

Article

Investigation of the Relationships between Individual Innovation and Sustainable Education Beliefs

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Abstract: The concept of sustainable education has seven main features: being holistic and interdisciplinary, focusing on values, directing to critical thinking and problem solving, requiring the use of multiple teaching methods, encouraging participatory decision-making, highlighting applicability and locality. The knowledge and beliefs of the people, who will start teaching as a vocation, have an important role for both teachers and students in terms of being in an innovative understanding and attitude. Describing the attitudes of prospective teachers with the potential to raise future generations is important for reviewing teacher training policies. For this purpose, two scales were used in the study. The first one, “The Beliefs for Sustainable Development Education Scale”, consists of 32 items and three sub-factors. The other is the “Individual Innovation Scale”; this 20-item 5-point Likert scale has five sub-dimensions as Innovative, Pioneer, Questioner, Sceptic, and Traditionalist. The data obtained were subjected to correlation and regression statistics and discussed in the light of literature. All in all, it can be seen that there are significant relationships between personal innovativeness and the dimensions of sustainable development education. According to findings, it was observed that as long as the willingness and openness-to-experience of teacher candidates’ taking risk increases in the context of personal innovativeness, their beliefs regarding sustainable development increase concordantly. Teacher candidates can resist change with the concern over whether the current knowledge and efforts will be valuable in the new situation afterwards.

Keywords: individual innovation; sustainable education beliefs; teacher

1. Introduction

Sustainable development arose from the need to leave places to live to the next generations because of the rapid consumption of natural resources and the increased damage to the environment brought by the economy that developed after the Industrial Revolution. In this context; UNESCO has prioritized sustainability ideas and actions [1]. Beliefs in sustainable development education and tendencies towards [2] individual innovation [3] studies have started to increase. Although countries worldwide do not see the gradual damage to humans and the environment brought by the manufacturing age, in the beginning of the 21st century, they formulated objectives to make the public welfare of the present generation and next generations sustainable in terms of the economy and the environment with the question, what kind of a world do we want? The objectives are to eradicate hunger and poverty, reach universal fundamental education, support equality for women and men, decrease the number of infant deaths, improve maternal health, fight contagious diseases, ensure universal sustainability, and cooperate for development [4].

United Nation’s 2030 Sustainable Development Agenda and Sustainable Development Objectives instilled hope for both a desired future and objectives package. In this package, qualified education is encouraged and especially Sustainability Education is emphasized [5]. As a matter of fact, the successful globalization concept is related to educational expressions for sustainable development and

education for sustainable development [6]. In sustainable development, individuals must have the ability to think critically and must be able to observe the sophistication of environmental, social, and economic systems and the relationships between them [5,7]. This can be achieved through education. In this context, within this process, the relationship between visionary approaches, humans, and the ecosystem, and the role of humans in this relationship, humane behaviours and what is important must be discussed and evaluated [8–10]. Thus, for this purpose, at the Johannesburg United Nations summit of 2002, the years 2005–2014 were declared as a sustainable development-oriented education period [2,4,11–13].

The aim of sustainable development is to enable individuals to acquire the ability to think critically, essentially through sustainable development-oriented education to reach its fundamental objectives [14]. Accordingly, the focus is on the education process, developing thinking and skills and presenting question-based learning methods instead of collecting information.

In the 2000s, the United Nations' Sustainable Development Education aimed to play an active role in contributing to community life. These include respecting the world and the diversity of life, promoting democracy and creating a society governed by peace. [1,15].

In the last decade, there has been an important increase in interest for sustainability in various units of Higher Education Institutions [16]. In the study of Berzosa et al., it was seen that universities have different approaches for sustainability. Higher Education Institutions diagnose current situations via Sustainable Assessment Tools, they reach a consensus concerning what is understood from sustainability, and they reveal their objectives and strategies regarding these conditions [17]. In this sense, different shareholders' diagnosis and engagement in assessment and also their sustainability action plan are considered pursuing SAT handbooks. There is a close relation between participants' constituting strategies regarding sustainability and applying it. Precautions are taken regarding via what innovations and changes sustainability will be provided, and authorities of education have an important role and effect in legitimating and realization of this situation [18]. On the other hand, there have been studies emphasizing that achieving sustainable development is an important part of lifelong learning [19–21].

