sciendo

Acta Educationis Generalis
Volume 13, 2023, Issue 1

DOI: 10.2478/atd-2023-0004

Investigating Lifelong Learning Tendencies and Scientific Creativity Levels of Prospective Science Teachers

Oğuzhan Nacaroğlu - Fatma Mutlu*

Received: March 23, 2021; received in revised form: June 14, 2021;
accepted: June 17, 2021

Abstract:

Introduction: Prospective science teachers must themselves first generate rather than simply using knowledge and they must be science literate must be science literate and abreas of the changes in industry if we want future generations to be and do the same. Therefore, the purpose of this study is to determine lifelong learning tendencies and scientific creativity levels of prospective science teachers and examine the correlation between these variables.

Methods: In the study, correlational survey, one of the quantitative research methods, was used. The sample of the study was composed of 201 prospective science teachers studying at the 1st, 2nd, 3rd, and 4th years in a public university in Eastern Anatolia Region within the academic year 2019/2020. "Lifelong Learning Scale" and "Scientific Creativity Test" were used as data collection tools in the study. Independent samples t-test was used to compare the scale scores of the participants in terms of gender and age and ANOVA was used to compare them in terms of class level. In addition, Pearson's Product-Moment Correlation Coefficient (r) analysis technique was used in order to examine whether or not there was a significant correlation between lifelong learning tendencies and scientific creativity levels of prospective science teachers.

Results: The results of the study indicated that the prospective science teachers had high lifelong learning tendencies. No statistically significant difference was found between the Lifelong Learning Scale (LLS) total scores of female and male prospective science teachers. However, a statistically significant difference was found between the Scientific Creativity Test (SCT) total scores of male and female prospective science teachers and this difference was observed in favor of male teachers. Additionally, there was a positive and moderate correlation between the lifelong learning tendencies and scientific creative levels of the participants.

Discussion: As a result of the study, it was observed that there was a moderate and positive correlation between lifelong learning tendencies and scientific

* Oğuzhan Nacaroğlu, Sivas Cumhuriyet University, Sivas, Turkey; onacaroglu44@gmail.com
Fatma Mutlu, Inonu University, Malatya, Turkey; fatma.mutlu@inonu.edu.tr

creativity levels of the participants. High levels of lifelong learning were correlated with high levels of scientific creativity. Lifelong learning requires individuals to have some atypical knowledge, skills and competencies to cope with current life problems. In addition, it is recommended in the literature that individuals should have some competencies, such as searching information, accessing information and knowing the ways of reaching information in order to have lifelong learning skills. Therefore, it can be interpreted that scientific creativity skills of individuals, who integrate learning processes throughout their lives and have the mentioned competences, will also improve.

Limitations: The limitations of the study are that the study included 201 prospective science teachers studying in a public university located in Eastern Anatolia Region and the number of male participants was less than the number of female participants.

Conclusions: It is important for prospective teachers to do practices, which will improve their lifelong learning skills during their undergraduate education, in terms of scientific creativities. This is because scientific creativity and lifelong learning skills should be included in the science course in order for students to acquire sense of task, scientific perspective, and skills for controlling and regulating their learning.

Key words: lifelong learning, scientific creativity, science education, prospective science teachers, correlational survey.

Introduction

Societies experience many changes in science, industrial, and technological fields as a result of their increased knowledge level. These changes have led to Industry 4.0, the last industrial revolution, in which machine power has replaced with manpower and is different from the other industrial revolutions in terms of speed, digitalization, and system (Banger, 2016). Societies need to have qualified labor that adopts technology, in order to adapt to this industrial revolution. In this context, it is important for individuals to have 21st century skills such as information and technology literacy, critical and creative thinking, and lifelong learning (Demir, 2018; Qina, Liua, & Grosvenor, 2016).

Although there is no general definition for 21st century skills, these skills are also referred to as survival skills (Trilling & Fadel, 2009) as well as the characteristics individuals need to possess in order to adapt to the new industrial revolution (Ledward & Hirata, 2011). 21st century skills involve basic and critical thinking, such as language skills, science literacy, and mathematical literacy, as well as practical skills such as creative thinking and problem solving (Lai & Viering, 2012; Casner-Lotto & Barrington, 2006). Transferring these skills to future generations is necessary for the survival of societies and Industry 4.0 and the presence of these skills has led to the emergence of a new education

system, such as Education 4.0 based on innovation and production (Saxena & Bhat, 2017). Education 4.0 aims to train individuals who produce and transfer information, have higher-order thinking and innovation skills, and can respond to the needs of the technological world (Demir, 2018; Gurjanov et al., 2020). In addition, it is crucial in this education system to educate individuals in such a way to constantly produce and use what they have produced. This is because in Education 4.0 approach learning processes, which regulate understanding, trigger research, and are based on producing results, will be used by preventing Bloom's taxonomy (Chea & Huan, 2019; Gomaratat, 2015) and lifelong learning is the basic mission of educational institutions by attaching importance to sense of education (Doğan & Baloğlu, 2020; Öztemel, 2018).

The concept of lifelong learning, used by Grundtvig in 1800s for the first time is defined by European Commission as "all activities aiming to improve individuals' knowledge, skills, and competences individually, socially or professionally throughout their life". Besides, while Dinevski and Dinevski (2004) describe lifelong learning as the lifelong education process without any restriction, White (1982) stated lifelong learning as the process in which the individuals improve their potentials throughout their lives in order to manage their life. Lifelong learning includes individual developments which strengthen qualifications individuals have and are able to adapt them to the changing environment throughout their lives as well as all formal and informal educations acquired throughout their lives (Kulich, 1982; Cross, 2014). Lifelong learning, which attaches importance to improvement of professional and personal competence of individuals, is also referred to as the responsibility given to the knowledge in social and economic fields (Hursen, 2014). Shuman, Besterfield-Sacre and McGourty (2005) describe lifelong learning skills as being aware of what needs to be learnt, learning by using different ways, following a learning plan in learning processes using technology, critical reading, and research. Individuals with these skills are curious, are interested in new developments, are information and technology literate; analyze the problems deeply by evaluating their learning, and make intellectual struggles to solve these problems (Mitkovska & Hristovska, 2011).

