Exploring the Role of Technological Representations to Facilitate Mathematics Learning In E-Class

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Abstract:

This paper explores the role that is played by technological representations used in e-classes during pandemic, in promoting interactions among peers and teacher & students in order to provoke mathematical understandings. The analysis is based upon the theoretical framework as the Johonson Mathematical Representation Model which is an extension of Lesh's Multimodal model of translations amongst the representations. Findings of the study suggest that Constructive tasks which used dynamic pictorial representations were successful in capturing the interest and curiosity among students and provided ample of opportunities to students to interact and think mathematically.

Key words: ***Representations, Geogebra, Mathematics***

Introduction

The mathematical concepts are abstract in nature and so Representations play an important role in learning and teaching of mathematics. Teachers and students employ the use of representations to support their mathematical understanding, so, it is crucial to explore the use of representations in mathematics classroom.

Further, COVID-19 -19 pandemic has insisted in rerouting the students' learning and teachers' teaching trajectories, while on one place, it has brought up many issues and hurdles in educating school children on the other hand it has also provided opportunities to exploit the technology so as to use it as a great medium of teacher instruction and learning as well.

The researchers in the present study explore how in E Math classes, conducted during pandemic the technology too became an integral mode to represent the mathematical ideas and implications it had for teaching and learning of mathematics.

Review of Related Literature

There are various research studies undertaken to explore how the modes of representation help in communicating mathematical ideas and thinking." The power of a representation can . . . be described as its capacity, in the hands of a learner, to connect matters that, on the surface, seem quite separate. This is especially crucial in mathematics" (Bruner, 1966, p. 48).

Representations became all the more integral to learning of concepts in mathematics, when it was added as a new process strand in National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics (2000) "The ways in which mathematical ideas are represented is fundamental to how people can people can understand and use those ideas." (National Council of Teachers of Mathematics,2000,p 67).

NCTM's representation standard says "instructional programs from prekindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; [and] use representations to model and interpret physical, social, and mathematical phenomena" (National Council of Teachers of Mathematics, 2000, p.67)."Mathematics requires representations. In fact, because of the abstract nature of mathematics, people have access to mathematical ideas only through the representation of those ideas" (Kilpatrick, Swafford, & Findell, 2001, p. 94, Duval, 1997)). Learners should be able to choose, apply, and translate among mathematical representations to solve problems (Lesh, 2003; Johnson, 2015). Studies (Jo Boaler et. Al.,2016;) emphasise the importance of engaging students with visual representations as it is extremely helpful in mathematics learning.

Theoretical Framework

Mathematical concepts can be "represented" in many ways. It can be represented through drawings and pictures, written or oral words, through manipulatives and, all of these, alongside the abstract entities. The researchers use as a theoretical foundation the Johonson Mathematical Representation Model which is an extension of Lesh's Multimodal model of translations (Lesh et. Al., 1987) amongst the representations as a framework for this study. Johonson Mathematical Representation Model along with five modes of representation suggested by Lesh namely Real-Life Situations, Manipulatives, Visuals, Symbols (Oral and Written) includes technology too as the mode of representation.

The different modes of representation as used with reference to Johonson and Lesh Mathematical Representation Model in present study are :

Manipulatives, the concrete representations, are objects which facilitate learners to learn a particular mathematical concept by manipulating them .Pictorial representations, the visuals, as a picture, graph, photograph that represents concrete objects. It could be Real-life situations are the contextual situations related primarily with everyday lives of our learners. Symbolic representation is the symbols, both written and oral. Technological representation refers to the use of any technology (iPad, computer program, website, app, etc.) that produces moveable replicas of concrete or pictorial representation. Examples might include a website /apps with moveable base ten blocks that can express place value of whole numbers or decimals, educational videos augmented with different modes of representation to develop mathematical ideas, dynamic software which provide interactive interface as Geo Gebra for dynamic visual representations.

The Present Study

The present study involved almost 30, Govt Girls Secondary (grade 9th & 10th) School students from Faridabad, Haryana, who attended e classes during pandemic. E Maths classes were conducted in both online synchronous (through Zoom and Google Meet) and online asynchronous (Whats app) mode. For asynchronous mode, students were free to respond any time during the day as per the accessibility of the smart phone. It is worth to be mentioned that none of the students was having computer/ laptop with them, so they were using small screen for connecting with school teachers. During synchronous mode of e-classes, students were usually provided with a task to explore from GeoGebra resources through live class mode. In this study, discussion on the analysis of two tasks that were given to students is presented. Students' responses were recorded through video recording and screenshots were captured wherever required.

GeoGebra provides the opportunities to explore mathematical concepts through multiple representations. It is an open software and cen be accessed in online and offline both the modes and GeoGebra offers a Graphics view, an Algebra view and an Input Bar at the bottom of the window. The platform has millions of ready to use classroom resources which can be assigned to the students through Geogebra Classroom.

