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An examination of pre-service teachers' environmental attitudes, behaviors, and knowledge

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Abstract

The environmental literacy (EL) of pre-service teachers is of crucial importance for the development of environmentally responsible individuals and the promotion of EL. However, most of these studies have focused on Western and European contexts and have not yet conducted comparative studies to assess pre-service teachers' EL, including attitude, behavior, and knowledge. This study aims to investigate and evaluate the EL of pre-service teachers in two countries by comparing and assessing their knowledge, attitudes, and behavior. The researchers collected data from 282 pre-service teachers. The results show that although the participants' attitude is generally positive, this positive attitude is not fully reflected in their behaviors. The level of knowledge is relatively low. This shows that although the participants have positive attitudes and behaviors, they lack knowledge. There were significant differences between the countries in the attitudes of female and male students' knowledge levels. However, it was found that there was no significant effect of grade level and no significant effect of school branch in high school on knowledge, behavior, and attitudes. In light of the results obtained, we made recommendations for future research.

Keywords: environmental literacy, pre-service teachers, attitude, behavior, knowledge

INTRODUCTION

Promoting environmental literacy (EL) requires identifying and developing future teachers' affective outcomes and knowledge levels. Studies have indicated that their environmental behaviors and knowledge influence their EL awareness. Understanding the affective outcomes and knowledge of future teachers is important when evaluating their role in promoting environmental education (EE) for the next generation. This will help to increase the effectiveness of EE initiatives (Dada et al., 2017; Orbanić & Kovač, 2021). Additionally, teachers who have prepared and designed EE materials can help students encourage EL and sustainable practices (Obiagu et al., 2024; Zhdanov et al., 2023). According to this rationality, successful EE implementation relies on knowledge and behaviors of eco-friendly practices that can result in community-level changes outside of the classroom (Boubonari et al., 2013; Yavetz et al., 2009). Thus, by addressing effective environmental teaching and curriculum design for EE, teacher education programs play a critical role in fostering and molding students' EL (Dada et al., 2017; Obiagu et al., 2024). Researchers have indicated that pre-service teachers' EL contributes to improved classroom outcomes and implementation of effective EE in addressing environmental issues.

The researchers examined the EL levels of pre-service teachers, including their affective, behavioral, and knowledge factors, and other affective factors such as motivation and self-efficacy. To this end, they examined the EL levels of pre-service teachers in different countries and contexts. Notably, the results of these studies have led to different outcomes. Previous studies

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Contribution to the literature

- Previous studies show that attitudes and behaviors towards the environment vary depending on the context in which the studies were conducted.
- Although many studies have been conducted on the attitudes, behaviors, and knowledge of prospective teachers in Western and European contexts, very little is known about prospective teachers from Asian contexts.
- The present study's findings provide new insights by revealing the complex nature of EL from a comparative perspective in two countries.

show that although pre-service teachers generally have a positive attitude towards the environment, their environmental knowledge varies depending on the context in which the studies were conducted (Álvarez-García et al., 2018; Stylos et al., 2019). Furthermore, previous research findings on pre-service teachers' ELs have indicated that a lack of sound environmental knowledge is a problem in fully implementing and advocating effective environmental practices. This finding suggests that there is a need to address environmental knowledge to apply EL in the classroom and outdoors (Álvarez-García et al., 2018; Zhdanov et al., 2023). In addition, there is a need for further studies to identify and understand the attitudes and behaviors of pre-service teachers in order to contribute to the literature. Furthermore, the gap between knowledge and behavior underscores the challenge of implementing effective EE instruction. Understanding the gap between attitudes and actions in EE can be enhanced by further studies on pre-service teachers' attitudes, behaviors, and knowledge. Most studies on pre-service teachers' attitudes, behaviors, and knowledge have been conducted in Western and European contexts; very little is known about pre-service teachers from Asian contexts. In particular, no studies compare the behavior and knowledge of pre-service teachers from different countries. This article investigates the environmental competence of pre-service teachers at two universities in two countries by assessing their knowledge, attitude, and behavior.

RELATED LITERATURE

Researchers have studied to identify and understand the environmental competence of pre-service teachers. For example, Boubonari et al. (2013) investigated Greek primary school teachers' knowledge, attitudes, and behavior on marine pollution. Their results showed that pre-service teachers have only moderate knowledge and misconceptions about marine pollution. Although pre-service teachers had a very positive attitude towards the marine environment and a relatively high willingness to pay, they showed moderately high individual and low collective action towards marine pollution. Goulgouti et al. (2019) investigated the environmental literacies of pre-service teachers in Greece. They examined the EL of pre-service teachers in terms of attitudes, affects, behaviors, knowledge, and some variables, including gender, grade level, and major in school. The results show that pre-service teachers have a positive attitude towards the environment. The results also show that they have moderate environmental knowledge and limited participation in environmental actions, focusing mainly on individual rather than collective actions. The results also show that pre-service teachers had misunderstandings regarding certain environmental concepts.

Gavrilakis et al. (2017) investigated the EL of pre-service primary school teachers in Greece. Their results showed that pre-service teachers have a positive attitude towards environmental issues, strong beliefs, and a high awareness of environmental concepts. However, they found moderate environmental knowledge and limited participation in environmentally friendly actions. Research by Orbanić and Kovač (2021) investigated pre-service preschool and primary school teachers' environmental awareness, attitudes, and behavior. They examined 152 Slovenian pre-service teachers. Their results showed that the students have a relatively high level of environmental awareness and mostly show a positive attitude towards nature and its protection. They also found that course content had a less significant impact on students' awareness, behavior, and attitudes. They concluded that an improved course in the teacher education program and more innovative teaching methods and activities are needed to increase students' EL.

