JOURNAL OF EDUCATIONAL
AND INSTRUCTIONAL STUDIES IN THE WORLD
February 2017, Volume: 7 Issue: 4 ISSN: 2146-7463

THE COMPARISON OF THE SUCCESS OF PRE-SERVICE MATH AND SCIENCE TEACHERS REGARDING ASTRONOMY

Assist. Prof. Dr. Cumhur Türk
Muş Alparslan University- Turkey
c.turk@alparslan.edu.tr

Prof. Dr. Hüseyin Kalkan
Ondokuz Mayıs University- Turkey
kalkanh@omu.edu.tr

Assist. Prof. Mualla Bolat
Ondokuz Mayıs University- Turkey
mbolat@omu.edu.tr

Demet Gürel
Ondokuz Mayıs University- Turkey
dmt.grl05@gmail.com

Abstract
The objective of this study was to find out the changes in pre-service Mathematics and Science teachers' achievements about the subjects of basic astronomy as a result of their teaching program, to compare these changes in terms of departments. For this purpose, the study was conducted with pre-service elementary school Mathematics and Science teachers studying their first and fourth years in the education faculty of a university chosen from the Black Sea region of Turkey. "Astronomy Achievement Test" which had 32 questions and which was tested for validity and reliability was used as data collection tool. T-test was used for the data analysis of independent samples in order to find out whether pre-service teachers' levels of achievement about the subjects of basic astronomy differed in terms of their department and their year of study. As a result of data analysis, although pre-service Mathematics and Science teachers started their undergraduate education at the same level in terms of basic astronomy, statistically significant difference was found in the achievements of pre-service Science teachers while no significant difference was found in pre-service Mathematics teachers. Thus, it was thought that it would be useful to add astronomy lesson to elementary school Mathematic teaching department curriculum and to increase the hours of 2-hour long astronomy lesson in the curriculum of Science teaching department. In addition, conducting various experimental studies to examine the efficiency of these was recommended to improve astronomy achievement of pre-service teachers.

Keywords: Astronomy, pre-service teacher, alternative concept.

INTRODUCTION

The sky has happened to be one of the mysteries that need to be solved for human beings. With a brief look at the past, we can see that the sky has been a subject for spells, poems and most importantly religions. The explanations brought for the sky in the light of data collected by telescopes are the subject of science. The field of science which researches the places of heavenly bodies, their physical presence, the differences they have undergone from past to present, their physical and chemical structures and presents theories about these is called astronomy. According to Düşkün (2011), astronomy is the field of science that studies the Earth, the Moon, the Sun, and the planets in the Solar system, the stars, interstellar environment and galaxies. According to the Ministry of National Education (MEB, 2011), astronomy has been defined as a field of science that explains the

mystery of the sky, sheds a light on the origins of the Earth and the developmental process of human beings and all the building blocks of the universe of all sizes. Astronomy is one of the oldest sciences that researches concepts such as stars, comets, satellites, space and solar system (Pena & Quilez, 2001). As stated in the definitions, the evolution of science on the path to understand the universe has been effective in the emergence of different sciences. Within these different sciences, physical sciences include astronomy. Aslan (2006) stated the connection between physical sciences and astronomy as "Universe is the biggest laboratory and astronomy is the indispensable part of natural sciences. It is the oldest and at the same time the newest science that has developed fast with especially satellite technology. Developments have provided very quick accumulation of knowledge about the universe. The assessment of fast accumulating knowledge and the urge to analyze the universe deeper in terms of distance and the urge to learn about the earlier times increase the interest in this field".

Astronomy education and teaching have a big importance also in science education. The developments that have recently gained speed in space sciences accelerates the developments in other basic sciences. Astronomy can be thought as a perfect education tool that can be used in teaching correct and reasonable thinking to people. Developed countries such as the United States of America (USA) use astronomy effectively to canalize students to physical sciences and to make students like science (Tunca, 2002).

The Purpose and Research Questions of the Study

The objective of this study is to find out the changes in pre-service middle school mathematics and science teachers' achievements in basic astronomy subjects as a result of the teaching program in education faculties and to compare these changes in terms of departments. To this end, answers were sought to the following problem statement and sub problems. The main problem statement of this study is as follows;

"How are the achievement levels of pre-service middle school mathematics and science teachers about basic astronomy subjects?"

Within the context of this problem statement, answers were sought to the following sub problems.

- Is there a significant change in the astronomy achievement scores of pre-service science teachers in terms of their class level?
- Is there a significant change in the astronomy achievement scores of pre-service middle school mathematics teachers in terms of their class level?
- Do the astronomy achievement scores of pre-service teachers differ in terms of the program they are educated in?