Individuals, at early ages, should acquire lifelong learning skills aiming to ensure economic growth by increasing production and efficiency and to increase social solidarity by providing equal opportunities and ensuring them to receive education based on their interests and abilities (Çiftcibaşı, Korkmaz, & Karamustafaoğlu, 2020). Teachers and prospective teachers should have lifelong learning skills (Rausch, 2003) and for this reason, lifelong learning should be included in the education of prospective teachers in order for the lifelong learning referred to as continuity in education to be part of education and for individuals to acquire lifelong learning competence and skills. Continuous self-

improvement of teachers is associated with lifelong learning. In other words, teachers should learn lifelong due to their profession, follow developments related to their professional fields, adopt these novelties, and apply them in classroom activities. In this regard, it is attached importance that teachers and prospective teachers should be trained in such a way to contribute to the improvement of their lifelong learning skills by determining their lifelong learning tendencies. In their study, Demirel and Akkoyunlu (2017) stated that teachers should acquire lifelong learning skills for the development of a society composed of lifelong learning individuals, who are information literate, and then the teacher training programs in universities should be arranged to support lifelong learning for achieving this. Therefore, it is important to have lifelong learning skills as well as scientific creativity skills in processes of producing, spreading, using and structuring information on the basis of being a strong individual and society (Wang & Yu, 2011; Zulkarnaen, Supardi & Jatmiko, 2018).

Although scientific creativity is an important concept in the internalization of knowledge by students and especially in science, it has no common definition (Demirhan, Önder, & Beşoluk, 2018). In this context, Sak and Ayas (2013) define scientific creativity as producing different and original ideas and products in the field of science and Hu and Adey (2002) describes it as finding and imagining novel techniques for a solution after exploring a problem. The characteristic distinguishing scientific creativity from general creativity is that information related to the study field is taken into consideration during creative thinking (Amabile, 1996). Scientific creative thinking has a theoretical and practical systematic and aims to solve a scientific problem. Therefore, scientific creativity should be examined separately from general creativity (Hu et al., 2013). Besides, students should acquire scientific creative thinking skills as a requirement of the new education system (Kiras & Bezir-Akçay, 2016; Siew, Chin, & Sombuling, 2017).

Today, it is important that individuals have 21st century skills and lifelong learning and scientific creative thinking skills within the scope of Education 4.0 education system. This situation has been involved also in the new curricula. the Science Education Curriculum states that students should acquire 21st century skills, such as creative and innovative thinking, lifelong learning skills, problem solving, critical thinking, collaboration, communication, media and technology literacy, leadership, and entrepreneurship (MEB, 2018). For this purpose, first of all, teachers should have lifelong learning and scientific creative thinking skills which is an important gain in Education 4.0 education system and they should be the teachers of 21st century as a requirement of this understanding (Brun & Hinostroza, 2014). This is because all these changes in education have led to changes in tasks and responsibilities of teachers along with learning processes

(Yenice & Alpak-Tunç, 2019). In this context, it is thought that science teachers have more duties and responsibilities in acquiring these skills to their students (Yenice & Yavaşoğlu, 2018).

Scientific creativity and lifelong learning skills should be involved in the science courses in order for students to acquire skills related to sense of task, scientific perspective, and regulating and controlling their learning (Pise & Jadhav, 2016; Shanahan & Nieswandt, 2009). The studies have showed that there is a positive correlation between science and scientific creativity (Yang et al., 2016). For this purpose, it is important to investigate lifelong learning tendencies and scientific creativity levels of prospective science teachers in particular. In the literature, there are studies investigating separately the scientific creativity levels (Demir, 2015; Demirhan, Önder, & Beşoluk, 2018; Polat & Kontaş, 2018) and lifelong learning tendencies (Bulaç, 2019; Demirel, Sadi, & Dağyar, 2016; Hanewald, 2012; Mitkovska & Hristovska, 2011) of prospective science teachers, however, no study has been found investigating both lifelong learning tendencies and scientific creativity levels of prospective science teachers. Therefore, the study is believed to contribute to the literature. Prospective science teachers must themselves first generate rather than simply using knowledge and they must be science literate must be science literate and abreas of the changes in industry if we want future generations to be and do the same. Therefore, the purpose of this study is to determine lifelong learning tendencies and scientific creativity levels of prospective science teachers and examine the correlation between these variables. In accordance with the specified objective, answers to the following sub-problems were sought:

1. What are the lifelong learning tendencies of prospective science teachers?
2. Do lifelong learning tendencies and scientific creativities of prospective science teachers differ significantly in terms of gender, age and class level variables?
3. Is there any significant correlation between lifelong learning tendencies and scientific creativity levels of prospective science teachers?

1 Methodology

1.1 Research design

In this study, correlational survey, one of the quantitative research methods, was used. Correlational survey is used to examine the correlation between two or more variables and determine the correlation level between variables if any (Fraenkel & Wallen, 2006). Since the correlation between lifelong learning tendencies and scientific creativity levels of the prospective science teachers was investigated in this study, correlational survey was used.

1.2 Sample group

While the population of the study was composed of the prospective science teachers continuing to receive education in a public university located in Eastern Anatolia Region within the 2019-2020 academic year, the sample of the study consisted of 201 prospective science teachers studying in the 1st, 2nd, 3rd, and 4th years of the same university. Appropriate sampling method was preferred for sample selection. In order to reach the sample required for the study with the appropriate sampling method, the most easily accessible samples are preferred. Besides, the generalization was made to the "accessible population" and the whole accessible population was reached during the data collection process. In this context, Table 1 shows the demographic information of the participants in the sample.

Table 1

Demographic characteristics of the participants

Class level	*f*	*%*
1st Year	47	23.4
2nd Year	43	21.4
3rd Year	60	29.9
4th Year	51	25.3
Gender		
Female	152	75.6
Male	49	24.4
Age		
16-20 years	98	48.7
21-25 years	103	51.3

When Table 1 was examined, it was determined that 47 (23.4%) of the participants were the 1st-year students, 43 (21.4%) were the 2nd-year students, 60 (29.9%) were the 3rd-year students and 51 (25.3%) were the 4th-year students. In addition, 75.6% of the participants (152 participants) were female and 24.4% were male.