Borhan and Ismail (2011) investigated the environmental knowledge, attitudes, and behaviors of pre-service teachers in Malaysia. Their participants were pre-service teachers teaching methods in chemistry. Their results showed that pre-service teachers knew little about environmental issues, particularly climate change. However, respondents showed high positive attitudes towards the environment based on their responses to the relevant attitude questions, particularly those related to adopting significant actions. Most items in the environmental behavior component yielded considerably high mean scores, indicating a strong willingness of pre-service teachers to behave in an environmentally friendly manner. On the other hand, their results also revealed no significant relationship between knowledge, attitudes, and behavior. In another

research, Álvarez-García et al. (2018) examined the environmental competencies of two groups of students enrolled at two universities in Spain. Their results show no significant differences in outcomes related to the level of greening of the education programs. The pre-service teachers have insufficient environmental knowledge but a fairly positive, responsible attitude towards environmental issues and environmentally friendly behavior that can be classified as moderate.

Recently, Samur and Akman (2023) examined the EL of pre-service social studies teachers. Their participants were pre-service teachers studying in social studies programs at two universities. Their results showed a significant difference between pre-service teachers' environmental knowledge and EL and their beliefs. In addition, they found significant differences between pre-service teachers' EL and gender in favor of female pre-service teachers. Zhdanov et al. (2023) investigated the attitudes of Russian pre-service teachers towards environmental technologies. Their results showed that the participants had moderate and low attitude scores regarding the positive aspects of environmental technologies. Participants also had very positive attitudes towards the benefits of environmental technologies, while they had the lowest mean scores on the negative aspects of environmental technologies. The results also showed significant differences in participants' age, branch, and gender. Obiagu et al. (2024) investigated the role of EE in the acquisition of environmental knowledge, pro-environmental beliefs, and pro-environmental behaviors among pre-service teachers in a Nigerian context. Their results showed that pre-service teachers who had attended the EE course had higher environmental knowledge and pro-environmental behaviors than their counterparts who had not participated in the EE course. They also found no relationships between environmental knowledge, pro-environmental beliefs, and pro-environmental behavior.

In light of the studies presented above, it can be concluded easily that despite having only moderate or low levels of factual environmental knowledge, pre-service teachers generally show positive environmental attitudes and high awareness of environmental issues (e.g., Álvarez-García et al., 2018; Stylos et al., 2019). However, the existing studies in the literature have yielded different outcomes about pre-service teachers and their attitudes, behaviors, and knowledge. Moreover, most of the studies have been conducted in Western and European contexts, and very little is known about participants from the Asian context. To our knowledge, no comparative studies exist. Hence, this paper examines the environmental competence of pre-service teachers at two universities in two countries by assessing their attitudes, behaviors, and knowledge.

Environmental Education in Kazakhstan and Uzbekistan

Integrating EE into teacher preparation programs has gained increasing attention in Kazakhstan and Uzbekistan. Both countries' educational contexts are strongly influenced by their historical contexts. Both countries have recognized that EE should be taught effectively in teacher training. In light of this realization, scholars in both countries have researched EE.

For example, a study conducted in Kazakhstan by Agibayeva et al. (2024) investigated adult urban residents' perceptions, attitudes, and environmental knowledge about air quality. Their results showed that environmental knowledge remains low and that knowledge is essential to improving awareness and perception of air pollution. In another research, Agissova and Sautkina (2020) investigated the role of personal values in predicting environmental attitudes and behavior in Kazakhstan. They found that safety strongly predicted environmental concern and the new environmental paradigm (NEP). While self-direction positively predicted environmental concern, universalism and benevolence were positive predictors of NEP. They also found that ecological concern strongly predicted all pro-environmental behaviors. They found that personal factors significantly predict the Kazakh participants' environmental attitudes and pro-environmental behaviors. Furthermore, Tursynbayeva et al. (2020) studied the intersection of national policy and media efforts and found a crucial relationship in shaping students' environmental awareness. They indicated that training educators to teach EE effectively is essential to foster an understanding of environmental policies.

In a study with high school students, Sapanova et al. (2023) investigated the environmental knowledge, attitudes toward the environment, environmental awareness, and concern for the environment of Kazakh high school students. They found that Kazakh high school students did not have strong environmental knowledge and awareness but had very positive attitudes toward environmental protection. The study of Sapanova et al. (2023) reveals gaps in their understanding and engagement with environmental topics for more robust EE in Kazakh schools. Maratkyzy et al. (2024) evaluated a model for training prospective biology teachers' ecological competencies for EE. Their results showed that the experimental groups significantly increased environmental knowledge, values, and skills compared to the control groups.

In a comparative study, Sergey et al. (2024) assessed students' and teachers' current knowledge of the sustainable development goals (SDGs) to understand how universities in the region integrate ESD principles into their educational programs in Kazakhstan, Tajikistan, Kyrgyzstan, and Uzbekistan. Their results

Table 1. Participants' demographic information

		Kazakhstan		Uzbekistan	
		N	Percentage (%)	N	Percentage (%)
Participants		202	72	80	28
Gender	Female	173	86	70	87
	Male	29	14	10	13
Grade level	1	90	45	11	14
	2	93	46	39	48
	3	7	3	19	24
	4	12	6	11	14
High school course specialization	Science	21	10	16	20
	Technology	3	2	3	4
	Humanities	178	88	61	76

show that students generally have limited knowledge of the global SDGs, while teachers have a higher level of awareness. These studies show that although EE in Kazakhstan is important, EL remains low in promoting environmental awareness (Agibayeva et al., 2024). In addition, there are few studies on EE and pre-service in Kazakhstan, and more research is needed on pre-service teacher education.

