

## **DETERMINATION OF MISCONCEPTIONS THAT ARE ENCOUNTERED BY TEACHER CANDIDATES AND SOLUTION PROPOSITIONS FOR RELIEVING OF THESE MISCONCEPTIONS**

Dokuz Eylül University , Faculty Of Education  
Department Of Mathematics, Buca, IZMIR

Cenk KEŞAN,  
cenkkesan@deu.edu.tr

Deniz KAYA  
denizkaya55@yahoo.com

### **INTRODUCTION**

In order to think, to interpret and judge correctly, the humans have to comprehend what they have learned. Concepts are the abstract representatives of the classifications that are formed by objects, events, ideas and behaviors which have common specifications. (Fidan, N., 1985).

Concepts reduce the complexity by simplifying the environment that people live. They help us in defining and explaining the objects in our environment. Learning concepts cannot be determined only by classifying objects or by telling the name or definition of a class of objects. Learning concepts has three steps; interpreting, translating and transition. For an individual to overcome these three steps, he has to have the ability to percept common elements objects, events, ideas and behaviors by abstracting them and has to distinguish the common and uncommon sides of these. Glover, Ronning and Bruning (Glover,A.Roning,R.R.,Bruning, R. H., 1990) have divided the database needed in problem solving process into three parts as subject knowledge, general and specific strategic knowledge. The conceptual knowledge that is related to the subject of the problem constitutes the first type of knowledge. Remembering a knowledge signifies that it is known. However, this remembrance can both be by memorizing and comprehending. It is the comprehension step, which is formed by the behaviors that distinguishes a person who has comprehended, from a person who has memorized. (Alkan, H., Altun, M., 1998). As knowledge and skill is not transferred genetically and cannot be controlled by instinct, the behaviors that will be necessary in life should be designated to the person. This can be achieved by learning. The people agree that without learning life cannot be successful. While teaching new knowledge to individuals, it should be made sure that the concepts are formed correctly. In recent years, students' understanding of the scientific concepts is one of the subjects that researchers and teachers give importance to. The reason is that students have difficulties in understanding scientific concepts. Learning concepts in a non-meaningful way leads to the formation and increasing of misconceptions. Misconception is the perception of concepts by students in a different way than their scientifically accepted definitions.

The difficulties for students that can occur in learning concepts can also be related to; time, memory, strategies, concentration, culture, development and insufficiency of teachers. (Ülgen,G.,1988).

Misconceptions are a big impediment in meaningful learning. Especially, the permanent mistakes creates great difficulties for the math education to reach its goals if they aren't avoided on time. Traditional teaching techniques seem to be the major reason in the occurrence of mistakes. (Lawson, A. E., Thompson, L. D. 1988 & Ubuz, B., 1999 & Marek, E. A., Cowan, C. C., 1994).

Studies have showed that, as misconceptions are permanent and continuous, and at the same time they are not sufficient to make the student develop the right concepts, it is hard to relieve misconceptions by traditional teaching techniques. (Lawson, A. E., Thompson, L. D. 1988). The definition of misconceptions and distinguish these from insufficient knowledge is a very important area in educational research(Teaching Physics, 1999). The reasons for misconceptions can be explained as; lesson books, teacher factor and not having information of the students' past knowledge, not preparing the appropriate environment, wrong usage of technological tools, not making the necessary concept exchanging in lessons.

Seeing the missing part of the knowledge should be taught to the students. Error-correction operation should take place.

The questionnaires which were made with different teachers working in private schools, government colleges, government high-schools showed that even teachers have serious misconceptions concerning high-school mathematics. For this reason, it is necessary to determine teachers' misconceptions and to search ways for relieving these. (Alkan, H. ve arkadaşları, 1996 & Köroğlu, H. ve arkadaşları, 1996 & Alkan, H. ve arkadaşları, 1995).

While their studies in educational faculties, by learning the necessary knowledge, theories, basic principles and concepts, teacher candidates will be able to make relations with their knowledge and practices in their working areas. (YOK/Dünya Bankası, 1997). This study is made under the light of these thoughts and is based on the results of the questions which were designed for testing field knowledge. These questions were applied to the teacher candidates which were attending Applied Seminar classes held in the final class of University of Dokuz Eylül (DEU) Educational Faculty of Buca (EFB) Main Division of Secondary Science and Mathematical Fields Education (DSSMFE) in the educational term of 2000-2001 and the attendees of certification program who were graduated DEU Faculty of Science and Literature (FSL) in the educational term of 2000-2001.

\*\*Dokuz Eylül Üniversitesi Eğitim Bilimler Enstitüsü İlköğretim Matematik Eğitimi Tezli Yüksek Lisans Öğrencisi

\* Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi İlköğretim Matematik A.B:D

### **THE OBJECT AND LIMITATIONS OF THE RESEARCH**

The object of this research is, to evaluate the knowledge of the teacher candidates which will graduate from Educational Faculty of Buca (DSSMFE) 2000-2001 educational term and certification program attendees which were graduated from University of Dokuz Eylül (DEU) Faculty of Literature Division of Mathematics and to make contribution to the studies that have been made to determine the different misconceptions that these groups separately experienced, and the misconceptions that they commonly experienced.

To achieve this object, answers searched for the sub-problems below.

- 1- What are lack of knowledge and misconceptions of the graduates of EFB – DSSMFE Main Division of Mathematics and FSL Division of Mathematics related to sequence concept?
- 2- What are lack of knowledge and misconceptions of the graduates of EFB – DSSMFE Main Division of Mathematics and FSL Division of Mathematics related to permutation and combination which are one of the basic subjects of secondary level possibility concept?
- 3- What are lack of knowledge and misconceptions related to logarithm?
- 4- What are lack of knowledge and misconceptions related to complex numbers ?
- 5- What are lack of knowledge and misconceptions related to trigonometry, geometry and application of these to second degree equations.
- 6- What are lack of knowledge and misconceptions related to relation and function?
- 7- What are lack of knowledge and misconceptions related to modular arithmetic and sets?