1.3 Data collection tools

Lifelong Learning Scale (LLS), which was developed by Wielkiewicz and Meuwissen (2014) to examine lifelong learning tendencies of prospective science teachers and was adapted to Turkish by Boztepe and Demirtaş (2016), was used in the present study. The one-dimension scale with 13 items was prepared as 5-point Likert type. In this context, the minimum and maximum scores of the scale are 13(13x1) and 65 (13x5), respectively. In their study Boztepe and Demirtaş (2016) calculated the Cronbach's alpha reliability

coefficient of the lifelong learning scale as .78; whereas, as a result of the repeated reliability analysis, the Cronbach's alpha reliability coefficient of the scale was calculated as .83 in this study.

Scientific Creativity Test (SCT), which was developed by Hu and Adey (2002) and adapted to Turkish by Deniş-Çeliker and Balım (2012), was used in the study to investigate scientific creativity levels of prospective science teachers. The test is composed of seven open-ended questions and includes all sub-dimensions of the scientific creativity model (Baysal, Kaya, & Üçüncü, 2013). The answers given to the questions are rated and scored in terms of fluency, flexibility and originality. The subjects related to each question are presented in Table 2.

Table 2

SCT questions and contents

Question number	*Related subject (Content)*	*Evaluation criteria*
1	Unusual situations	Fluency, flexibility and originality
2	Exploring the problem	
3	Developing product	
4	Scientific imagination	
5	Problem solution	Flexibility and originality
6	Science experiment	
7	Product design	

As seen in Table 2, while the questions 1, 2, 3 and 4 are evaluated in terms of fluency, flexibility and originality, questions 5, 6 and 7 are evaluated in terms of flexibility and originality. For example, 1 point for each answer (fluency), 1 point for each different answer (flexibility) and 2 points for each answer found in less than 5% of people, 1 point between 5% - 10% (originality) criteria are taken into account in the evaluation of the answers given by the participants to the 1st question; (Kılıç, 2011). While the reliability coefficient of the original version of the test was calculated by Hu and Adey (2002) as .89; Deniş-Çeliker and Balım (2012) who adapted the test into Turkish calculated it as .86. In the present study, the reliability coefficient of the test was found as .72.

1.4 Data analysis

Firstly, normality test was performed in the study. Table 3 shows the normality test results for each variable.

Table 3

Results of normality test

Scale	*Variables*	*Kolmogorov-Smirnov*		
		Statistic	*DF*	*Sig.*
SCT	Male	.070	49	.200
	Female	.092	152	.003
LLS	Male	.114	49	.149
	Female	.070	152	.068
SCT	1st-Year	.154	47	.007
	2nd-Year	.132	43	.059
	3rd-Year	.100	60	.200
	4th-Year	.117	51	.078
LLS	1st-Year	.116	47	.130
	2nd-Year	.080	43	.200
	3rd-Year	.086	60	.200
	4th-Year	.134	51	.024
SCT	16-20 years	.094	98	.032
	21-25 years	.091	103	.036
LLS	16-20 years	.074	98	.200
	21-25 years	.061	103	.200

Based on Table 3, the SCT scores of students who were female, first-year, and from different age groups were not distributed normally. Since kurtosis and skewness values of SCT scores do not exceed the range of +/- 1, it is accepted that the scores obtained from this scale are normally distributed (George & Mallery, 2001). As a result of these explanations, independent samples t-test was used to compare the scale scores of the participants in terms of gender and age and ANOVA was used to compare them in terms of class level. In addition, Pearson's Product-Moment Correlation Coefficient (r) analysis technique was employed in order to examine whether or not there was a significant correlation between lifelong learning tendencies and scientific creativity levels of the prospective science teachers.

2 Findings

2.1 Lifelong learning tendencies of the prospective science teachers

Within the scope of the study, the answer of the question "what are the lifelong learning tendencies of prospective science teachers?" was sought. In this context, Table 4 shows mean ($\bar{x}$) and standard deviation (SD) of LLS scores of the participants.

Table 4

Descriptive statistics for LLS

	LLS	*N*	$\bar{x}$	*SD*
1	I enjoy intellectual challenges.	201	3.91	0.93
2	I share things I've just learned with others.	201	4.15	0.85
3	I like to analyze issues and problems in depth.	201	3.64	0.92
4	Reading is an activity I do regularly.	201	3.50	1.07
5	I'm a self-motivated person.	201	3.61	1.07
6	I search libraries and bookstores for interesting books, magazines.	201	3.35	1.10
7	I make interesting contributions to discussions around me or in school.	201	3.14	0.98
8	Critical thinking is one of the activities I do.	201	3.64	0.98
9	I read something for fun or entertainment.	201	3.82	0.98
10	I'm interested in many different areas.	201	3.70	0.98
11	I follow different interest areas.	201	3.64	1.02
12	I like to learn new things.	201	4.41	0.75
13	I read a lot of books, magazines etc. that are not related to school or courses.	201	3.31	1.16
	General		3.67	

When Table 4 was examined, LLS total mean score of the participants was calculated as 3.67. Therefore, the prospective science teachers said "Often" with agreement level of 3.67 to the overall LLS. While the participants agreed mostly the item "I like to learn new things." ($\bar{x}$=4.41), they agreed the item "I make interesting contributions to discussions around me or in school." the least ($\bar{x}$=3.14). Also, while they said sometimes to the item "I make interesting contributions to discussions around me or in school." as "sometimes" and responded to the item "I like to learn new things." as "always", their mean value for the other items was in the range of "Often".

2.2 Investigating the lifelong learning tendencies and scientific creativities of the prospective science teachers in terms of gender

Within the scope of the study, answer of the question "Do lifelong learning tendencies and scientific creativities of prospective science teachers differ significantly in terms of gender?" was sought. In this context, independent samples t-test was carried out to examine if the participants' LLS and SCT scores differed in terms of gender variable or not. Table 5 shows t-test results for the scores of the female and male participants included in the study.

