THE N[illegible]ERIAN [illegible] EDUC[illegible]ON

A JOURNAL OF THE INSTITUTE OF
ECUMENICAL EDUCATION THINKERS
CORNER, ENUGU

VOL. 2, No. 1 APRIL 2002.

A JOURNAL OF THE INSTITUTE OF ECUMENICAL EDUCATION THINKERS CORNER, ENUGU

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CONTENTS

IMPLICATION OF MATHEMATICS AS A NECESSARY LANGUAGE OF NATURE.

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Abstract

A descriptive study (research) was conducted last year 2001 to find out the extent the students in Secondary Schools appreciate School's mathematics as 'real' subject for understanding of nature.

They were asked whether a good knowledge of mathematics (mathematical concepts) can enhance one's ability to achieve skills in medicine and surgery, in astronomy, in geology in Engineering even in English and other languages.

300 students from SIX secondary schools in Udi Education zone were used, 200 of them representing 67% do not think that Maths has any relevance to those areas mentioned above. Only 80 students representing 26.7% were convinced that Maths is related to the subjects as above. While 6.3% felt indifferent.

Therefore, the purpose of this research was to expose students and student teachers of the relevance of Maths as a necessary language (in connection) to all that is in nature.

Introduction

From century to century and from generations to generations many scientists thought about, and made frantic efforts in defining or rather explaining what mathematics is or what it ought to be. Some saw it as a process of determining quantities and of estimating values (Diophantus, 630AD, Format 1818, Rolle 1850).

Others explained it as a science of space and number and viewed it's broadness as necessary large and unrestricting (Desecrate 1920, Kepling 1925).

Some astronomers and earth scientists felt that the subject mathematics deals with the properties of projectorics forecasting, prediction, formatting, measuring dissecting, counting, relationship and gesticulation of matter in where ever place and position they appear (Alven, 1951, Appolo 1969, Collins 1970).

Yet some others believed that mathematics is a scientific art of initiating changes in space using quantities of varied cultures. This art of changing involves transformations, combinations, connections, projections, oppositions, transpositions and cancellations in relations and non-relations. (Mohambled of Kharwanz 415AD, Boole 1910, Egisten 1946). Looking at the spectrum of mathematics and its roles in scientific development the author is convinced that the last explanation seems the one that is closely related to what mathematics ought to be. Many scholars believe that the role played by mathematics makes the subject a pivot of other sciences or the gateway for other study areas in life beginning with Philosophy and ending at the new genetic engineering.

Mathematics is viewed as unending activities without restrictions. All the interrelationships and combination of ideas for decisions as involved in an adult functional life and his practical use of numbers for domestic and business endeavours are aspects of his mathematical knowledge. Children as well as adults, working independently as well as in-group are mathematically encouraged by nature to experiment, to measure, to guess, to feel their way and conjuncture. The life in mathematics encourages one to refute and to play, so as to gain mathematical knowledge and acquire attitudes, modes of thought and working forms such as curiosity and problem solving ability. Mathematical conjures obtained by induction from a number of instances, are accepted just as results obtained by deduction and proof.

Mathematics as a culture has afforded man the opportunity to know and assess things and objects within his immediate and remote environment. A disciplined and ordered pattern of life is gained through the culture of Maths. The usefulness of repeated observations in making inquires, the hypothetical format in relating with people, and in linking one idea to another are all aspect of mathematical communication of human culture. Approaching problems through short cuts,' applying precise models in solving human problems and identifying simple, concise ideas amidst a pool of ideas and ideologies is purely mathematical. The man's ability to graduate from a random thought process, trial and error method, guess work approach of solving problems to a systematic, objective oriented and analytic procedure of problem solving in the modern times is evident that mathematics is communicating the culture of man.

From the evolution of science in the 17th century mathematics has evolved from disjointed study of natural phenomena like in earth measure (Geometry), triganglic measure (trigonometry) the study of heavenly bodies (astrology), Science of life uncertainties (probability) study of relationship or mapping (functions) to themes involving projectorics, space functions and spatial constructions and utilities of numbers.

Today in the 21st Century mathematics has become the Central focus of all-scientific investigations and Studies. Mathematics is the only language of culture common to all studies involving human developments.

