

## “A LITERARY REVIEW: MATLAB AS A TEACHING AND LEARNING TOOL FOR MATHEMATICS”

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### ABSTRACT

*This is research on “A Literary Review: Matlab as a Teaching and Learning Tool for Mathematics”, and in this article, we discuss how to make use of computer technology in the educational setting. The exposure that students have to the software MATLAB, which is used to facilitate the teaching and learning of mathematical ideas, may have a significant influence on the learning processes that they use. In this empirical research, we demonstrated the many methods in which MATLAB was used as a teaching and learning aid for mathematics. MATLAB is an acronym that stands for "computer algebra system." It has been used as a tool for the visualization of the graphs of mathematical functions, calculation, problem-solving, encouraging good attitudes toward mathematics, enhancing motivation and self-confidence, and so on.*

**Keywords:** MATLAB, Teaching, Learning, Mathematics.

### INTRODUCTION

In today's world, information and communication technologies (ICT) provide a wide variety of learning aids for mathematics, including those that are required for understanding complicated number systems. Complex numbers are useful in a variety of contexts, including engineering (namely, the description of electrical circuits and electromagnetic waves), physics, chemistry, biology, mathematics, and statistics, to name a few of these contexts. There are a few ideas, one of which is understanding complicated numbers, that call for visual comprehension, which is difficult to achieve just reading a guide book or listening to a lecture. When the learner uses interactive technologies to better understand this issue, they are able to comprehend the material on a deeper level.

Utilizing these technologies as an important instrument to acquire or develop knowledge makes the application of theoretical concepts simpler, and information and communication technologies (ICTs) become an entertaining way to learn new things. All of the new technologies allow for an increasingly important development in each of the daily activities. It is essential that in order to obtain greater interaction with the new environments for the learning of complex numbers, we have prior knowledge on the subject as well as on the use of the tools that are to be used, in this

case MATLAB and GeoGebra. This is because it is only through this that we will be able to achieve our goal of obtaining greater interaction.

In this article, we demonstrate the use of Matlab to the solution of linear nth-order constant coefficient differential equations by providing examples of such applications. The above differential equation may be solved with the use of a few simple instructions made available by the program me Matlab. The examples may be used by students as a simple guide to follow; all that is required is a fundamental understanding of Matlab and mathematics at the level of the first year of a bachelor's degree program me. Differential equations are covered in depth and solved by our students in seminars, where they also learn how to comprehend such problems. Because of our previous experiences, we are aware that the level of interest demonstrated by the students in the subject that is being studied is proportional to the degree to which they are given a real-world application of differential equations. However, these application examples may sometimes be computationally expensive, which in turn causes them to take up a lot of time. However, if these instances can be solved with the assistance of the program me Matlab, they may be included into the instructional process in order to boost the motivation of the students. The use of Matlab is not intended to serve as a replacement for more conventional methods of teaching mathematics. On the other hand, we would want to encourage pupils to be able to solve increasingly difficult tasks as a result of their practice. The Matlab system is not only a tool for eliminating mundane and mechanical computations, but it is primarily used for enhancing students' motivation throughout the process of learning about this thematic unit.

## **MATLAB**

The all-purpose computer program me is known as MATLAB, and it is a product of the Mathworks Company. In addition to having a wide variety of specialized toolboxes, it also functions as the computer algebra system thanks to the symbolic math toolbox that it has. This toolbox is capable of performing symbolic algebraic and mathematical manipulative operations, and it has a large number of built-in interactive features. There is no question that MATLAB is well-liked among computer scientists, scientists from a variety of other fields, engineers, and most especially specialists in the field of computational mathematics. It blends numerical, symbolic, and the most advanced graphic visualization capabilities available today into a computer programming environment that is highly user-friendly.

## **Computer algebra systems, often known as CAS, and their use in the classroom instruction of mathematics**

Computer algebra systems, such as Matlab, are powerful computational and visual tools with a broad range of potential applications in the real world. Both advocates and opponents of using

CAS systems in the teaching of mathematics at the university may be found in this camp. Bernhard Kutzler, who works at the Austrian Centre for Didactics of Computer Algebra, has some really insightful things to say about it: "There are millions of methods, both good and terrible, how to utilize CAS in education. Approaches that are not suitable often originate from technical hobbyists, such as educators who employ CAS just because they are available. However, the CAS should never govern the teaching of mathematics; rather, the teaching of mathematics (the didactic aim) should manage their application. "If CAS application is not pedagogically justified, then it is pedagogically reasonable not to use it," says Helmut Heugl, the head of an Austrian initiative called Derive and TI-89/92.[7]

Systems Calculation assistance systems (CAS) were developed so that humans would no longer have to do tedious, time-consuming, and difficult mathematical tasks in order to get the same or similar outcomes. However, if they are exclusively used for this purpose, then from a pedagogical point of view (when we focus on the growth of students' mathematical education), it is incorrect and inadequate to use them. We are unable to be content with the fact that our pupils are capable of obtaining the outcome by using appropriate mathematical software. Our goal is to guide students to a comprehension of mathematical concepts and then, ultimately, to an application of the information they have acquired in the real world.

