THE TEACHING AND LEARNING OF TRIGONOMETRY IN TERTIARY EDUCATIONS

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ABSTRACT

Trigonometry is an important part of mathematics at high school, college and university. Trigonometry is a subject that many university students find it difficult because it is not offered in depth in the high school to the extent that algebra and geometry were taught. The teaching professionals often said that the tertiary students' knowledge about trigonometry was quite poor based on the assessments given to them. It has been observed that some of the elementary concepts of trigonometry are more easily comprehended than much of the usual work in algebra. The authors also believe that the teaching of trigonometry has to be developed from the meaning of the trigonometry functions as ratios (measurement of angles and sides of right angle triangles) and as number (compute the numerical value of the ratios representing different functions). Students should be acquainted with meanings of the tangents ration, the sine ratio, cosine ration and also terms as "angle of elevation" and "angle of depression". Trigonometric functions appear to be difficult for the students due to the fact that their meanings have not been adequately explained. Therefore in this paper the authors want discuss further on how and what to be taught from trigonometric for the beginners in tertiary level.This paper suggests some of the avenues for exploration.

Introduction

The advent of the senior secondary system has gone a long way in dispelling the restricted view of the trigonometric subject. There has come about the realization that, while certain parts of trigonometric indeed difficult and suitable only for mature students, there is much, on the other hand, which is quite simple and easily understood by students of senior secondary stage. It has been observed that some of the elementary concepts of trigonometry are more easily comprehended than much of the usual work in algebra. Also the application of these principles is quite interesting to the pupils in the final years of the secondary school. Such application offers an excellent means of correlating arithmetic with certain parts informal geometry and with the solution of the simple linear equations.

From my observation of the Malaysian students in first semester in tertiary education, they find that the trigonometry subject is difficult because they are given choice to choose for the best subject that they could answer in Mathematics. Students have been prepared or trained not to answer trigonometric questions as they find it difficult. These students fail to empower this subject in the tertiary education as well because their knowledge on this subject and their perception of this subject is negative. The first action to be taken is to identify what parts of trigonometry should be taught. The parts to be included must find their justification in the direct contribution which they can make to the goals of general education at this level.

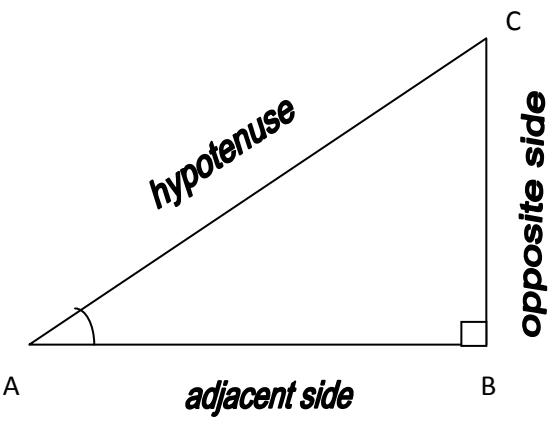
As for the beginning, the best way to accomplish clear meaning of trigonometric is to ask students make careful measurements of the angle and sides of the right angle triangle. In the process of learning trigonometry students are eager to know the meaning of the terms. The early introduction and simple treatment of these aspects of trigonometry maybe expected to have considerable influence in removing the reluctance of students to undertake later the systematic of the subject.

Why trigonometric is important in tertiary education?

Trigonometry is an important subject as it has strong relation with all discipline in tertiary education. Scientific fields that make use of trigonometry areacoustics, architecture, astronomy (and hence navigation, on the oceans, in aircraft, and in space; in this connection, see great circle distance), biology, cartography, chemistry, civil engineering, computer graphics, geophysics, crystallography, economics (in particular in analysis of financial markets), electrical engineering, electronics, land surveying and geodesy, many physical sciences, mechanical engineering, machining, medical imaging (CAT scans and ultrasound), meteorology, music theory, number theory (including cryptography), oceanography, optics, pharmacology, phonetics, probability theory, psychology, seismology, statistics, and visual perception, education.

Trigonometry is used in engineering to design buildings, cars, ships, and planes. In physics it is used to calculate the properties of electric and magnetic fields. It is used in navigation, and projectile motion. It is also used in the design of musical chords and instruments, as well as lenses and optics. These describes well how important is trigonometry in tertiary education as we produce engineers.

Traditionally trigonometry is taught by introducing the property of triangle. Students have to be clear of the meaning for Tangent, Cosine and Sine in order to learn trigonometry.

