Centre for Mathematics, Science and Technology Education in Africa

CEMASTEA

MATHEMATICS INNOVATION

ON LOCUS OF A POINT AT A GIVEN DISTANCE FROM A FIXED POINT

1.0 INTRODUCTION-

The Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) core mandate is to strengthen the teaching and learning of Mathematics and Sciences. Part of this strengthening includes development of innovative teaching and learning resources that make learner more involved, interested and have better visualization resulting to teaching and learning being more concrete

In FY 2020/21, the Board committed to develop teaching and learning Innovations in Biology, Chemistry, Physics, and Mathematics. Mathematics department recognizes the importance of implementing the Performance Contracting commitments and also the importance of innovations in the teaching and learning. Therefore the department has developed innovations to enhance teaching and learning and also meet the Performance Contracting commitment

2.0 RATIONALE FOR THE INNOVATION

Mathematics is applicable in solving real-world problems. Very often, we are faced with interesting figures and objects with unique shapes. In our desire to understand them more, we have to view them as sets of points obeying certain rules or having certain properties.

If a given set of points obeys some given rules, it should be possible to outline the resultant shape they define. How can you motivate students to appreciate these components of Mathematics? The response to this question can be achieved by involving students in activities where they either come up with the shapes given a

set of points. This is the guided-approach method in unravelling the wonders of nature.

In teaching and learning of Mathematics, it's important to let learners know the real life application of the concepts in Loci. This will add more value to the learning and is also likely to enhance learner's interest. As learners carry out their daily activities and also interact with the environment, in many instances they come across the application of Loci. This may include opening and closing of a door, animal tethering, road marking, land subdivision, crop planting, watering plants using sprinklers, wall clocks, foot pitches markings, toilet brush, merry go rounds and darts board. Locus is also used in engineering, sports and air traffic control. However teaching of Loci has mainly been done theoretically and this causes a challenge for learners to visualize the locus.

KCSE analysis revealed that most candidates were unable to accurately construct using a ruler and a pair of compasses and locate the Locus of points (KNEC report, 2019). Further, the Training Needs Assessment (TNA) report indicated that Loci were among the topics mostly considered difficult to teach online (CEMASTEA, 2021). The respondents in the TNA were county trainers. Nevertheless, this need more likely cuts across both county trainers and teachers. Thus, the necessity to enhance the use of ICT integrated activities in Loci. This could also be linked to the current trends occasioned by COVID-19 where there is need for enhanced use of online platforms.

2.0 STRUCTURE OF THE INNOVATION

The innovative activity is on Locus of a point at a given distance from a fixed point in two and three dimensions. The activity has taken the blended approaches which include both ICT integration and practical demonstration. Teachers are encouraged to use blended approach to enhance understanding of the concepts. This is also a strategy for stimulus variation in teaching and learning of mathematics. An ICT integrated activity and practical activities have been developed and are explained below.

Locus is defined as the path, area or volume traced out by a point, line or region as it moves according to some given conditions. Practical demonstration of the locus is a powerful strategy to enhance the teaching and learning of the concepts. Below is an innovation that can be used.

Reflection

How would you innovatively help learners to conceptualize Locus of a point at a given distance from a fixed point in two and three dimensional geometry?

2.1 INNOVATIVE ACTIVITIES TO HELP LEARNERS CONCEPTUALIZE LOCUS OF A POINT AT A GIVEN DISTANCE FROM A FIXED POINT

Reflection

Suppose Q is a fixed point. How can you help learners describe the locus of a point P such that it is always at a given distance ***m*** units from point Q.

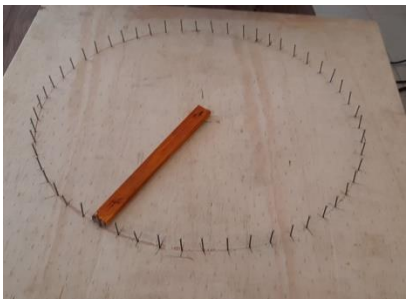
2.1.1 Out of class activity

Steps

1. Take learners to the field at the goal post area.
2. Tie a 2m string to the goal post and ask one **learner A** to hold the string to waist position and stand at the furthest length the string can allow.
3. Let learner A walk in small steps with the string held taut as learner B marks on the ground, the heel position of one of the legs of the learner A consistently until Learner A gets back to the starting point.
4. After the activities, learners can be asked the questions to draw out the concept of Locus a point at a given distance from a fixed (*fixed point, constant distance , path traced*)

2.1.2 A practical demonstration of Locus a point at a given distance from a fixed point in two dimensions.

The hand represents the '*given distance'.* The hand is fixed at the centre representing the '*fixed point'*. When the hand moves around, the '*path traced'* by the tip of the hand is marked by the nails



Locus a point at a given distance from a fixed point in two dimensions

2.1.3 Demonstration of Locus of a point at a given distance from a fixed point in two dimension using the Geo-gebra

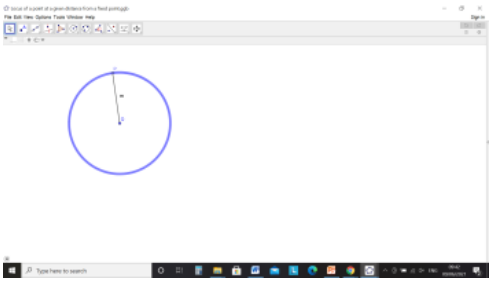
Follow the steps below

1) Open the GeoGebra software and select Geometry.

