Available online at ijci.wcci-international.org

International Journal of Curriculum and Instruction 14(3) (2022) 2345- 2365

IJCI
International Journal of Curriculum and Instruction

Determining the astronomy literacy levels of secondary school students and examining them in terms of some variables

Esra Benli Özdemir [a] *

[a] *Ministry of Education, Ankara, 06140, Turkey*

Abstract

In this study, it was aimed to determine the astronomy literacy levels of secondary school 5th, 6th, 7th and 8th grade students and to examine the sub-dimensions of astronomy literacy in terms of some variables. In the research, descriptive scanning method was used. The study was carried out with secondary school students studying in a secondary school in the central district of Ankara province in the spring term of the 2021-2022 academic year. 518 students participated in the study ($n_{5th\ grade}$ = 125, $n_{6th\ grade}$ = 134, $n_{7th\ grade}$ = 131 and $n_{8th\ grade}$ = 128). In the study, the study group was selected by using convenient sampling method. The data of the research were collected with the astronomy literacy scale. The data were analyzed with the SPSS package program. As a result of the analysis of the data, the affective characteristics of the students towards astronomy, which is one of the sub-dimensions of the astronomy literacy scale, were at "moderate"; behavioral and cognitive characteristics of astronomy were determined to be at "low" level. It was revealed that when the grade level of the students increased, their astronomy literacy levels increased for all dimensions. It was seen that the gender of secondary school students made a difference for all sub-dimensions of astronomy literacy, and this difference was in favor of girl students. It is noteworthy that the students who use sky observation applications have higher astronomy literacy levels for all dimensions than the students who do not use these applications.

Keywords: Astronomy literacy; secondary school students; affective; behavioral; cognitive.

* Corresponding author: Esra Benli Özdemir. ORCID ID.: https://orcid.org/ 0000-0002-2246-2420

E-mail address: esrabenli86@hotmail.com

1. Introduction

The science of astronomy, adapted to Turkish as "astronomy", is the science of observing celestial bodies. Astronomy, which works interdisciplinary with other branches of science, is a very important field of application (Şensoy, Türk, Bolat, & Kalkan, 2010). The developments in the field of astronomy, one of the first branches of science that emerged with the existence of humanity, are increasing day by day. Astronomy constantly renews itself and brings new fields of study (mathematics, physics, chemistry and biology) to many branches of science (Tunca, 2002).

Interest and curiosity towards astronomy since the early ages; it has gradually increased its importance with the development of technology. Teaching the subjects and concepts related to astronomy in our country and in the world has an important place in the curriculum. Subjects related to astronomy have an important place not only in the curricula of other countries, but also in the curricula of our country. One of the main objectives of the 2018 Science course curriculum is to "gain basic knowledge about astronomy, biology, physics, chemistry, earth and environmental sciences, and science and engineering applications." (MEB, 2018). Within the framework of this basic purpose, astronomy units start from the 3rd grade in the subject area of "Earth and Universe" with the 2018 Science course curriculum. With the updated curriculum, astronomy units within the subject area of "Earth and Universe" are included as the first unit of each grade level. In 2010, secondary education classes "Astronomy and Space Sciences" course curriculum was put into effect (MEB, 2010). It is aimed to gain affective, behavioral and cognitive goals for astronomy, which takes place in the curriculum at all levels of education.

When the literature on the subject area of "Earth and the Universe" is examined, it is seen that students have difficulty in understanding the concepts of astronomy, they cannot explain scientifically, they structure the concepts with their daily life experiences, and therefore they have significant misconceptions (Benli Özdemir, 2019). When the literature on astronomy is examined, it is emphasized that astronomy literacy is an important cornerstone of scientific literacy. Using different methods and techniques in teaching astronomy concepts and subjects; It plays a very important role in gaining affective, behavioral and cognitive goals.

The concept of "astronomy literacy" refers to a broad content knowledge about affective and behavioral dimensions as well as basic astronomy concepts. An astronomy literate individual; conceptual knowledge of basic astronomy in terms of cognitive dimension; positive attitude, interest and motivation towards astronomy in terms of affective dimension; in terms of behavioral dimension, it should have observation, participation

and action related to astronomy (Benli Özdemir, 2022). Astronomical literacy is an important part of scientific literacy.

Analyzing the literature, Love et al. (2013) determined the astronomy literacy level of 990 adult individuals over the age of 18. These individuals were asked six true-false questions. 80% of the participants gave correct answers to 4 of the 6 questions asked. However; the questions that astronomers "found life on Mars" and "can calculate the age of the universe" are among the two questions most frequently answered incorrectly by the participants. Benli Özdemir (2022) investigated the effects of augmented reality (AR) applications on determining the astronomy literacy levels of secondary school seventh and eighth grade students and on students' astronomy literacy levels. According to the results of the research, it was noted that the astronomy literacy levels of the secondary school students were low before the application. It was determined that augmented reality (AR) applications positively affected the astronomy literacy levels of the experimental group students.

In the literature, there are many studies in areas such as success, attitude, interest, and self-efficacy beliefs towards astronomy (Güneş, 2010; Türk, 2010; Kurnaz & Değermenci, 2011; Hoşkün, 2011; Okul, 2012; Canbazoğlu-Bilici et al. , 2012; Türk et al., 2012; Deniş Çeliker, 2012; Göncü, 2013; Bektaşlı, 2013; Şahin, Bülbül and Durukan, 2013; Küçüközer, Küçüközer, Bostan Sarıoğlan, 2014; Yılmaz, Türkoğuz and Şahin, 2014; Gündoğdu, 2014; Ezberci, 2014; Yılmaz, 2014; Zurnacı, 2015; Dadlı, 2015; Öktem, 2015; Arıkurt, Durukan, and Şahin, 2015; Taşcan and Ünal, 2015; Şenel-Çoruhlu and Çepni, 2015; Albayrak, 2016; Atik, 2016; Dereli, 2016; Kazanç and Kılıç, 2016; Kurnaz, Bozdemir, Deniz-Altunoğlu, and Ezberci Çevik, 2016; Demirci and Özyürek, 2017; Ertaş-Kılıç and Keleş, 2017; Taner et al., 2017; Yener et al. , 2017). However, studies on students' "astronomy literacy" levels are very limited (Benli Özdemir, 2022; Love et al., 2013). In this context, it is thought that determining the astronomy literacy levels of the students in this study and examining the astronomy literacy sub-dimensions in terms of some variables will fill the gap in the literature.