The data of the research is limited to the field knowledge of the teacher candidates which will graduate from Educational Faculty of Buca (DSSMFE) 2000-2001 educational term and certification program attendees which were graduated from University of Dokuz Eylül (DEU) Faculty of Literature Division of Mathematics that has been tried to be determined by a test. In the applied test a target and a behavior has been determined for each question's right alternative and misleading.

### **Statistics**

In this research, inside the teacher candidates which will graduate from Educational Faculty of Buca (DSSMFE) 2000-2001 educational term and certification program attendees which were graduated from University of Dokuz Eylül (DEU) Faculty of Literature Division of Mathematics, it is decided that a group of 104 individuals has the quality to represent the other mathematics teachers.

### **Limitation**

Limitations are given as below.

- a) The data of the research is limited to test answers given by the teacher candidates which will graduate from Educational Faculty of Buca (DSSMFE) 2000-2001 educational term and certification program attendees which were graduated from University of Dokuz Eylül (DEU) Faculty of Science and Literature Division of Mathematics.
- b) Distribution of the test questions with respect to the subjects has been based upon quizzes and the test has been limited to 25 questions.
- c) The validity of the evaluation tool is limited to the time section.

### **METHOD**

The research is directed towards revealing misconceptions of the teacher candidates that are graduated from Educational Faculties and teacher candidates who had attended certification program and graduated from Faculty of Science and Literature, and to present suggestions that could prevent these mistakes.

### Population

The sampling of the research is formed by the teacher candidates which will graduate from Educational Faculty of Buca (DSSMFE) 2000-2001 educational term and certification program attendees which were graduated from University of Dokuz Eylül (DEU) Faculty of Science and Literature.

In the sampling there are 49 teacher candidates of Educational Faculty of Buca (DSSMFE) Division of Mathematics and 55 certification program attendees graduated from Faculty of Science and Literature.

### Data Collection Tool and Analysis

In the research, data collection tool consists of a test that is applied to 104 teacher candidates. Five alternatives have been determined for each question, in each alternative different behavior and mistakes have been searched. It is given as a fore condition that four wrong answers will disvalue one right answer. This condition prevented the ones who answered this test to answer randomly because of inefficient knowledge. In the applied test there were 25 questions related to field knowledge. In the evaluation of the data, SPSS 8.0 pack software was used. Average, standard deviation, frequency and percentage display results were evaluated.

### The Object of Asking the Questions of the Data Collection Tool and the Target and Behaviors That are Wanted to be Measured.

1) In alternative A, this knowledge was searched. Does he/she know that infinity isn't included in  $\mathbb{R}$ ? If he/she isn't aware that infinity isn't included in  $\mathbb{R}$ , he/she will think that the result that was obtained for  $n \rightarrow \infty$  belongs to the sequence. For alternatives B and C, this knowledge was searched. If

$\forall n \in \mathbb{N}$  için,  $0 < a_n < b_n$  condition is provided in the  $\left(\frac{a_n}{b_n}\right)$  division sequence, the division sequence is

limited,  $a_n$  and  $b_n$  are convergent, then division sequence is also convergent. Otherwise it is not proved. For alternative D, are they aware that limit may not belong to the sequence? For alternative E, there shouldn't be any  $n \in \mathbb{N}$  that causes infinity for the rule that will be attained to the sequence.

2) For A and B, to confirm “**Each convergent sequence is limited but opposite is not right.**” the alternatives C, D and E were asked to measure the basic concepts that determines the relation between convergent sequences and monotony.

3) It is asked to confirm that a common multiplier can be negative in a geometric sequence and the sequence will be convergent for  $|r| < 1$

4) It is asked with the idea if a teacher candidate could distinguish the theory: “For a serial to be convergent, it is necessary but not enough to make the general term's limit go to zero.”

5) It is searched if the teacher candidates know that ; “ $\mathbb{R}$  is the Cauchy sequence of every convergent sequence”

6) It is searched how the sub-sequence of a sequence is obtained, given that there is sub-sequence.

7) It is searched that, if a teacher candidate will express a behavior of solving the problem of a total of a serial that can state convergence by moving from the  $S_n$  total of pieces.

8) It is asked to measure if it is known that in a binomial expansion, the coefficients of the terms that are in the equal distance from the starting point and the end, also if they use the knowledge that the possibility of the complementary of an event is obtained by subtracting the event's possibility from 1.

9) To solve a question, problem, a research it is necessary to understand the question completely. To provide this, the teacher candidate should catch the lighting words in the question. Is he/she is able to reach another type of question by leaving the type of question that he/she decided before? It is asked to search how much he/she reflects the mistakes to the combination.

10) It is asked to measure if they are aware of a serious relation between the set and the possibility.

11) It is asked to measure if the teacher candidates could exactly percept the difference between the arranging and grouping.

12) It is asked to measure, if the teacher candidates keep in mind that a number which is possible to take the logarithm of, cannot have a negative mantis (decimal fraction).

13) It is asked to measure, their capacity to solve the logarithmic equality system and if they know that the base of the logarithm should be different than 1.

14) It is asked to measure, that the absolute of the difference between the two complex numbers is equal to the distance between the two points that are equivalent to these complex numbers, and if they are aware that when one is variable then there is a geometrical area problem or not.

15) It is asked to measure, that the product of two complex numbers' argument is equal to its' arguments' total separately, and if they could use their knowledge of second degree equality together with the knowledge of complex number.

16) It is asked to measure, if they know that instead of Cartesian coordinates the polar coordinates can be used to designate the point on a plane and if they are aware of the dense relation between trigonometry and complex numbers.

17) It is asked to measure, if they know that the relation between the roots of a second grade equality can also be used in trigonometry.

18) and 19) It is asked to measure if they are of the dense relation between geometry and trigonometry.

20) It is asked to measure the knowledge level of teacher candidates that it is possible to obtain special results by the help of total, difference and radius formulas in trigonometry, and when one of the trigonometric rates is known then the other can be calculated.