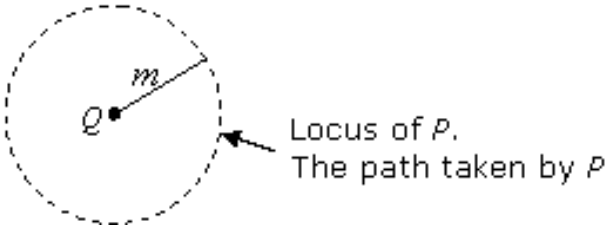
2) Click on the arrow at the bottom right corner of the tool  and select “segment with given length” from the drop-down menu that appears.
3) Click anywhere inside the plane and this window  will appear. Enter the length of the segment in the window and click ok.
4) The line segment is labeled AB by default. If it is not labeled, right click on the points and label point A and point B by clicking “Show Label”
5) Right click on point B and select “Trace On”.
6) Right-click on the same point B again and select “Animation On”. An animation showing the path traced out by point B (locus of point B) from the fixed point A will appear

Expected demonstration is shown below

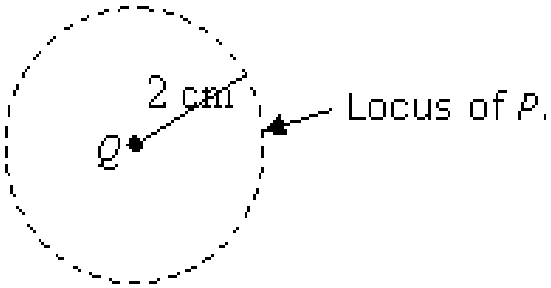
Locus of a point at a given distance from a



Based on those three activities, we can conclude that in general, the locus of a point P such that it is always a given distance ***m*** units from point P is a circle with Centre Q and radius **m** units
The Locus a point at a given distance from a fixed point has been demonstrated using the out of class activity, locus board and Geo-gebra software and this is a powerful approach to making the concept more concrete. The same Locus board can also be demonstrated physically using materials in the environment such as wood, thread, straws, and nails.



Thus, point P can lie anywhere on the circumference of the circle. For instance, suppose point P moves in such a way that it is always 2cm from point Q. Hence, the locus of point P is a circle centre Q and radius 2cm as shown below.



The Locus a point at a given distance from a fixed point can be demonstrated effectively using the Geo gebra software and this is a powerful approach to making the concept more concrete. In many cases students are not able to visualize the path made by a point especially in three dimensions. The same locus was can also be demonstrated physically using materials in the environment such as wood, thread, straws, and nails.

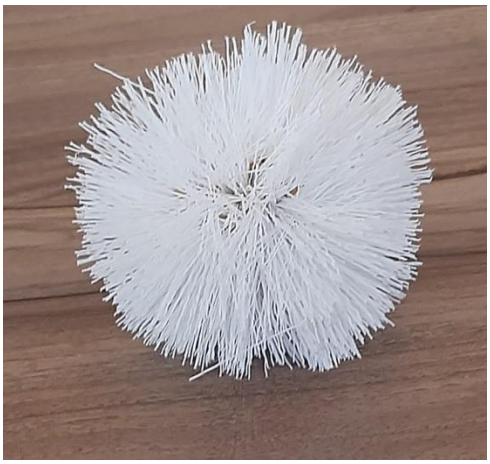
2.2 Locus of a point at a given distance from a fixed point in Three-Dimensions

Reflection

Suppose Q is a fixed point. How can you help learners describe the locus of a point P such that it is always at a given distance ***m*** units from point Q.

