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Role of Geogebra in the Hard Spots of Higher Education Through Optic Math

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ABSTRACT

Optic Math is a powerful tool to make the students as idea hamster. Engaging students in Optic Mathematics improves the Mathematics performance. An advantage of visual learning is that recollection is easier when the learner is exposed to picturesque representation .Visual learners typically excel at observation and memory skill. In fact, Optic learning can promote deeper thinking, problem solving skill and build overall critical thinking skill. As learning throughout life as the heartbeat of society, Optic Math is framed based on the higher education program of study and to remove the hard spots in Mathematics. This paper focuses on hard spots such as Multiple Integrals and Vector Calculus for visual based approach.

Key Words: Geogebra, Higher Education, Multiple integrals, Optic Math, Vector calculus

INTRODUCTION

Markus Hohenwarter created Geogebra in 2001/2002. He is a project leader of Geogebra. This Geogebra is a FOSS (free and open source software). It can be downloaded without any cost via internet. Geogebra is an Interactive user-friendly Geometry system and This Math app Geogebra mainly supports to implement the Optic Math in education System and makes all the students to involve in learning process visually.

ROLE OF GEOGEBRA IN THE MULTIPLE INTEGRALS

The Multiple Integral and Vector calculus play a central role in Real world. In Vector calculus, computing the line integral and converting the line integral into the double integral can be easily done using Green's theorem.

In Multiple integrals topic, Double Integral is considered as hard spot which is helpful to find the area between the curves.

The evaluation of double integral is facilitated by the change of order of integration Whereas Triple Integral is considered for calculating the volume of the solid object. Hence the Multiple Integral and Vector calculus are applied in physics and engineering field. Therefore the main target of this paper is to remove the learning difficulties in the topics such as Multiple Integral and Vector calculus through visualization.

Technology can no longer be looked at in isolation but rather as part of a carefully planned program of school change as it relates to student achievement. Technology can broaden the range of students' choices as they learn. Students routinely use technology tools to find information, collect, organize and interpret data, and present results. In addition, technology offers teachers options for adapting instruction to special student needs. Teachers can work within specific content areas to integrate technology rather than making technology a separate subject area. In nutshell, information technologies are restructuring teaching learning process to meet the International Standards.

DOUBLE INTEGRATION THROUGH OPTIC REPRESENTATION

Obtaining the area between two curves and area enclosed by plane curves is the main purpose of double integral. In General the area lying between the curves x=a and x=b; y=f(x) and y=g(x) is defined as Area $=\int_a^b \int_{f(x)}^{g(x)} dy\,dx$. In Geogebra, The following example illustrates how the area lying between the parabola y=4x-x^2 and the line y=x in Graphics view and the

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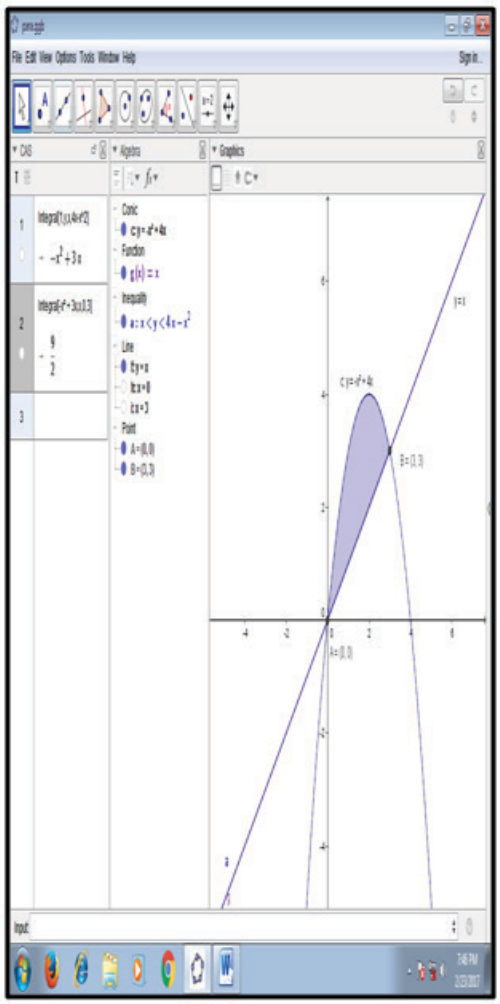
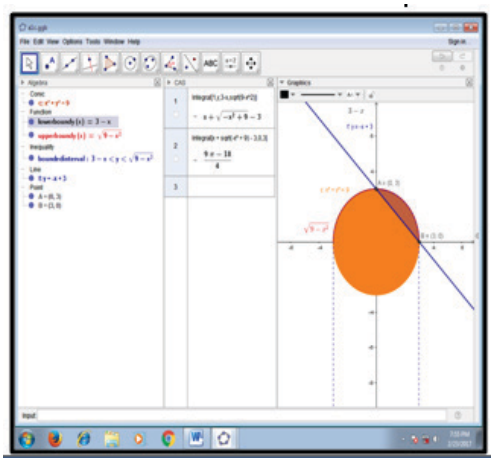
Graphics view shows the shaded region to represent an area between the curve and line .The highlighting feature of this Geogebra is that if the commands of any function are entered in Algebra view the corresponding graph of the function will appear in Graphics view and vice versa. The integral value can be calculated by integral command in CAS view. Hence Struggling students also easily understand the mathematical concept through this visualization approach.