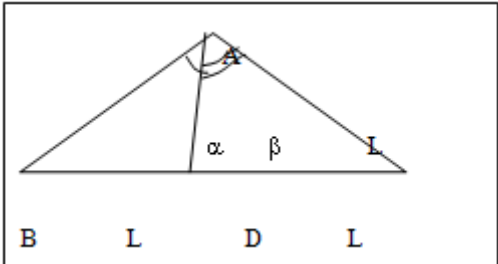
21) It is asked to measure the how successfully they can use these knowledge on an example: Why equality relation? Why equality classification? What are the conditions of being an equality relation?

22) It is asked to measure, if they can produce alternative solution steps for the ability of obtaining a function's opposite.

23) It is asked to see, how these knowledge are applied on an example: What is mode? When solving a problem in modular arithmetic, how do you search its relation with the number concept?

24) and 25) It is asked to find out, how much they are aware of the basic specifications of a set. How frequently they can use these knowledge on the examples?

EXAM QUESTIONS
<p>1-Which one of the below is wrong ?</p> <p>A) <math>\left(5 + \frac{2}{n}\right)</math> sequence doesn't have the lowest element i) 15,53 ii) 13-83</p> <p><b>B) The division of two limited sequences is also limited i) 30,53 ii)30,83</b></p> <p>C) The division of two divergent sequences can be convergent I)20,53 ii)24-83</p> <p>D)The limit of a positive termed sequence may not be positive I) 20,53 ii) 19-83</p> <p>E) <math>\left(\frac{n+3}{n-2}\right)</math>.expression cannot be general term of a sequence D)15,53 ii)14-83</p>
<p>2-Which one of the below expressions is wrong ?</p> <p>A) <b>A convergent sequence may not be limited i)44,28-ii)61-76</b></p> <p>B) A limited sequence may not be convergent i)14,28-ii)23-76</p> <p>C) A convergent sequence may not be monotonous i)28,28-ii)08-76</p> <p>D) A monotonous sequence may not be convergent i)00,28-ii)00-76</p> <p>E) In a monotonous increasing upper limited sequence, the limit is the LUB i)14,28-ii)08-76</p>
<p>3- What is the limit of the Sn sequence with a general term of :<math>S_n = 1-(0,4)+(0,4)^2-(0,4)^3+\dots+(-1)^{n-1} \cdot (0,4)^{n-1}</math> ?</p> <p>A)7/3 i)00,40-ii)08,45 B) 0,64 i)05,40-ii)08,45 C) <b>5/7 i)40,40-ii)32,45</b> D) 0 i)30,40-ii)32,45 E) 1 i)25,40-ii)20,45</p>
<p>4 – Which one of the below is divergent ?</p> <p>A) <math>\sum_{n=1}^{\infty} \frac{2^n + 3^n}{5^n}</math> i)38,53-ii)27-85 B) <math>\sum_{n=1}^{\infty} \frac{1}{3^n}</math> i)11,53-ii)17-85 C) <math>\sum_{n=1}^{\infty} \frac{1}{n(n+1)}</math> i)03,53-ii)04-85 D) <math>\sum_{n=1}^{\infty} \frac{5n+2}{n+3}</math> <b>i)35,53-ii)36-85</b></p> <p>E) <math>\sum_{n=1}^{\infty} \frac{1}{(2n-1)(2n+1)}</math> i)11,53-ii)14-85</p>
<p>5 – Which one of the below is not a basic ( CAUCHY ) progression ?</p> <p>A) <math>\left(\sqrt{\frac{2}{n}} + 1\right)</math> i)20,20-ii)00,43 B) <math>\left(\frac{4n^3 + 1}{n^3 + 2}\right)</math> i)00,20-ii)16,43 C) <math>\left(\frac{1}{2^{n(n+1)}}\right)</math> i)10,20-ii)16,43 D) <math>\left(\frac{\cos n}{3^n}\right)</math> i)10,20-ii)29,43</p> <p><b>E) <math>\left(\sqrt{n+1}\right)</math> i) 60,20-37,43</b></p>
<p>6- Which one of the below is <math>(a_{2n})</math> for the <math>(a_n)</math> progression that has a general term of; <math>a_n = 1 + \frac{1}{2} + \frac{1}{2^2} + \dots + \frac{1}{2^n}</math></p> <p>A) <math>\left(\frac{2^{2n+1} - 1}{2^n}\right)</math> i)18,34-ii)13,56 <b>B) <math>\left(\frac{2^{2n+1} - 1}{2^{2n}}\right)</math> i)35,34-ii) 51,56</b> C) <math>\left(\frac{1}{2^n}\right)</math> i)05,34-ii)03,56 D) <math>\left(\frac{1}{(2^n)^2}\right)</math> i)12,34-ii)10,56</p>