Regarding EE in Uzbekistan, the existing literature studies offer only minimal insights into the environmental awareness and EL of Uzbek participants. In particular, there are no studies on teachers in education and EE in Uzbekistan. According to Xaitov et al. (2024), educational reforms in the field of EE in Uzbekistan need to address urgent environmental challenges and promote a culture of sustainability among teachers in training. From this perspective, there is a need for more research on EE in Uzbekistan. Given the limited research on EE in Uzbekistan, this study will contribute to the literature.

METHOD

For this study, we used questionnaires to collect data and answer the research questions. We used three instruments to collect data for each variable: affect, behavior, and knowledge. We used the items adopted and developed by Goulgouti et al. (2019). They used 17 items for environment-related attitudes and 15 items for environment-related behaviors. Considering previous studies on environmental attitudes and behaviors, they developed and used the same items. Regarding demographic characteristics, we asked participants about their gender, grade level, and high school major areas, such as science, technology, and humanities. Once the questionnaires and their items had been determined, two experienced researchers translated the questionnaires into Russian. Subsequently, a third person translated the questionnaires from Russian into English. Later, the researchers commissioned three science education researchers with a PhD in science education to evaluate the content validity of the translated questionnaires. These three experts gave the researchers feedback on the translated questionnaires and items. The researchers then made the necessary revisions to the questionnaires and items. In this way, the final versions of the data collection instruments were created. After this process, the researchers conducted a pilot study with 30 pre-service teachers to investigate the readability of the questionnaires at a college. Given the feedback from the participants in the pilot study, the researchers decided that the data collection instruments could be presented to the participants in the main study. The first two questionnaires on attitude and behavior included Likert-type questions.

The third questionnaire was on environmental knowledge. The questions on environmental knowledge were adopted from Yavetz et al. (2009). They developed the questions in four themes. According to the aim of this study, the researchers selected ten questions to assess the participants' environmental knowledge. In choosing the questions, the researcher used the questions on two themes in the Yavetz et al. (2009) study. These themes were global environmental issues and local environmental issues. In this theme, Yavetz et al. (2009) used 11 questions. In this study, we used ten questions. Therefore, we excluded one question from the Yavetz et al. (2009) study because the questions were not suitable for the aim of our research. So, to assess knowledge about the environment, we used the questions. Knowledge questionnaires included multiple-choice questions. These questions contained four options. One of these options contained the correct answer, while the other three contained incorrect knowledge.

Participants

The participants were 280 pre-service teachers enrolled at two different universities in two countries, Kazakhstan and Uzbekistan. The pre-service teachers were enrolled in their universities' primary teacher education departments. **Table 1** shows the basic demographic characteristics of the participants, including gender, grade level, and major. All participants voluntarily participated in the study. The researchers asked them for consent to collect data for the present study.

Table 2. The descriptive statistics

	Number of items	Reliability (Cronbach's alpha)	Minimum	Maximum	Mean	SD	Skewness	Kurtosis
Attitude	17	0.84	1.53	5	3.58	0.60	0.302	0.289
Behavior	15	0.89	1.00	5	3.18	0.77	0.657	0.267
Knowledge	10	0.70	0.00	1	0.40	0.24	0.913	0.445

Data Collection

The data was collected using Google Forms. The researchers entered the questionnaire into Google Forms and shared a link with the participants who agreed to volunteer to participate in the study. The researchers invited their students to their universities' department of pre-service education. At the beginning of the form, we explained the research objectives and asked the participants to answer the questions. We found that answering the questions took about 20-25 minutes, which was very reasonable for the participants.

Data Analysis

We used the SPSS 22.0 software package to analyze the data. First, we coded Likert items from 1 to 5 for the statistical analysis based on the participants' questionnaire responses. We coded participants' correct answers as '1' and incorrect answers as '0' for the knowledge questions. Second, we calculated descriptive statistics for the three domains (cognitive, affect, and behavioral). Statistical analyses were performed for gender, high school course specialization, and year of study using nonparametric tests (Mann-Whitney U and Kruskal Wallis test) because the data were not normally distributed.

RESULTS

Results in **Table 1** show that regarding the gender distribution of participants, approximately 86% of Kazakh participants are female, while the proportion of male participants is 14%. The proportion of female participants among Uzbek participants is approximately 87%, while the proportion of male participants is 13%. Regarding grade levels, most Kazakh participants (46%) are in grade 2, followed by grade 1 with 45% and grade 4 with 6%. The ratio of grade 3 is 3%. Among Uzbek respondents, grade 2 had the highest percentage (48%), followed by grade 3 with 24% and grade 1 and grade 4 with 14%. Regarding high school majors, most Kazakh respondents (88%) specialize in the humanities. The fields of science (10%) and technology (2%) are quite low. The highest specialization in humanities among Uzbek respondents is again 76 %. The proportions of science and technology are 20% and 4%, respectively.

Table 2 shows the statistical properties of three variables (attitude, behavior, and knowledge). Each variable shows fundamental statistical values such as Cronbach's alpha, minimum and maximum values, mean, standard deviation (SD), skewness, and kurtosis. The attitude scale consists of 17 items. Therefore, the reliability coefficient of the "attitude" scale was calculated at 0.84 and is relatively high. This shows that the scale's internal consistency is at a good level. The values for the participants' attitude ranged from 1.53 to 5, and the average value was 3.58. In general, this shows that the participants' attitude is relatively positive. The SD is 0.60, which indicates a relatively low dispersion. In addition, the skewness value of 0.302 and the kurtosis value of 0.289 suggest that the distribution is approximately normal. The mean value of 3.58 indicates that the participants' attitude is generally positive. The skewness value is 0.302 and is positive. This value suggests that lower values are assigned less frequently, and the participants generally have a more positive attitude. The kurtosis value of 0.289 indicates that the distribution is close to a normal curve and that the extreme values are not concentrated.

