

## THE IMPACT OF MATHEMATICS IN SCIENCE AND TECHNOLOGY DEVELOPMENT

**Loso Judijanto** \*<sup>1</sup>

IPOSS Jakarta, Indonesia  
[losojudijantobumn@gmail.com](mailto:losojudijantobumn@gmail.com)

**Charisal Matsen A Manu**

Universitas Persatuan Guru 45 NTT, Indonesia  
[manucharisal@gmail.com](mailto:manucharisal@gmail.com)

**Joni Wilson Sitopu**

Universitas Simalungun, Indonesia  
[jwsitopu@gmail.com](mailto:jwsitopu@gmail.com)

**Navel Oktaviandy Mangelep**

Universitas Negeri Manado, Indonesia  
[navelmangelep@unima.ac.id](mailto:navelmangelep@unima.ac.id)

**Alim Hardiansyah**

Universitas Sultan Ageng Tirtayasa, Indonesia  
[alim.hardiansyah@untirta.ac.id](mailto:alim.hardiansyah@untirta.ac.id)

### Abstract

Mathematics is a basic science that is very necessary as a foundation for modern technology and knowledge. Apart from that, Mathematics gives a person high skills in terms of abstraction, problem analysis and logical reasoning. In this way, mathematics functions to help study the natural environment so that it can be developed into technology for the welfare of humanity. This research aims to find out the role of mathematics in science and technology. By using the library study method where data is collected and obtained from various sources. The data source uses secondary data obtained from published scientific journal articles. The conclusion of this research is that mathematics has several important roles in science and technological development, namely mathematics as the language of science, mathematics as logic and deductive in science, mathematics as the basis of programming languages, mathematics can express the position of a point, line, plane or object. which is used to create animated videos, and mathematics as a basis for hardware and software development.

**Keywords:** Role of mathematics, science, technology.

### INTRODUCTION

As world civilization develops, the complexity of life's problems demands human resources who are reliable and able to compete. In the 21st century, it is

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<sup>1</sup> Correspondence author.

predicted that there will be more jobs that require high-level skills involving critical thinking, problem solving, conveying ideas, and effective collaboration (Preparing for 21<sup>st</sup> Century, The Education Imperative, 1997; Sitopu et al., 2024; Tubagus et al., 2023)

Field surveys show a trend towards the importance of basic mathematical skills in the world of work. High school graduate workers with high math skills have better careers and lower unemployment rates than those with low math skills (Laporan Departemen Pendidikan Amerika Serikat dalam *Mathematics Equal Opportunity*, 1997). In another report, it was argued that the use of mathematics in industry is growing rapidly, and mathematicians have contributed to technical excellence and cost savings through ingenious modeling, analysis, and computing (SIAM *Report on Mathematics*, 1995).

The rapid development of science and technology is thanks to the support of mathematics (Nurhayati et al., 2023); (Nurdiana et al., 2023; Haddar et al., 2023; Tuhuteru et al., 2023). The basis of support is due to the strength of mathematics in its structure and reasoning. The development of mathematics often pioneers the possibility of new applications in various other fields of science. On the other hand, the demands of solving problems in various fields of science and technology also encourage the development of mathematics.

Currently, many mathematics graduates work in various fields, such as computers, insurance, banking, aviation technology, production processes, research, planning and development. The profession of lecturer and mathematics teacher also always requires mathematics graduates. The need for Mathematics graduates is also related to the big problems in the world today, namely population explosion, hunger, infectious diseases, energy and environmental crises which increasingly threaten humans. These problems can be solved with mathematical studies such as forming mathematical models and computer simulations. In the future, it is predicted that many more types of work will require the services of mathematicians.