<p>E) <math>\left(\frac{2^{2n}-1}{2^{2n}}\right)</math> i)30,34-ii)23,56</p>
<p>7-What is the total for <math>x=1+2x+3x^2+4x^3+\dots</math>?</p> <p>A) <b>9/4</b> i)79,27-ii) <b>52,41</b> B) 2/3 i)00,27-ii)00,41 C) 3/2 i)07,27-ii)26,41 D) 4/9 i)07,27-ii)14,41 E)1/3 i)07,27-ii)08,41</p>
<p>8- In the expansion of <math>(x+y)^{12}</math> expression the different coefficients formed are written on different cards and put inside a box. When a card is randomly picked, what is the possibility of number on the card to be higher than 12 ?</p> <p>A) 2/7 i)00,47-ii)04,45 B) 3/4 i)00,47-ii)00,45 C)9/13 i)70,47-ii)72,45 <b>D) 5/7</b> i)30,47-ii)<b>20,45</b> E)7/8 i)00,47-ii)04,45</p>
<p>9 – 32 teams are playing in a league, in each match one is eliminated and always winning teams are playing. In this league, how many matches can be played at most?</p> <p>A) <math>\binom{32}{2}</math> i)12,51-ii)06,56 B) <math>\binom{16}{2}</math> i)05,51-ii)09,56 C) 962 i)00,51-ii)06,56 D) 62 i)00,51-ii)00,56 <b>E) 31</b> i)84,51-ii)<b>77,56</b></p>
<p>10 - In a class of 40 students, the number of students who passed Deutsch is 26, the number of students who passed Mathematics is 22 and the number of students who passed both is 18. When you randomly call a student from this class, if it is known that he/she is failed mathematics, what is the possibility for him/her to be also failed from Deutsch ?</p> <p>A) 7/10 i)13,44-ii)00,36 B) 2/5 i)00,44-ii)10,36 <b>C) 5/9</b> i)69,44-ii)<b>55,36</b> D) 4/9 i)18,44-ii)35,36 E) 1/3 i)00,44-ii)00,36</p>
<p>11- 3 girl and 4 boy students had gone to a theatre. If the girls cannot sit side by side, how many different sitting combinations can be ?</p> <p>A) 2880 i)10,38-ii)18,29 <b>B) 1440</b> i)21,38-ii)<b>37,29</b> C)4320 i)53,38-ii)31,29 D) 2160 i)06,38-ii)00,29 E) 5040 i)11,38-ii)12,29</p>
<p>12- If <math>\log_3 3=0,48</math> then what is <math>\log_3 \sqrt[3]{0,03}</math> ?</p> <p>A) 2,48 i)04,51-ii)00,35 B) <math>\sqrt{2}</math>,493 i)00,51-ii)05,35 C) <math>\sqrt{1}</math>,506 i)48,51-ii)47,35 D) <math>\sqrt{2}</math>,506 i)04,51-ii)15,35 <b>E) <math>\sqrt{1}</math>,493</b> i)44,51-ii)<b>31,35</b></p>
<p>13- If <math>\log_x + \log_y = \log_x \cdot \log_y</math> and <math>\log_x y = 2</math> then what is (x,y) ?</p> <p>A) (1,1) i)10,96-ii)09,78 B) <math>(\sqrt{2}, \sqrt{2})</math> i)02,96-ii)00,78 C) <math>(\sqrt[3]{10}, 10)</math> i)00,96-ii)06,78 <b>D) <math>(10\sqrt{10}, 1000)</math></b> i)80,96-ii)<b>67,78</b> E) (10,100) i)06,96-ii)16,78</p>
<p>14- What can be the highest base argument of z numbers which proves the equality of <math> z - 4i  = 2</math> ?</p> <p>A) <math>\frac{\pi}{3}</math> i)06,32-ii)00,14 B) <math>\frac{5\pi}{12}</math> i)06,32-ii)12,14 C) <math>\frac{\pi}{2}</math> i)56,32-ii)26,14 <b>D) <math>\frac{2\pi}{3}</math></b> i)18,32-ii)<b>62,14</b> E) <math>\frac{5\pi}{6}</math> i)06,32-ii)00,14</p>
<p>15- What are the total degree of base arguments of the equivalency of <math>z^2 - (6-i)z + 5 - 5i = 0</math> ?</p> <p>A) <math>45^\circ</math> i)00,12-ii)33,05 B) <math>120^\circ</math> i)16,12-ii)00,05 C) <math>210^\circ</math> i)00,12-ii)00,05 D) <math>240^\circ</math> i)00,12-ii)00,05 <b>E) <math>315^\circ</math></b> i)84,12-ii)<b>67,05</b></p>
<p>16- What is the distance between the complex numbers given with their polar coordinates of <math>z_1 = (2,780)</math> and <math>z_2 = (5,180)</math> ?</p> <p>A) <math>3\sqrt{2}</math> i)00,26-ii)00,09 <b>B) <math>\sqrt{19}</math></b> i)92,26-ii)<b>60,09</b> C) <math>\sqrt{20}</math> i)00,26-ii)00,09 D) <math>\sqrt{22}</math> i)00,26-ii)00,09 E) <math>3\sqrt{3}</math> i)07,26-ii)40,09</p>
<p>17- In an ABC triangle, if <math>m\angle A &lt; 90^\circ</math> and <math>\tan B</math> and <math>\tan C</math> are the roots of <math>2x^2 + 3x - 1 = 0</math> equality, then what is the measure of <math>\angle A</math> ?</p> <p>A) <math>45^\circ</math> <b>i)100,20-ii)41,30</b> B) <math>15^\circ</math> i)00,20-ii)00,30 C) <math>30^\circ</math> i)00,20-ii)05,30 D) <math>60^\circ</math> i)00,20-ii)36,30 E) <math>75^\circ</math> i)00,20-ii)18,30</p>
<p>18- In an ABC triangle, if <math> AC  =  BD  =  DC  = L</math> dir <math>\tan \alpha = m</math> then what is <math>\tan \beta</math>?</p> <div style="display: flex; align-items: center;"> <div style="flex: 1;">  </div> <div style="flex: 2;"> <p>A) <math>\frac{m}{2}</math> i)50,04-ii)00,11</p> <p>B) <math>\frac{m-1}{2}</math> i)00,04-ii)33,11</p> <p>C) <math>\frac{m}{3}</math> <b>i)00,04-ii)50,11</b></p> </div> </div>

D)  $\frac{m-1}{3}$  i)50,04-ii)16,11

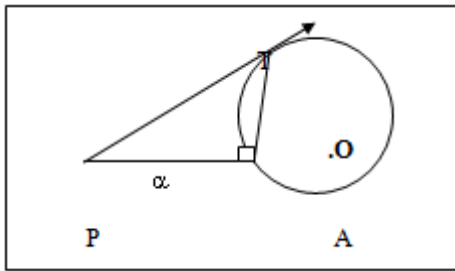
E)  $\frac{2m}{3}$  i)00,04-ii)00,11

19- If  $\tan \frac{\alpha}{2} = 2 - \sqrt{3}$  then what is  $\text{Cos}\alpha$ ?

A)  $\frac{\sqrt{3}}{2}$  i)86,30-ii)90,36 B)  $1 - \sqrt{3}$  i)00,30-ii)00,36 C)  $\frac{1}{2}$  i)06,30-ii)00,36 D)  $\frac{\sqrt{3}-2}{2}$  i)06,30-ii)05,36

E)  $\frac{1-\sqrt{3}}{2}$  i)00,30-ii)05,36

20-



In an O centered circle with 6 cm. radius , [PT is tangent to the circle and  $|\text{PT}| = 8$ .cm. If  $[\text{PA}] \perp [\text{AT}]$  then what is the value of  $\tan \alpha$  ?