The behavior scale consists of 15 items and has a very good internal consistency with a very high Cronbach's alpha value of 0.89. The scores are between 1 and 5, with a mean value of 3.18. This mean value indicates that the behavior level of the respondents is in the middle range. The SD of 0.78 shows slightly greater variability than the attitude scale. The skewness value of 0.657 indicates that the distribution is positively skewed, meaning lower values are more intense. The value for kurtosis of 0.267 indicates a structure that comes close to a normal distribution. The mean value of 3.18 indicates that the participants perform the corresponding behaviors with an average frequency. Since the skewness value of 0.657 shows a more pronounced positive skewness, it can be assumed that some participants perform these behaviors less frequently. This could indicate that for some people, the behaviors are at a lower level than the attitudes. The kurtosis value of 0.267 indicates that the distribution is close to a normal distribution, but slightly more skewed.

The knowledge variable was rated on a 10-point scale, and the Cronbach's alpha value was 0.70. This value indicates an acceptable level of reliability. The average value is 0.40. This value indicates that the participants' level of knowledge is generally low. The SD is 0.24, which suggests that the variability is low. The value for skewness is 0.913, indicating a more pronounced positive skewness, i.e., more participants have a low level of knowledge. The value for kurtosis is 0.445, indicating that the distribution is slightly skewed than normal. The mean value is 0.40, meaning the respondents correctly answered about 40% of the knowledge questions. This is a very low percentage and shows that the participants' level of knowledge is insufficient.

Table 3. Analysis of mean and standard deviations according to the main variables

	Kazakhstan		Uzbekistan	
	Mean	SD	Mean	SD
Attitude	3.56	0.60	3.62	0.61
Behavior	3.19	0.75	3.14	0.83
Knowledge	0.41	0.24	0.38	0.23

While the participants' attitudes are generally positive and almost stable, it is evident that these positive attitudes are not fully reflected in their behaviors. In other words, participants have positive thoughts, but these thoughts are not always translated into behaviors. The level of knowledge is relatively low. This low level of knowledge shows that although the participants have positive attitudes and behaviors, they lack knowledge. This suggests that knowledge-based interventions and training are essential in overcoming this deficiency.

The results in **Table 3** compare people's attitudes, behaviors, and knowledge levels in Kazakhstan and Uzbekistan. Regarding attitudes, the average score was 3.56 in Kazakhstan and 3.62 in Uzbekistan. Although the SDs are very close (0.60 vs. 0.61), people's attitudes in Uzbekistan seem slightly higher. However, the difference of only 0.059 indicates that the difference in attitudes between the two countries is insignificant. Regarding behavior, the average is 3.19 in Kazakhstan and 3.14 in Uzbekistan; the difference (0.04) is relatively small.

However, the variability between individuals is greater in Uzbekistan, as the SD of 0.83 is higher than the value of 0.75 in Kazakhstan. This could indicate that individual behavior differences are more pronounced in Uzbekistan.

Regarding knowledge, the average knowledge level of individuals in Kazakhstan is 0.41, while in Uzbekistan it is 0.38. The difference between the two countries is 0.023, which is relatively small. In addition, the close SDs (0.24 vs. 0.23) indicate that the level of knowledge in the two countries is similar. Overall, the differences between the countries are quite slight, and the individuals have similar profiles in terms of attitudes, behaviors, and knowledge levels. However, Uzbekistan's broader spread of behavioral scores suggests that individual differences may be more pronounced.

The results in **Table 4** provide detailed information on comparing people's environmental attitudes in Kazakhstan and Uzbekistan. In general, slight differences were found between the two countries concerning certain items. For example, agreement with the view that environmental issues should be included in the education system is higher in Kazakhstan, with an average score of 3.89. At the same time, it is slightly lower in Uzbekistan (3.75). The importance of organizing school events on the environment was also rated at an average of 3.96 in Kazakhstan, while it was higher in Uzbekistan (4.05). This indicates that respondents in Uzbekistan attach more importance to such activities.

Table 4. Responses on environmental-related attitude items

No	Items	Kazakhstan		Uzbekistan	
		Mean	SD	Mean	SD
1	It is every teacher's responsibility to include environmental subjects and values in his/her teaching.	3.71	0.97	3.51	1.27
2	Each student in a teacher training institution should be required to study an environmental course during his/her studies.	3.83	1.01	3.74	1.26
3	It is very important to organize school activities on the environment–green days, trips and exhibitions.	3.96	1.06	4.05	1.11
4	It is important to include environmental topics in the educational system.	3.89	1.02	3.75	1.21
5	Laws reduce damage to the environment.	3.80	1.00	3.73	1.19
6	Punishment doesn't prevent damage to the environment.	3.57	1.14	3.60	1.29
7	Factories should be penalized for environmental damage.	3.97	1.01	3.86	1.25
8	Industry should be forced to reduce pollutant emissions even if this entails higher consumer prices.	3.77	0.98	3.83	1.13
9	I believe I can contribute to the quality of the environment through my personal behavior.	3.95	0.97	4.11	1.06
10	There's no use in trying to influence my family or friends on environmental issues.	2.59	1.35	2.44	1.43
11	If I had more knowledge I would integrate environmental considerations into my daily habits.	3.81	0.96	3.84	1.06
12	It is each person's responsibility to take care of the environment.	4.39	0.87	4.46	0.89
13	Even if I save water or energy or purchase environmentally friendly products, it won't make a difference because the influence caused by other people is too great.	3.00	1.30	3.21	1.49
14	Concern for the environment is out of proportion.	3.43	0.98	3.62	1.19
15	It is humanity's right to exploit nature's resources according to their needs.	3.00	1.22	3.13	1.30
16	Action conducted by single citizens are useless because the 'authorities' aren't impressed by the 'little citizen'.	3.05	1.17	3.38	1.20
17	The value of living creatures in nature is determined solely by their use for humanity.	2.89	1.37	3.35	1.40