Table 5

Results of t test for the scale scores of male and female participants

	Gender	*N*	$\bar{X}$	*SD*	*DF*	*t*	*P*
LLS	Male	49	47.38	8.11	199	-.550	.58
	Female	152	48.08	7.39			
SCT	Male	49	47.44	14.04	199	1.800	.04
	Female	152	42.72	16.52			

When Table 5 was examined, no statistically significant difference was found between the LLS total scores of male and female prospective teachers (Female participants = 48.08, Male participants = 47.38) (p>.05, t=-0.550). Besides, a statistically significant difference was found between SCT total scores of female and male prospective science teachers (p=.043<.05, t=1.800). This difference was in favor of male participants (Female participant = 42.72, Male participant = 47.44).

2.3 Investigation of lifelong learning tendencies and scientific creativities of the prospective science teachers in terms of age variable

In the study, the answer of the question "Do lifelong learning tendencies and scientific creativities of prospective science teachers differ significantly in terms of age variable?" was sought. In this context, independent samples t-test was carried out to examine whether or not the participants' LLS and SCT scores differed in terms of age variable. Table 6 shows t-test results for the scale scores of the participants from different age groups.

Table 6

Results of t test for the scale scores of the participants from different age groups

	Age	*N*	$\bar{X}$	*SD*	*DF*	*t*	*p*
LLS	16-20 years	98	47.80	7.75	199	-.181	.856
	21-25 years	103	48.00	7.41			
SCT	16-20 years	98	39.59	14.73	199	-3.809	.000
	21-25 years	103	47.95	16.29			

When Table 6 was examined, no statistically significant difference was found between the LLS total scores of the prospective science teachers from different age groups (16-20 age = 47.80, 21-25 age = 48.00) (p>.05, t=-0.181). Besides, a statistically significant difference was found between SCT total scores of the prospective science teachers (p=.000<.05, t=-3.809). When the mean scores were examined, it was observed that the difference was in favor of the participants in the age group of 21-25 years (16-20 age = 39.59, 21-25 age = 47.95).

2.4 Investigation of lifelong learning tendencies and scientific creativities of the prospective science teachers in terms of class level variable

In the study, the answer of the question "Do lifelong learning tendencies and scientific creativities of prospective science teachers differ significantly in terms of class level variable?" was sought. One-way analysis of variance (ANOVA) from parametric tests was carried out to answer this sub-problem. While Table 7 shows the group statistics obtained from LLS as a result of the analysis, Table 8 shows ANOVA results.

Table 7

Group statistics

Class level	*N*	$\bar{X}$	*SD*	*Standard error*
1st Year	47	46.17	7.92	1.15
2nd Year	43	49.27	7.95	1.21
3rd Year	60	49.23	7.66	.99
4th Year	51	46.78	6.36	.89
Total	201	47.90	7.56	.53

Table 8

Results of ANOVA statistics

Scale	*Source of Variance*	*Sum of squares*	*DF*	*Mean squares*	*F*	*P*
	Between-group	392.554	3	130.851		
LLS	Within-group	11048.650	197	56.085	2.333	.045
	Total	11441.204	200			

A significant difference was found between the LLS total scores in terms of class level [F(3-197)=2.333; p=.045<.05]. LSD (Least Significant Difference) from multiple comparison tests was preferred to determine the cause of the difference since variances were homogeneously distributed. Table 9 shows the results obtained in this context.

Table 9

Distribution showing LSD test comparison in terms of class level

Class	*Class*	*Difference of Means*	*Standard error*	*P*
	2nd Year	-3.10886	1.58	.051
1st Year	3rd Year	-3.06312	1.45	.037
	4th Year	-.61410	1.51	.686
2nd Year	1st Year	-3.10886	1.58	.051

	3rd Year	.04574	1.49	.976
	4th Year	2.49476	1.55	.109
	1st Year	-3.06312	1.45	.037
3rd Year	2nd Year	.04574	1.49	.976
	4th Year	2.44902	1.42	.048
	1st Year	-.61410	1.51	.686
4th Year	2nd Year	2.49476	1.55	.109
	3rd Year	2.44902	1.42	.048

The results of LSD carried out to determine the cause of difference between class levels indicated that the difference was between the 3rd -year students and 1st -year and 4th -year students and in favor of 3rd -year students. The group statistics obtained from SCT as a result of the analysis are present in Table 10 and the ANOVA results are present in Table 11.

Table 10

Descriptive statistics results of class level

Class level	*N*	$\bar{x}$	*SD*	*Standard error*
1st -Year	47	35.29	14.43	2.10
2nd -Year	43	41.06	13.79	2.10
3rd -Year	60	49.33	15.77	2.03
4th -Year	51	47.72	16.15	2.26
Total	201	43.87	16.06	1.13

Table 11

Results of ANOVA statistics

Scale	*Variance Source*	*Sum of squares*	*DF*	*Mean squares*	*F*	*P*
	Between-group	6339.780	3	2113.260		
SCT	Within-group	45304.111	197	229.970	9.189	.000
	Total	51643.891	200			

A significant difference was found between the SCT total scores and class level [F(3-197) =9.189; p=.000<.05]. The cause of the resulting difference was found by LSD test. Table 12 shows the findings obtained in this context.

Table 12

Distribution showing LSD test comparison in terms of class level

Class	*Class*	*Means Difference*	*Standard error*	*p*
	2nd-Year	-5.77190	3.20	.073
1st-Year	3rd-Year	-14.03546	2.95	.000
	4th-Year	-12.42762	3.06	.000
	1st -Year	-5.77190	3.20	.073
2nd-Year	3rd -Year	-8.26357	3.03	.007
	4th -Year	6.65572	3.13	.035
	1st -Year	-14.03546	2.95	.000
3rd-Year	2nd -Year	-8.26357	3.03	.007
	4th -Year	-1.60784	2.88	.578
	1st -Year	-12.42762	3.06	.000
4th-Year	2nd -Year	6.65572	3.13	.035
	3rd -Year	-1.60784	2.88	.578

LSD test results revealed between class levels showed that the difference was between the 3rd year students and 1st year and 2nd year students and in favor of 3rd year students. In addition, it was found that there was a significant difference between the scale scores of 4th year students and the scale scores of 1st and 2nd year students and this difference was in favor of 4th year students.