METHOD

This study is a descriptive survey conducted to find out the achievement levels and alternative concepts of pre-service middle school mathematics and science teachers related to basic astronomy concepts and to analyze the differences in terms of students' departments and their class level. Survey research designs are procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behaviors, or characteristics of the population (Creswell, 2012). In this research the data collected at just one point in time using cross sectional survey which is one of the survey designs. The cross sectional survey collects information from a sample that has been drawn from a predetermined population (Fraenkel, Wallen, and Hyun 2012).

Sample

The sample of the study consists of pre-service middle school mathematics and science teachers studying at a university chosen from Black Sea Region of Turkey. In order to reach the sample, simple random sampling method, which is one of the random sampling methods, was used. The demographic information about the sample is given in Table 1.

Table 1: Sample

Gender	Pre-Service Science Teacher		Pre-Service Mathematics Teacher	
	1st Grade	4th Grade	1st Grade	4th Grade
Female	30	34	26	35
Male	10	6	14	5
Total	**40**	**40**	**40**	**40**

Data Collection Instrument and Data Analysis

As data collection tool, "Astronomy Achievement Test" (AAT), which is a valid and reliable test developed by Türk and Kalkan (2015) to measure students' achievements related to basic astronomy concepts, was used. Table 2 gives information about the average difficulty, average distinctiveness and KR-20 reliability coefficient of the test, which has 32 items.

Table 2: Information about MAT

	Total Item	N	Difficulty p	Discrimination rjx	KR-20
AAT	32	160	0,59	0,34	0,75

KR-20 reliability coefficient of AAT was found as 0.75 at the end of the application. This result is parallel with its original (Türk & Kalkan, 2015).

SPSS 22.0 statistical program was used for the data obtained from the implementation of AAT. Before the statistical analysis, descriptive analyses were calculated for the scores taken from each test. After this, the following criteria were analyzed to find out which parametric/non-parametric technique to use for data analysis.

- Are the data normally distributed or no?
- Is the study group more/less than 30 people?

While determining the analysis technique of quantitative data, the data should be tested for having normal distribution. If the data have a normal distribution, parametric tests are used in analysis. The second point to take into consideration is the number of people to compare in groups. If the number of participants in groups is more than 30, it is possible to use parametric tests assuming that the results obtained from the data will be distributed normally (Can, 2014).

The number of pre-service teachers in this study is more than 30. Thus, the criterion that having a number of participants more than 30 was fulfilled. Normality tests were conducted to test whether the data were normally distributed, which is another criterion. Normality test results of AAT are given in Table 3.

Table 3:The Results of Normality Tests

	Kolmogorov-Smirnov		
Program	**Statistic**	**df**	**p**
Science	,100	80	,056*
Mathematics	,090	80	,165*

*p>,05

When Table 3 is analyzed, it can be seen that the data were normally distributed in all groups. Thus, parametric analysis techniques were decided upon to be used in the analysis of AAT data.

Independent Sample t-test techniques was used to find out whether the astronomy achievement scores of pre-service middle school mathematics and science teachers differed in terms of their department and the class level. While the statistical results were being interpreted, significance level was taken as 0,05. Cohen's d values, which show the effect size, were calculated to test the effect of

independent variables on each dependent variable. 0,20 Cohen's d value shows small effect, while 0,50 shows moderate effect and 0,80 shows big effect (Cohen, 1988).

FINDINGS

Table 4 presents descriptive statistics that include pre-service teachers' average achievement scores and standard deviation values from AAT.

Table 4: Descriptive Statistics of MAT

	Grade	N	Mean	SD
Science	**1st**	40	16,5750	3,45586
	4th	40	20,9000	3,68504
Mathematics	**1st**	40	17,1500	4,22781
	4th	40	17,1750	4,31983

When Table 4 is analyzed, it can be seen that there is a scarce difference between the average astronomy achievement scores of pre-service middle school mathematics teachers in first and fourth classes. On the other hand, a significant improvement was seen in the average achievement scores of pre-service science teachers.

Independent groups t test was conducted to determine whether there were significant differences between the astronomy achievement scores of pre-service middle school mathematics and science teachers at the level of first class and the results are given in Table 5.

Table 5: T-Test Results of First Year Pre-Service Middle School Mathematics and Science Teachers' Basic Astronomy Achievement Scores in Terms of Department

Grade	Program	N	Mean	SD	df	t	p
1st	**Science**	40	16,5750	3,45586	78	-0.666	0.524
	Mathematics	40	17,1500	4,22781			

When Table 4 is analyzed, it can be seen that basic astronomy achievement levels of first year pre-service middle school mathematics and science teachers do not differ significantly in terms of their department *(t=-0,666, p>0,05).* This result shows that astronomy achievement levels of pre-service middle school mathematics and science teachers are equal when they start their teaching education.