3.0 A practical demonstration of Locus of a point at a given distance from a fixed point in three dimensions

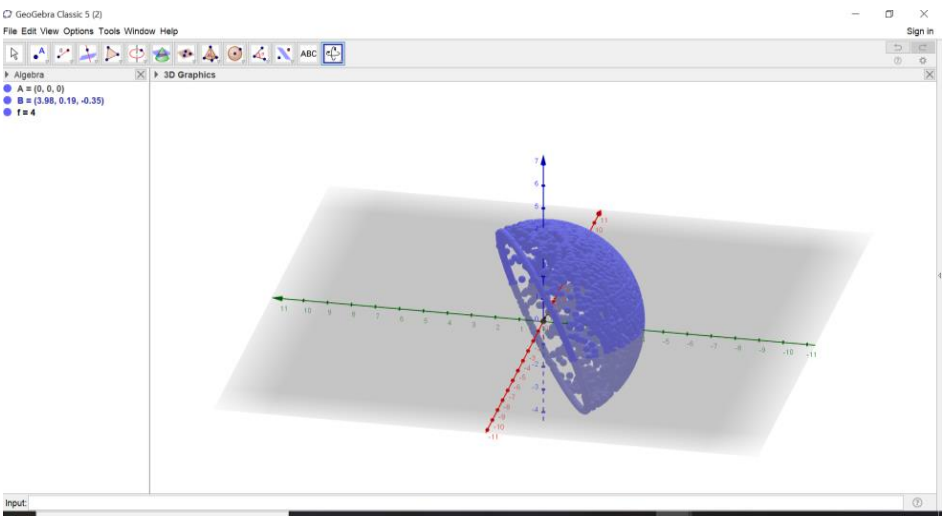
The match

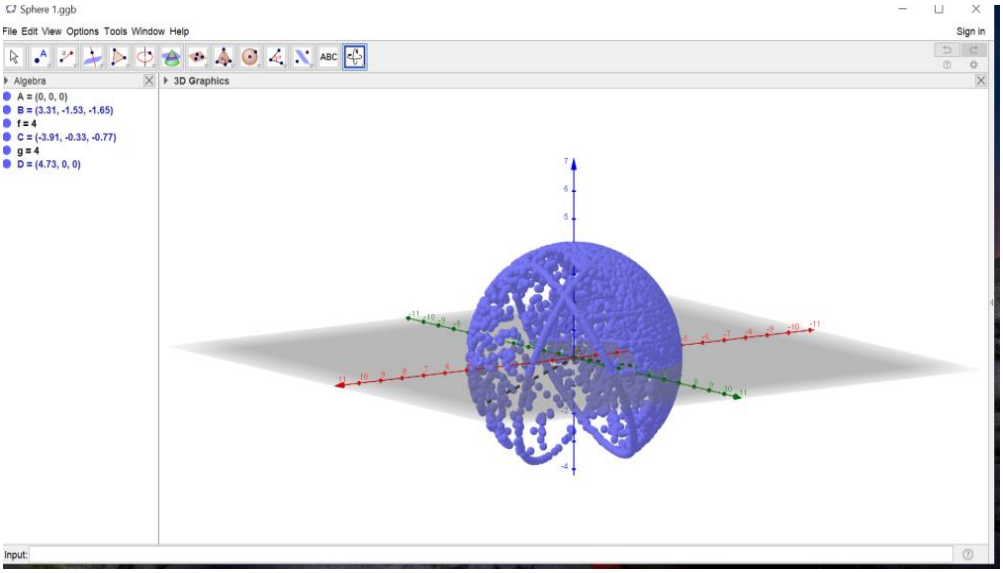


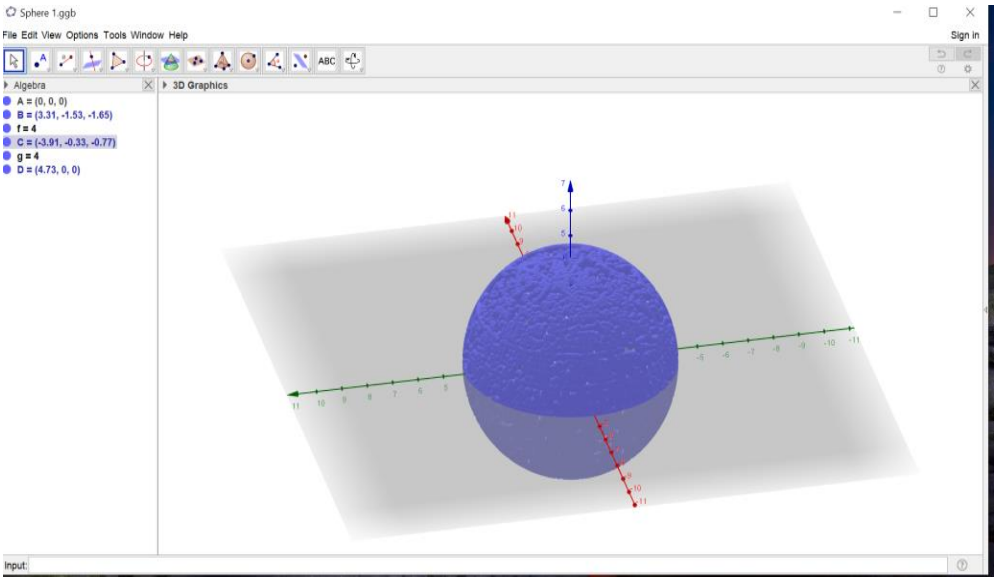
Follow the steps below

1. Open GeoGebra and get to 3D graphics
2. Draw a segment with given length from the origin in the xyz plane
3. Right click on point B, and then click on trace on.
4. Pick the move tool and trace out the Locus of point B by dragging point B

Use the rotation tool to rotate and complete tracing out the locus of point B. You can draw the radius again, after rotating the traced hemisphrere to be able to trace the locus in the remaining hemisphere




Sphere 1.ggb
File Edit View Options Tools Window Help
Sign in
Algebra
3D Graphics
A = (0, 0, 0)
B = (3.31, -1.53, -1.65)
f = 4
C = (-3.91, -0.33, -0.77)
g = 4
D = (4.73, 0, 0)
Input: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