1.2 Definition of Language

Language according to sturtevant in Ijeoma (1988) is a system of arbitrary vocal symbols by which members of a social group co-operate and interact. In a more encompassing sense it is any set or system of symbols or gestures used to express meaning. Human language serves to externalize thought processes. The only way to pin down a thought before it slips away is to translate it into language using diagrams, symbols, words etc. Language, therefore gives man the ability to organize thoughts and thus enables him to collect, sort, relate and record ideas. It is made up of a complex inventory of all the ideas, interests and occupations that take up the attention of a society. It could be observed that language reflects the physical and social environment of the people. It involves both the visible and the invisible environment of a human society.

According to the stecoing (1975), language is an aspect of culture. It is common to all human societies. Its functions include: identifying wants and needs; facilitating the acquisition and exchange of information and ideas; a means of self-identification, a means of social interaction; a means of expressing feelings and emotions; and a basis for reflective critical and creative thinking. Ijeoma further emphasized that language becomes in effect what unites firmly the personal reactions of the individual and the verbal symbols of communication with others. It is a social function that permits the individual to become an interacting member of the society. It gives clear expression to the culture of a people.

Language is a sine qua non skill for intellectual development. Uno (1982) sees the intellectual development as one characterized by the qualitative and quantitative expansion of knowledge or the expansion of the frontiers of learning. These learning situations are categorized as rational, associational and appreciational learning. Language plays a very important role in the development of these learning situations. For instance, national learning involves the process of abstraction by which concepts are formed, and it demands the interpretation and comprehension of the specialized vocabularies of the various fields of learning. It also involves the exercise of judgement and reasoning abilities as well as the comparison, identification, discrimination, discernment and mental integration of ideas and facts. Furthermore, it is concerned with the analysis of casual relationships with drawing of valid inference, with mental problem solving as well as with the rational integration of new knowledge with previously acquired knowledge.

Associational learning involves the development of *associative chains or mental pattern by which facts, information* and experiences are retained, recalled and recognized through the process of linking them together or establishing relationships between or among them. And the appreciational learning situation involves the process of acquiring attitudes, ideals, satisfactions, judgement and knowledge concerning values.

In evaluating language in terms of mathematical symbols and development of human mind and human thought processes, Egoun (1988) said that language has been described as an arbitrary code of symbols by which people communicate with each other, interact and co-operate. Language is vital to the development of the human mind and the thought processes, for without language there would be no thought and without thought there would be no human mind. This nature of language is that which mathematics offered to the modern society as language of nature.

2.1 Some aspects of Mathematical Communications

One of the major objectives of schools mathematics is to enhance the understanding of basic concepts, principles and laws of mathematics to foster an attitude that can encourage the use of mathematics in application to daily life problems; to cultivate mathematics thinking, precise and logical reasoning (UNESCO, 1990). The use of photography and pictograms in mathematics textbooks of our school not only enhances aesthetic utility of mathematics but also serve as a powerful means of communication. It is especially useful in visualisations in spatial geometry and at times might even be helpful in the presentation of some unusual algorithms. According to Zawadowski (1992) it is easier to introduce and explain mathematics once a problem is clearly visualised by photography. The use of words to describe spatial relations is clumsy; a photograph gives an impression of something authentic or real even if it is infact an abstract construct of the viewer. Such an approach could also be helpful in arguing for instance that the usual analytic definition given on the plane is equivalent to the spatial one, using plane cuts of cylinder by Nandelin's spheres.

In the early 1970s education world over experience the apogee of modern mathematics teaching and learning. This was characterized by the wish to build school mathematics on the solid foundations of sets and on systematic logical education, spelling out all the details explicitly and giving the receiver little room for his own intention but today there is now a growing number of teachers and educators of a post – modern persuasion. Here post modern implies less emphasis on formal vigour, more on visual representation and the overt use of pictures in communicating mathematics. Post modern school mathematics is much more linked to personal experiences (Zawadowski, 1992). The inclusion of computer science programs and computer-aided instructions in the teaching and learning of mathematics made the application of mathematics in today's world a viable means of communication in social engineering. This new approach to the utility of mathematical concepts makes mathematics quartile the basic language for development of the human society in the technological age. In discussing the agenda of the school mathematics for the 3rd millennium, the National Council of Teachers of Mathematics of the USA, NCTM (1980) said that problems solving should be the focus of mathematics learning. Moreso, that the concept of basic skills in mathematics must encompass more than computational facility. That it must involve a wider range of measure than conventional modes of calculating, proving constructing graphs and engaging in measurations. It must get into high level of professionalism, solving individuals as well as society's problems in an efficient flexible and dynamic manner.

