AN EXPERIMENTAL STUDY OF PRE-SERVICE SCIENCE TEACHERS BASED ON THEIR SUCCESS IN ASTRONOMY

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Abstract

The aim of this study is to test the success of pre-service Science teachers in the basic knowledge related to astronomy and alternative concepts they possess in the graduate program. In order to do this, a study was implemented to 90 final year (forth year) pre-service Science teachers from education faculty in a university located in the Black Sea region of Turkey. This study had one group (no control group) and pre-, post-test experimental research design was the method used in the study. A 32 question "Astronomy Achievement Test" that validity and reliability studies had been performed on was used as a data collection tool. T-test for the related samples was used for data analysis. The results revealed significant differences in success in astronomy of pre-service Science teachers in favor of the post-test. During the study while there was a decrease in some of the alternative concepts others stayed the same. From results obtained it was proposed to investigate the effectiveness of the elimination of alternative concepts by performing a variety of studies on pre-service Science teachers. In addition, it was thought to be useful to increase the number of hours for the 2-hour long astronomy lesson in the curriculum of Science teaching department.

Keywords: Astronomy, pre-service science teacher, experimental study.

INTRODUCTION

Human beings are by nature curious beings and ever since the beginning of time we have been trying to understand the universe, the basic way in which it works and how we can use it to make our day to day life easier. Astronomy is one of the oldest principles of science and we have made great progress in understanding this field over millions of years. Lastly. Galileo facing his telescope his telescope toward the sky for the first time was a touch stone which increases the speed in the period where Humans were understanding nature and the universe. During present times the space age Astronomy has become an indispensable part of our culture which is relative to our daily lives from every aspect. Astronomy is related to other basic principle (Physics, Chemistry, Geology and mathematics) and it plays a central role in natural sciences. Astronomy generally alongside Philosophy contains important cultural content like; Humanity's distant roots, Space and our small place in time-knowing our location and cosmologic aspects.

Astronomy field success is directly related to developed technologic methods like; Optics. Electronic, Detector techniques of all wave lengths, Image proceeding computer techniques and Taking, transferring and saving of Hufe data (Trumper, 2006). In current day Astronomy education takes a significant role in books, magazines, radio, TV, Astronomy clubs, amateur-youth groups camps and the internet outside the classroom (Fraknoi, 1996).

Studies related to Astronomy started a very long time ago, Astronomy being the oldest field of study. Sputnik being launched into space in 1957 increased the speed of education in Astronomy. This is because the developed countries did not want to be left behind space race they started education-teaching programs to educate the society on scientific terms (Borghi et al., 1991; Department of Employment, Education and Training, 1989; Orpwood & Souque, 1985) In order to realize this astronomy benefited from visual wealth Visual wealth. This situation took the education of astronomy to the fore ground.