In this context, it was aimed to determine the astronomy literacy levels of secondary school students and to examine the astronomy literacy sub-dimensions in terms of some variables. In line with the stated main purpose, the problem sentence of the research is: “What is the astronomy literacy level of secondary school students?” can be expressed as based on the problem statement of the research, the sub-problems identified can be expressed as follows:

1. What is the effect of gender on the sub-dimensions of secondary school students' astronomy literacy levels?

2. What is the effect of grade levels on the sub-dimensions of secondary school students' astronomy literacy levels?

3. What is the effect of sky observation practices on the sub-dimensions of secondary school students' astronomy literacy levels?

2. Method

In this section, information about the model of the research, the study group of the research, the data collection process and the analysis of the data are given.

2.1. Model of the Research

In this study, descriptive survey method was used to examine the dimensions of astronomy literacy of secondary school students according to some variables. This research is a descriptive study and scanning model was used in the research. It is a case-detection study aiming to determine the astronomy literacy levels of secondary school students. Survey models are research approaches that aim to describe a past or present situation as it is. The event, individual or object that is the subject of the research is tried to be defined in its own conditions and as it is. No effort is made to change or influence them in any way. The important thing is to observe and determine what is desired to be known in an appropriate way (Karasar, 2000: 77).

2.2. Study Group

In this study, the study group was selected according to the convenience sampling method, using non-probability sampling method. In this method, participants are selected from among individuals who are easily accessible to the researcher, volunteer and suitable for the research (Gravetter & Forzano, 2012). The study was carried out with secondary school students studying in a public secondary school in the central district of Ankara province in the spring term of the 2021-2022 academic year. 518 students participated in the study (n5th grade = 125, n6th grade = 134, n7th grade = 131 and n8th grade = 128). Attention was paid to the volunteering principle of the students in the participant group of the study. Table 1 shows the descriptive statistics results for the students in the study group.

Table 1. Descriptive statistics results for the students in the study group

Grade Level	Gender				Total	
	Girl		Boy			
	n	%	n	%	N	%
5th grade	63	50,4	62	49,6	125	24.13
6th grade	55	41,04	79	58,96	134	25.86
7th grade	59	45,03	72	54,97	131	25.29
8th grade	76	59,37	52	40,63	128	24.72
TOTAL	253	48,84	265	51,16	518	100

According to Table 1; 24.13% are 5th grade students, 25.86% are 6th grade students, 25.29% are 7th grade students and 24.72% are 8th grade students of the participants.

2.3. Data Collection Process

The data obtained in this study were collected with the "Astronomy Literacy Scale" developed by the researcher (Benli Özdemir, 2022).

2.3.1. Astronomy Literacy Scale

The "Astronomy Literacy Scale" developed by the researcher was used to measure the students' astronomy literacy levels (Benli Özdemir, 2022). The scale is in five-point Likert type, consists of four separate parts and 21 judgments. The first part is self-perception towards astronomy; the second part, the affective dimension to astronomy; the third part includes the behavioral dimension for astronomy and the fourth part includes the cognitive dimension for astronomy. While the 5 items in the first section, "self-perception towards astronomy", are evaluated as frequency/percentage; 16 judgments including affective, behavioral and cognitive dimensions were numbered from 1 point to 5 points from the lowest to the highest astronomy literacy levels of the students. The applied astronomy literacy scale was evaluated as 80 points in total. A reliability study was conducted for the astronomy literacy scale developed by the researcher (Benli Özdemir, 2022). The scale was applied to 316 students different from the study group. According to the analysis obtained, the coefficients of internal consistency and sub-factors were determined. The reliability coefficient was found as α =.89. Since this value is over α = .70, the measurement tool has sufficient reliability to collect data (Büyüköztürk, 2011).

2.4. Analysis of Data

The data of the "astronomy literacy scale", which is used to determine the astronomy literacy levels of the students and to examine them in terms of some variables, were analyzed with the SPSS statistical package program. The sum of the answers given by each student to the scale was calculated. Independent group t-test was used to determine whether gender and astronomy observation practices have any effect on the sub-dimensions that make up students' astronomy literacy. A one-way ANOVA test was applied to find out if the grade level had any effect on the scores obtained by the students for these dimensions. Percentage and frequency values were used in the evaluation of astronomy literacy levels.

2.5. Compliance with Ethical Rules

Ethics, principles and rules were followed at all stages of this research. In order to determine the compliance of the research with the ethical rules, it was discussed at the meeting of Gazi University Ethics Committee dated 24.05.2022 and numbered 10, and the approval of the Ethics Committee was obtained with the letter dated 01.06.2022 and numbered E.374395. Approval document related to ethics committee approval is presented in Appendix B.

3. Results

In the study, three sub-problems were examined in order to determine the astronomy literacy levels of secondary school 5th, 6th, 7th and 8th grade students and to examine the astronomy literacy sub-dimensions in terms of some variables. Findings and comments regarding the astronomy literacy levels of the students in the study group are given below, respectively.