Table 6 gives the unrelated samples t-test results conducted for independent groups in order to test whether the scores of fourth year pre-service middle school mathematics and science teachers from basic astronomy test differed significantly in terms of their department.

Table 6: T-Test Results of Fourth Year Pre-Service Middle School Mathematics and Science Teachers' Basic Astronomy Achievement Scores in Terms of Department

Grade	Program	N	Mean	SD	df	t	p	Cohen's d
4th	**Science**	40	20,9000	3,68504	78	4,149	0,000*	0,39
	Mathematics	40	17,1750	4,31983				

*p<,05

When Table 6 is analyzed, it can be seen that astronomy achievement levels of fourth year pre-service middle school mathematics and science teachers differ significantly in terms of their department *(t=4,149, p<0,05.* This difference was found to be in favor of pre-service science teachers. In addition, it can be stated that according to Cohen's d value, students' departments did not have a high effect on students' astronomy achievement (d=,39).

Table 7 gives the unrelated samples t-test results conducted for independent groups in order to test whether the average achievement scores of pre-service science teachers from astronomy test differed significantly in terms of their level of class.

Table 7: Independent Sample T-Test Results of Astronomy Achievement Test Scores of Pre-Service Science Teachers in Terms of Their Level of Class

Program	Grade	N	Mean	SD	df	t	p	Cohen's d
Science	**1st**	40	16,5750	3,45586	78	-5,414	0,000*	0,12
	4th	40	20,9000	3,68504				

*p<,05

When Table 7 is analyzed, it can be seen that astronomy achievement scores of first year and fourth year pre-service science teachers differed statistically significantly in terms of level of class *(t=-5,414, p<0,05).* In addition, it can be stated that according to Cohen's d value, students' level of class had a low effect on students' astronomy achievement (d=,12).

Table 8 gives the unrelated samples t-test results conducted for independent groups in order to test whether the average achievement scores of pre-service mathematics teachers from astronomy test differed significantly in terms of their level of class.

Table 8: Independent Sample T-Test Results of Astronomy Achievement Test Scores of Pre-Service Mathematics Teachers in Terms of Their Level Of Class

Program	Grade	N	Mean	SD	df	t	p
Mathematics	**1st**	40	17,1500	4,22781	78	-,026	0,979
	4th	40	17,1750	4,31983			

The results in Table 8 show that astronomy achievement scores of first year and fourth year pre-service mathematics teachers did not differ statistically significantly in terms of level of class *(t=-,026, p>0,05)*

DISCUSSION AND CONCLUSION

As a result of analyses conducted to answer the study's first sub problem "Do the astronomy achievement scores of pre-service science teachers differ significantly in terms of their class level?", a significant difference in favor of fourth class was found between the astronomy achievement scores of first and fourth classes. In education faculties in Turkey, astronomy classes are only 2 hours for a term in the undergraduate program of Science teaching department. Thus, this situation can be the reason of the result in our study. In other words, the reason for the increase in the astronomy achievement of pre-service science teachers in their fourth year can be the 2 hours of astronomy class in the last year of Science teaching undergraduate program. Similarly, in his study Türk (2016) stated as the reason for why the astronomy achievement of pre-service science teachers did not change as their classes and ages advanced until their achievement increased suddenly at their fourth year was because the 2-hour astronomy class in science teaching undergraduate program was given in students' fourth year. These results are in parallel with the results of some studies in literature (Bisard et al., 1994; Emrahoğlu ve Öztürk, 2009; Kalkan ve Kıroğlu, 2007; Trumper 2001; Zeilik et al., 1998).

As a result of analyses conducted to answer the study's second sub problem "Do the astronomy achievement scores of pre-service middle school mathematic teachers differ significantly in terms of their class level?", no significant difference was found between the first and fourth year astronomy achievement scores of pre-service teachers. Astronomy achievement scores of pre-service teachers in

first year and fourth year were found to be very close. This result shows that the education pre-service teachers get in the education faculty does not have any effect on their astronomy success. While there is no astronomy lesson in mathematics teaching undergraduate program, there are also no other lessons which include astronomy subjects. Some astronomy concepts are thought indirectly only in mathematics field lessons. Thus, a vicious circle emerges as pre-service mathematics teachers teaching the astronomy knowledge when they become teachers with the astronomy knowledge they learned in their primary school. Similarly, Bisard et al. (1994) showed that pre-service and middle school students had almost the same achievement percentage and as a conclusion, astronomy knowledge of students did not change significantly after middle school. Thus, astronomy lesson should be certainly added in mathematics teaching undergraduate program.