University Students and Pre-Service Teachers' Conceptions of Astronomy Concepts
Concepts of astronomy are more often than not abstract and three dimensional (Yu,2005). This causes a major problem when it comes to grasping and correctly understanding the concepts of astronomy. Because of this when individuals understand astronomy it helps in their general perception and comprehension abilities. Therefore, understanding other abstract concepts in science and technology. This situation clearly shows the relationship between science and technology and astronomy. Over the last 30 years when we look at the studies that have been carried out in astronomy it is evident that the number of studies carried out in primary school. (Baxter, 1989; Bisard et al., 1994; Klein, 1982; Mant & Summers 1993; Sharp, 1996; Sneider & Pulos, 1983; Trundle et al.,2002; Vosniadou, 1992; Vosniadou & Brewer,1992, 1994) are more the ones done in university (Bisard et al., 1994 Kalkan & Kıroglu, 2007; Trumper, 2001a; 2001b, 2001c, 2003, 2006b; Zeilik et al., 1998). Pasachof and Percy (1990) the answers of questions like, Should Astronomy be taught as an independent subject or should it be part of another subject; If it is taught, which topics should be taught; Which age group should it be taught to and which methods and techniques should be used; were researched. Most primary school teachers (especially in the field of astronomy) possess insufficient knowledge. This can be attributed to the fact that astronomy is taught in ways that are not suitable for the developing mind of the student, this in turn causes hardships in comprehension of this topic. Bisard & et al (1994) carried out a study to test alternative concepts in geography and science on 700 students ranging from primary school through university level. The aim of the study was to see if alternative concepts would decrease with the level of education, and multiple choice questions were used as a tool of measurement. The interesting thing about the result was that the alternative concepts were basically the same for primary school students and pre-service teachers. This shows that there is no significant change level of knowledge after primary school. When we generally look at the studies carried out on pre-service teachers related to concepts in astronomy we can see that we are faced with the same problems in relation to alternative concepts. Zeilik et al. (1998) investigated the conceptions of science and non-science university majors on several physical and astronomical concepts. They found that, before entering an "Introduction to Astronomy" course at the university, only 10% of the students held the correct view of the Moon's rotation, 23% had the right conception of the Sun overhead and about 30% knew the accepted scientific explanation of the phases of the Moon and the solar eclipse. Trumper (2001c), A study carried out on 433 university students (156 in first year, 122 in second year, 87 in third year and 68 in fourth year) The student's alternative concepts and the changes according to the class level was examined by using a test made up of 19 questions. The findings show that science and non-science oriented college students in pre-service training to become high-school teachers hold a series of misconceptions on several central topics in basic astronomy. Lastly, Kalkan and Kıroğlu (2007) a study carried out on science and social studies pre service teachers showed that there were many alternative concepts when it came to basic concepts in Astronomy. The differences in the ratio of the correct answers given by the Pre- service teachers was observed throughout a semester. The result of the study showed that Pre-service teachers experienced difficulty in explaining basic scientific ideas on the location of Earth and the concrete-abstract relationship related to the location of other celestial bodies.

The Purpose and Research Questions of the Study

This study was aimed to test the level of success in astronomy of pre-service science teachers after using a variety of methods and techniques to teach them this topic. In order to achieve this, aim the problem question and sub-problem questions below were researched. This study's main problem statement was as follows;

"*What were the changes observed after using a variety of methods and techniques to teach pre-service teachers Astronomy?*"

In the frame of this problem statement the sub-problem statements below were researched.

- Is there a significant difference in the success of pre-service teachers related in astronomy before and after the study?
- Which are the most alternative concepts faced by pre-service teachers in relation to astronomy?
- Were there any differences in alternative concepts of pre-service teachers in relation to astronomy?

METHOD

This is an experimental study aimed at testing the effect on the level of success in Astronomy of pre-service science teachers after using a variety of methods and techniques prepared for the purpose of educating them. The research was designed in a one-group pre-test post-test research method. In this design the variable dependent subject measurements are tested before application by a pre-test and later the same variable dependent subjects are measured by a post-test (Fraenkel, Wallen & Hyun 2012). Due to the fact that all science pre-service teachers take the Astronomy class together there was no control group.

Sample

The research sample group was made up of science pre-service teachers from a university in Turkey's Black sea region. In order to reach the research sample target group simple random sample method was used. The sample group consisted of 56 female and 34 male students.

Data Collection Instrument and Data Analysis

In this study "Astronomy Achievement Test" (AAT) Türk & Kalkan (2015) was used as a data collection tool. This is a valid and reliable tool designed to test student's success related to terms in Astronomy. The test was made up of 32 multiple choice questions with average difficulty, average discrimination and KR-20 as illustrated in Table 1 below.

Table 1: Information about AAT

	Total Item	**N**	**Difficulty p**	**Discrimination rjx**	**KR-20**
AAT	32	90	0,49	0,40	0,81

The result was analyzed by using SPSS 22.0 statistic program. Before statistical analysis, descriptive statistics was calculated on all the results from the test taken by pre service teachers. To determine whether parametric or non-parametric analysis technique would be used during the result analysis. The following criterion was examined.

– The results not showing a normal distribution
– Is the study group made up of less than or more than 30 people?

