Student's Mistakes and Misconceptions on Teaching of Trigonometry

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Abstract: Trigonometry is an unseparable part of mathematics in high school.It takes some subjects of arithmetics and geometry as any source.In other words,it is a product of algebraic techniques,geometrical realities and trigonometric relationships.

For most of the students in higher education,it is necessary the analytical part of trigonometry.Namely,the trigonometry of the numbers is more important than the other subjects.Creativeness and understanding of its foundations are important on development of the notions and methods on trigonometry.

As it is generally to be in teaching of mathematics,if the principles of development of notions and methods on trigonometry would put forward,it would find the tricks which make easy to learn.

The aim of this study is to investigate the levels of learning on the subject of trigonometry and mistakes and misconceptions on trigonometry.The research-pattern is totaly 77 students that are from one class of any high school and one class of science high school in Eskişehir-Turkey, both of which are 10th grades.The research data were obtained from the exam which consists 15 questions.It stands on four questions which select from 15 questions in this study.

According to the findings,it is confirm that students' mistakes are very systematically.It was seen that the subject of trigonometry stands on the level of establishment of relationships between the angles and triangles.At this position,it is unavoidable to obtain some cautions at the studies that happens later.

Introduction:

Mathematics education is based on problem –solving,application of knowledge and manipulations problems and when the students meet word-problems,their non-systematical and uncompleted knowledges cause faults and conceptual mistakes.

Generally when developing the problems,analysing the problems,explaining the results and confirming processes aren't comprehended well,students go away from creativeness and are directed to learn by heart.For this reason,teachers' education is very important.Field-knowledge and pedagogical knowledge of the teachers play important role on teaching (Cochran,et,al.,1993).Recent researches have developed the widespread misunderstandings of the students on many subjects.

The aim of this study is to investigate the widespread misunderstanding on trigonometry of the students.

Trigonometry is unseparable part of Mathematics in high school.It takes some topics from arithmetic and geometry as sources.Trigonometry is unit in which algebraic techniques,geometrical realities and trigonometric relations come together.Development of trigonometric functions are based on some concept in analysis(Gillman,1991).

Meanings of ratios between the edges of right triangle,ratios of sine,cosine,tangent,in trigonometry are taught in secondary school,but the teaching of trigonometry in secondary school is limited to obtain these ratios for any special angle.The teaching of trigonometry in high schools needs more detail.Although,fundamental changes in the nature of trigonometry are made in the modern Mathematics education after the 60's,Mathematic teachers,still,continue traditional methodology.From this point of view,there are instructional problems with teachers.This manner causes to remove students from fundamental concepts and thinking which have to be acquired in trigonometry.The trend of paying attention to teachers' knowledge of mathematics topics and the nature of mathematics has been triggered in part by the need to improve the quality of teacher education.In several countries,the need to improve mathematics teacher education is also made more urgent by introduction of new mathematics curricula (Jong and Brinkman,1997).This is particularly important.Because teacher education programmes can not only prepare teachers to teach all student but also continue to push the boundaries on what teaching might look like (Barton,2000).In the past,traditional ability to manipulate in trigonometric relations were considered important.Besides,the importance to be developed student's ability in this field have been examined(Kieran,1994).

Usually,serious misconceptions can arise when students are introduced to new mathematical meanings.This may be that they are not so ready to exploit the new mathematical meanings or this may be that the new mathematical meanings are so abstract.In order to avoid serious misconceptions assess student's understanding of new concepts by observing their own use of the terminology(Lansdell,1999).

It has been noticed that the knowledge of trigonometry which is needed to be successful in calculus through the first year in the university is insufficient.Analytical part of trigonometry is necessary for more students in the university.In other words,trigonometry of the numbers is considered important.

Creativeness and conceiving the fundamental of the study in development of the concepts and methods in trigonometry is very important.As it is in whole Mathematics education,if the principles of development of concepts and methods in the education of trigonometry is explained,hints to the easy learning could be obtained.

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We know that some students understand a relation better when it is pictured.Interpreting graphs and using them to make predictions is a fundamental skill that we want all students to develop.Therefore,the graphical representation of a function are very important for making synthesis.Furthermore,teaching via graphs makes it easy to comprehend and remember (Dyke,1994).For this reason, graphs should be used for exact learning of trigonometric functions.

The Aim of this Study:

The aim of this study.is to investigate the difficulties that students have when they try to use trigonometry for solving problems, and mistakes or misconceptions of the students in trigonometry.

Method:

The pattern of this study is totally 77 students from the 10th grade classes in a normal school and Science high-school in Eski°ehir.In this research,15 questions about under-standing the basic concepts of trigonometry were asked to students.In this study 4 of them were taken.These selected questions are first,second,seventh and fourteenth.These questions make complete according to how the students understand general concepts in trigonometry and mislearn trigonometric functions.

Findings:

This study revealed that many students had not developed clear concepts for trigonometry,and that some of them use algebraic notation as an informal and inconsistent personal shorthand.

Correct answers of the students to questions are shown with 1 and wrong answers are shown with 0.The percentages of right answers are shown in Table 1.

Table 1.Percentages of right answers

Question	1	2	7	14
Percentage of Right Answers	**70.1**	**19.5**	**11.7**	**9.1**

Questions 1 and 2 explore the student's ability in making connection between the angle and the length of arc in unit circle.

Question 1.

What is the arc length subtended by a central angle 60^{0} in a unit circle?

Question 2.