As a result of analyses conducted to answer the study's third and last sub problem "Do the astronomy achievement scores of pre-service teachers differ significantly in terms of their department?", it was found that although pre-service science and middle school mathematics teachers started their teaching education equally in terms of their astronomy achievement, pre-service science teachers were found to be more successful than pre-service mathematics teachers four years later.

Research Limitations and Future Directions

- In line with the results of the study, the number of astronomy lessons in science teaching undergraduate program should be increased and astronomy lessons should be included not only in the fourth year, but also in first, second, third and fourth years.
- Astronomy lesson should be included in mathematics teaching undergraduate program.
- This study was planned as a latitudinal study. Although this saves time, it also has limitations such as not being able to take data from the same person in different time intervals. Thus, developmental (longitudinal) studies can be conducted which will measure the astronomy achievement of pre-service teachers with measurements from different levels (1st, 2nd, 3rd, 4th class) of the same sample.
- Since this was a quantitative study, we did not have the chance to get thorough information about some subjects. Thus, qualitative studies can be conducted on the astronomy achievement of pre-service teachers. This study is a descriptive study. Various experimental studies can be conducted to increase the astronomy achievement of pre-service teachers and the efficacy of these studies can be examined.

WJEIS's Note: This article was presented at 5th World Conference on Educational and Instructional Studies**-** WCEIS, 27- 29 October, 2016, Antalya-Turkey and was selected for publication for Volume 7 Number 1 of WJEIS 2017 by WJEIS Scientific Committee.

REFERENCES

Aslan, Z. (2006, 27-29 Mart). *Astronomi neden okutulmalı?* 2006 Tam Güneş Tutulması ve Astronominin Fen Bilimleri Eğitimindeki Yeri Sempozyumunda sunuldu, Antalya.

Bisard, W. J., Aron, R. H., Francek, M. A., & Nelson, B. D. (1994). Assessing selected physical science and earth science misconceptions of middle school through university pre-service teachers: Breaking the science 'misconception cycle'. *Journal of College Science Teaching*, 24(1), 38-42. Retrieved from http://adsabs.harvard.edu/abs/1994JCSTe..24...38B (accessed 17 May 2014).

Can, A. (2014). *Quantitative data analysis with SPSS research process*. (2nd ed.). Ankara: Pegem Akademi.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.) Hillsdale, NJ: Erlbaum.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson.

Düşkün, İ. (2011). Güneş-dünya-ay modeli geliştirilmesi ve fen bilgisi öğretmen adaylarının astronomi eğitimindeki akademik başarılarına etkisi. Yüksek Lisans Tezi, Eğitim Bilimleri enstitüsü, İnönü Üniversitesi.

Emrahoğlu, N., & Öztürk, A. (2009). A longitudınal research on the analysis of the prospectıve science teachers' level of understanding the astronomical concepts and their misconceptions. *Cukurova University Institute of Social Sciences Journal*, 18(1).

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education*. New York, NY: McGraw-Hill.

Kalkan, H. & Kıroğlu, K. (2007). Science and nonscience students' conceptions of basic astronomy concepts in preservice training for education teachers. *Astronomy Education Review*, 1 (6), 15-24. http://dx.doi.org/10.3847/AER2007002

MEB. (2011). *Ortaöğretim astronomi ve uzay bilimleri ders kitabı.* Ankara: Milli Eğitim Bakanlığı.

Pena, B. M., & Gil Quilez, M. J. (2001). The importance of images in astronomy education. *International Journal of Science Education*, *23*(11), 1125-1135.

Trumper, R. (2001). A cross-college age study of science and nonscience students' conceptions of basic astronomy concepts in preservice training for high-school teachers. *Journal of Science Education and Technology*, 10(2), 189-195. Doi: 10.1023/A:1009477316035

Tunca, Z., 2002. V. Fen Bilimleri ve Matematik Eğitimi Kongresi, http://www.fedu.metu.edu.tr/ufbmek-5/b_kitabi/b_kitabi.htm., en son erişim tarihi; 20 Ekim 2009.

Türk, C., & Kalkan, H. (2015a). Developing an achievement test for astronomy education. *Journal of Studies in Education*, 5 (3), 89-112.

Türk, C. (2016). The Correlation between Pre-Service Science Teachers' Astronomy Achievement, Attitudes towards Astronomy and Spatial Thinking Skills. *Journal of Education and Learning*, *5*(2), 187.

Zeilik, M., Schau, C., & Mattern, N. (1998). Misconceptions and their change in university level astronomy courses. *The Physics Teacher*, 36(2), 104–107. Doi.org/10.1119/1.880056