When the analysis technique used for quantitative data analysis was being determined, the date distribution suitability for a normal distribution needed to be tested. If the data showed a normal distribution the parametric test would be used. The second point was the number of people in the group that was going to be compared. If the number of participants is more than 30 due to the normal distribution hypothesis it is possible to use parametric tests (Can, 2014). The number of pre service teachers in this study was more than 30. This met the requirement of the more than 30 people

17

needed in order to use the parametric test. Normality test was applied to test whether the data in the other criterion showed normal distribution. The results related to AAT'S normality test are as in Table 2 below.

Table 2: The Results of Normality Tests

Test	Kolmogorov-Smirnov		
	Statistic	df	p
Pre-	,104	90	,170*
Post-	,194	90	,089*

*p>,05

When Table 2 was examined, it can be seen that all the tests showed normal distribution. Due to this it was decided to use parametric analysis technique to analyze the AAT data. Dependent sample t-test technique was used to determine whether the Astronomy success results to the pre- and post-test of the pre service teachers had a difference according to the level. The significance level was taken as 0.05 while analyzing the statistic results. In order to test the effect of Independent on every dependent Cohen's value that shows effect margins was calculated. According to Cohen's value comments 0.20 is small,0.50 middle and 0,80 high (Cohen, 1988).

Experimental Process
The study was implemented on 4th year science students during the 2nd semester's astronomy unit, in the academic year 2015-2016. Astronomy is a 2 credit unit given 2 hours every week. Special attention was paid to having the students who took the pre-test take the post-test.

Table 3 contains the educational activities that took place during the 14 week pre-graduate program. The last tests were taken 2 weeks after the end of the classes.

Table 3: Educational Activities That Took Place During the Experimental Period

Weeks	Learning Environment	Activity	Method
1,2	Classroom	Power Point	Presentations
3,4	Observatory	Observatory Implementations	Observation
5,6	Planetarium	Planetarium Implementations	3D simulation
7	Classroom	Classroom Implementations	Documentary
8	Examination	-	-
9,10,11	Classroom	Hands-on Implementations	Hands on learning
12	Outdoor	Sun Observing	Observation
13,14	Classroom	Discussing	Question answer

FINDINGS

The results from the Pre service teacher's AAT test and descriptive statistic values are given in the Table 4 below.

Table 4: Descriptive Statistics Related to AAT

Test	N	Mean	SD
Pre-	90	20,7778	3,63744
Post-	90	28,9111	2,47070

When Table 4 examined, it can be seen that pre-test and post-test values are significant positive outcome. To determine whether the difference seen between the pre- and post-test AAT result values of the preservice teachers was significant a t test was done and the results are as in table 5 below.

Table 5: T-test Results

Test	Mean	SD	df	t	p	Cohen's d
Pre - Post-test	-8,13333	4,56710	89	-16,895	,000	,26

When Table 5 was examined, the difference in the result of the success in astronomy of the pre-service teachers seen is statistically significant (t=-16.895, p<0.05). This finding shows that the method used on the pre service teachers during the study had an effect on the increase in their success in Astronomy. When we look at Cohen's P value (0.26) we can also say that the experimental effect on the result of the student's success that we are looking at is limited.

In order to identify the alternative concepts that pre-service teachers possess the test was designed in a such a way that the multiple choices had distracters. The Table 6 below illustrates the most common alternative concepts in this field as per the change in the pre-test and the post-test.

Table 6: The Percentages of the Most Widespread Alternative Concepts of Pre-Service Teachers