3.1. Findings and Comments on Students' Self-Perception of Astronomy

The dimensions in the "astronomy literacy scale" include the "affective, behavioral and cognitive dimensions", as well as the "self-perception of astronomy" dimension. The answers of the students regarding this dimension included in the scale are given in the table below.

Table 2. Descriptive analysis of students' "self-perception of astronomy" dimension

	5th grade		***6th grade***		***7th grade***		***8th grade***	
	f	***%***	***f***	***%***	***f***	***%***	***f***	***%***
Level of knowledge about astronomy								
Too much	8	6.4	12	8.95	13	9.92	12	9,37
More	13	10.4	19	14.18	21	16.03	23	17,9
Intermediate	54	43.2	61	45.5	65	49.6	71	55,4
Not much	32	25.6	26	19.40	24	18.32	20	15,6
None	18	14.4	16	11.97	8	6,13	2	1,73
Total	125	100	134	100	131	100	128	100
Frequency of studying on astronomy								
Too much	5	4	9	6,71	8	6.13	11	8,59
More	10	8	16	11,96	17	12,97	20	15,62
Intermediate	51	40,8	59	44,02	59	45,03	64	50
Not much	31	24,8	35	26,11	27	20,61	27	21,09
None	28	22,4	15	11,2	20	15,26	8	4,7
Total	125	100	134	100	131	100	128	100
Way to learn about astronomy								
Lessons at school	74	59,2	72	53,73	67	51,14	65	50,78
Internet	25	20	36	26,86	38	29,00	35	27,34
Tv	13	10,4	17	12,68	15	11,45	15	11,71
Article/book/magazine/newspaper	8	6,4	5	3,73	7	5,34	9	7,03
Family/friends	5	4	4	3	4	3,07	4	3,14
Total	125	100	134	100	131	100	128	100
People he/she talked to about astronomy								
Teachers	92	73,6	80	59,70	69	52,67	68	53,12
Friends	18	14,4	30	22,38	34	25,95	32	25
Family	5	4	9	6,71	15	11,45	16	12,5
People in the virtual environment	6	4,8	11	8,20	10	7,63	10	7,81
No one	4	3,2	4	3,01	3	5,3	2	1,57
Total	125	100	134	100	131	100	128	100
Frequency of speaking about astronomy								
Too much	10	8	14	10,44	9	6,87	11	8,59
More	11	8,8	17	12,68	20	15,62	18	14,06
Intermediate	53	42,4	65	48,50	67	51,14	73	57,03
Not much	31	24,8	24	17,91	22	16,79	18	14,06
None	10	8	14	10,47	13	9,58	8	6,26
Total	125	100	134	100	131	100	128	100

When Table 2 is examined, it is seen that as the grade level increases, the students show higher improvement in the dimension of "self-perception towards astronomy".

3.2. Findings and Comments on the First Sub-Problem

"What is the effect of gender on the sub-dimensions of secondary school students' astronomy literacy levels?" The t-test analysis results for independent samples related to the sub-problem are given in Table 3.

Table 3. Independent samples t-test results by gender variable for students' astronomy literacy levels

Gender	Factors	n	$\overline{X}$	SD	df	t	p
Girl	Affective	254	24.03	6.01	516	9.26	.00
Boy		264	19.08	6.11			
Girl	Behavioral	254	11.45	2.71	516	8.06	.00
Boy		264	9.35	3.18			
Girl	Cognitive	254	32.96	7.61	516	11.96	.00
Boy		264	23.88	9.52			

When Table 3 was examined, it was seen that gender made a difference for all sub-dimensions of astronomy literacy ($p < .05$). When the average scores of astronomy literacy levels are examined, it is seen that this difference is in favor of girl students.

In Figure 1 below, the average scores of the students for the sub-dimensions of astronomy literacy by gender are given.

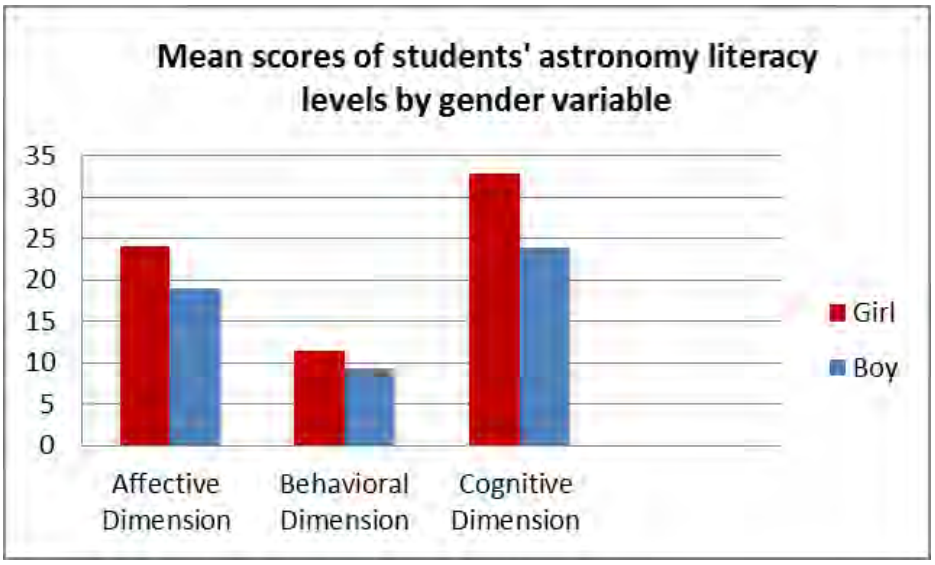

Figure 1. Mean scores of students' astronomy literacy levels by gender variable

According to Figure 1, considering the average scores; It is noteworthy that there is gender-related variability for affective, behavioral and cognitive dimensions.