OUTPUT OF PROGRAM IS 9/2



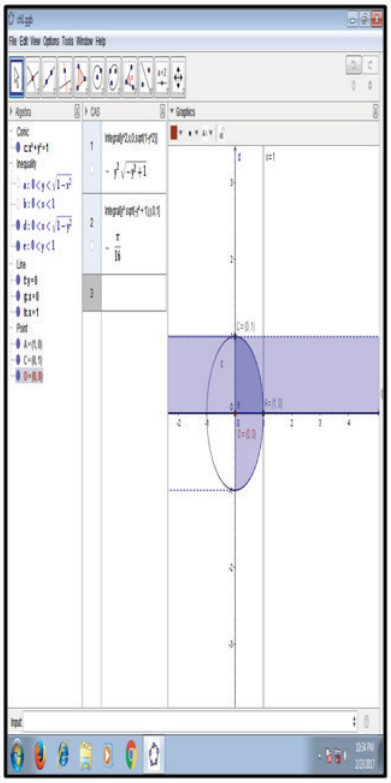
In this visual app, the following program exactly shows smaller of the area bounded by y=3-x and $x^2+y^2=9$ visually

THE RESULT OF THE PROGRAM IS (9Π-18)/4

This **picturesque representation provides a better understanding of mathematical concept.**

CHANGE OF THE ORDER OF INTEGRATION

Change of order of Integration is the appropriate method that makes the evaluation of the Integral easier. In Geogebra, CAS view facilitates to evaluate the Integral such as $\int_0^1 \int_0^{\sqrt{1-x^2}} y^2 \, dy \, dx$. An effective feature of Geogebra is that In Graphics view, the bounded region of Integral before change of order of integration and the bounded region after change of order of integration can be viewed simultaneously. Hence the following example demonstrates how to evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} y^2 \, dy \, dx$ by interchanging the order of integration visually.

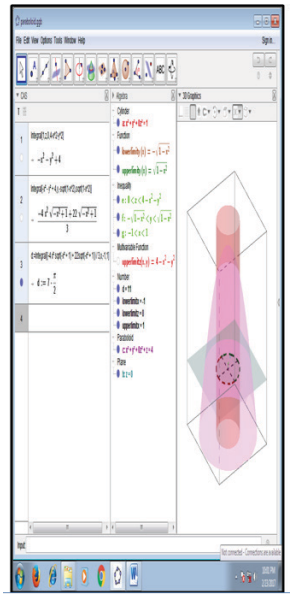


OUTPUT OF THIS PROGRAM IS Π/16

TRIPLE INTEGRATION

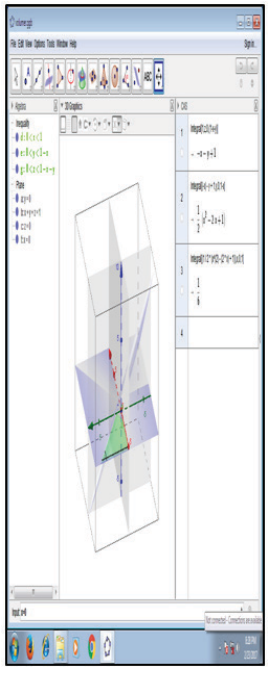
The triple integral of a function defined over a region R is denoted by $\iiint_R f(x,y,z)dxdydz$.Triple integration helps to obtain the volume of the region bounded by plane and the shapes such as cylinder, sphere, paraboloid. In Geogebra app, obtaining the figure with exact measurement and viewing

the volume of the shapes in Graphics view is possible. With the help of this incredible and amazing feature, the volume of the portion of the cylinder $x^2 + y^2$=1 intercepted between the plane z=0 and the paraboloid $x^2 + y^2 = 4 - z$ is shown below