What is the measure of a central angle $\boldsymbol{q}$ subtends an arc of length $\dfrac{\boldsymbol{p}}{3}$ radian?

The students were more successful in question 1.Performance for this question is 70,1 %.Performance for second question is 19,5 %.It can be seen that the concept of measure of an angle in radians through the students is inadequate.It is understood that the relation between the measure of angle in radians and in degrees is known thoroughly.The comparison of the performances of the students for these two questions is given on Table 2.

Table 2. The Comparison of the Numbers of the Answers to Questions 1 and 2.

Question 2		Question 1		
		Wrong	Correct	Total
	Wrong	18	44	62
	Correct	5	10	15
	Total	23	54	77

As shown in Table 2,that 10 students answered the both questions correct and 18 students answered the both questions wrong.44 students found correct answer for arc length subtended by a central angle 60^{0} but wrong answer for the measure of a central angle $\boldsymbol{q}$ in a unit circle if $\boldsymbol{q}$ subtends an arc of length $\dfrac{\boldsymbol{p}}{3}$ radian.5 students find correct answer for the measure of a central angle $\boldsymbol{q}$ in a unit circle if

q subtends an arc of length $\dfrac{p}{3}$ radian ,but wrong answer for arc length subtended but a central angle 60^0.An analysis of the students have difficulties understanding the conversion between the measure of any angle in degrees and in radians.

Question 7 and 14 explore the knowledge about trigonometric functions.

Question 7.

What is the maximal domain of below function?

f(x)=sinx

Question 14.

f: R → R

x → sinx

is given.What is the value of x if sin30 = x

As shown in Table 1,the performances of the students on questions 7th and 14th are 11,7% and 9,1% in respectively,the performances are more lower.The performances of the students on these two questions are given on Table 3.

As shown in Table 3,63 students answered the both questions, wrong and only 2 students answered the both questions, correct.7 students found correct answer for the maximal domain of the sin function,but wrong answer for the value of real number of sin30.5 students find

Table 3. Comparison of the Numbers of the Answers to Questions 7 and 14.

		Q u e s t i o n 7		
		Wrong	Correct	Total
Q u e s t i o n 14	Wrong	63	7	70
	Correct	5	2	7
	Total	68	9	77

correct answer for the value of real number of sin30,but wrong answer for the maximal domain of the sin function.An analysis of the students' performances in these questions showed that many students have difficulties understanding the concept of domain of trigonometric functions.In the question here,the student knows that y = sinx,x must be an angle.Many students have not learned to perceive a real number as an angle in trigonometric function.In other words,substantial numbers of students appeared to have not understanding the concept of numerical trigonometry.

Conclusion and Suggestions

According to analysis of the student's performances in these 4 questions,trigonometry is understood as relations between the angle and the edges of right triangle.For this reason, the students were successful on the questions concerned with trigonometry of

angles.The topics taught in trigonometry are known.The problem is how these topics could be taught i.e,how they could be presented in classroom.The impression is that trigonometry is generally taught via teacher-active method and memorizing the ready knowledge and repeating them,the students learn trigonometry.It is known that this learning is generally active in brief term and it is hard to transfer the principle learned

to new situations.The main reasons of students' mistakes are due to teaching method.

The lower performances on questions 7 and 14 are developed our teachers' teaching problem.

The aim of trigonometry teaching is to be easy to learn and to develop the abilities of communication and rationalism.

It must be developed the concept of angle and the measure of angle in radians for students.To take the measure of an angle in degrees is in contradiction to general definitions and concepts in

trigonometry.If it might be started the definitions of trigonometric functions,before it is concerned with the angles,many problems in trigonometry education could be solved.In other words,it isn't appropriate to teach the topics of trigonometry taught in high school in approximation based on activities in former grades.Novel thoughts concerned with presentation of the topics must be taught via new method of learning-teaching and the new content.Thus,the learning level concerned with trigonometric functions will be risen.Besides,trigonometric functions must be taught by using their graphs.To interpret and to use these graphs is the students' fundamental ability which we want to be developed.First of all,what the students learned is related to which they learned.So that,to improve the teaching of mathematics,it is emphasised that the possible misunderstanding should be determined and some methods of eliminating it should be developed.

References

1) Barton,A.,C.,(2000),Crafting multicultural science education with preservice teachers through service-learning,Journal Curriculum Studies,Vol 32,6,797-820.

2). Cochran,K.F.,Derutter,J.A and King,R.A.(1993),Pedagogical content knowing:an integrative model for teacher preparation,Journal of Teacher Education,44,4.

3) Dyke,V.,F.,(1994)Relating to Graphs in Introductory Algebra,The Mathematics Teacher ,Vol 87,6,427-437.

4) Jong,O.,D.,and Brinkman,F.,(1997), Teacher Thinking and Conceptual Change in Science and Mathematics Education,European Journal of Teacher Education,Vol.20,2,121-124.

5) .Kieran,C.,(1994),Mathematics:Topics of Instruction in The International Encyclop- edia of Education Oxford,UK,Pergamon Press.

6) Lansdell,J.,M.,(1999),Introducing Young Children to Mathematical Conceps: problems with 'new' terminology,Educational Studies,Vol.25,3,327-333.

7) Gillman,L.,(1991),p ,The Limit of $\dfrac{\sin x}{x}$, Teaching of Mathematics,346-352.

8) Orta Öðretim Matematik Cilt 1
9) Orta Öðretim Matematik Cilt 2