The 3rd millennium calls for a desire to emphasize the structural aspects of mathematics to follow the economic plans and policies of international organisations like the Organisation for Europe Economic Co-operation (OEEC) the Economic Community for West Africa States (ECOWAS), North Atlantic Treaty Organisation (NATO) and *et cetra.*

2.2 Role of Maths

Considering the role of mathematics for the new millennium, the Federal Republic of Germany decreed in August 1972 that mathematics in schools should provoke three reactions: first projektorien tierter mathematickum (project oriented mathematics), this should be characterized by interdisciplinary subjects and students self determination of themes, and methods in relation to the every day word (Munrigner 1977). The second is prasisorientierter mathematikum (practically Oriented mathematics). This emphasizes the use of mathematics as a tool for every day life and as a method of solving real life situations (Grumman 1977). The third reaction is Anwenduoh orientierter. The aim of this mathematics learning is individual's prominence. Its relevance is the applications of relationships with the environment and the use of computer science.

This German mathematics programme was exactly what Nigeria's mathematics curriculum planners designed in the 6-3-3-4 education system of the 1980s for the 21^{st} century mathematics, objective of mathematics study, which is practical, applicational and project oriented with thematic instructional approach. In Italy the story is the same, the mathematics of the 3^{rd} millennium is one with the growing influence of society, essentially based on the use of machines. For Montaldo (1992).

Now is the era of the computer when society relies very heavily on information, using those most precious of human resources, the individual conscience intelligence and creative capacity. People use computer as providing a strong stimulus especially for interdisciplinary work. In the Scandinavian countries of Poland and Newmark mathematics has turned a viable tool for social engineering and high level development in the society. On this Niss (1992) said that mathematics in the new millennium is highly meaningful in a social context and within some kind of structural and institutional framework.

2.2 Mathematical analysis for the modern Society

The needs of science and industry in a deeper understanding and exploration of phenomena of nature led to the investigation of processes and motions in the real world. This development was first of all connected with studying physical phenomena. Since their quantitative of describing interrelations between the variations of the quantities involved (Bermant, 1975). The main object in mathematical analysis is the study of variables and their relationships. This is closely related to the study made by Nescarte (1927) of relationships between algebraic and geometric methods in analytic geometry. It is also connected to the mathematical analysis of differential and integral calculus.

Newton (1720). The fundamental idea of mathematical analysis is centered around the concept of functions of variables or the relationships of variables or the mapping of variables. It is in this function that the language of mathematics is found. The basic concept that explains this function is magnitude. According to Aramanovich (1975), "we regard as scalar magnitude everything that can be measured and expressed by a number." In concrete problems of natural, technical, and behavioral sciences we encounter magnitudes of different types. For instance, scalar magnitudes are length, area, volume, mass, temperature and so on. Mathematics communicates on vector quantities such as force, velocity, acceleration, (that which makes an objection rest to move or stops an object retardation and so on). This language begins in stating mathematical propositions and laws the concrete physical nature of the magnitude involved. are abstracted while the numerical values are considered. According to Bermant (1975) mathematics deals with a general notion of a magnitude without considering its physical meaning. This fundamental feature of mathematics abstractness is extremely important since it makes it possible to apply mathematical methods to various kinds of activity and phenomena and provides its generality and universality. The abstractness of mathematics is a powerful tool in practical work and has nothing in common with the indifference to reality.

Within the context of a problem, some magnitude changes while others remain invariable. Those that change are said to assume different numerical values called variables. And those invariable magnitudes retain one and the same value and therefore are called constants. But variation is one of the most important features characterizing a motion or a process. An industrial process (a natural phenomenon) is usually observed as a variation of some magnitudes involved which is produced by the change of the others. Let us take some instances. If the volume of a mass of gas kept at a constant temperature varies its pressure also undergoes a variation. Also in a free fall of a body (in Vacuum) under the action of gravity we observe the variation the velocity of motion as the distance between the body and its initial position changes and also the variation of this distance and of the velocity of motion in time. At the same time the acceleration of gravity remains constant at any time moment along the whole path. From quantitative point of view, every process is characterized by a mutual variation of a number of magnitudes. This leads to the most important mathematical concept of a functional relationship, ie to the idea of an interconnection between variables. According to vygosky (1968) the main purpose of a natural or technical science is to establish the relationships between the variables involved in the process under consideration and to describe it mathematically. In his own analysis, Aramanovich (1975) believed that the law of a process is nothing but a functional relationship observed in this process and characterizing it. For instance, the functional relationship between the pressure (p) and the volume (v) of a mass of gas having a constant temperature is described by the equality $P = \frac{K}{V}$ where K is a constant and expresses the general law which the gases obey in the corresponding circumstances. The law can be verbally stated as: the gas pressure at a constant temperature inversely proportional to the volume. Moreso, the functional relationship between the path length(s) covered by a freely falling body in vacuum and the time taken (t) is described by the formula $S= 1/22t^2$ where g is the acceleration of gravity and expresses the general law of free fall. Hence the basic and the most important aim of mathematical analysis is to provide a thorough investigation (language) of functional relationships.

