



# Teaching Mathematics through Geogebra at College Level

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**Abstract:** This paper provides overview of learning some of the Mathematics topics through Geogebra software. Geogebra is a free open source, software which is designed for innovative, interactive and dynamic teaching in various areas of Mathematics. This paper describes how one can find determinant, inverse, rank of matrices of order more than 4 using geogebra .

**Keywords:** Open source software, Geogebra, Matrices.

## 1 INTRODUCTION

To stimulate the interest and increase the proficiency of the students in mathematics, technology can be strategically used as it is an essential tool for learning mathematics in the 21<sup>st</sup> Century. The use of technology can enhance both teaching and learning. Teachers should take advantage of technology – rich environment and integrate technology in day to day instructions which will have a potential impact on students' learning, preparing them for their future lives. The computers these days are equipped with increasingly sophisticated software. Teachers need to be prepared for exploring the current and emerging possibilities.

It was observed by Norton, McRobbie and Cooper (2000) who investigated on the barriers for teachers to use technology in teaching mathematics, that it was either the teachers' feeling uncomfortable with technology or they were not sure how to incorporate technology into their curricular which made them reluctant to effectively use this. The immediate concern regards teachers who have learnt mathematic without the use of technology. Everett Rogers (1995), a researcher, explained that teachers need to progress a five-step process of facing the ultimate decision as to whether to accept or reject a particular innovation for teaching mathematics with technology. Like knowledge, persuasion, decision, implementation and confirmation.

Research suggest that despite the numerous benefits of using technology in mathematics education, the process of using technology in classrooms is slow and complex.(Cuban, Krikpatrick & Peck, 2001). GeoGebra is an open-source software for mathematics teaching and learning that offers geometry, algebra and calculus features in a fully connected and easy-to-use software environment. It is available free of

charge and is used by thousands of students and teachers around the world in classrooms. In this presentation, we will present applications of Geogebra at college level.

There are several methods to solve rank of the matrix, inverse of the matrix, determinants of the matrix, which students are learning in their curriculum. But these methods are restricted to certain orders. Such as of order 2, 3 or 4. When it comes to higher order such as 10, 20, etc., it is tedious to solve on paper. For such examples technology is needed.

## 2 WHAT IS GEOGEBRA?

GeoGebra is free and multi-platform dynamic mathematics software which is freely downloadable from the internet and can be used on any computer for all the levels of education that joins geometry, algebra, tables, graphing, statistics and calculus in one easy to use package.

At the moment GeoGebra (Geometry & Algebra) is one of the most Innovative, open code Math Software (GNU General Public License) which can be freely downloaded from [www.geogebra.org](http://www.geogebra.org). Geogebra works on spectrum of operating system platforms which have Java virtual machine installed on.

Markus Hohenwarter created free, open source dynamic Mathematics software GeoGebra which is used for both teaching and learning Mathematics from middle school through college to the University level. Geogebra offers geometry, algebra and calculus features in a fully connected, compacted, Geogebra provides typical features for a computer Algebra system such as multiplication of two matrices, finding determinant of matrix, finding inverse of matrix even for large size of matrices.

The basic idea of GeoGebra interface is to provide two presentations of each mathematical object in its algebra and graphics windows. If you change one object in one of these windows, its presentation in the other one will be immediately updated.

Geogebra Software is a powerful teaching tool. We choose Geogebra as the software to be utilised in the institute for several reasons. First of all, GeoGebra is a free,



# International Journal of Ethics in Engineering & Management Education

Website: www.ijeee.in (ISSN: 2348-4748, Volume 1, Issue 9, September 2014)

multiplatform, open-source dynamic mathematics software. Thus, because of its open-source nature there are no licensing issues associated with its use, allowing students & teachers freedom to use it both within the classroom. Secondly, Geogebra combines dynamic geometry, algebra, calculus and spreadsheet features (which other packages treat separately) into a single easy to use package making it suitable for learning and teaching mathematics from elementary through University. Thirdly, Geogebra has a large international user and developer community with users from 190 countries. The software is currently translated into 55 languages and attracts close to 3,00,000 downloads per month.