Table 5. Responses on environmental-related behavior items

No	Items	Kazakhstan		Uzbekistan	
		Mean	SD	Mean	SD
1	Conserve energy by turning off lights and electric appliances when not in use (PC, TV, and radio).	3.93	0.96	4.08	1.07
2	Conserve water at home (close faucet when brushing teeth, washing dishes, etc.).	4.06	0.99	4.06	1.12
3	Re-use plastic bags that previously served as shopping bags.	3.80	1.14	4.06	1.21
4	Re-use used writing paper as draft paper.	3.67	1.17	3.71	1.31
5	Purchase 'environmentally friendly' products (such as ozone friendly sprays, products with recyclable packaging, and economy size products).	3.13	1.25	3.48	1.20
6	Bring things (such as newspapers and plastic bottles) to recycling collection points.	2.79	1.33	3.08	1.45
7	Recycle batteries.	2.54	1.35	2.30	1.40
8	Comment on people who throw trash in public space or damage the environment in any manner.	3.57	1.12	3.30	1.36
9	Collect things that people have thrown in public areas and dispose of them in trash barrels.	3.22	1.23	3.14	1.29
10	Participate in campaigns for cleanup and care of public spaces.	2.80	1.22	2.75	1.40
11	Report to authorities on environmental problems or send letters to media on environmental problems.	2.43	1.31	2.17	1.32
12	Take part in campaigns for the prevention of environmental damage (petitions, demonstrations, etc.).	2.60	1.34	2.41	1.31
13	I'm active in an environmental organization (Greenpeace, WWF, etc.).	2.15	1.42	1.89	1.30
14	Recycle electric or electronic devices.	2.84	1.42	2.47	1.40
15	Turn off the lights when you leave the room.	4.39	0.88	4.32	1.13

The view that legal regulations will reduce environmental damage is supported in Kazakhstan with a score of 3.80, while respondents in Uzbekistan have a similar view with an average score of 3.73. However, the belief that individual behavior can make a difference to the environment was more strongly supported by those in Uzbekistan, with a mean score of 4.11 in Uzbekistan compared to 3.95 in Kazakhstan. However, the opinion that the individual's influence on the environment is insufficient is more widespread in Uzbekistan. This opinion is expressed in Uzbekistan, which has an average score of 3.21, compared to 3.0 in Kazakhstan.

On the other hand, there are considerable differences between citizens' opinions on some points. For example, the view that the value of living beings is measured only by the benefits they bring to humanity was less strongly supported in Kazakhstan, with an average score of 2.89. At the same time, it was more strongly supported in Uzbekistan, with an average score of 3.35. This result suggests that people in Uzbekistan have a more pragmatic attitude towards environmental issues, while Kazakhstan has a broader view of nature. Although people's environmental attitudes in both countries are broadly similar, there are small but noticeable differences in specific issues.

The results in **Table 5** compare the environmental behavior of people in Kazakhstan and Uzbekistan from specific points of view. More general environmental behaviors, such as saving energy or not wasting water, were supported by high scores in both countries. For example, the habit of switching off electrical appliances when they are not in use is rated 4.08 in Uzbekistan and 3.93 in Kazakhstan. The behavior of saving water at home also has the same mean score in both countries (4.06), but the SD is larger in Uzbekistan (1.12 vs. 0.99), indicating a slightly larger inter-individual difference in this behavior.

For reusing shopping bags, the mean score in Uzbekistan was 4.06, while the mean score in Kazakhstan was 3.80. This result shows that this behavior is more widespread in Uzbekistan. However, the difference between the two countries is striking regarding more specific and costly behaviors. The recycling of batteries, for example, is rated at an average of 2.54 in Kazakhstan and 2.30 in Uzbekistan. This result shows that the recycling rates of batteries are quite low in both countries.

Regarding the purchase of environmentally friendly products, the average score in Uzbekistan is 3.48, while the average score in Kazakhstan is 3.13. The fact that Uzbekistan has a higher average score indicates that people place more emphasis on environmentally friendly consumption habits. However, both countries have low average scores for participation in campaigns to clean up the environment. Uzbekistan scores 2.75 and Kazakhstan 2.80 in this regard, indicating that people are generally less motivated to act for the environment. In addition, reporting environmental problems to the authorities was rated at 2.17 in Uzbekistan and 2.43 in Kazakhstan. These low scores indicate that people in both countries are reluctant to do so. Basic behaviors, such as turning off the lights when leaving a room, were rated quite highly in both countries. In this respect, a value of 4.32 was given in Uzbekistan and 4.39 in Kazakhstan.