3.1 Natural Analysis of Mathematical Language

In analysing mathematical language naturally, the author wishes to call up the relevance of mathematical models in doing a multiple work in the modern times. Real mathematics teachers especially at the post primary school level are always in search of interesting ways of showing the use of mathematics or how the knowledge of school mathematics is applied. This is often done in order to infuse the feelings of real – world relevance into the subject – mathematics. According to Williams (1971), very simple applications, especially if they are novel or varied in their scope, are a strong aid to a teacher in maintaining interest among students who do foresee careers in mathematics, engineering, or physical sciences. As a matter of fact many interesting and easy to follow applications of plane geometry and plane trigonometry are used by practicing plastic and re-constructive surgeons in their medical practices. According to a medical consultant fleming (1971), "I would like to pass on a few "Scar revision" techniques that have come to my attention in the hope that the reader will find them interesting and unique addition to his or her repertoine of motivational materials used in the mathematics classrooms. We shall discuss as our first example the use of mathematical models in plastic surgery. Here the only necessary background for following the procedures here is an indept under standing of right – triangle trigonometry.

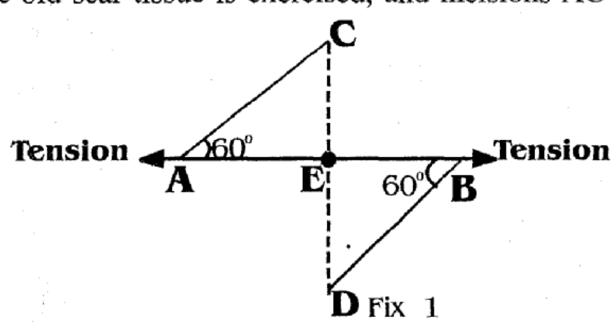
Let us therefore produce the maths models as they appear in medicine and surgery.

3.2 The Z – Plasty Revision

Frequently scars occur on areas of the body in such a way that the underlying muscle – tissue structure in that area creates tension along the line or axis of the scar. Causing the scar tissue to puff up and discolor. Examples of this type of scar are burn scars, vertical lacerations on the back of the neck, or scars on the inside or outside of the bend of the elbow or knee. The plastic surgeon, in revising such scars, desires to exercise the old scar tissue and suture the surrounding skin back together in such a way as to relieve the tension along the axis of the old scar. A technique called the "Z- plasty revision" is often used for this purpose and is an interesting application of simple plane geometry and trigonometry.

Suppose that AB is an unsightly scar such that the underlying muscle structure caused tension forces on the scar directed along AB, as shown in figure I.

The old scar tissue is exercised, and incisions AC and BD



Fix 1

are made such that angle CAB and angle ABD are each approximately 60°, CD is perpendicular to AB, and E is the midpoint of AB. There will then be two flaps of skin CAB. In suturing the flaps back together a transposition of the flaps is made. Tip A is moved (or stretched) over to point D, and the upper edge of AB is sutured along DB. Tip B is moved over to point C, and the lower edge of DB and AC are seven together. The resulting configuration is as shown in figure 2, where the unprimed letters refer to the points as shown in figure I and the primed letters refer to the transformed positions of points.

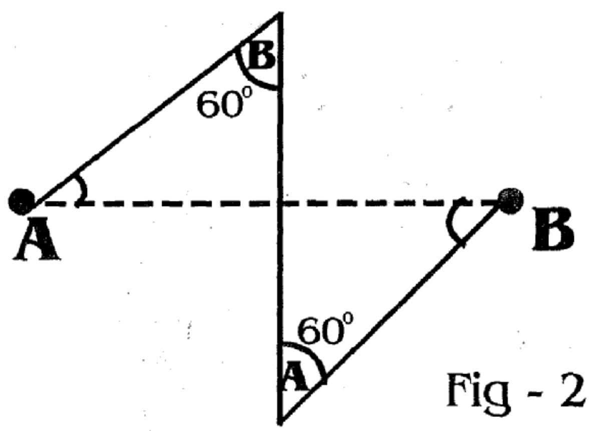


Fig - 2

If the operation is properly performed, the angles at A' and B' will remain approximately 60° (perhaps slightly more due to stretching) and segment AC and BD will remain approximately the same length as prior to the operation.