As a result, we believe that combining CAS with understanding is the approach that is the most suited. We want our students to be able to handle the subject matter that has been covered in a theoretical manner and to master the fundamentals of how particular exercises should be solved during the initial phase of the educational process. This will assist students in achieving the critical and detached perspective that is required for the appropriate selection of a solution approach as well as the interpretation and assessment of the outcomes that were produced. Mathematical software that is appropriate for the solving of more difficult application problems is only made available to students who have a background in the theory of mathematics. The use of Matlab is not intended to serve as a replacement for more conventional methods of teaching mathematics. On the other hand, we would want to encourage pupils to be able to solve increasingly difficult tasks as a result of their practice. Matlab is equipped with a robust collection of functions that may be used to solve ordinary differential equations. In addition to this, Matlab offers a wide variety of graphical options that may be used into the instructional process. Ordinary differential equations, which are often encountered in engineering practice, are linear differential equations of the  $n$ th order with constant coefficients.[8]

The incorporation of contemporary information technologies into educational settings is not ephemeral in character and entails a great deal more than just blending digital tools with more conventional modes of instruction. Students develop their critical thinking skills and acquire the

ability to keep up with changes in current technology. We have seen that today's pupils have access to the Internet, as well as mobile devices (Android, iPad, and iPhone), tablets, and computers. They have the opportunity to double verify the information that is provided to them while they are in class. Their instructors and parents, for the most part, do not make use of contemporary accomplishments. Our task is to modify the environment in which they were raised, and in a similar vein, we are responsible for the organisations of classrooms.

The fact that mathematics requires Labour at a very abstract level is the primary obstacle faced while attempting to educate students in the subject. The teaching of mathematics in the classroom should achieve a harmonic connection between mathematical facts, skills, conceptual frameworks, methodologies, and general problem-solving procedures. This is not a simple task to do. When one does this, they often find that they have a natural aversion to mathematics since it is such a challenging topic. The difficulty of learning arithmetic begs the question: "Why?" In any event, the teaching of mathematics requires the presence of feedback that is relevant to the activities of each individual student. A computer application that may be used in the classroom setting is known as educational software. There are two primary modes of instruction that may be carried out with the use of computers. [9,10]

1. teaching in which the computer is utilized at every step of the instructional process
2. teaching in which the computer is used in just part of the instructional stages.

In either scenario, the usage of software needs to cover the steps of the instructional process that are outlined below:

- Preparing students;
- Presentation of new content;
- Exercise;
- Repetition;
- Check

Interactivity should be increased in this sort of teaching; the instructor will not only serve as a source of knowledge for the students in the class; rather, their active involvement will assist the students in the process of teaching via resource coordination. This method enables quicker and more effective content transmission. Think, investigate, draw conclusions, and uncover previously unknown ideas. [11,12]

## **OBJECTIVE**

1. To increase one's knowledge of Matlab-Assisted Teaching Concepts
2. To get familiar with the Teaching and Learning Tool.

### *Literature Review*

The Selected Articles and Papers That Were Analyzed, Compiled, and Summarized for This Review of the Literature on MATLAB's Use as a Teaching and Learning Tool for Mathematics The following articles and papers were chosen to be analysed, collected, and summarised for:

#### **Proposals to use MATLAB as a Teaching and Learning Tool for Mathematics**

**Lydia Kontrova, (2020)**This article discusses how the improved and pedagogically defensible implementation of CAS systems (such as the Matlab system) is a significant addition to the field of higher mathematics education. The use of real-world examples into mathematical instruction boosts both students' intrinsic motivation and their interest in the subject matter being covered in class. The Computer Algebra System, more often referred to as CAS, is a cutting-edge piece of computer technology that offers excellent learning and teaching possibilities to a wide range of individuals, including students as well as teachers. The computer algebra system (CAS) known as MATLAB is one of the most extensively used applications in mathematics lecture halls and classrooms, particularly at the university level. It is vital to research and assess how the software may be employed in the teaching and learning of mathematics since its use in education is being adopted by an increasing number of educational institutions, particularly universities. It has been shown that this technology might be used for the development of mathematical thinking, mathematical ideas, and mathematical abilities, as well as a source of motivation for students to acquire mathematics. In the process of teaching and studying mathematics, it is also a very helpful tool for explaining links between a wide variety of fundamental mathematical ideas.[2]