2.5 Investigation of the correlation between lifelong learning tendencies and scientific creativity levels of the prospective science teachers

In the study, the answer of the question "Is there a significant correlation between lifelong learning tendencies and scientific creativity levels of prospective science teachers?" was sought. The correlation between the lifelong learning tendencies and scientific creativity levels of the participants was investigated using the Pearson's Product-Moment Correlation Coefficient. Preliminary analysis indicated that there was a moderate and positive correlation between two variables (r=.304, n=201, p=.000<.01) (Table 13).

Table 13

Pearson's product-moment correlation results

Scales	R	p
LLS SCT	.304	.000*

*p<.01

3 Discussion

This study was conducted to investigate the lifelong learning tendencies and scientific creativity levels of the prospective science teachers and the correlation between these variables. Their LLS total mean score was found to be 3.67. Accordingly, it can be asserted that the prospective teachers had high lifelong learning tendencies. In other words, they were willing to learn new things continuously and develop themselves in numerous areas. The studies conducted by Kurt, Cevher and Arslan (2019) with prospective Turkish teachers; by Altın (2018), Ayaz (2016) and Ayra (2015) with teachers; by Kuzu, Demir, and Canpolat (2015) with prospective teachers, and by Karaduman (2015) with university students reported that lifelong learning tendencies of the participants were high, which supports the result of the prospective studies.

The lifelong learning tendency levels were in moderate level for Turkish teaching students in the study by Ürün-Karahan (2017) and for university students in the study by Yasa (2018). While Donnison (2009) stated that prospective teachers always considered themselves as lifelong learning individuals, Bulaç (2019) determined that the scores obtained by the prospective teachers from lifelong learning tendencies scale were above the moderate level and recommended that lifelong learning related courses should be involved in the education of prospective teachers. On the other hand, the participants had low levels of lifelong learning tendency in the studies conducted by Diker-Coşkun and Demirel (2012) and Gökyer and Türkoğlu (2018) with university students and by Tunca, Şahin and Aydın (2015) with prospective teachers and this result is not compatible with the present study. Tunca, Şahin and Aydın (2015) suggested that this may be associated with the fact that the lifelong learning skills are not fully involved into the teacher training programs.

In the literature, an inconsistency is seen in lifelong learning tendency levels of prospective teachers. Therefore, the underlying causes of this situation should be revealed. Likewise, it is important to take necessary steps for teachers, who are social architects of societies, to acquire lifelong learning skills including formal and informal all-purpose activities (Green, 2002). It was also determined in the present study that the participants agreed mostly with the item “I like to learn new things.” and with the item “I make interesting contributions to discussions around me or in school.” the least (Table 4). As a component of lifelong learning strengthening individuals’ knowledge and skills, providing them an unlimited learning environment and giving them the opportunity to use these skills in real life, the prospective teachers stated that they were pleased with learning new things. This was an expected result in terms of the current study (Rausch, 2003; Wetzel, 2010). However, the prospective teachers stated that they were reluctant to contribute to the discussions in general. This is a subject requiring to be emphasized and solved. This is because individuals should acquire lifelong

learning skills from early ages and teachers have important duties in this process (Fenwick, 2001). It is also important for teachers, who undertake major tasks to influence societies, to acquire the desire of solving current problems and providing necessary contributions to discussions and to prepare appropriate learning environments in which teacher candidates can make discussions on scientific and social issues during their undergraduate education.

No statistically significant difference was found between the LLS total scores of female and male prospective science teachers (Table 5). This result was an expected situation in terms of gender equality and is similar to some studies in the literature (Şahin & Arcagök, 2014; Yaman & Yazar, 2015). Besides, Kurt, Cevher and Arslan (2019) and Kahraman (2019) found that lifelong learning skills of female prospective teachers were higher than male prospective teachers in motivation, curiosity, and lack of regulation of learning dimensions. Woonsun (2013), on the other hand, stated that lifelong learning tendencies of prospective teachers were partly dependent on gender. These studies have revealed that there is a need for further studies to investigate the effect of gender variable on lifelong learning tendencies. In addition, no statistically significant difference was found between the LLS total scores of the prospective science teachers in different age groups (Table 6). This result is not compatible with the results of some studies (Horuz & Şahan, 2016; Yasa, 2018). For example, Yasa (2018) stated that younger teacher candidates could make more efforts to have lifelong learning skills and importance should be attached on elective courses that will improve lifelong learning skills of prospective teachers from different age groups. Bulaç (2019) emphasized that prospective teachers should acquire lifelong learning skills during undergraduate education, which supports this recommendation. From this point of view, preparing suitable learning environments for prospective teachers from any age group to have lifelong learning skills, making appropriate course selections and encouraging them to receive graduate education are seen to be important.

A significant difference was found between the LLS total scores of the prospective science teachers in terms of class level (Table 8). The results of LSD test performed to determine the cause of the difference indicated a difference between the 3rd-year students and the 1st- and 4th-year students and it was in favor of 3rd-year students (Table 9). This result is compatible with results of some studies conducted with prospective teachers (Kurt, Cevher, & Arslan, 2019; Tunca, Şahin, & Aydın, 2015; Yasa, 2018). However, Bahadır (2019) stated that class level variable and the education given in universities had no effect on lifelong learning tendencies of university students. All these results indicated that lifelong learning tendencies of teacher candidates should increase with increasing class level but there were inconsistencies at this point. Therefore, it seems important to investigate profoundly the lifelong learning tendencies of

prospective teachers studying in different classes with the supports of qualitative studies.