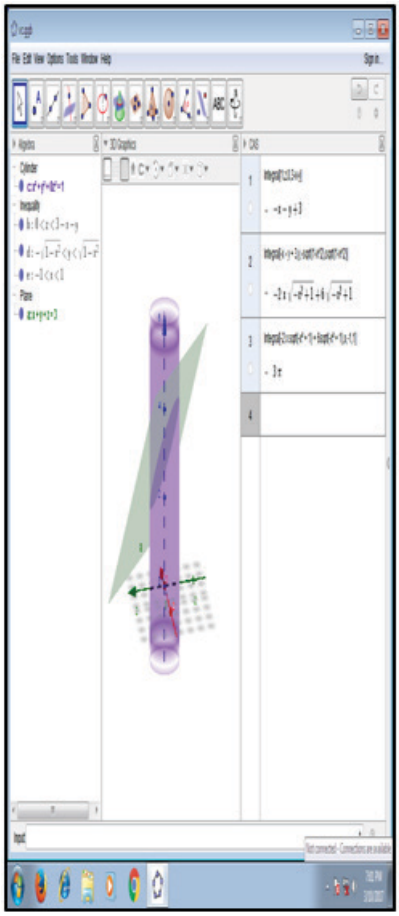
OUTPUT OF THE PROGRAM IS 7Π /2

In addition, rotating the figure, making animation are the salient features of Geogebra. The following problem shows how to calculate the volume of the solid bounded by the planes x=0, y=0,x+y+z=1 and z=0 and rotating the figure in 3D Graphics view. In fact, this approach is feast to the eyes of all the students and hones all the students' creative and problem solving skills.



OUTPUT OF THE ABOVE PROGRAM IS 1/6

In Geogebra app, the following program displays the volume of the region bounded by the XOY plane, the cylinder x^2 +y²=1 and the plane x+y+z=3 visually. This practical and visual based methodology enhances the students 'performance in Mathematics.



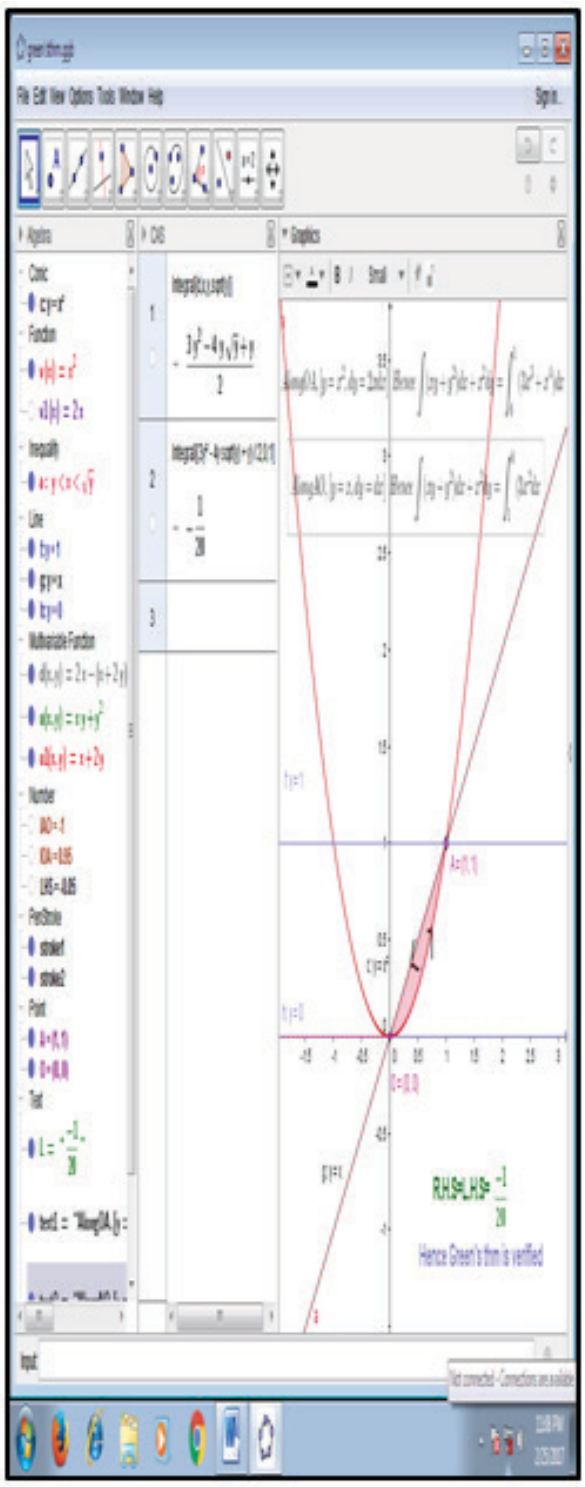
OUTPUT OF THE PROGRAM IS 3Π

GREEN'S THEOREM THROUGH VISUAL REPRESENTATION

Green's theorem is defined as If u,v,$\frac{\partial u}{\partial y}$,$\frac{\partial v}{\partial x}$ are continuous and one-valued functions in the region R enclosed by the curve C, then $\int_C u\,dx + v\,dy = \iint_R \{\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\}\,dx\,dy$. Green's theorem deals with the relationship between line integral over the closed curve C and the double integral over the Region R bounded by C.