**Arif Khan (2019)**When it comes to computation and simulation, MATLAB is an extremely powerful tool. The fundamental mathematical core underpins high-performance computing by providing many functionalities. In this article, we discuss the many ways in which fundamental mathematical concepts may be acquired via the use of computer technology. MATLAB is a programming environment that is helpful for numerical calculation. MATLAB is a high-level mathematics tool that was developed for the purpose of doing numerical calculations and generating graphics. Additionally, MATLAB is equipped with excellent symbolic math capabilities. Additionally, many learning theories pertinent to the teaching and learning of mathematics using computer technology have been investigated as part of this study. In addition to that, it has contained the propositions in which it has been suggested that the program be used. We are writing this review in the hopes that it may be of some value to anyone who are considering incorporating MATLAB into their mathematics education. MATLAB is used to specifically outline the following topics in basic mathematics: the order of operations, factoring, operations with polynomials, quadratic equations, functions, and systems of linear equations. The purpose of this review was to provide a concise summary of the various applications of the

software, including its use as a tool for visualization, computation, problem-solving, encouraging constructive attitudes and mathematical self-assurance, increasing mathematical motivation and performance, and various projects.[3]

**Alberto Acosta-Lopez (2018)** Using mathematical software tools, the author of this article presents a way for teaching students about complex numbers and the operations that correspond to them. At the beginning of the paper, both the premium program me MATLAB and the open-source software GeoGebra are shown. After that, the author of the paper walks the reader through the process of defining the representations of the fundamental (addition, subtraction, multiplication, and division) and complementary (module and conjugate, roots, and polar form) operations of the numerical system of complex numbers by making use of the two tools and a number of proposed exercises. The fundamental operations include addition, subtraction, multiplication, and division. In conclusion, this section of the study focuses on the features that were evident throughout the construction of the exercises as well as their transcendence in terms of teaching and learning.[4]

**Pantelis Z. Lappas (2018)**The primary purpose of this study is to suggest a pedagogical structure for the subject of Applied Mathematics within the context of higher education. Following an explanation of the architecture of the framework, many examples of using inquiry-based learning to teach numerical analysis and optimization are shown in order to demonstrate the usefulness of the framework that has been offered. The framework is based on the Process of Scientific Inquiry (PoSI), while it consists of three pillars, each of which is characterized by the use of a particular cognitive tool: Algorithm for presenting a list of steps to follow in order to solve a problem, CMAP software for constructing concept maps, and MATLAB software for computer programming. Each of these pillars is characterized by the use of a particular cognitive tool. In addition to this, a WebQuest Scenario can be used as a "auxiliary" cognitive tool by giving students the opportunity to combine technology (such as MATLAB and CMAP software) with educational concepts (such as optimization), and by incorporating inquiry-based learning. In other words, a WebQuest Scenario can act as a "complementary" to a traditional learning environment (i.e., PoSI). The incorporation of these cognitive tools into the design of the proposed didactic framework offers a significant opportunity for the consolidation of information in relation to the solution of complicated numerical problems via the use of effective algorithms.[5]

**M. Abdul Majid (2017)** This review of the relevant literature focuses on the application of MATLAB, a computer algebra system, as a pedagogical instrument for the study of mathematics. Additionally, many learning theories pertinent to the teaching and learning of mathematics using computer technology have been investigated as part of this study. The purpose of this review was



to provide a concise summary of the various applications of the software as a tool, including but not limited to visualization, computation, problem-solving, fostering positive attitudes and mathematical confidence, increasing motivation and mathematical performance, and projects. In addition to that, it has contained the propositions in which it has been suggested that the program be used. We are writing this review with the aim that it may be of some value to individuals who are considering incorporating MATLAB into their mathematics education.[6]

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### **Matlab-Supported Concepts In Education**

Order of Operations in MATLAB: As a first step, and before moving on to the subjects that were described, we teach students how to use MATLAB as a calculator. In addition to that, we start looking at the sequence of the procedures. Our previous experiences have shown that the most effective method for grasping the fundamental concept of MATLAB, known as the sequence of operations, may be accomplished visually inside MATLAB by experimenting with the positions of brackets, powers, multiplication, and division. Following from least significant to most significant, the arithmetic operators are:

- Raise to power (^)
- Division (/)
- Multiplication (\*)
- Subtraction (-)
- Addition (+)

We follow the PEMDAS rule for the order of operations, which goes from left to right as follows: we start by doing things in parentheses, then move on to exponents or powers, then multiplication (from left to right), then division (from left to right), then addition (from left to right), then subtraction (from left to right) (from left to right).

### **Using MATLAB for factoring**

The process of determining the factors is referred to as factoring in the United States and as factorising in the United Kingdom. Determine what should be multiplied together to get the desired phrase. The MATLAB function known as "factor(expression)" is the one that we

employ. Because we are working symbolically, we need to declare the variable that will be used in the "expression" by using the command "syms x." This will allow us to create the x variable.