In summary, although the basic environmental protection behaviors are the same in both countries, differences were found in behaviors that require more

Table 6. Environmental knowledge scores

Questions	Kazakhstan		Uzbekistan		All	
	True	Wrong	True	Wrong	True	Wrong
1	110	92	37	43	147	135
2	45	157	18	62	63	219
3	94	108	33	47	127	155
4	63	139	28	52	91	191
5	57	145	26	54	83	199
6	101	101	25	55	126	156
7	104	98	41	39	145	137
8	61	141	24	56	85	197
9	138	64	52	28	190	92
10	59	143	27	53	86	196

Table 7. Analysis of responses based on gender

		Kazakhstan		Uzbekistan		All			
		Mean	SD	Mean	SD	Mean	SD	t	p
Attitude	Male	3.43	0.46	3.80	0.87	3.61	0.67	0.55	0.59
	Female	3.58	0.61	3.59	0.56	3.59	0.59	-2.54	0.01
Behavior	Male	3.13	0.73	3.59	1.24	3.36	0.98	-1.23	0.23
	Female	3.20	0.76	3.08	0.75	3.14	0.75	0.54	0.59
Knowledge	Male	0.38	0.30	0.39	0.26	0.38	0.28	-2.08	0.04
	Female	0.41	0.23	0.38	0.23	0.40	0.23	1.03	0.31

effort, such as recycling, using environmentally friendly products, and environmental activism. People in Uzbekistan attach more importance to environmentally friendly behaviors in their shopping habits and consumption choices.

The results in **Table 6** compare people in Kazakhstan and Uzbekistan regarding certain environment-related behaviors. Regarding turning off lights and electronic devices when not in use, 110 people in Kazakhstan correctly reported this information, while 92 people incorrectly reported this information. In Uzbekistan, 37 people reported this behavior as correct, while 43 reported it as incorrect. In total, 147 people described this behavior as accurate, while 135 described it as wrong. 45 people in Kazakhstan described the behavior of saving water at home as correct, while 157 people described it as incorrect. In Uzbekistan, 18 people knew correctly about saving water, while 62 people described this knowledge as incorrect. In total, 63 people knew this information correctly, and 219 people knew it incorrectly.

94 people in Kazakhstan correctly reused shopping bags, but 108 reported this behavior as incorrect. In Uzbekistan, 33 people practiced this behavior, and 47 reported it incorrectly. 127 people practiced this behavior correctly, and 155 reported it incorrectly. In Kazakhstan, 63 respondents identified the habit of reusing used papers as drafts as correct, while 139 respondents identified this behavior as incorrect. In Uzbekistan, 28 people correctly identified this behavior, while 52 incorrectly identified it. Ninety-one people correctly identified this behavior, while 191 people incorrectly identified it.

In Kazakhstan, 57 people correctly identified the behavior of buying environmentally friendly products, while 145 people incorrectly identified it. In Uzbekistan, 26 people knew this behavior correctly, while 54 people described this information as incorrect. Overall, 83 people knew this behavior correctly, and 199 misreported it.

101 people in Kazakhstan know the behavior of taking materials to recycling points correctly, while 101 people describe it as incorrect. In Uzbekistan, 25 people know this behavior correctly, while 55 describe it as wrong. Overall, 126 people see this behavior correctly, and 156 misdescribe it. In Kazakhstan, 104 people were correctly aware of battery recycling, but 98 people stated this information incorrectly. In Uzbekistan, 41 people knew this behavior correctly, while 39 people stated it incorrectly. 145 people knew this information correctly, and 137 stated it incorrectly.

These results reveal differences in implementing specific environmental behaviors in Kazakhstan and Uzbekistan. However, less common behaviors such as recycling and environmentally friendly consumption are generally practiced to a lesser extent in both countries.

The results in **Table 7** show the mean, SD, and t-test results for independent samples of the responses of students in Kazakhstan and Uzbekistan in the dimensions of attitude, behavior, and knowledge depending on their gender. In the attitude dimension, the mean score of Kazakh male students was 3.43 (SD = 0.46), while the mean score of Uzbekistan male students was 3.80 (SD = 0.87). There was no significant difference between the groups ($t = 0.55$; $p = 0.59$).

Table 8. Analysis of responses based on high school course specialization

		Kazakhstan		Uzbekistan		All			
		Mean	SD	Mean	SD	Mean	SD	t	p
Attitude	Science-technology	3.66	0.69	3.55	0.66	3.61	0.67	0.55	0.59
	Humanities	3.45	0.60	3.59	0.63	3.49	0.61	-1.49	0.14
Behavior	Science-technology	3.37	0.83	3.22	0.88	3.30	0.84	0.55	0.58
	Humanities	3.17	0.75	3.13	0.83	3.16	0.77	0.39	0.70
Knowledge	Science-technology	0.36	0.23	0.33	0.21	0.35	0.22	0.54	0.59
	Humanities	0.42	0.25	0.41	0.25	0.42	0.25	0.28	0.78

Among the female participants, the average of Kazakh students was 3.58 (SD = 0.61), while the average of Uzbekistan students was 3.59 (SD = 0.56). However, a statistically significant difference was found between these groups (t = -2.54; p = 0.01). This result shows that the difference in attitudes between the countries is more pronounced among female students.

In the behavioral dimension, the mean score of Kazakh male students was 3.13 (SD = 0.73) and the mean score of Uzbek male students was 3.59 (SD = 1.24). The difference between them was not statistically significant (t = -1.23; p = 0.23). Among the female students, the Kazakhs had a mean score of 3.20 (SD = 0.76) and the Uzbeks had a mean score of 3.08 (SD = 0.75). These two groups' differences were insignificant (t = 0.54; p = 0.59). This shows a general consistency by gender and country in the dimension.