Concept	Alternative Concept	Pre Test (%)	Post Test (%)
Day and night	The Earth's rotation around the sun	14,4	2,2
Overhead position of the sun	Every day at noon	45,6	27,8
The sun's changing position in the sky within the day	The Earth's rotation around the sun	32,2	21,1
The orbit of the earth around the sun	Axis	13,3	2,2
Direction of the earth's rotation	From east to west	31,1	4,4
Summer being a hotter season than winter	The Earth is closer to the earth during summer	22,2	3,3
Occurrence of seasons	Change in the distance between the Sun and the Earth	20,0	1,1
Occurrence of seasons if the distance between the earth and the sun stays constant	Seasons would not occur	60,0	10,0
	Only Summer and Winter would occur	13,3	3,3
One revolution of the moon around the earth	1 week	10,0	0,0
Order of the phases of the moon	New moon-First quarter-Last quarter-Full moon	15,6	8,9
Universal size	The Earth is bigger than Jupiter	25,6	3,3
Universal distance	Pluto is closer to the Earth than the sun	40,0	11,1
Constellations (Relative distance)	From the surface of the Moon constellations appear different	17,8	2,2
Satellite technology (Artificial satellite)	Between the Earth and the Moon	44,4	7,8
	Very close to the Moon	24,4	3,3
Solar eclipse	Full moon	61,1	3,3
Lunar eclipse	Solar eclipse	23,3	3,3

As seen in Table 6 pre-service teachers had alternative concepts in Astronomy. After the experimental procedures a significant percentage of the alternative concepts reduced, It's safe to say that alternative concepts were almost completely taken care of.

DISCUSSION AND CONCLUSIONS

As seen through out the study Astronomy concepts require a high level of observation and perception. From the pre-test it is very clear that pre-service teachers have a problem when it comes to grasping these concepts. The result is that when pre service teachers graduate and become science teachers when they teach concepts in astronomy they will cause the students to have the same alternative concepts that they do. This problem can only be solved in the university's education faculty by giving better quality education. Pasachoff and Percy (2005) clearly states that in lots of countries most pre-service teachers don't fully comprehend Astronomy concepts and this makes explanation of these concepts a challenge. This study gives a valid solution to this problem when a variety of methods and techniques is used in transferring information a significant percentage of the problem is solved. From the study we can openly see a positive development in the preservice teachers when we use more than one method and technique at a time.

As seen in table 6 after the pretest we can clearly see that the pre service teachers possessed alternative concepts in the field of Astronomy. At the same time after the experimental period we can see remarkable change in the alternative concepts. They were almost completely taken care of. This situation is clear in Table 6. This result shows the remarkability of our study's originality. A study showed that the same alternative concepts experienced by primary school students were also experienced by pre service teachers (Bisard et al., 1994; Lightman & Sadler, 1993; Trumper, 2001b, 2006). The best way to reduce the alternative concepts experienced by primary school students is to have them prepared in the basic concepts in Astronomy therefore providing the suitable educational environment. This is why the primary school level science teachers that will teach the students concepts of Astronomy need to have good knowledge of this topic (Kalkan & Kıroğlu, 2007). Astronomy concepts are relatively abstract Therefore Pre-service teachers need to use Concrete-physical-scale models ,3D stimulation models, Planetarium environment should be used and Indoor and outdoor models. Pre-service teachers should be taught how to use these models effectively. Therefore, students from this concrete period where explaining astronomy concepts in the 2-dimensional traditional method is hard and not effective more suitable methods from the constructivist approach should be used.

In Turkey Astronomy class in the educational faculty is only taken in the science education department in a period of one semester for 2 hours every week. In the class teaching department despite the fact that they don't have the Astronomy class they also don't have any class that contains topics related to Astronomy. Concepts in Astronomy are only mentioned indirectly in some of their field's classes. Therefore, the vicious cycle continues with the preservice teachers passing on the same wrong information to their students when they get in the field. Similarly, in a study carried out by Bisard et al. (1994) pre service teachers and students have almost the same level in the success in Astronomy, this shows that after primary school there is no significant change in the level of success of students. This shows that a class in Astronomy should definitely be given to pre service class teachers. It is also thought that increasing the no. of hours of Astronomy taken by pre-service science teachers would be beneficial. Therefore, the pre service teachers will have enough gear in these topics before commencing in their professional lives. In addition to this teacher in the field should be regularly equipped with new information new methods and techniques on basic astronomy. It is thought that application of teacher support programs in cooperation with higher education institutions and teachers being provided with the opportunity to attend pre service classes will positively influence the quality of education in Astronomy.

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