Mathematics is a basic science that is very necessary as a foundation for modern technology and knowledge. Apart from that, Mathematics gives a person high skills in terms of abstraction, problem analysis and logical reasoning. In this way, mathematics functions to help study the natural environment so that it can be developed into technology for the welfare of humanity. Problems that arise in the agricultural, industrial, economic and health sectors can also be solved using mathematical approaches. Nowadays mathematics has developed rapidly, there are various reasons underlying this opinion: 1) The problems in which mathematics is contained have grown increasingly sophisticated; 2) The role of mathematics in the development of the computer world, which includes the need for designing and using computers effectively, efficiently and cheaply; 3) The tendency of the scientific world

to be increasingly quantitative, relying on mathematics. The rapid development in the field of information and communication technology today is based on mathematical developments in the fields of number theory, algebra, analysis, probability theory and discrete mathematics.

## **RESEARCH METHOD**

This research uses a library study method, namely a data collection method sourced from scientific journal articles to solve existing problem formulations (Tahmidaten & Krismanto, 2020).

The research data used is secondary data which discusses mathematics, science and technological developments. Data was obtained from scientific journal articles with published research topics. Data collection techniques use listening, free, involved and note-taking techniques. In this technique, data is obtained by listening to journal articles freely, then recording the keywords that have been obtained and continuing by combining several important words that have been obtained with the researcher's opinion so that a unified idea emerges and then obtains a new concept.

In data analysis techniques, researchers use distributional methods with the steps of classifying, matching, analyzing and drawing conclusions. The data validation technique uses source triangulation techniques which are carried out by collecting data from various sources and then checking it with the researcher's opinion.

## **RESULT AND DISCUSSION**

Mathematics has a part, namely probability. Probability knows how a program should evaluate an outcome. Probability regulates the possibilities with values 0 and 1, where 1 is an event that is certain to occur while 0 is an event that is unlikely to occur. Then there is an algorithm which is a sequence of steps to solve a problem using computer commands with a programming problem. As for calculus, where it is applied in technology, computers usually read data in binary form. Calculus consists of derivatives, integrals, limits and infinite series.

### **Mathematics as the Language of Science**

Without good mathematical provisions, very little modern science can be studied, this is because the basic laws of natural knowledge are expressed in mathematical language. Because mathematics is dynamic in nature, other sciences are increasingly using mathematics. Mathematics is a language that symbolizes a series of meanings from the statements to be conveyed. Mathematical symbols are "artificial" in nature and only have meaning after a meaning is given to them. In mathematics there are many symbols that represent certain meanings that convey certain messages. The language of mathematics becomes a means or tool for studying other sciences. There

is not a single science in this world that does not use mathematics as a language to open the horizons of scientific knowledge.

Since the beginning of human civilization, mathematics has played a very vital role in everyday life. Various forms of symbols are used to assist calculations, measurements, assessments and forecasting. From the discovery of ancient sites, archaeologists have discovered the use of the addition system in Africa, and it is estimated that it has existed since 8,500 BC using bones as a calculation tool.

Even though human civilization is changing rapidly, the field of mathematics continues to be relevant and supports these changes. Mathematics is a very important subject in the education system in all countries in the world. Countries that ignore mathematics education as a top priority will lag behind in all fields, compared to other countries that place mathematics as a very important subject. Students who have good grades in mathematics will usually not have problems if they continue their studies at university, whether in science, engineering or social sciences. In the field of science, of course Mathematics is queen. The education system will not be stable if students at school and students at universities are weak in mastering mathematics (Sri Rahayu, 2017).

The status of ancient mathematicians was high and they were always role models for society. The names of figures such as Al-Khowarismi, Al-Khasi, Euclid, Pascal, Leibnitz, Chebychev, Markov, are some of the names recognized by society in their time until now. Mathematicians have expertise in various fields and are easy to handle and carry out the assigned tasks. We have no doubt that the contribution of Mathematics to the development of Science and Technology is enormous. Boolean Algebra for modern digital computers, Splines for changing 3-dimensional shapes, Fuzzy (electronic equipment, finance, animal husbandry), numerical methods for engineering, Markov chains for finance and economics are some examples of the use of mathematics in the fields of science and technology (Hasia Marto, 2020).