3.3. Findings and Comments on the Second Sub-Problem

"What is the effect of grade levels on the sub-dimensions of secondary school students' astronomy literacy levels?" ANOVA test analysis results for independent samples for the sub-problem are given in Table 4.

Table 4. Descriptive analysis results regarding the average of students' astronomy literacy levels according to grade level

Factor	**Group**	**N**	$\overline{X}$	**S**
Affective	5th grade	125	18.26	7.30
	6th grade	134	21.12	5.80
	7th grade	131	21.60	5.33
	8th grade	128	**24.99**	5.93
	Total	518	21.51	6.54
Behavioral	5th grade	125	8.92	3.90
	6th grade	134	10.29	2.98
	7th grade	131	**10.97**	2.39
	8th grade	128	11.29	2.60
	Total	518	10.38	3.14
Cognitive	5th grade	125	24.78	11.09
	6th grade	134	27.93	8.05
	7th grade	131	28.40	8.40
	8th grade	128	**32.14**	9.95
	Total	518	28.33	9.57

When Table 4 is examined, 8th grade students have the highest average of astronomy literacy levels in terms of affective and cognitive dimensions; 7th grade students have the highest behavioral dimension.

In Figure 2 below, the average scores of the sub-dimensions of astronomy literacy according to the grade levels of the students are given.

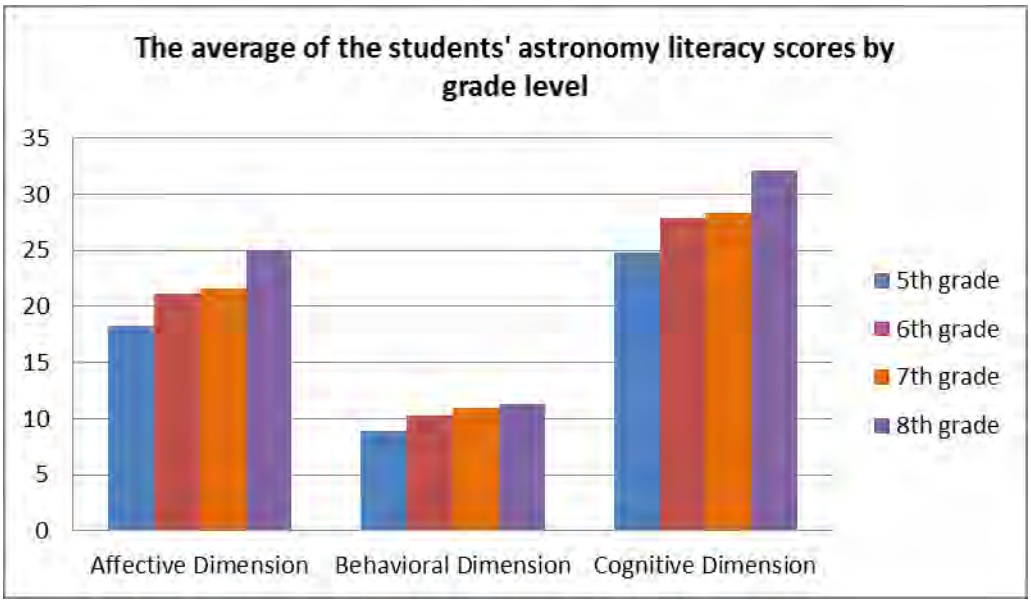

Figure 2. The average of the students' astronomy literacy scores by grade level

According to Figure 2, when the average scores of astronomy literacy are taken into account, it is noteworthy that there is a difference for all sub-dimensions.

Table 5. ANOVA results of students' astronomy literacy levels by grade level variable

Factor	**Source of variance**	**Sum of squares**	**Degrees of freedom**	**Mean squares**	**F**	**p**
Affective	Between Groups	2897,22	3	965.74	25.75	.00
	Within Groups	19274,24	514	37.49		
	Total	22171,46	517			
Behavioral	Between Groups	418,80	3	139.60	15.32	.00
	Within Groups	4683,03	514	9.11		
	Total	5101,83	517			
Cognitive	Between Groups	3452,29	3	1150.76	12.92	.00
	Within Groups	45768,59	514	89.04		
	Total	49220,88	517			

When Table 5 is examined, all sub-dimensions of the astronomy literacy levels of the students participating in the research show a significant difference according to their grade levels ($F_{Affective}$ = 25.75; p<.05; $F_{Behavioral}$ = 15.32; p<.05 $F_{Cognitive}$ = 12.92; p<.05). Scheffe test was used to find out between which grade levels this difference was.

Table 6. Scheffe results of students' astronomy literacy levels by grade level

Factor	**Group (i)**	**Group (j)**	**p**
Affective	5th grade	6 th grade	.00
		7 th grade	.00
		8 th grade	.00
	6th grade	5 th grade	.00
		7 th grade	.93
		8 th grade	.00
	7th grade	5 th grade	.00
		6 th grade	.93
		8 th grade	.00
	8th grade	5 th grade	.00
		6 th grade	.00
		7 th grade	.00
Behavioral	5 th grade	6 th grade	.00
		7 th grade	.00
		8 th grade	.00
	6 th grade	5 th grade	.00
		7 th grade	.34
		8 th grade	.06
	7 th grade	5 th grade	.00
		6 th grade	.34
		8 th grade	.86
	8 th grade	5 th grade	.00
		6 th grade	.06
		7 th grade	.86
Cognitive	5 th grade	6 th grade	.06
		7 th grade	.02
		8 th grade	.00
	6 th grade	5 th grade	.06
		7 th grade	.98
		8 th grade	.00
	7 th grade	5 th grade	.02
		6 th grade	.98
		8 th grade	.01
	8 th grade	5 th grade	.00
		6 th grade	.00
		7 th grade	.01

When Table 6 is examined, in terms of affective dimension; there is a significant difference between grade levels except for Grades 6th – 7th Grades ($p<.05$). In terms of behavioral dimension; There is a significant difference between grade levels except for 6th Grade - 7th Grades, 6th Grade - 8th Grades, 7th Grade - 8th Grades ($p<.05$). In terms of cognitive dimension; There is a significant difference between grade levels except for Grade 5th - Grade 6th, Grade 6th - Grade 7th ($p<.05$).