In figure I, AB = AC = BD. In figure 2,

$AE = AC\ \text{Sin}\ 60^\circ = \frac{3}{2}\ AC$ and

$$EB = BD \sin 60^{\circ} = \frac{3}{2} \quad BD$$

$$\mathbf{AB = \frac{AE}{2} + EB = \frac{3}{2} \quad AC + 3 \quad BD}$$

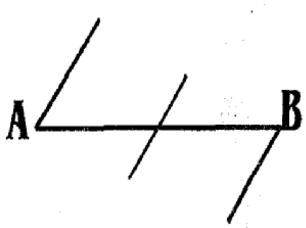
$$= 3 \ AC = 1.73 \ AC$$

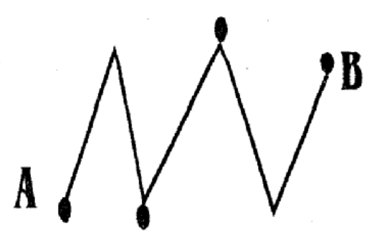
The distance between A and B is altered by this operation by a factor of approximately 1.73 or a 73% increase.

The beneficial effects of this procedure on a patient are derived from essentially three features.

1. The old Scar tissue excised and the skin tissue is carefully and skillfully rejoined.
2. As is shown is figure 2, the revised Scars do not run parallel to the muscle tension lines but rather are oblique to them, thus allowing the skin in the area to give or relax with the tension exerted by the muscle structure.
3. The distance between A and B has increased, thus relieving some of the tension from A and B physiologically, the trick that has been used to achieve this effect to borrow skin tissue from the vertical direction, where there is minimal muscle tension, and to re-channel this borrowed tissue to the horizontal direction, where tension is maximal.

For long Scars of this type, a multiple Z – revision is frequently used. The procedure is illustrated in figure 3. It can be seen that this procedure consists of a sequence of Z – plasty incisions as illustrated in figures 1 and 2.





Incision pattern fig. 3. Revised pattern.

Incision pattern **fig. 3.** **Revised pattern.**

3.3 The W – Plasty Revision

There are other Scars encountered that are unsightly because the underlying muscle – tissue structure causes tension forces perpendicular to the line of the Scar. This caused spreading and discoloration. Examples of this are horizontal cheek Scars and vertical forehead Scars. A "W – plasty revision" is frequently used effectively to improve such a situation.

If AP is a Scar with muscle – tension forces T directed approximately normal (perpendicular) to AP, incisions are made as shown in figure 4 and the tissue interior to the incisions is excised, which removes the old scar tissue as well as some surrounding tissue. The tissue then sutured back together with no transpositions; that is, B and B', C and C,' and D and D' are brought together. The desired or suggested angle of inclination of the incisions with the
line of A B is approximately 60°, as shown.

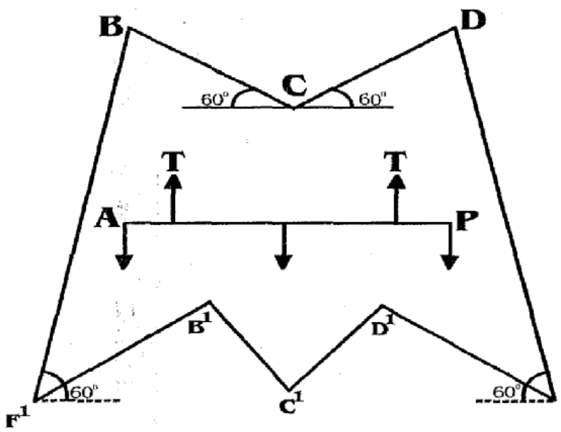
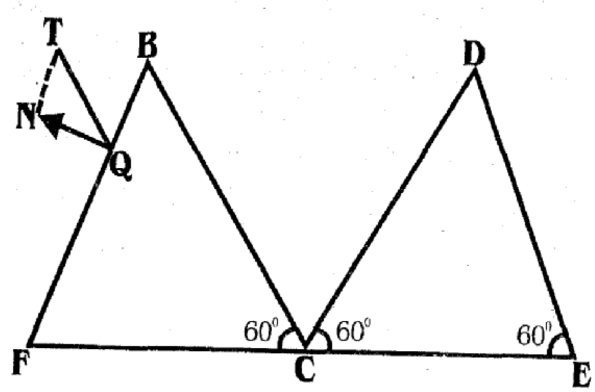