A statistically significant difference was found between the SCT total scores of male and female prospective science teachers and this difference was in favor of male participants (Table 5). This result is different from results of some studies (Karaçelik, 2009; Öztekin, 2013; Ulusoy-Yılmaz & Yıldız, 2019). Polat and Kontaş (2018) stated that gender variable had no significant effect on the creativity of teachers and higher education programs should be updated in this direction in order for teachers to have higher-order thinking skills. Likewise, Şahin (2010) investigated the scientific creativity levels of teachers and stated that gender had no effect on scientific creativity level. Although these results have revealed that gender variable does not have any effect on scientific creativity, it is important to conduct further related studies. Besides, a statistically significant difference was found between the SCT total scores of prospective science teachers in different age groups and this difference was in favor of the participants from the age group of 21-25 years (Table 6). It is expected that scientific creativity levels increase with increasing age. This result is supported by the finding reporting that as the class levels of the prospective teachers increased, their scientific creativity levels increased (Table 10). A significant difference was found between the SCT total scores in terms of class level (Table 11) and this difference was observed between the 3rd-year students and 1st- and 2nd-year students and it was in favor of the 3rd -year students (Table 12). However, no significant difference was found between scientific creativity scores of 3rd- and 4th-year prospective teachers. The results showed that the SCT scores of the prospective teachers increased until 3rd-year but the scores of 4th-year prospective teachers decreased. This may be associated with the effect of the exam that prospective teachers studying in the last year have to take in order to work as teachers in educational institutions after graduation. Therefore, it can be concluded that focusing on exam-oriented studies rather than conducting studies to develop higher-order thinking skills for 4th -year teacher candidates led to a decrease in their scientific creativity scores.

As a result of the analysis, it was seen that there was a moderate and positive correlation between lifelong learning tendencies and scientific creativity levels of the participants (Table 13). These results indicated that high levels of lifelong learning were correlated with high levels of scientific creativity. Lifelong learning requires individuals to have some atypical knowledge, skills and competencies to cope with current life problems (Cross, 2014). In addition, it is recommended in the literature that individuals should have competencies such as searching information, accessing information, and knowing the ways of reaching information in order to have lifelong learning skills (Knapper & Cropley, 2000; Shuman, Besterfield-Sacre, & McGourty, 2005). Therefore, it can be asserted

that scientific creativity skills of individuals who integrate learning processes to all their lives and have the mentioned competences will also improve. Similarly, Kozikoğlu and Altunova (2018) expressed that lifelong learning tendencies of prospective teachers will increase with increasing self-efficacy perceptions for 21st century skills and an individual should improve and use his/her own creativity in lifelong learning.

Conclusion

The limitations of the study are that the study included 201 prospective science teachers studying in a public university located in Eastern Anatolia Region and the number of male participants was less than the number of female participants. As a result of all these explanations, it is important for prospective teachers to do practices, which will improve their lifelong learning skills during their undergraduate education, in terms of scientific creativities. This is because scientific creativity and lifelong learning skills should be included in the science course in order for students to acquire sense of task, scientific perspective, and skills for controlling and regulating their learnings. Besides, unlike this study conducted with prospective science teachers studying at faculty of education, the correlation between lifelong learning tendencies and scientific creativity levels of teachers in different branches can be revealed.

References

Akyol, B., Başaran, R., & Yeşilbaş, Y. (2018). Life satisfaction level and lifelong learning tendencies of public education center trainees. *Mehmet Akif Ersoy University Faculty of Education Journal 48*, 301-324.

Altın, S. (2018). *Investigating of Lifelong Learning Tendencies of Secondary School Teachers* (Master thesis). Zonguldak: Zonguldak Bülent Ecevit University Institute of Social Sciences.

Amabile, T. M. (1996). *Creativity in Context: Update to the Social Psychology of Creativity*. Colorado, Boulder: Westview.

Ayaz, C. (2016). *The Analysis of Lifelong Learning Tendencies of Teachers in Terms of Some Variables* (Master thesis). Bartın: Bartın University Institute of Education Sciences.

Ayra, M. (2015). *The Relationship of the Lifelong Learning Tendencies of Teachers with Their Self-Confidence about Their Vocational Proficiency* (Master thesis). Amasya: Amasya University Institute of Social Sciences.

Bahadır, Z. (2019). *The Analysis of the Lifelong Learning Tendencies and Meaning of Life with Some Demographic Variables.* (Master thesis). Sakarya: Sakarya University Institute of Education Sciences.

Banger, G. (2016). *Endüstri 4.0 ve akıllı işletme.* Ankara: Dorlion Yayınları.

Baysal, Z. N., Kaya, N. B., & Üçüncü, G. (2013). Examination of scientific creativity level of fourth grade students in terms of several variables. *Journal of Educational Sciences, 38,* 55-64.

Boztepe, Ö., & Demirtaş, Z. (2016). The adaptation of lifelong learning scale into Turkish culture. *Journal of Family, Counseling, and Education, 1*(1), 10-17.

Brun, M., & Hinostroza, J. E. (2014). Learning to become a teacher in the 21st century: ICT integration in initial teacher education in Chile. *Educational Technology & Society, 17*(3), 222-238.

Bulaç, E. (2019). *Investigation of Tendencies of Prospective Teachers towards Lifelong Learning* (Master thesis). Amasya: Amasya University Institute of Social Sciences.

Casner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century US workforce. Partnership for 21st Century Skills.* Washington, DC 20001.

Chea, C. C., & Huan, J. T. (2019). Higher education 4.0: The possibilities and challenges. *Journal of Social Sciences and Humanities, 5*(2), 81-85.

Cross, J. (2014). *Motives and Barriers Affecting Participation in Lifelong Learning Activities by Older Adults* (Unpublished doctoral dissertation). Fullerton: California State University.

Çiftcibaşı, F., Korkmaz, Ö., & Karamustafaoğlu, S. (2020). Lifelong learning skills scale for secondary school students: Validity and reliability study. *Erzincan University Journal of Education Faculty, 22*(1), 211-226.

Davis, B., & Sumara, D. J. (1997). Cognition, complexity and teacher education. *Harvard Educational Review, 67*(1), 105-125.

Demir, A. (2018). Changing education & training paradigms from industrial 4.0 to education 4.0. *Turkish Studies, 13*(15), 147-171.

