sum f} = \frac{147}{52} = 2.08$

The table below represents the results of learners in the post- intervention pedagogy exercise. For the (36) learners in Foso College of Education, it was observed that the least mark was five (5) and eight (8) learners representing 22.2% of the population scored that. Twelve (12) learners representing 33.3% scored 6 marks, and this was followed by seven (7) learners representing 19.5% scoring seven (7) marks. Again eight (8) learners representing 22.2% scored eight (8) marks. The highest score was nine (9) score by one (1) learner representing 2.8% of the population. In Accra College of Education, 1 learner representing 2% scored the lowest score of 4 marks. 18 learners representing 35% scored 5 marks and 15 learners representing 29% scored 6 marks. Good results of 7 marks was scored by 4 learners representing 8% and very good score of 8 marks was attained by 8 learners representing 15%. Surprisingly, score 9, the highest score attracted 6 learners representing 11%. The authors used an interactive chart as a teaching and learning Resource which brought about active participation of learners, making them relaxed and have fun. In summary, the impact of the interactive chart was very great. This therefore calls for the need to use simple explanation and low or no cost TLRs to enhance college students'

performance in the facilitating of angle properties of parallel lines in Junior High School Two. This post-intervention score confirms the new curriculum's assertion that when content and pedagogy are taught concurrently in the Teacher Education lecture theatres, learners grasp the concept to enhance their creativity and innovations, leadership and entrepreneurship skills to take control of and be skillful in their professional practice.

Table 3: Post intervention pedagogy results

Foso College of Education				**Accra College of Education:52**			
Scores (x)	Fx	∑fx	%	Scores (x)	fx	∑fx	%
1	0	0	0	1	0	0	0
2	0	0	0	2	0	0	0
3	0	0	0	3	0	0	0
4	0	0	0	4	1	4	2
5	8	40	22..2	5	18	90	35
6	12	72	33.3	6	15	90	29
7	7	49	19.5	7	4	28	8
8	8	64	22.2	8	8	64	15
9	1	9	2.8	9	6	54	11
10	0	0	0	10	0	0	0
Total	36	234	100	Total	52	330	100

Mean = $\frac{\sum fx}{\sum f} = \frac{234}{36} = 6.5$ Mean = $\frac{\sum fx}{\sum f} = \frac{330}{52} = 6.3$

5. Recommendations

Based on the findings of the study, the following recommendations are made.

1. Tutors of colleges of education must acquaint themselves with the demands of the new ITE curriculum so as to equip student-teachers with Professional Values and Attitudes, Professional Practice and PCK
2. Tutors in the colleges of education should embed and make constant reference to the dictates of the pre-tertiary curriculum in the lecture-theatres so that their PCKs reflect that of the basic schools where

the student-teachers will be practicing.

3. There is the need for educational authorities to organize in-service training, workshop and seminars more frequently for mathematics teachers to explore the relevance and adequacy of the use of teaching and learning resources in teaching mathematics concepts.
4. A percentage of Internal Generated Fund (IGF) to cater for ready purchase of and improvisation of teaching and learning resources teaching for effective teaching and learning in the basic schools of Ghana should be encouraged.
5. Interactive pedagogy should be used to enhance learners understanding of mathematics concepts, especially angle properties of parallel lines.
6. Government should not hesitate to regularly remunerate college tutors with Book and Research Allowances to enable them research on current pedagogical issues to prepare them adequately for suitable mathematics activities.
7. The organization of mathematics competitions and games should have a practical component attached to the existing content based sessions for awards to be given to learners who show appreciable skills in both so as to take mathematics seriously.
8. Educational authorities should extend the period for mathematics in particular on the time table to enable teachers get ample time to design series of activates to help the learners get the requisite mathematics skill
9. Learners should remove the notion that mathematics is difficult in order to comprehend its topics. This can be ensured by constant practice of mathematics topics and exploring the environment to acquire real situations such as experience in connection with mathematics.
10. Finally future research into similar topics should be extended to other colleges. Also, the interactive chart should be made of wood to stand the test of time.

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