3.4. Findings and Comments on the Third Sub-Problem

"What is the effect of sky observation practices on the sub-dimensions of secondary school students' astronomy literacy levels?" The t-test analysis results for independent samples for the sub-problem are given in Table 7.

Table 7. Independent samples t-test results according to the variable of students' astronomy literacy levels using sky observation applications

Using Sky Observation Applications	**Factor**	**n**	$\overline{X}$	**SD**	**df**	**t**	**p**
There is	Affective	202	24.01	5.98	516	7.29	.00
There isn't		316	19.91	6.39			
There is	Behavioral	202	11.54	2.73	516	7.03	.00
There isn't		316	9.64	3.16			
There is	Cognitive	202	32.32	7.91	516	7.86	.00
There isn't		316	25.78	9.97			

When Table 7 is examined, it is seen that sky observation practices make a difference for all sub-dimensions of astronomy literacy ($p<.05$). When the mean scores were examined, it was revealed that this difference was in favor of the students who used sky observation applications.

In Figure 3 below, the average scores of the sub-dimensions of astronomy literacy according to the usage status of sky observation applications are given.

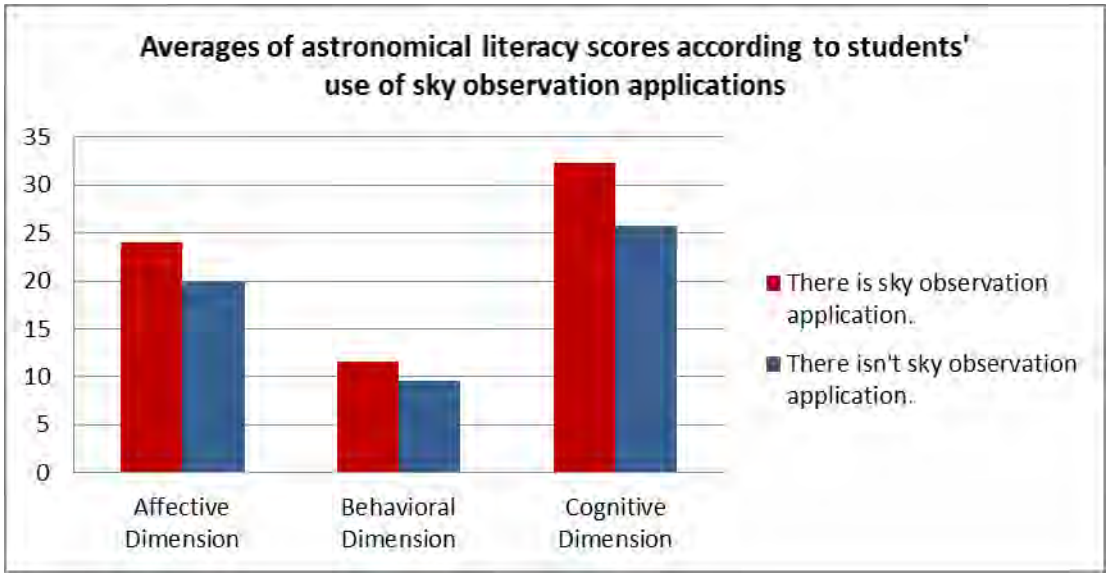

Figure 3. Averages of astronomical literacy scores according to students' use of sky observation applications

According to Figure 3, when the average scores of astronomy literacy are taken into account, it is noteworthy that there is a difference for all sub-dimensions.

4. Discussion and Conclusions

In this study, the astronomy literacy levels of secondary school 5th, 6th, 7th and 8th grade students were determined and the sub-dimensions of astronomy literacy were

examined in terms of some variables. In this context, it is very important for the literature to determine the factors affecting the astronomy literacy, which has been a subject of curiosity and interest since the early ages, and whose importance is gradually increasing. According to the findings obtained, the results of the study and its comparison with the relevant literature are expressed as follows.

According to the results of the research, the affective characteristics of the students towards astronomy, which is one of the sub-dimensions of the astronomy literacy scale, were at "moderate"; behavioral and cognitive characteristics of astronomy were determined to be at "low" level. When the literature is examined, Okul and Oğuz-Ünver (2011) and Karatay and Meriç (2015) examined the attitudes of pre-service teachers from different branches towards astronomy and showed that the attitudes of pre-service teachers towards astronomy are moderate.

According to another result obtained from the research, it was revealed that as the grade levels of the students increased, their astronomy literacy levels increased in affective, behavioral and cognitive levels.

In the studies conducted by Bostan (2008), Ekiz and Akbaş (2005), Öztürk and Uçar (2012) and Saraç (2017) regarding the attitude towards astronomy, it was concluded that the students had prejudices towards astronomy and their attitudes progressed negatively as the grade level increased.

According to the results of the research, it was seen that the gender of secondary school students made a difference for all sub-dimensions of astronomy literacy. It was observed that this difference was in favor of girl students. When the literature is examined, in the studies conducted by Balbağ and Koç (2020), Özcan and Yılmaz (2018) and Bozdoğan (2008) on interest in astronomy, they concluded that students who go to science centers have a higher interest in astronomy. According to another result obtained from the research, it was noted that the students who used sky observation applications had a higher level of astronomy literacy for all dimensions than the students who did not use these applications.

The findings obtained in this study may contribute to detecting the existing situation and taking precautions.