As Hohenwarter and Levicza(2007) explain, for the majority of teachers, solely providing technology such as GeoGebra is going to be fully integrated in to their teaching. To date, for teachers using Geogebra, online collaboration is being supported via a User Forum (where by users can help other users) and a Geo Gebra Wiki(a way of pooling and sharing teaching materials). A beneficial next step would to be able to offer professional development for teachers and coordinate research activities in relation to GeoGebra. In terms of working with pre-service mathematics teachers, some ideas and examples are provided by KokolVoljc(2007) and by Edwards and Jones(2006)

### 3 TEACHING MATHEMATICS USING GEOGEBRA

Here are few examples of matrices of order 10 for which we got the results through Geogebra software.

$$A = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 1 \\ 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 1 & 2 \\ 3 & 4 & 5 & 6 & 7 & 8 & 9 & 1 & 2 & 3 \\ 4 & 5 & 6 & 7 & 8 & 9 & 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 & 9 & 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 1 & 2 & 3 & 4 & 5 & 6 \\ 7 & 8 & 9 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 8 & 9 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 9 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 9 \end{pmatrix}$$

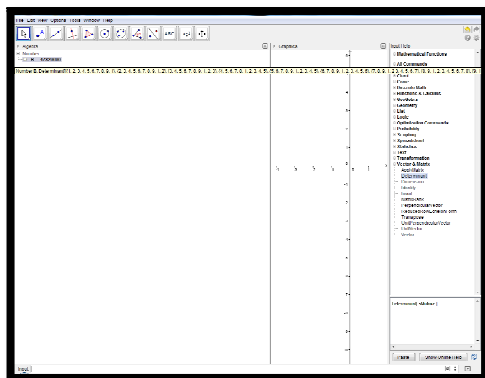


Figure1: Finding Determinant of the above matrix A:

Determinant of above matrix A = -47829690

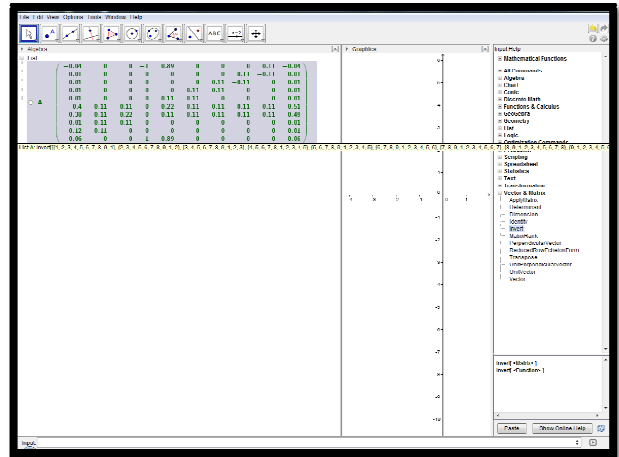


Figure 2: Finding Inverse of the above matrix A

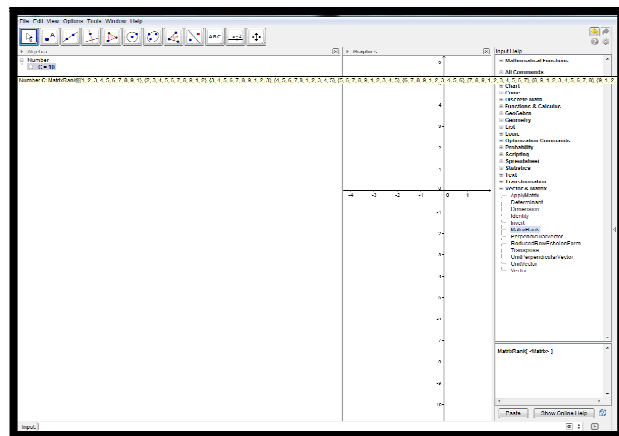


Figure3: Finding Rank of the above matrix A

Rank of the matrix A is 10

### 4 CONCLUSION :

With the availability of dynamic mathematics software, like Geogebra, teachers are able to make graphical representations of math concepts. As the concepts are introduced with pictorial representations, teachers and their students are able to make the connection between the pictures, the math concepts, and the symbolic representation. When presented with a new concept, students need to think, visualize and explore relationships and patterns. Technology makes all of this possible for them in a short amount of time.

As a freely available open source software package that combines both geometry and algebra, GeoGebra has much to offer. It is perhaps worth concluding with the words of Edwards and Jones(2006) that utilising software like GeoGebra could inspire a change to forms of classroom problems “that need high level –thinking, and things that students may find themselves wanting to follow -up outside of regular lessons.



# International Journal of Ethics in Engineering & Management Education

Website: [www.ijeee.in](http://www.ijeee.in) (ISSN: 2348-4748, Volume 1, Issue 9, September 2014)

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