### **MATLAB operations involving the use of polynomials**

When working in MATLAB, a polynomial is represented as a vector of its coefficients. For example, the representation of the polynomial in MATLAB is as follows:  $p = [1 \ -7 \ 11 \ 0 \ -12]$ . In MATLAB, we may add or remove two polynomials by simply adding or subtracting the coefficient vectors of each of the polynomials. Since both vectors need to have the same length, the one that is shorter needs to have zeros added to it so that they are both the same size. By using the command "conv (polynomial 1, polynomial 2)", MATLAB is able to perform the operation of multiplying polynomials. We are able to do the division by use the command "deconv (polynomial 1, polynomial 2)."

### **Quadratic equations in MATLAB:**

Additionally, higher order equations may be solved by using the "solve('equation')" command. It is often used in the process of solving quadratic equations. The function will provide you the equation's roots to work with. In MATLAB, the "ezplot('function')" command may be used to generate a plot of the quadratic function.

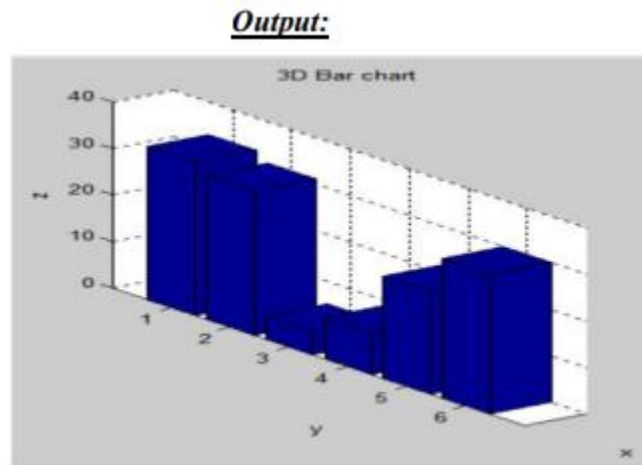
### **MATLAB's built-in functions:**

A function establishes a connection between an input and an output. It is comparable to a machine in that it receives input and produces output. Furthermore, the output is connected to the input in some way. Since functions have been used in mathematics for such a significant amount of time, a huge variety of names for functions as well as several methods of expressing functions have emerged. The "inline" command is what we use in Matlab when we want to express a function. In a same manner, this command must be followed by parentheses and take the following form in order to solve: inline ('function,' 'independent variable of the function'). In MATLAB, a system of linear equations looks like this: By utilising the "solve" command, we may concurrently find solutions to more than one equation. Please take note that the [list of all variables] command must come before the solution command. Creating a Three-Dimensional Bar Graph with MATLAB: Functions and scripts each give their own unique set of instructions that are required for output data calculation. It is quite challenging to interpret bare data, and as a result, we want some way to describe these readings. Plotting instructions for 2D and 3D figures may be found in MATLAB's extensive library (Blaho, Foltin, Fodrek & Murgas, 2012). When producing 3D graphs, you may use the mesh grid command to create a grid for the 3D environment. Students sometimes have trouble grasping the idea of changing the plot properties, which is why they need to learn how to establish a handler for plotting and how to use get and set



commands to change the line colour or type. Changing plot properties is another key body of knowledge. Objects like as buttons, labels, inputs, and check boxes may be used to provide users with no previous MATLAB expertise with the ability to create interactive experiences.[1]

**Example:**Creating a Bar Graph in Three Dimensions



**Figure 1 Script Code: bar graph using the ratio 1:6 and the coordinates 33 31 5 9 22 30 ;  
bar3 (y,z) xlabel('x') ylabel('y') zlabel('z') title: "3D Bar";**

## CONCLUSION

In this discussion, we have walked through the myriad of applications that MATLAB has seen in its role as a teaching and learning tool for the subject of mathematics. It has been used as a tool for the visualization of the graphs of mathematical functions, calculation, problem-solving, encouraging good attitudes toward mathematics, enhancing motivation and self-confidence, and so on. Students were able to get a fundamental understanding of the possibilities of this software package after applying MATLAB to real-world problems. Unlike the majority of free online math tools, which are mainly designed to cater to the fundamental requirements of pupils, MATLAB provides "countless" alternatives, such as the independent generation of functions, great visual solutions, simulations, etc. It has been used as a tool for the visualization of the graphs of mathematical functions, calculation, problem-solving, encouraging good attitudes toward mathematics, enhancing motivation and self-confidence, and so on. A significant majority of studies have employed MATLAB as a complement to the conventional teaching and learning of mathematics. In our future plans, we are going to investigate the performance of students who learn fundamental mathematics using the more conventional method of attending lectures as well as through MATLAB.

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