A)  $\frac{1}{2}$  i)00,18-ii)11,16 B)  $\frac{2}{3}$  i)00,18-ii)22,16

C)  $\frac{3}{4}$  i)11,18-ii)00,16 D)  $\frac{4}{3}$  i)11,18-ii)11,16

E)  $\frac{3}{2}$  i)77,18-ii)55,16

21-According to  $\beta = \{(x,y):4, \text{ divides } x-y\}$ . relation defined in the set of  $A = \{0,1,2,3,4,5,6,7,8,9,10,11,12\}$ , which one of the below is not in the equivalency class of  $\bar{0}$  ?

A) 0 i)00,33-ii)03,55 B) 4 i)06,33-ii)03,55 C) 6 i)94,33-ii)90,55 D) 8 i)00,33-ii)00,55 E) 12 i)00,33-ii)03,55

22-f:1-1 and is a onto function. What is  $f^{-1}(x)$  for the value of  $f(x)$  that provides the condition of  $\frac{[f(x)]^2}{x} - 2f(x) + \frac{1}{x} = 0$  ?

A)  $\frac{x}{x^2+2}$  i)00,45-ii)00,27 B)  $\frac{x^2+1}{2x}$  i)77,45-ii)60,27 C)  $\frac{2x}{x^2+1}$  i)09,45-ii)20,27 D)  $\frac{1-x^2}{2x}$  i)09,45-ii)20,27

E)  $\frac{-x}{x^2+1}$  i)04,45-ii)00,27

23- How many whole numbers are there, that provides the equivalency of  $x-3 \equiv 4[\text{mod}(x-2)]$  ?

A) 1 i)76,27-ii)48,42 B) 2 i)00,27-ii)13,42 C) 3 i)15,27-ii)27,42 D) 4 i)07,27-ii)08,42 E) 5 i)00,27-ii)04,42

24- If  $s(A)=5$ ,  $s(B)=6$ ,  $s(C)=9$  and if the highest value of  $s(A \cup B \cup C)$  is a, the lowest value is b and the highest value of  $s(A \cap B \cap C)$  is c, the lowest value is d, then what is the rate of  $\frac{a-b}{c+d}$  ?

A)  $\frac{17}{5}$  i)04,43-ii)02,62 B)  $\frac{21}{5}$  i)04,43-ii)02,62 C)  $\frac{9}{5}$  i)04,43-ii)08,62 D)  $\frac{11}{5}$  i)86,43-ii)88,62 E)  $\frac{7}{5}$  i)00,43-ii)00,62

25- For A,B,C sets, which one of the propositions below is precisely right ?

A)  $(A \cap B = \phi \vee B \cap C = \phi) \Rightarrow A \cap C = \phi$  dir i)07,80-ii)16,65

B)  $A \cap B = A \cap C \Rightarrow B = C$  dir i)07,80-ii)08,65

C)  $A \cup B = A \cup C \Rightarrow B = C$  dir i)33,80-ii)32,65

D)  $A' \cup B' \subset C \Rightarrow C' \subset (A \cap B)$  dir i)49,80-ii)44,65

E)  $A \cup (A \cap B) = B$  dir i)02,80-ii)00,65

Note: The i) aa,bb-ii)aa,bb symbols given in tables above signifies these;

The numbers coming after symbol i) are the percentages that are related to the answers given by the final class teacher candidates at Educational Faculty of Buca, Division of Mathematics Teaching.

The numbers coming after symbol ii) are the percentages that are related to the answers given by the teacher candidates attending Faculty of Science and Literature, Division of Mathematics.

aa symbol is the marking percentage of the related alternatives by teacher candidates that answered the related question,

bb symbol is the percentage of students that answered the related question. The expressions written in bold signifies the correct answers.

## **FINDINGS**

For teacher candidates attending Educational Faculty of Buca, the rate of answering the question that measures the concepts related with sequences was lower comparing to the graduates of the Faculty of Science and Literature. For this reason, it is determined that there is a real lack of knowledge considering sequence subject.

Despite this, it was noticed that the misconceptions were same considering the defined values of the Sequence and that its value was not at real numbers.

They couldn't comprehend that two divergent sequences' division can be convergent. The reason for this is thought that the teacher candidates couldn't achieve transition, which is one of the steps of comprehension.

To be able to determine that the positive termed sequence's limit may not be positive, it is needed to be able to interpret that zero is not positive. For the graduates of Faculty of Science and Literature, we feel that there is a serious lack of knowledge transition and misconception in determining the rightness of two divergent sequences division may be positive. Here, the transformation, which is one of the steps of comprehending in limitation subject, couldn't be achieved.

The teacher candidates of DSSMFE in the Educational Faculty of Buca by not agreeing that a limited sequence may not be convergent and that limit is LUB in a monotonous increasing upper limited sequence, showed that due to the lack of interpretation they have mistakes in the subjects of limitation and convergence, monotonous increasing and upper limited. As the number of teacher candidates who tended that a convergent sequence may not be monotonous was higher, it is clear that there is a misconception related to the subject of monotony.

The two of groups has answered the question related to calculating the limit of a sequence with its general term given almost in the same rate. Educational Faculty of Buca had a higher percentage of correct answers than the teacher candidates of Faculty of Science and Literature, had serious mistakes in the subject of partial total in determining general term.

In determining divergent sequence the teacher candidates of Faculty of Science and Literature answered the questions at a higher rate than the teacher candidates of Educational Faculty of Buca. Both of the two groups had right answers in a lower rate. They had mistakes about convergence criteria. The number of the ones who couldn't achieve transition, which is a step of comprehension in the subject of convergence – divergence, was not low.

In determining the specifications of Cauchy sequence the groups of Faculty of Science and Literature and Educational Faculty of Buca had difficulties almost at the same rate. In both of the groups, there were ones who didn't use the expression; "Every convergent sequence is a Cauchy sequence", and fell into contradictive side.