References

Albayrak, H. (2016). Astronomi konularında istasyon tekniğinin öğrencilerin akademik başarısına ve astronomiye karşı tutumuna etkisi (Yayımlanmamış yüksek lisans tezi). Erzincan Üniversitesi, Fen Bilimleri Enstitüsü, Erzincan.

Arıkurt, E., Durukan, Ü.G., & Şahin, Ç. (2015). Farklı öğrenim seviyesindeki öğrencilerin astronomi kavramıyla ilgili görüşlerinin gelişimsel olarak incelenmesi. *Amasya Üniversitesi Eğitim Fakültesi Dergisi, 4*(1), 66-91.

Atik, S. (2016). Akademik başarının yordayıcıları olarak öğretmene güven, okula karşı tutum, okula yabancılaşma ve okul tükenmişliği (Doktora tezi). İnönü Üniversitesi, Eğitim Bilimleri Enstitüsü, Malatya.

Balbağ, M.Z. , & Koç, B.Ş. (2020). Fen Bilgisi öğretmen adaylarının astronomiye yönelik ilgilerinin bazı değişkenler açısından incelenmesi. *International Journal of Field Education, 6* (1), 107-122.

Benli Özdemir, E. (2022). Development of astronomy literacy scale: A study of validity and reliability. *International Online Journal of Education and Teaching (IOJET), 9*(3), 1356-1376.

Benli Özdemir, E. (2022). Artırılmış gerçeklik uygulamalarının ortaokul öğrencilerinin astronomi okuryazarlık düzeylerine etkisinin incelenmesi. *Gazi Eğitim Fakültesi Dergisi, 42*(2), 1050-1075.

Bostan, A. (2008). Farklı yaş grubu öğrencilerinin astronominin bazı temel kavramlarına ilişkin düşünceleri. (Yayınlanmamış Yüksek lisans tezi), Balıkesir Üniversitesi, Fen Bilimleri Enstitüsü, Balıkesir.

Bozdoğan, A.E. (2008). Fen Bilgisi öğretmen adaylarının bilim merkezlerini fen öğretimi açısından değerlendirmesi: Feza Gürsey bilim merkezi örneği. *Uludağ Üniversitesi, Eğitim Fakültesi Dergisi, 21*(1), 19-41.

Bektaşlı, B. (2013). Fen bilgisi öğretmen adaylarının astronomi hakkındaki kavram yanılgılarının tespiti için astronomi kavram testinin geliştirilmesi. *Eğitim ve Bilim Dergisi, 38*(168), 362-372.

Büyüköztürk, Ş. (2017). *Sosyal bilimler için veri analizi el kitabı (23. Baskı).* Ankara: Pegem Yayıncılık.

Canbazoğlu-Bilici, S., Öner-Armağan, F., Kozcu-Çakır, N., & Yürük, N. (2012). Astronomi tutum ölçeğinin Türkçe'ye uyarlanması: geçerlik ve güvenirlik çalışması. *Türk Fen Eğitimi Dergisi, 9*(2), 117-127.

Dadlı, G. (2015). Ortaokul 8. sınıf öğrencilerinin fen ve teknoloji dersine yönelik öz düzenleme becerileri ve öz yeterlikleri ile akademik başarıları arasındaki ilişkinin incelenmesi (Yayımlanmamış yüksek lisans tezi). Kahramanmaraş Sütçü İmam Üniversitesi, Sosyal Bilimler Enstitüsü, Kahramanmaraş.

Demirci, F. ve Özyürek, C. (2017). Fen bilimleri öğretmenlerinin astronomi konularının öğretimi öz-yeterlik inanç düzeylerinin belirlenmesi ve bazı değişkenlere göre incelenmesi. *Ordu Üniversitesi Sosyal Bilimler Araştırmaları Dergisi, 7*(3), 499-518.

Deniş-Çeliker, H. (2012). Fen ve teknoloji dersi "güneş sistemi ve ötesi: uzay bilmecesi" ünitesinde proje tabanlı öğrenme uygulamalarının öğrenci başarılarına, yaratıcı düşünmelerine, fen ve teknolojiye yönelik tutumlarına etkisi (doktora tezi). Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, İzmir.

Dereli, F. (2016). 6. sınıf dünya ve evren konu alanına uyarlanmış bilimin doğası kazanımlarının akıllı tahta etkinlikleri ile öğretimi (Yayımlanmamış yüksek lisans tezi). Mehmet Akif Ersoy Üniversitesi, Eğitim Bilimleri Enstitüsü, Burdur.

Ekiz, D., & Akbaş, Y. (2005). İlköğretim 6. Sınıf öğrencilerinin astronomi ile ilgili kavramları anlama düzeyi ve kavram yanılgıları. *Milli Eğitim Dergisi, 165,* 61-78.

Ertaş-Kılıç, H., & Keleş, Ö. (2017). Astronomiye yönelik ilgi ölçeği geliştirilmesi: geçerlik ve güvenirlik çalışmaları. *Çanakkale Onsekiz Mart Üniversitesi Dergisi, 13*(1), 35-54.

Ezberci, E. (2014). Üstkavramsal faaliyetleri aktif hale getirici etkinliklerle desteklenmiş 5E öğrenme döngüsü modelinin 7. sınıf öğrencilerinin Ay'ın evreleri konusundaki kavramsal anlamalarına etkisi (Yayımlanmamış yüksek lisans tezi). Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Göncü, Ö. (2013). İlköğretim beşinci ve yedinci sınıf öğrencilerinin astronomi konularındaki kavram yanılgılarının tespiti (Yayımlanmamış yüksek lisans tezi). Mehmet Akif Ersoy Üniversitesi, Eğitim Bilimleri Enstitüsü, Burdur.