Demir, S. (2015). Perspectives of science teacher candidates regarding scientific creativity and critical thinking. *Journal of Education and Practice, 6*(17), 157-159.

Demirel, M., Sadi, Ö., & Dağyar, M. (2016). An investigation of science teachers' lifelong learning competencies (The case of Karaman). *Pegem Journal of Education and Instruction, 6*(1), 19-40.

Demirel, M., & Akkoyunlu, B. (2017). Prospective teachers' lifelong learning tendencies and information literacy self-efficacy. *Educational Research and Reviews, 12*(6), 329-337.

Demirhan, E., Önder, İ., & Beşoluk, Ş. (2018). The change in scientific creativity and academic achievement of prospective science teachers by years. *Kastamonu Education Journal, 26*(3), 685-696.

Deniş-Çeliker, H., & Balım, A. G. (2012). Adaptation of scientific creativity test to Turkish and its assessment criteria. *Uşak University Journal of Social Sciences, 5*(2), 1-21.

Diker-Coşkun, Y., & Demirel, M. (2012). Lifelong learning tendencies of university students. *Hacettepe University Journal of Education, 42,* 108-120.

Dinevski, D., & Dinevski, I. V. (2004). The concepts of university lifelong learning provision in Europe. *Transition Studies Review, 11*(3), 227-235.

Doğan, O., & Baloğlu, N. (2020). Industrial 4.0 conceptual awareness levels of university students. *TÜBAV Bilim Dergisi, 13*(1), 126-142.

Donnison, S. (2009). Discourses in conflict: the relationship between gen y pre-service teachers, digital technologies and lifelong learning. *Australasian Journal of Educational Technology, 25*(3), 336-350.

Fenwick, T. A. (2001). Fostering teachers' lifelong learning through professional growth plans: A cautious recommendation for policy. In *2001 Pan-Canadian Education Research Agenda Symposium Teacher Education/Educator Training: Current Trends and Future Directions,* 1-21, 2001 Laval University, Quebec City.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to Design and Evaluate Research in Education* (6th ed.). Boston: McGraw-Hill.

George, D., & Mallery, P. (2001). *SPSS for Windows. Step by step* (3rd ed.). USA: Allyn & Bacon.

Gomaratat.S. (2015). Subject: Learning productivity. In P. Sinlarat, *10 Ways of Progressive Learning Encouraging/Facilitating the Ability of the Learner of 21st Century*. Bangkok: Education Science, Dhurakit Bandit University.

Gökyer, N., & Türkoğlu, İ. (2018). Lifelong learning trends of university students. *The Journal of International Social Sciences, 28*(2), 125-136.

Green, A. (2002). The many faces of lifelong learning: Recent education policy trends in Europe. *Journal of Education Policy, 17*(6), 611-626.

Gurjanov, A. V., Zakoldaev, D. A., Shukalov, A. V., & Zharinov, I. O. (2020). The high industrial Education 4.0 soft skills and hard skills. *Journal of Physics: Conference Series*, 1691(1), 012022.

Gülel, G. (2006). *Elementary school teacher candidates' creativity levels towards different variables* (Master thesis). Denizli: Pamukkale University, Institute of Social Sciences.

Hanewald, R. (2012). Cultivating life-long learning skills in undergraduate students through the collaborative creation of digital knowledge maps. *Social and Behavioral Sciences, 69,* 847-853.

Horuz, O. R., & Şahan, G. (2016). Investigation of lifelong learning trends of vocational education center students (Bartın province sample). In *World Congress on Lifelong Education* (pp. 442-453).

Hu, W., & Adey, P. (2002). A scientific creativity test for secondary school students. *International Journal of Science Education, 24*(4), 389-403.

Hu, W., Wu, B., Jia, X., Yi, X., Duan, C., Meyer, W., & Kaufman, J. (2013). Increasing students' scientific creativity: The "learn to think" intervention program. *The Journal of Creative Behavior, 47*(1), 3-21.

Hursen, C. (2014). Are the teachers lifelong learners? *Procedia-Social and Behavioral Sciences, 116,* 5036-5040.

Kahraman, S. (2019). *The Relationship between Prospective Teachers' Lifelong Learning Tendencies and Attitudes towards English Course* (Master thesis). Bolu: Bolu Abant İzzet Baysal University Institute of Education Sciences.

Kangalgil, M., & Özgül, F. (2018). Investigation of physical education and sports training students in lifelong learning trends. *Journal of Global Sport and Education Research, 1*(1), 64-72.

Karaçelik, S. (2009). *An Investigation of Creative Thinking Skills of Pre-School Teacher and Teacher Candidates* (Master thesis). Muğla: Muğla University Institute of Social Sciences.

Karaduman, A. (2015). *The Relationship between the Lifelong Learning Tendencies of Undergraduate Students and their Self- Efficacy Perceptions* (Master thesis). Bartın: Bartın University Institute of Education Sciences.

Kılıç, B. (2011). *Determining Scientific Creativity Levels of 8th Grade Students* (Master thesis). Eskişehir: Eskişehir Osmangazi University Institute of Education Sciences.

Kiras, B., & Bezir-Akçay, B. (2016). The effect of active learning methods' techniques on student's scientific creativity in teaching body systems unit in seventh grade. *International Journal of Active Learning, 1*(2), 1-20.

Knapper, C., & Cropley, A. (2000). *Lifelong Learning in Higher Education.* London: Kogan Page.

Kozikoğlu İ., & Altunova N. (2018). The predictive power of prospective teachers' self-efficacy perceptions of 21st century skills for their lifelong learning tendencies. *Journal of Higher Education and Science, 8*(3), 522-531.

Kulich, J. (1982). Lifelong education and the universities: A Canadian perspective. *International Journal of Lifelong Education, 1*(2), 123-142.

Kurt, E., Cevher, T., & Arslan, N. (2019). Pre-service Turkish teachers' tendencies towards lifelong learning. *Trakya Eğitim Dergisi, 9*(1), 152-160.

Kuzu, S., Demir, S., & Canpolat, M. (2015). Evaluation of life-long learning tendencies of pre-service teachers in terms of some variables. *Journal of Theory and Practice in Education, 11*(4), 1089-1105.