They had mistakes in calculating the general term of sequence, which is given as partial total, and reaching to sub-sequence. Considering this, the teacher candidates of Educational Faculty of Buca had mistaken more than the teacher candidates of Faculty of Science and Literature.

In calculating a certain value of a serial expansion, the teacher candidates of Educational Faculty of Buca has answered in a lower rate than the teacher candidates of Faculty of Science and Literature. However, the teacher candidates of Educational Faculty of Buca had a higher rate in finding the correct answer. They couldn't achieve transition operation, which is a step of comprehension.

In Binomial expansion, the terms after certain terms may have same coefficients. The percentage of giving the right answer was at the same rate. However, by sticking the contradiction above or not reading the question carefully, the rate of persons giving wrong answer was high.

Even the rate of answering possibility question was low in both groups, it was lower for the graduates of Faculty of Science and Literature. The percentage of correct answering for the possibility question which included sets was higher for Educational Faculty of Buca than Faculty of Science and Literature. However, we cannot avoid the percentage of teacher candidates who mixed with the condition and had mistaken.

The percentage of correct answering for the question related to arranging was low for both two groups. A lack of interpretation was observed in subject of arranging.

The percentage of answering the logarithm question related to Mantis and Logarithm was higher for the group of Educational Faculty of Buca than the group of Faculty of Science and Literature. The percentage of correct answering was also higher for the group of Educational Faculty of Buca. They fell into contradictive side in the same and unavoidable rate. The mistakes related to the operations in logarithm was not high.

In both of two groups there was lack of knowledge related to the absolute value and argument of complex number. But the percentage of correct answering was higher for the group of Faculty of Science and Literature than the Educational Faculty of Buca. The percentage of the ones who fell into contradiction because of wrongly determining the complex numbers that supplied equality, cannot be avoided.

There is lack of knowledge in finding the roots of equivalencies with complex varieties. However, the percentage of correct answers was high.

There is a very high lack of knowledge in polar displaying of the complex numbers. However, the percentage of answering this question correctly was high. The group of Educational Faculty of Buca has given more correct answers than the group of Faculty of Science and Literature.

Considering a triangle, there is lack of knowledge in using trigonometric relations for solving equivalencies. The teacher candidates of Educational Faculty of Buca has answered 100% correctly but teacher candidates of Faculty of Science and Literature has answered correctly at a lower rate. The rate of the ones who answered the question related to length in a triangle was almost none, so there is a high lack of knowledge. The rate of answering this question correctly was 0% for the group of Educational Faculty of Buca. For the group of Faculty of Science and Literature, it is 50%. Here, we can see that there are serious misconceptions related to geometry; transition, transformation or interpretation was not made in these questions.

The rate of answering the question related to trigonometric identity was low and both of the two groups has given correct answers at a higher rate. About the question that demanded trigonometry and circle knowledge, a lack of knowledge was observed in both of the two groups. The teacher candidates of Educational Faculty of Buca (EFB) have given correct answers at higher rate than the teacher candidates of Faculty of Science and Literature (FSL).

The EFB candidates had a higher rate of answering the question that demanded the equivalency grade of a set according to relation, but the rate for the ones who answered correctly was high in both of the two groups.

As the rate for answering the question related to determine reverse function was low, there is a lack of knowledge considering this subject. The correct answering rate is high, but it is higher for the the group of Educational Faculty of Buca. Considering the subject related to modular arithmetic, the group of Educational Faculty of Buca has more lack of knowledge than the group of Faculty of Science and Literature. However, the group of Educational Faculty of Buca has given more correct answers. Misconception is higher for FSL.

Group of EFB has more lack of knowledge considering the subject related to element number of a set. However, both of the groups have answered at the same and a higher rate. The question determining the propositions related to the operations in a set was answered by both of the two groups at a higher rate, but the group of Educational Faculty of Buca had a higher rate of correct answers. The correct answers' rate was low for the two groups almost at the same amount and there is misconception about this subject. When determining the unity of two sets, even one set is evident; it may not be expressed in a unique type. The mistaking rate is high at this point and there is misconception.

## **DISCUSSION**

The teacher candidates which will graduate from Educational Faculty of Buca (DSSMFE) 2000-2001 educational term and certification program attendees which were graduated from University of Dokuz Eylül (DEU) Faculty of Science and Literature were tested in this research.



The research is oriented to determine the general knowledge levels related to the steps of interpretation, transformation and transition of high school mathematics which these teacher candidates will service in the future. It is evident that the evaluation tool, which was applied, was not enough to measure all the dimensions of a subject. For each subject, the knowledge levels and lack of knowledge of the teacher candidates should be researched and the ways of relieving these should be determined.

Furthermore, these subjects should be researched and the solution steps should be determined for the teacher candidates of Educational Faculty and Faculty of Science and Literature which will soon gain to the army of education.

By the findings and results obtained from this study which the numerations and limitations are determined of, we think that it will make it necessary to reach the decisions below.

The available educational model is still based on straight expression method; the principle of explaining the lesson books and notes in a straight way. This means that, education which is made by a passive method, cannot achieve its duty (Gürol, M. 1997).

It is very important to make the teacher candidates comprehend the basic points while dealing with the sequences, which are one of the basic subjects of analysis. It is necessary to give a better definition of sequence and teach the concepts like limit of sequence, limitations in sequences, convergence, divergence, the lowest element, the highest element, in a careful way. Especially, in Educational Faculties and Science and Literature Faculties these concepts should be handled very carefully. In explanation of the subjects, active education should be preferred.

General mathematics is the beginning point of advanced mathematics and the basic for other advanced subjects. The last twenty years is the witness for the publications related to the understanding of general mathematics by teacher candidates (Monaghan, J., 1986).