Güneş, G. (2010). Öğretmen adaylarının temel astronomi konularında bilgi seviyeleri ile bilimin doğası ve astronomi öz-yeterlilikleri arasındaki ilişkinin incelenmesi (Yayımlanmamış yüksek lisans tezi). Çukurova Üniversitesi, Sosyal Bilimler Enstitüsü, Adana.

Gündoğdu, T. (2014). 8. sınıf öğrencilerinin astronomi konusundaki başarı ve kavramsal anlama düzeyleri ile fen dersine yönelik tutumları arasındaki ilişkinin incelenmesi (Yayımlanmamış yüksek lisans tezi). Marmara Üniversitesi, Eğitim Bilimleri Enstitüsü, İstanbul.

Karatay, R., & Meriç, G. (2015). Öğretmen adaylarının astronomiye yönelik bilgi ve tutum düzeylerinin incelenmesi. VII. Uluslararası Türkiye Eğitim Araştırmaları Kongresi, Muğla.

Kazanç, S., & Kılıç, A. (2016). Fen bilimleri öğretmen adaylarının ay ve güneş tutulması konusuna ilişkin teknolojik pedagojik alan bilgileri. *Turkish Journal of Educational Studies, 3*(3), 114-138.

Küçüközer, A., Küçüközer, H., & Bostan-Sarıoğlan, A. (2014). Sınıf öğretmeni adaylarının astronomi kavramları hakkındaki kavramsal anlamaları. *Fen Bilimleri Öğretimi Dergisi, 2*(1), 23-34.

Kurnaz, M.A., Bozdemir, H., Altunoğlu, B.D., & Çevik-Ezberci, E. (2016). Fen eğitiminde astronomi konu alanında yayınlanan ulusal makalelerin incelenmesi. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi, 18*(2), 1398-1417.

Öztürk, D., & Uçar, S. (2012). İlköğretim öğrencilerinin Ay'ın evreleri konusunda kavram değişimlerinin işbirliğine dayalı ortamda incelenmesi. *Türk Fen Eğitimi Dergisi, 9*(2), 98-112.

Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı (2018). İlköğretim Kurumları (İlkokullar ve Ortaokullar) Fen Bilimleri Dersi (3, 4, 5, 6, 7 ve 8. Sınıflar) Öğretim Programı, Ankara.

Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı (2010). Ortaöğretim Astronomi Ve Uzay Bilimleri Dersi Öğretim Programı, Ankara.

Okulu, H. (2012). Geliştirilen astronomi etkinliklerinin fen ve teknoloji öğretmen adaylarının astronomi bilgi ve tutum düzeylerine etkisi (Muğla örneği) (Yayımlanmamış yüksek lisans tezi). Muğla Sıtkı Koçman Üniversitesi, Eğitim Bilimleri Enstitüsü, Muğla.

Okulu, H. Z., & Oğuz Ünver, A. (2011). Determination of the teacher candidates' attitudes towards astronomy. *Western Anatolian Journal Of Educational Sciences, Special Issue,* 107–112.

Öktem, Ö. (2015). Fen bilgisi öğretmen adaylarının uzay araştırmaları konusunda pedagojik alan bilgilerinin belirlenmesi (Yayımlanmamış yüksek lisans tezi). Mersin Üniversitesi, Eğitim Bilimleri Enstitüsü, Mersin.

Özcan, H., & Yılmaz, Ş. (2018). Planetaryum gezisi ile fen bilgisi öğretmen adaylarının astronomi kavramlarındaki değişimin incelenmesi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi (EFMED), 12*(1), 392 - 418.

Saraç, H. (2017). Temel eğitim düzeyindeki öğrencilerin dünya ve evren konularına ilişkin tutumlarının incelenmesi. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi, (43)*, 25-36.

Şahin, Ç., Bülbül, E., & Durukan, Ü. G. (2013). Öğrencilerin gök cisimleri konusundaki alternatif kavramlarının giderilmesinde kavramsal değişim metinlerinin etkisi. *Journal of Computer and Education Research, 1*(2), 38-64.

Şenel-Çoruhlu, T., & Çepni, S. (2015). Teachers' Problems and Misconceptions Relate to "Solar System And Beyond: Space Puzzle" Unit: A Case Study Research. *Kuramsal Eğitimbilim Dergisi, 8*(2), 268-281.

Şensoy, A., Türk, C., Bolat, M., & Kalkan, H. (2010). İlköğretim ikinci kademe öğrencilerinin temel astronomi kavramlarını anlama düzeyleri üzerine bir durum çalışması. *Ulusal Astronomi Kongresi,* Adana, 31 Ağustos-4 Eylül 2010.

Taner, M.S., Manap, Ö., Tunca, Z., Koçer, D., & Aslan, Z. (2017). Türkiye'de Bilim Eğitiminin Geliştirilmesi Açısından Astronomi Alanında Yapılanlar: Astronomi Öğretmen Seminerleri (AÖS) Örneği. *Anadolu Öğretmen Dergisi, 1*(1).

Taşcan, M., & Ünal, İ. (2015). Astronomi eğitiminin önemi ve türkiye'de öğretim programları açısından değerlendirilmesi. *Buca Eğitim Fakültesi Dergisi, (40),* 25-37.

Tunca, Z. (2002). Türkiye'de ilk ve orta öğretimde astronomi eğitim öğretiminin dünü, bugünü, V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Ankara.

Türk, C. (2010). İlköğretim temel astronomi kavramlarının öğretimi (Yayımlanmamış yüksek lisans tezi). Ondokuz Mayıs Üniversitesi, Fen Bilimleri Enstitüsü, Samsun.

Türk, C., Kalkan, S., Bolat, M., Akdemir, E., Karakoç, Ö., & Kalkan, H. (2012). Fen ve teknoloji öğretmen adaylarının temel astronomi kavramlarını kavrama düzeyleri üzerine bir durum çalışması. *Eğitim ve Öğretim Araştırmaları Dergisi, 1*(2), 202- 209.