### **Mathematics invites logical thinking**

Logical thinking is a thinking process in drawing conclusions in the form of knowledge based on existing facts by using arguments that are in accordance with the steps in solving the problem until a conclusion is reached (Andriawan, 2014). One of the uses that we often put forward is that mathematics trains people to think logically. In ancient writings, the name "LOGIC" first appeared in CICERO (1st century BC), in the art of debating. Around the beginning of the 3rd century AD ALEXANDER APHRODISIAS was the first person to use the word LOGIC in its current meaning. The application of logic is used as a basis for programming languages, data structures, computational theory, software engineering, expert systems, artificial neural networks and databases.

### **Mathematics: logic and deduction in science**

To find knowledge we must be able to draw conclusions from various statements in the form of agreements or opinions. Formal logic is a field of science that discusses statements or positions in relation to deductive reasoning (Britannica, 1982). Deduction process, namely drawing individual conclusions from general logical statements/framework. The oldest field of science that applies deduction based on formal logic is MATHEMATICS. One that can be used as an example of Euclid's Geometry (Djojinegoro Wardiman, 1999).

### **Mathematics as the basis of programming languages**

Programming languages compose a program in an application, where the programming language controls the computer to carry out its respective tasks. As can be found in the operations of addition, subtraction, multiplication, division, equals, etc. That is an example of the display of symbols in a programming language. The programming language uses mathematical theories such as algebra, sets, functions and mathematical logic (Firdaus, Nashiroh, & Djuniadi, 2020).

Mathematical logic is used in basic programming languages, especially in the process of creating algorithms to solve a problem, so that programming algorithms can be completed. In the field of programming expertise, strong basic mathematical logic skills are needed. For those who are skilled in mathematics, it will be easier to explore the world of video game programming, web design and even the process of developing artificial intelligence (Maulana, 2017).

There are two connections between mathematics and programming languages, namely mathematics can look for rational logical equations which can be translated into computers through programming languages and computers can carry out mathematical rational logic calculations quickly and precisely. The limitations of computers can be overcome with mathematical logic, while mathematical problems can be computerized like counting the amount of sand on a scale (Allen Marga Retta, 2020).

Information theory is a scientific discipline in the field of applied mathematics that is concerned with the quantization of data or information that can be stored and transmitted without error through a communication channel. The implementation of this theory has a direct impact on space missions, understanding of black holes in galaxies, with computer networks, internet networks, and mobile phone networks. Specifically, information theory is a branch of probability mathematics and statistics, which is related to the concepts of information and information entropy (Anwar, 2018).

### **Mathematics can express the position of a point, line, plane, or object**

The mathematical science applied to express the position of a point, line, plane or object is a matrix, especially the science of geometric transformations. Where in the science of geometric transformations there are translations, rotations and dilations. For example, in animated videos, the processing of objects in the video is done by

determining the coordinates of each object, applying translation to move, and dilation to determine the size of the object, and rotation to rotate. In applying the science of geometric transformations, computers can do it quickly so that when using a computer, there are mathematical operations that are running quickly (Dwi Novita Sari & Dian Armanto, 2022).

### **Mathematics as a basis for hardware and software development**

In technological developments, especially in information and communication technology, there is hardware and software. Hardware is a variety of tools found on a computer that can be seen by the sense of sight so that it can be felt directly physically. Hardware is the physical equipment on a computer that plays a role in the input and output processes. Hardware and software are related, where the software itself functions to manage the hardware on the computer. In operation, hardware and software also require mathematics because mathematics plays a role in computers, especially in processor development. Where mathematical operations on the processor are used to carry out commands originating from the user. The processor itself continues to develop to carry out commands quickly so that the work produced is more efficient (Amin Akbar & Nia Noviani, 2019).

### **CONCLUSION**

Current technological developments cannot be separated from mathematics. Because technology requires mathematical knowledge to carry out operations and mathematics has an important role in the development of science and technology, namely:

1. Mathematics as the Language of Science
2. Mathematics: logic and deduction in science
3. Mathematics as the basis of programming languages
4. Mathematics can express the position of a point, line, plane, or object used to make animated videos
5. Mathematics as a basis for hardware and software development

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