Lai, E. R., & Viering, M. (2012). *Assessing 21st century skills: Integrating research findings.* Vancouver, B.C.: National Council on Measurement in Education.

Ledward, B. C., & Hirata, D. (2011). *An Overview of 21st century skills.* Honolulu: Kamehameha Schools Research & Evaluation. Retrieved from http://www.ksbe.edu/_assets/spi/pdfs/21st_Century_Skills_Brief.pdf

MEB. (2018). *Science Course Curriculum (Primary and Middle School 3, 4, 5, 6, 7 and 8 Grades).* Ankara, Turkey.

Mitkovska, S. J., & Hristovska, D. (2011). Contemporary teacher and core competences for lifelong learning. *Procedia - Social and Behavioral Sciences, 28,* 573-578.

Öztekin, E. (2013). *Investigation of Science Teacher Candidates' Creative Thinking Levels in Terms of Different Variabilities* (Master thesis). Burdur: Mehmet Akif Ersoy University Institute of Education Sciences.

Öztemel, E. (2018). Evaluation of new trends in education and Education 4.0. *Journal of University Research, 1*(1), 25-30.

Pise, S., & Jadhav, V. G. (2016). Nurturing creativity through science education. *EduInspire: An International E-Journal, 3*(2), 1-9.

Polat, M., & Kontaş, H. (2018). Examining primary school teachers' creativity level. *Abant İzzet Baysal University Journal of Faculty of Education, 18*(3), 1702-1721.

Qina, J., Liu, Y., & Grosvenor, R. (2016). A categorical framework of manufacturing for industry 4.0 and beyond. *Procedia CIRP, 52,* 173-178.

Rausch, A. S. (2003). A case study of lifelong learning in Japan: Objectives, curriculum, accountability, and visibility. *International Journal of Lifelong Education. 22*(5), 518-532.

Sak, U., & Ayas, M.B. (2013). Creative Scientific Ability Test (c-sat): A new measure of scientific creativity. *Psychological Test and Assessment Modeling, 55*(3), 316-329.

Saxena, R., & Bhat, V. (2017). *Leapfrogging to Education 4.0: Student at the Core.* London: Ernst & Young.

Shanahan, M. C., & Nieswandt, M. (2009). Creative activities and their influence on identification in science: Three case studies. *Journal of Elementary Science Education, 21*(3), 63-79.

Shuman, L. J., Besterfield-Sacre, M., & McGourty, J. (2005). The ABET "professional skills" - can they be taught? Can they be assessed? *Journal of Engineering Education, 94*(1), 41-55.

Siew, N. M., Chin, M. K., & Sombuling, A. (2017). The effects of problem based learning with cooperative learning on preschoolers' scientific creativity. *Journal of Baltic Science Education, 16*(1), 100-112.

Şahin, Ç., & Arcagök, S. (2014). Examination of the teachers' lifelong learning competences levels ın terms of some variables. *Journal of Social Sciences, 7*(16), 394-417.

Şahin, E. (2010). *Creativity, Professional Burnout and Life Satisfaction of Primary School Teachers* (Master thesis). Sakarya: Sakarya University Institute of Social Sciences.

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times.* San Francisco, CA: John Wiley & Sons.

Tunca, N., Şahin, S. A., & Aydın, Ö. (2015). Life-long learning tendencies of pre-service teachers. *Mersin University Journal of the Faculty of Education, 11*(2), 432-446.

Ulusoy-Yılmaz, D., & Yıldız, Y. (2019). Investigation of creative thinking skills of music teacher candidates in terms of various variables. *Cumhuriyet International Journal of Education, 8*(2), 516-530.

Ürün-Karahan, B. (2017). The correlation between life-long learning tendencies of students of Turkish teaching and Turkish language and literature departments and their attitudes toward profession. *E-Kafkas Journal of Educational Research, 4*(3), 45-58.

Wang, J., & Yu, J. (2011). Scientific creativity research based on generalizability theory and BP Adaboost RT. *Procedia Engineering, 15,* 4178-4182.

Wetzel, D. R. (2010). *10 Secrets to Lifelong Learning for Everyone: The Benefits of Continuing Education for Work and Self Improvement.* Retrieved from http://suite101.com/article/10-secrets-to-lifelong-learning-for-everyone-a188260

White, J. P. (1982). *The aims of education re-stated.* London: Routledge & Kegan Paul.

Wielkiewicz, R. M., & Meuwissen, A. S. (2014). A lifelong learning scale for research and evaluation of teaching and curricular effectiveness. *Teaching of Psychology, 41*(3), 220-227.

Woonsun, K. (2013). Korean pre-service teachers' service learning and lifelong learning competency. *Procedia-Social and Behavioral Sciences 116*, 3502-3505.

Yaman, F., & Yazar, T. (2015). Investigating of lifelong learning tendency of teachers (The Example of Diyarbakır). *Kastamonu Education Journal, 23*(4), 1553-1566.

Yang, K. K., Lin, S. F., Hong, Z. R., & Lin, H. S. (2016). Exploring the assessment of and relationship between elementary students' scientific creativity and science inquiry. *Creativity Research Journal, 28*(1), 16-23.

Yasa, H. D. (2018). *Analysis of the Relationship between the Lifelong Learning Tendencies and Information Literacy Skills of Teacher Candidates* (Master thesis). Bartın: Bartın University Institute of Education Sciences.

Yenice, N., & Alpak-Tunç, G. (2019). An investigation of pre-service teachers' lifelong learning tendencies and their individual innovativeness levels. *Kastamonu Education Journal, 27*(2), 753-765.

Yenice, N., & Yavaşoğlu, N. (2018). Investigation of the relationship between pre-service science teachers' personal innovativeness levels and personal creativity. *Journal of Theory and Practice in Education, 14*(2), 107-128.

Zulkarnaen, Z., Supardi, Z. I., & Jatmiko, B. (2018). The role of knowledge mastery and science process skills to increase the scientific creativity. *Unnes Science Education Journal, 7*(2), 178-185.