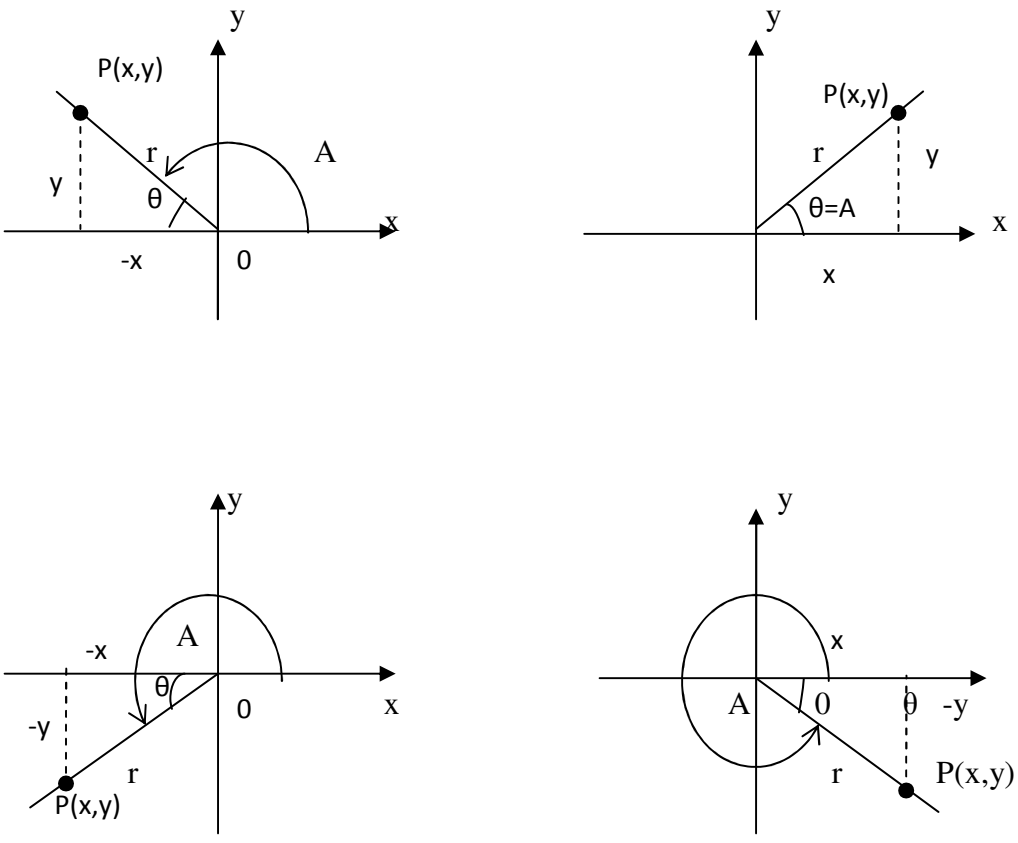


Some measurements and reading on the sides of right angle triangle that contains acute angle between the sides will give them the clear definition that it is the ratio. After having learnt the meaning of the sine, cosine and tangent the students should have no difficulties to define secant, cosecant and cotangent. At this stage the students are curious to know what the prefix "Co" stands for is. Students are rarely explained with all this terms so it is difficult to make them

understand as they have lost their interest to learn trigonometry. It should be explained that the cosine of an angle is the sine of the complementary angle which is the other acute angle in the right angle triangle and that in the word cosine, "co" stands for 'complement'. This is proved from finding of the ratio of the sides. If sine, cosine, tangent, cotangent, secant and cosecant are written in that order, it is apparent that the two functions joined are the reciprocals of each other. The device specifies and emphasizes the reciprocal relationships.

What part of trigonometry should be taught?

In tertiary education I still found some students who are confused with the inverse trigonometry notation and the complementary trigonometry function. For example $\sin^{-1}$ and cosecant where in trigonometry cosine is $\frac{1}{\sin}$ and in algebraic equation, $\frac{1}{x}$ can be written as x^{-1} .Students will not make mistake if they understand all the trigonometry terms. A most effective device for studying the functions of 0 and 90 degrees is the unit circle. Exact values of these special angles that are 30, 45 and 60 degrees can be listed in a table and except for infinity value; others can be easily converted to decimals. To explain the transformation of special angles into the functions of general angle, let A be the given angle in standard position as in the diagram below..



If any point P(x,y) is taken on the terminal side of angle A, and a perpendicular is dropped on the X-axis, there will be formed a right angle triangle which is called the triangle of reference. The values of the trigonometry functions of A will be determined by the length of the sides of its triangle which are respectively x, y and r.

Teaching the use of trigonometry function

As soon as a student learn how to comprehend the meaning of tangent ratio, students should be thought how to find distance by indirect measurement by the given angles of elevation, angle of depression and also by applying solutions of triangle to find height or distance. Though less known, there are many interesting application of trigonometry in engineering, astronomy, geology, navigation and aviation. Students should know this in order to have their interest to learn trigonometry. Following are examples of formulas in engineering that involves trigonometry.

1. For a coil rotating uniformly in a magnetic field, the instantaneous induced voltage (E) is given by the formula $E_i = E_m \sin\theta$ where E_M is the maximum voltage and θ is the phase angle and $i = \frac{Hr}{2\pi n}\tan\theta$
2. The index of reflection of light, n, is given by the formula $n = \frac{\sin i}{\sin r}$

Similarly, the motion of projectiles is another general problem involving trigonometric formulas. By illustrating all kind of formulas and discipline that involves trigonometry rarely fail to increase the interest of learning the subject. These will not only enhance the interest of learning to students but also broaden teacher's horizon add zest to his/her teaching.

In this era of modern technologies, computation of trigonometric function is not complicated anymore with the existence of computer and scientific calculators that provide built-in trigonometric function for any angle. Modern computers and calculators use a variety of techniques to provide trigonometric function values on demand for arbitrary angles (Kantabutra, 1996). Mathlab, TI-Inspire graphic calculator**, Cordic(Coordinate Rotation Digital Rotation) used to calculate hyperbolic and trigonometric functions**, and C++ programming which is identified to be a fast way to compute trigonometry function and etc.

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