In sequences, the relation between convergence and limitation, monotony and convergence, monotony and limitation and the theories related to determination of limit by utilizing these properties should be examined very well. Especially in analysis lessons, these concepts should be discussed in a better way. What are the necessary conditions of determining the limit of a sequence and how can we determine the limit of a sequence? These points should well be illuminated in lessons, homework should be given to the teacher candidates if necessary. These difficulties should be relieved by applying different teaching methods. The properties of the sequence given as a Cauchy sequence should be examined more carefully in analysis lessons at Educational Faculties and Science and Literature Faculties and conditions have to be determined very well. The theory of “Every convergent sequence in  $\mathbb{R}$  is a Cauchy sequence, every Cauchy sequence is convergent” needed to be very well examined. Considering the determination of general term in sequences and how the sub-sequences are obtained, different exercises should be made at analysis lessons at EFB and FSL by consolidating with examples. This subject is needed to be insisted in lessons. Computer supported teaching, which includes and helps to understand these subjects, can be made. In computer supported teaching, the teacher candidates can overcome mistakes by obtaining the errors faster.

In a computer supported teaching environment, the students use the softwares interactively, solve the problems step by step, by receiving errors learn their mistakes. In this manner, computer plays a bridge role which brings students' knowledge and talents into foreground (Baki, A., Budak, İ., 1999). The basic properties in the subject of determining series total and sequence concept, which constitutes the base for integral subject, needed to be comprehended well. Otherwise, it is possible to encounter important problems in making students comprehend integral and other related subjects.

Understanding possibility concept entirely can only take place in the adolescence period (Piaget, J., Inhelder, B., 1975). In our country, possibility subject is both included in 8<sup>th</sup> Class and 10<sup>th</sup> Class programs (National Ministry of Education, 1988). Despite possibility subject is so important, as in most of the foreign countries, also in our country for various reasons these concepts aren't effectively educated. (Aksu, M., 1990 & Bar-On, E., Or-Bach, R., 1988 & Carpenter, T. P., Corbitt, M. K., Kepner, H. S., Linquist, M. M., Reys, E. R., 1981 & Fischein, E., Schnarch, D., 1997). Having misconceptions related to possibility subject, affects students success (Fischein, E., Schnarch, D., 1997).

One of the reasons for this, is that most of the mathematics teachers doesn't have the necessary talent and knowledge for teaching possibility subject effectively (Tobuk, Z., 1994).

Being one of the basic subjects of possibility concept, the Binomial expansion by insisting on its properties, we should make both two groups of teacher candidates comprehend that in the expansion the terms, which are in same distance, have equal coefficients. It is delighted if they can apply combination in daily life. But this is not enough. In calculating conditional possibility, it should be insisted that conditions are needed to be determined well. The properties of the sets given in questions should be pointed out well. Distinguishing points should be brought into foreground.

Details about the subject of permutation's properties and its meaning should be put forward. The subject should be explained by many different examples. In logarithm subject, properties of characteristic and mantis are generally being forgotten. These properties should be insisted more.

A good level of success is observed on analyzing logarithmic equivalencies. However, Educational Faculties are more successful. Also, Science and Literature Faculties should attach importance to this subject.

Analogies that are formed by students not only support students to think, but also help the teachers to see the right or wrong concepts related to that concept, which students have in their mind (Wong, E. D., 1993). To understand a new event, analogy supplies the prior segmented knowledge to be used completely. Analogies not only play a productive role in students' self learning and education, but also have important duties in solution of wrong concepts and misconceptions (Şahin, F., Gürdal, A., Berkem, M.L., 2000).

We think that, it is necessary to make the students comprehend the base argument in complex numbers, interpretation of what can it be at most or least. In complex numbered equivalencies, it is necessary to be insisted on determining the roots and calculating the base argument. It is necessary to attach importance to analogy. As with other subjects, analogy should also be practiced when studying other subjects.

It should be insisted on giving different expressions of complex numbers and operations that are necessary for determining the distance between two complex numbers. It is observed that this subject should be insisted carefully especially in Science and Literature Faculties.

The students need to have strategic knowledge on the subject. This knowledge should be transferred from teacher to the student before. Using sinus and cosine terms when writing all expressions related to tangent and cotangent, can be given as an example for a this type of knowledge (Wilson, J.W., Fernandez, M.L., Hadaway, N., 1999).

For learning root totals and root products of a second-degree equivalency and solving problems by combining trigonometric rates with these and likely properties, exercises should be made by both of the two groups.

Models, which are a tool of material education, play a key role in interpreting science and help in understanding complex concepts. Also supports students to produce new and creative thoughts (Gilbert, K. J., Boulter, C., 1998). According to Van Hiele the most important reason for the mistakes that students make (Van Hiele, P. M., Van Hiele-Geldof, D., 1958) is the vision which is one levels of geometric thinking levels.

To make them able to use distance and angle relations, geometry lessons which include plane geometry, should also be given. It should be insisted more on trigonometric properties and identities. The tangent and vertical properties in circle should be determined well and the synthetic examination of the circle should be made in a better way. While working on these subjects, there should be a tool laboratory for mathematics and as well as objects of plane geometry, objects of space geometry should be kept in there.

As Cornell also stated, " Math education should be entertaining and interesting. When students are pleased in a math lesson which is equipped with projects, concepts, shows and likely activities, learning and motivation increase in education (Cornell, C., 2000).

Both of the two groups have successfully achieved determining equivalency classes of a set according to a given relation. The operations for determining function and reverse function should be handled more detailed by Science and Literature Faculties. More students should comprehend the operations in modular arithmetic. More

exercises should be made on this subject. The lack of preliminary and talent about sets subject effects possibility concept negatively (Bar-On, E., Or-Bach, R., 1988).

A good level of success was observed on sets subject. However, some basic properties related to the operations in sets wasn't determined completely by two groups. For this reason, operations in sets should be examined more carefully in lessons of Abstract Mathematics and Analysis.

Lesson books are another factor that causes misconceptions. Lesson books should be investigated by this point of view. It is agreed that "Lesson Books" and "Assistant Lesson Books" have an important part in education. This situation bears the obligation for arranging publications in a suitable way. Otherwise, one of the components of education remains missing (Alkan, H.ve arkadaşları, 1996).

Many different researches show that Elementary and Secondary Level students also have misconceptions. For this reason, misconceptions of the teachers working in Secondary Education Institutions should be relieved by inner service courses, seminars and publications. We think that it is necessary to conduct these kinds of studies in Educational Faculties for teacher candidates to be relieved from these misconceptions.