Analysis and Discussion

GeoGebra is an open dynamic geometry mathematics software for all grades that brings together geometry, algebra, spreadsheets and graphing. Geo-Gebra has become the leading provider of dynamic mathematics software, supporting science, technology, engineering and mathematics (STEM) education and innovations in teaching and learning worldwide. This open software can be used in both online and offline modes with ready to use applets or exploring on the graphic calculator by oneself. It also has an interesting feature 'Create Class' which came into play during pandemic only, Its main purpose is that all the students can work on a specific given task individually as per their own pace during the live class and at the same time, teacher can also monitor their progress in the task. The study described the analysis of one applets was used to teach geometry to grade 9th.

Analysis of Task 1

Topic: Triangle and its properties

Objective: Learners

- Explore the dynamic view of angles of triangle
- Notice observable properties of angles of triangles.
- Form conjecture by observing many cases of angles sum property
- Explain their justifications for deducing properties

Assumption about students' previous knowledge

Familiarity about the concept of angles and angle sum property of the Triangle

Link of the GeoGebra applet:

https://www.geogebra.org/m/HjfczzyE

Task Description

The GeoGebra based exploration task was part of week plan on the topic of triangle that was conducted blended mode. This particular task was done using online synchronous as well as asynchronous mode where Zoom platform (free version with 40 min limit) for synchronous and whats app chat platform for asynchronous mode were used.

The GeoGebra applet showed a dynamic view for angle sum property where sum of three angles of a triangle remains 180 degrees while all three angles measures keep changing (Angle Sum Property). Through this applet, students were given opportunities to observe what remains constant and what varies in three angles. Students were asked to join GeoGebra live class and were given 10-12 min to observe the measures of three angles by moving the slider. Students were then asked the invariant they observed in three angles in the dynamic view.

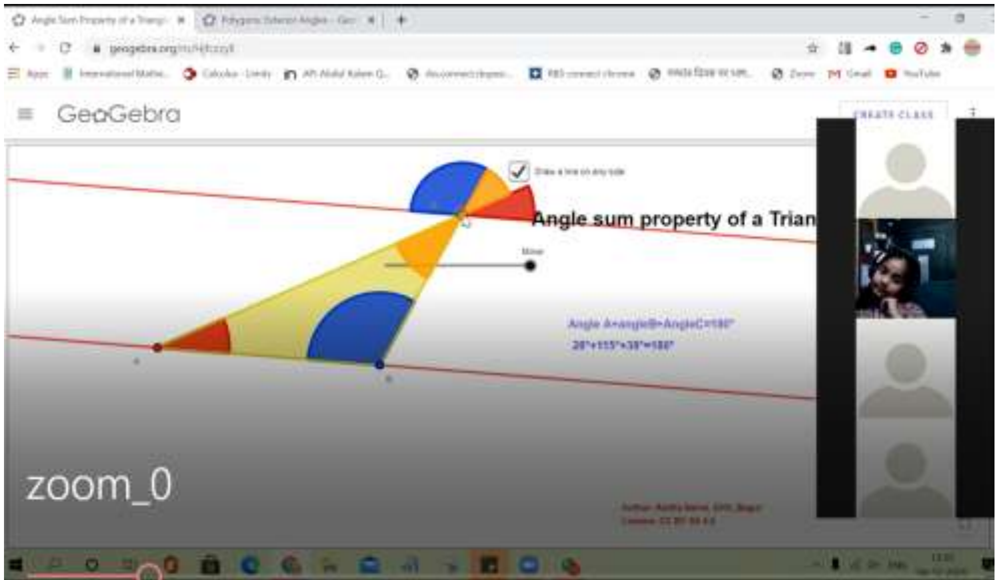

Fig 1: students in Zoom class and observing the dynamic movements of triangle

Fig 2: Monitoring students progress through GeoGebra 'Create Class' Feature

Students came up with different observations like we can have all three angles which are acute, among three angles, right angles or obtuse angle can also come. Due to constraints of timings, students were asked 'could they observe, whether we can have more than one obtuse angles in a tringle?' This question made students to work again and explore about the given statement. They came up with interesting explanations for justifying their stand.

Overall, this applet which was made to explore angle sum property was exploited in other way round i.e. by keeping the sum constant to 180 degrees what other aspects remains invariant was some thing new to explore for students and this applet being dynamic in nature consumed less time and effort to explore through many cases to form a conjecture.

Through this applet, It was feasible to explore that 'a triangle cannot have more than one right angle or an obtuse angle'.

Area of Improvement – To improve this applet and use it independently by students, it would be good if we code the angles in three colours- e.g. blue for obtuse, orange for right and white for acute angle. In the dynamic view, angles coloured keeps changing depends upon the kind of tringle it is.

Conclusion

Results of the study reveals that technological dynamic representations evident to be an add on to the regular class teaching as it provided students to ample opportunities to manipulate their mathematical processes like observing patterns, reasoning, justification and forming conjectures. Moreover, it has also proved to be less time consuming and creates number of images in few seconds which is not feasible to construct by the students or teachers with physical equipment in such a small span of time.

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