Fig: 4

The revised Scar is as shown in figure 5. The beneficial effects on the patient of this procedure are:

1. The revised Scar exhibits an " accordion effect" due to the provides sufficient resiliency to absorb normal tensions.

2. At any point Q on the revised Scar of figure 5, the component N of the tension force T which is normal to the revised Scar is now



Fig, 5

This may be compared to figure 4, in which the tension force normal to the Scar at any point was T. Thus a reduction of approximately 50% in normal tension forces on the Scar has been achieved through the use of this procedure.

For revision of long thin Scars, the W plasty is often used in sequence (as in the case with the Z plasty), creating a string of Ws in the final result.

3.4 Other Revisions

Several other Scar revision patterns are suggested in textbooks on the subject; however, they are not used with much frequency. None of these involve transpositions as does the Z plasty. They are thus similar in nature to the W plasty. Three such patterns are shown in figure 6.

It should be noted that the models described here and most of those described in plastic-surgery literature are plane geometry models. Obviously the anatomy of the human body is such that in actual practice one would never encounter truly planar areas but would in fact be dealing with some type of smooth manifold or surface. These models from a continuum mechanics standpoint, assume that within the region under consideration the stress – strain responses of the skin are homogeneous, elastic, and isotropic.

Again, however, these appear to be reasonable assumptions for producing an illustrative model to approximate the real-world conditions. According to Borges (1962), textbooks and journals of plastic and re-constructive surge often show both preoperative and postoperative photographs of clinical procedures of the types described, confirming in most cases very dramatic and pleasing results from these techniques. And it is important to note that Furnas (1965) has suggested the use of three dimensional Z – plasty procedures and has outlined the underlying geometry as well as the clinical significance of such procedures.

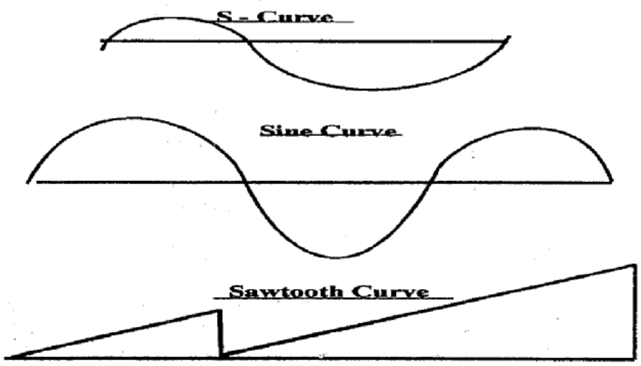


Fig. 6

3.5 Maths & Aviation

The Science of aviation discovered by a Russian Scientist, Professor Zhukovsky by means of mathematical methods and laws which enabled him to predict the possibility of aerobatics and in particular of looping the loop. Soon the loop was performed by a Russian pilot Captain Nesterov. Hence the possibility of looping the loop was thus discovered mathematically before it was realised physically (Aramanovich, 1975).

3.6 Maths & Solar System

In another instance a French astronomer Leverrier studied planetary motion in the solar system by applying the laws of classical – mechanics expressed in the form of some known functional relationships. He discovered a discrepancy between the theoretical results and real observation. He then discovered that the discrepancy can be eliminated of the existence of an unknown planet processing a certain mass and moving in a certain orbit is assumed.

Soon this new planet (Neptune) was in fact found in 1846, exactly the time and position predicted by Leverrier who thus discovered a new heavenly body by means of calculations made on a piece of paper at his desk (Bermant, 1975). Today predictions in sciences are based on techniques of mathematics and mathematical analysis through our knowledge of objective laws of reality.

4.0 Conclusion

As we enter the 3rd millennium, mathematics has increased its role in connection with the development of modern high – speed electronic computers that guarantees the realization of space flights, launching rockets to other planets, and establishing radio and television communication networks.

Finally, in the words of Bermant (1975) it can be asserted without exaggeration that no modern scientific and technical project can be realised without resorting to mathematics and its methods.

As the language of nature, mathematics and mathematical analysis have become project oriented. Mathematics uses magnitude and or process with different numerical values to convert general law of nature in physical fascinating realities of the technological age.

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