## LITERATURE

- Aksu, M. "Problem Areas Related to Statistics in Training Teachers of Mathematics in Turkey". A. Hawkins (Ed.), Training Teachers to Teach Statistics. International Statistical Institution. Voorburg, ss:127-137, (1990).
- Alkan, H., Altun, M. "Matematik Öğretimi", Anadolu Üniv. Yayınları, No: 1072, Eskişehir, (1998).
- Alkan, H., Sezer, M., Özçelik, A.Z., Köroğlu, H. "Matematik Öğretiminde Yeni Bir Model Yaklaşımı", II. Ulusal Eğitim Sempozyumu, Marmara Üniv. Eğt. Fak. , 19-20 Eylül, 1996.
- Alkan, H., Özçelik, A.Z., Köroğlu, H. "Ülkemizde Uygulanan Matematik Öğretiminde Görülen Yanlışlıklar ve Temel Nedenleri", II. Ulusal Fen Bilimleri Eğitimi Sempozyumu, ODTÜ Eğt. Fak., 11-13 Eylül, 1995.
- Alkan, H., Sezer, M., Özçelik, A.Z., Köroğlu, H. "Matematik Öğretiminde Ölçme ve Değerlendirmenin Etkisi", II. Ulusal Eğitim Sempozyumu, Marmara Üniversitesi, Atatürk Eğitim Fakültesi, İstanbul, 1996.
- Baki, A., Budak, İ. "Excel yardımıyla yeni bölünebilirlik kuralları tanımlama", EBİD'99 Sempozyumu Kitapçığı, s.76-78, (1999).
- Bar-On, E. Ve Or-Bach, R. "Programming Mathematics: A New Approach in Introducing Probability to Less Able Pupils", Journal of Mathematics Education in Science and Technology, 19(2): 281-297,(1988).
- Carpenter, T.P., Corbitt, M.K., Kepner, H.S., Linquist, M.M. ve Reys, E.R. "What are the Chances of Your Students Knowing Probability?", Mathematics Teacher, 73: 342-344, (1981).
- Cornell, C. "Matematikten Nefret Ediyorum", Yaşadıkça Eğitim, 65 Ocak-Mart: 15-22, (Çev: Eyüboğlu, N.), (2000).
- Gilbert, K. J., Boulter, C." Models in explanations. Part 1: Horses for courses?", Int. J. Sci. Educ. 20 (1), 83-97, (1998 a).
- Glover, A.,Roning, R. R., ve Bruning, R. H. "Cognitive Psychology for Teachers", The United States Of America, Macmillan Publishing Company, (1990).
- Gürol, M. "Teknik Öğretmen ve Adaylarının, Teknik Öğretmen Eğitiminde Bilgisayar Kullanımına İlişkin Görüşleri", Eğitim ve Bilim Dergisi, Ankara, (1997).
- Fidan, N. "Okulda Öğrenme ve Öğretme", Aklım yayınları, sayfa: 189, Ankara, (1985).
- Fischein, E. Ve Schnarch, D. "The Evolution with Age of Probabilistic, Intuitively Based Misconceptions", Educational Studies in Mathematics, 29: 97-105, (1997).
- Köroğlu, H., Albayrakoğlu, Kayser, S. "Matematik Öğretiminde Temel Kavramların Verilmesinde Karşılaşılan Güçlükler ve Giderilme Yolları", II. Ulusal Eğitim Sempozyumu, Marmara Üniv. Eğt. Fak. , 19-20 Eylül, 1996.
- Lawson, A.E. and Thompson, L.D. "Formal reasing ability and misconceptions concerning genetics and natural selection", Journal of Research in Science Teaching, Vol. 25: 733-746, (1988).
- Marek, E.A. and Cowan, C.C. and Cavallo, A.M.L." Students misconceptions about difusion: How can they be eliminated", The American Biology Teacher, Vol, 56: 74-77, (1994).
- Milli Eğitim Bakanlığı, "XII. Milli eğitim şurası kararları", Tebliğler Dergisi, 51, (2274), (1988).
- Monaghan, J. "Adolecent's Understanding of Limits and infinity", Unpublished Ph.D. Thesis, University of Warwick, (1986).
- Piaget, J. Ve Inhelder, B. "The Origin of the Idea of Chance in Chidren". New York, W.W. Norton Şirketi, (1975).
- Şahin, F., Gürdal, A., Berkem, M. L., "Fizyolojik Kavramların Anlamli Öğrenilmesi ile İlgili Bir Araştırma", IV. Fen Bilimleri Eğitimi Kongresi' 2000, Hacettepe Üniversitesi, Eylül, (2000).
- Teaching Physics , Volume 34, number 5 , , pp:294, September, (1999).

- Toluk, Z., “ A study on the Secondary School Teachers Views on the Importance of Mathematical Knowledge and When They Acquired This Knowledge”, Basılmış Yüksek Lisans Tezi, ODTÜ, (1994).
- Ubuz, B. “ 10 ve 11. Sınıf Öğrencilerinin Geometride Kavram Yanılgıları ve Cinsiyet Farklılıkları “ İzmir. Öğretmen Eğitiminde Çağdaş Yaklaşımlar Sempozyumu, DEÜ, Buca Eğitim Fakültesi, (1999).
- Ülgen. G. “ Kavram Geliştirme: Uygulama ve Kuramlar”, Ankara: Özkan Matbaacılık Sanayi, (1988).
- Van Hiele, P.M., &Van Hiele-Geldof, D. “ A method of initiation into geometry”. In H. Freudental (Ed). Report on Methods of Initiation into Geometry, Groningon, Walters , (1958).
- Wilson, J. W., Fernandez, M. L., and Hadaway, N. “ Mathematical Problem Solving”, <http://jwilson.coe.uga.edu/emt725/PSsyn/PSsyn.htm>, (1999).
- Wong, E. D. “Self- generated analogies as a tool for constructing and evaluating explanations of scientific phenomena.” Journal of Research in Science Teaching. 30, 367-380, (1993 a).
- YÖK/ Dünya Bankası, “ Okullarda Uygulama Çalışmaları Ortaöğretim”, Ankara , (1997).