Yener, D., Aksüt, P., Demir, N. S., Aydın, F., Fidan, H., Subaşi, Ö., & Aygün, M. (2017). Öğretmen adaylarının "astronomi" konusundaki kavramlara yönelik bilişsel yapılarının incelenmesi. *Amasya Üniversitesi Eğitim Fakültesi Dergisi, 6*(2), 531- 565.

Yılmaz, E. (2014). 7. sınıf temel astronomi kavramlarının etkin öğretimine yönelik bir eylem araştırması (yüksek lisans tezi). Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, İzmir.

Yılmaz, E., Türkoğuz, S., & Şahin, M. (2014). Güneş sistemi ve uzay konularına yönelik kavram yanılgılarının günlük yaşama etkisi üzerine öğretmen görüşleri. *Buca Eğitim Fakültesi Dergisi, (37),* 37-44.

Zurnacı, A. (2015). Fen eğitiminde astronomi uygulamaları (Yayımlanmamış yüksek lisans tezi). Ege Üniversitesi, Fen Bilimleri Enstitüsü, İzmir.

APPENDIXES

Appendix A. Astronomy literacy scale

CHAPTER 1 (Astronomy Literacy Self-Perception)

1. How much do you think you know about astronomy?
A. Too much
B. More
C. Intermediate
D. Not much
E. None

2. How would you describe yourself about doing studies/research on astronomy?
A. I do a lot of study/research.
B. I do more work/research.
A. I do a moderate amount of study/research.
D. I don't do much study/research.
E. Never

3. Which of the following contributes the most to learning the subjects and concepts related to astronomy?
A. Lessons at school
B. Internet
C. Television
D. Article/book/magazine/newspaper
E. Family/Friends

4. Which of the following do you talk about studies, researches or subjects related to astronomy?
A. Teachers
B. Friends
C. Family
D. People in the virtual environment
E. Nobody

5. How often do you talk to people around you about astronomy-related topics?
A. Too much
B. More
C. Intermediate
D. Not much
E. None

CHAPTER 2 (The Affective Dimension of Astronomy Literacy)

	Strongly agree	Agree	Neither agree nor	Disagree	Strongly disagree
1. 1. I am interested in astronomy.					
2. 2. I enjoy learning new information about astronomy.					
3. 3. I can easily learn the concepts and subjects related to astronomy.					
4. 4. I make mistakes when explaining astronomy concepts.					
5. 5. Astronomy has no contribution to my daily life.					
6. 6. I don't want to work on the sky.					

CHAPTER 3 (The Behavioral Dimension of Astronomy Literacy)

	Strongly agree	Agree	Neither agree nor	Disagree	Strongly disagree
7. 1. I observe the sky using sky survey programs (Google sky, sky map, NASA, sky walk etc.).					
8. 2. I watch the sky with the naked eye (without any observation tool) at night when the weather conditions are suitable.					
9. 3. I follow the astronomer or astronauts who work on the sky on social media.					

CHAPTER 4 (Cognitive Dimension of Astronomy Literacy)

	Strongly agree	Agree	Neither agree nor	Disagree	Strongly disagree
10. 1. I can express the geometric shape of the sun.					
11. 2. I can explain the direction, duration and consequences of the Sun's rotation.					
12. 3. I can express the geometric shape of the Earth.					
13. 4. I cannot tell the size of the moon.					
14. 5. I can explain the moon's age.					
15. 6. I can express the geometric shape of the moon.					
16. 7. I cannot explain how stars are formed.					

Appendix B: Ethics committee approval

Evrak Tarih ve Sayısı: 01.06.2022-E.374395

T.C.
GAZİ ÜNİVERSİTESİ
Etik Komisyonu

Sayı : E-77082166-604.01.02-374395 01.06.2022
Konu : Değerlendirme ve Onay

Sayın Prof. Dr. Ergin HAMZAOĞLU
Fen Bilgisi Eğitimi Anabilim Dalı Başkanlığı - Öğretim Üyesi

Araştırmacı grubu Ergin HAMZAOĞLU ve Esra BENLİ ÖZDEMİR'den oluşan ***"Ortaokul Öğrencilerinin Astronomi Okuryazarlık Düzeylerinin Belirlenmesi ve Bazı Değişkenler Açısından İncelenmesi"*** başlıklı araştırma öneriniz Komisyonumuzun **24.05.2022** tarih ve **10** sayılı toplantısında görüşülmüş olup,

Çalışmanızın, yapılması planlanan yerlerden izin alınması koşuluyla yapılmasında etik açıdan bir sakınca bulunmadığına oybirliği ile karar verilmiş ve karara ilişkin imza listesi ekte gönderilmiştir.

Bilgilerinizi rica ederim.

Araştırma Kod No: 2022 - 725

Prof. Dr. İsmail KARAKAYA
Komisyon Başkanı

Ek:1 Liste

Bu belge güvenli elektronik imza ile imzalanmıştır.
Belge Doğrulama Kodu :BSC01VKAK3 Belge Takip Adresi : https://www.turkiye.gov.tr/gazi-universitesi-ebys

Emniyet Mahallesi Bandırma Caddesi No :6/1 06560 Yenimahalle/ANKARA
Tel:0 (312) 202 20 57 - 0 (312) 2 Faks :0 (312) 202 38 76
İnternet Adresi :http://etikkomisyon.gazi.edu.tr/
Kep Adresi :gazisaymuhsus@hs01.kep.tr
Bilgi için :Ayfer Çekmez
Genel Evrak Sorumlusu
Telefon No:202 38 81

Bu belge güvenli elektronik imza ile imzalanmıştır.