In the knowledge dimension, the mean score of the Kazakh men was 0.38 (SD = 0.30) and the mean score of the Uzbek men was 0.39 (SD = 0.26). Although the mean values were close to each other, the difference between the groups was statistically significant (t = -2.08; p = 0.04). This shows that there is a small but significant difference in the level of knowledge of the male students. Among the female students, the Kazakh and Uzbek participants had a mean score of 0.41 (SD = 0.23) and 0.38 (SD = 0.23), respectively, and the difference between them was not significant (t = 1.03; p = 0.31). To summarize, there were substantial differences between the countries in the attitudes of female students and the knowledge level of male students. There were no statistically significant differences between genders and countries for the other dimensions.

The results in **Table 8** show the effects of the participants' high school majors on the variables. Regarding attitudes, in science and technology, the average attitude score of Kazakh students is 3.66 with a SD of 0.69. The average score of Uzbek students was found to be 3.55, with a SD of 0.66. The overall average for both groups is 3.61, while the SD is 0.67. As a result of the independent samples t-test conducted between the two countries, t = 0.55 and p = 0.59 were calculated. Since this p-value is above 0.05, it is concluded that there is no statistically significant difference. That is, the attitudes of students from both countries towards science and technology are similar.

In the field of humanities, the average attitude score of Kazakhstani students was found to be 3.45, while Uzbekistan students had an average score of 3.59. The SDs are 0.60 and 0.63, respectively. The overall average is 3.49, and the SD is 0.61. According to the t-test results conducted in this area, t = -1.49 and p = 0.14 were obtained. This also indicates that there is no statistically significant difference. This also shows that there is no statistically significant difference. In the behavioral dimension of the science and technology field, the average behavior score of Kazakhstani students is 3.37, while the average score of Uzbekistan students is 3.22.

In the behavioral dimension, in science and technology, the average behavior score of Kazakhstani students is 3.37, while the average of Uzbekistan students is 3.22. The SDs were calculated as 0.83 and 0.88, respectively. The overall average is 3.30, and the general SD is 0.84. In the statistical analysis of this area, t = 0.55 and p = 0.58 were found. The results indicate no statistically significant difference in the attitudes towards science and technology between the students of the two countries.

The results show no statistically significant difference between the behaviors of students from the two countries regarding science and technology. In the field of humanities, the average for Kazakhstan was determined to be 3.17, while the average for Uzbekistan was 3.13.

In the field of humanities, the average for Kazakhstan has been determined to be 3.17, while the average for Uzbekistan is 3.13. The SD values are 0.75 and 0.83, respectively. The overall average is 3.16, and the SD is 0.77. As a result of t-test, t = 0.39 and p = 0.70 were found. In this case, there is no significant difference between the two countries. In this case, there is no significant difference between the two countries. Regarding knowledge, the average score of Kazakh students in science and technology was measured at 0.36, while the average score of Uzbekistan students was 0.33.

Regarding the knowledge dimension, in the field of science and technology, the average knowledge level of Kazakhstani students was 0.36, while the average for Uzbekistan students was 0.33. The SDs are 0.23 and 0.21, respectively. The overall average is 0.35, and the SD is 0.22. The t-test result was calculated as 0.54, and p = 0.59. This result indicates that there is no statistically

Table 9. Analysis of responses based on grade level

Grades	Kazakhstan		Uzbekistan		All			
	Mean	SD	Mean	SD	Mean	SD	t	p
1	3.62	0.76	3.63	0.55	3.62	0.74	-0.046	0.964
2	3.98	0.66	3.83	0.81	3.93	0.71	0.983	0.745
3	3.64	0.77	3.52	0.82	3.55	0.7	0.333	0.745
4	3.62	0.94	3.78	1.20	3.70	1.05	-0.359	0.723

significant difference between the levels of knowledge. This result shows no statistically significant difference between the knowledge levels. In the field of humanities, Kazakh students have an average knowledge level of 0.42, while Uzbekistan students have an average knowledge level of 0.41.

In the field of humanities, Kazakhstani students have an average knowledge level of 0.42, while Uzbekistan students have an average knowledge level of 0.41. The SDs of both groups are 0.25. The overall average was found to be 0.42. It shows that the difference between the participants in the two countries is not statistically significant ($t = 0.28$ and $p = 0.78$). It shows that the difference between participants in the two countries is not statistically significant ($t = 0.28$, $p = 0.78$). In all three dimensions (attitude, behavior, and knowledge) and both main fields (science-technology and humanities), no statistically significant differences were found in the comparisons between Kazakhstan and Uzbekistan.

No statistically significant differences were found in the comparisons between Kazakhstan and Uzbekistan in all three dimensions (attitude, behavior, and knowledge) and both main fields (science-technology and humanities). The most striking finding is that the level of knowledge in both countries is very low (in the range of 0.33-0.42). The results indicate that the participants generally have a positive attitude, but their knowledge level is insufficient to support this attitude.

The results in **Table 9** show the effects of participants' grade levels on the variables. The participants' average attitude scores were compared based on countries and grade levels within the research scope. The results show that among grade 1 students, the average score of participants from Kazakhstan was 3.62 (SD = 0.765), while the average score of participants from Uzbekistan was 3.63 (SD = 0.55). No statistically significant difference was observed between the groups ($t = -0.046$, $p = 0.964$). This result indicates that students from both countries have similar attitudes.