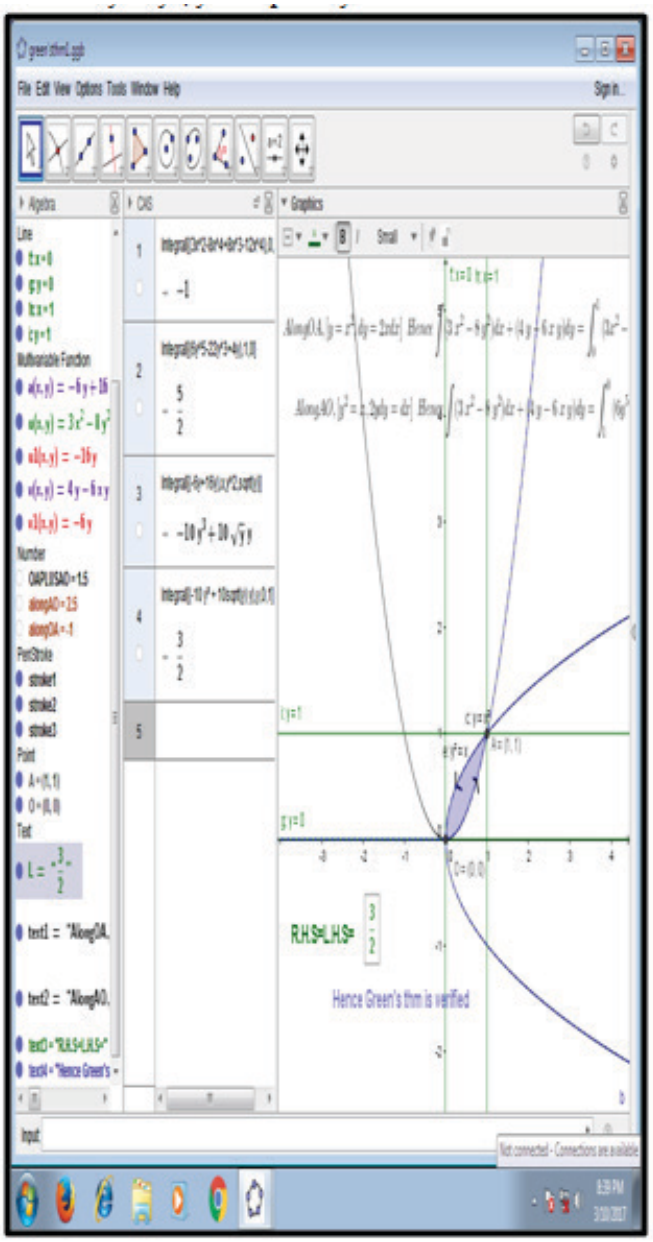
As Identifying line integral and double integral separately is possible in Geogebra,

Green's theorem in the XY plane for $\int_C \{(xy + y^2)\,dx + x^2\,dy\}$ where C is the closed curve of the region bounded by y=x and y=x^2 is verified optically,



OUTPUT OF THE PROGRAM IS -1/20 & GREEN'S THEOREM IS VERIFIED

In Geogebra, the following program converts the line integral into double integral theorem in the plane for $\int_c (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where c is the boundary of the region defined by $x=y^2$, $y=x^2$ optically



OUTPUT OF THE PROGRAM IS 3/2 & GREEN'S THEOREM IS VERIFIED

In fact, This Optic Math assists the students to understand the meaning of the problem and nature of the solution in vector calculus.

CONCLUSION

This optic math steers the younger generation towards Technology and invention. Students who are lower in the class hierarchy are able to make learning less stressful and more fun. Optic Math is an excellent way by which the students can develop the understanding skill in the hard spots such as Vector calculus, Multiple Integral and can access abstract idea in Mathematics. This type of Visual representation makes the

students as voracious learners in Mathematics and helps the students to improve in their weaker area. In 21st century, Students will learn themselves with the support of this visualization feature of Geogebra App. Conclusively, all the students will benefit by this visual approach.

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