In grade 2 students, the average for Kazakhstani students was 3.98 (SD = 0.66), while the average for Uzbekistan students was 3.83 (SD = 0.81). Although Kazakh students have a higher average, this difference is not statistically significant ($t = 0.983$, $p = 0.330$). At the third-grade (grade 3) level, students from Kazakhstan scored an average of 3.643 (SD = 0.778), while students from Uzbekistan had an average of 3.526 (SD = 0.823). The difference is relatively slight, and there is no statistically significant difference ($t = 0.333$, $p = 0.745$). Looking at the results of the fourth-grade (grade 4) students, participants from Uzbekistan scored an average of 3.788 (SD = 1.204), while participants from Kazakhstan scored an average of 3.625 (SD = 0.940). This group's difference is insignificant ($t = -0.359$, $p = 0.723$). As a result, the average attitude scores between Kazakhstan and Uzbekistan are quite close at all four grade levels, and no significant differences were observed at any level. These findings indicate that students' attitudes from both countries are generally similar.

DISCUSSION

This study investigated the EL of pre-service teachers in two countries by assessing their attitudes, behavior, and knowledge. Overall, the results show that while participants' attitudes are generally positive, these positive attitudes are not fully reflected in their behavior. The level of knowledge is relatively low. This shows that although participants have a positive attitude and behavior, they lack understanding. In particular, less common behaviors such as recycling and environmentally friendly consumption were generally only recognized correctly to a limited extent in both countries. There were significant differences in the attitudes of male and female students regarding knowledge between the countries. However, it was found that there was no significant effect of grade level and no significant effect of school branch on knowledge, behavior, and attitudes.

Regarding attitudes, our results are very similar to those of previous studies, which found that pre-service teachers have a positive attitude towards the environment (Álvarez-García et al., 2018; Orbanić & Kovač, 2021; Stylos et al., 2019). Behind positive attitudes toward the environment, one reason can be considered the role of EE given in schools to pre-service teachers. They might have received a formal education on EE in university and before (Orbanić & Kovač, 2021; Stylos et al., 2019). Another reason may stem from that affective dispositions such as sensitivity, personal responsibility, and values that are internalized through social and educational (Álvarez-García et al., 2018; Dada et al., 2017; Zhdanov et al., 2023). Another reason may be the role of social norms within educational environments (Boubonari et al., 2013; Samur & Akman, 2023; Stylos et al., 2019). Concerning the relationship between attitudes and gender, we found no significant difference between

the two countries. On the other hand, we only saw a significant difference in favor of Uzbek female participants. Furthermore, we did not find a significant difference in attitudes toward high school course specialization. This finding shows that high school course specialization is not a predictor of attitudes toward the environment.

Regarding the participants' behaviors, we found that their behavioral levels were close to the mean level and had a lower mean than their attitudes. This result is partly in line with previous studies that show that pre-service teachers exhibit limited environmental behavior (Stylos et al., 2019). This finding is consistent with empirical evidence from previous studies suggesting that attitudes towards the environment do not automatically translate into behaviors (Álvarez-García et al., 2018; Dada et al., 2017). In light of these results, we can conclude that the behavioral component can be considered the weakest link in EL. In addition, we did not find any significant differences between the genders of the participants at the behavioral level. We also found no significant difference in behavior concerning the high school course. This result shows that high school specialization does not predict behavior towards the environment.

Although the pre-service teachers in this study had a positive attitude towards the environment, our participants' knowledge of the environment was low. This finding is similar to the results of previous studies that found that pre-service teachers have only moderate or limited environmental knowledge (Álvarez-García et al., 2018; Orbanić & Kovač, 2021; Stylos et al., 2019). Based on this result, we can conclude that there was a discrepancy between environmental knowledge and attitude among our participants in the two countries. This finding is very similar to the results of previous studies, as they also found a common disconnect between attitudes and knowledge, suggesting that the formation of positive environmental attitudes does not necessarily depend on comprehensive factual knowledge (Álvarez-García et al., 2018; Stylos et al., 2019). The present study's findings and previous studies highlight that although pre-service teachers do not consistently demonstrate high levels of environmental knowledge regarding factual understanding of environmental issues, their positive attitudes can be a key advantage in supporting and integrating sustainable practices and EE into the curriculum.

CONCLUSION

This study assessed the EL of pre-service teachers in two countries by evaluating their attitudes, behavior, and knowledge. Given the lack of comparative studies on pre-service teachers' EL, this study adds new insights to the literature. In this regard, the present study provides new knowledge by revealing the complex nature of EL from a comparative perspective in two countries. It offers new insights into pre-service teachers' EL. Thus, the present study enhances researchers' understanding of how EE can be designed to achieve well-prepared and effective EE for future teachers.

Recommendations

Based on the present study's findings, we recommend that researchers conduct longitudinal studies to investigate the dynamic relationship between environmental knowledge, attitudes, and behaviors for teacher education programs. Since previous studies and the present study have found a discrepancy between pre-service teachers' positive environmental attitudes and their limited environmental knowledge, longitudinal studies would help to track the development of the relationship between attitudes, behaviors, and knowledge. Furthermore, there is a lack of longitudinal studies in the literature on the variables we used in this study. Moreover, researchers can explore integrating subject-specific concepts, such as ecological and marine pollution, and more general environmental concepts to develop pre-service teachers' EL models. This approach may require the application of structural equation modeling and other advanced statistical techniques to understand the latent variables that influence EL, including attitudes, behaviors, and knowledge. Furthermore, Fernández-Escandón et al. (2025) point out that effective teaching methods are still needed based on our findings and previous research results. Future studies could compare the effectiveness of effective and innovative approaches in different cultural contexts for EE in teacher education. In addition, comparative cross-national studies are needed to understand the contextual influences on pre-service teachers' EL. We suggest that contextual variables can significantly influence the relationship between EE components.

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