Most handicaps to the integration of sustainability in higher education are bound to factors such as individual resistance, communication, empowerment, participation, and organization culture [22]. To achieve the objectives, first students must acquire the habits of sustainable development understanding. For this purpose, teachers include in-class and out-of-class activities in the subjects of education for sustainable development (ESD) during the term. Peter Hopkins, manager of Education of Sustainable Development at Bradford University, revealed that the physical campus had become a general disappointment for candidate students over the years. Therefore, in the beginning, ecologic diversity focused on an environmental bioremediation task built on the creativity of humans working for a sustainable future. Connecting with extracurricular innovation and student welfare emphasized a campus environment that will bring information, talent, intelligence, and spiritual diversity together for the combination of nature and community that will increase their imagination [23,24].

Teachers sign an agreement with the class during the term. This agreement includes the fundamental objectives of ESD (environmental protection, healthy nutrition, democracy, tolerance, respect, etc.). While preparing items of the agreement, determining common items with students will create a positive effect for them to adopt it. Within this process, the teachers brainstorm with the students and decide on items in a critical and questioning way.

In addition, classroom commissions are constituted with regard to developing the awareness and devotion necessary for sustainable development in the classroom. In order to increase the influence of classroom commissions, school councils are constituted.

Within these groups, classifications and assignments are determined according to age. In order to enable students to take part in this application, produce ideas regarding the issues, and express their feelings, competitions, such as painting, essay, poem, story, photograph, and poster, are organized around problems concerning environment and situations to be developed. In planned

activities, to enable participation regarding sponsorship or specialists in their fields, cooperation with non-governmental organizations.

According to a literature survey, the features that teachers must have for sustainable development are: having an awareness of environmental protection with natural balance; having success on the basis of information, perception and values; being a role model for students in every age group to enable them to take responsibility in terms of a sustainable future; and being aware of a sustainable world and lifestyle. Sustainable development is innovative and is a voluntary long-term, constant, and participatory process in which socioeconomic life is accepted as a system and human factors take a central role [25].

Personal Innovativeness

Innovation “is the process of creating new ideas, taking the ordinary working order of the organization and putting them into practice” [26]. In this sense, innovation is the activity of turning ideas into applications directed towards work.

In the process of determining innovations, the innovativeness concept emerged since there are differences among individuals [27]. Personal innovativeness is a learning ability that provides the determination of a new product as an attitude and behaviour [28]. Personal innovativeness is defined as developing, adopting, and applying innovation [29]. Personal innovativeness means taking risks in the face of new ideas, and adopting, accepting, tolerating, and being open to experiences regarding new situations [30]. Mahajan, Muller and Srivastava [31], and [32] Martinez and Polo evaluated personal innovativeness as an individual’s time to adopt any innovation [33].

The innovating individual wants the innovation and applies it [33]. An individual who is open to new ideas and adopts them primarily is a person who can gather the masses around leading instructional as an opinion leader [34]. Accordingly, opinion leaders are tolerant, are constantly learning, possess autonomy, are cooperative and indicate behaviours compatible with change [35]; as an innovator model in social environments, they have a status as the centre of attraction for those who are interested in innovations [36].

According to Drucker [37], the world has become a place where information and intense learning are valid [38]. Especially in the 2000s, with each new day, new technology enters our lives and technological innovations force individuals to reinvent themselves. To be successful in working life, individuals must be informed about these innovations [39].

The slogan “education for everyone” has turned into the slogan “good qualification for everyone”. The development and increase of information and technology have caused the need for lifelong learning to emerge. Correspondingly, lifelong learning emerged as a political answer in changing and developing societies [40]. The activities presented within the context of lifelong learning will provide opportunities for personal innovativeness to emerge.

An educational system designed to be future-directed must be open to innovations and contain the whole life and revise itself appropriately for the needs of analyzing the requirements of time [41]. The skills to use for changing and developing information and communication technologies are as important as innovativeness to access new information [21].

Innovations include cultural innovations (seen in cultural aspects, language, conventions, traditions, and customs) and scientific and technological innovations (technology adding things to our lives every day causes the development of new values and efforts to adapt). Also, innovations are actualized as a result of changing individuals’ needs.

Daft and Becker [42] stated that the innovation process requires people who can manage innovating rather than adequate resources. The realization of the innovation process depends on individuals’ knowledge, skills, experiences, and interests [43]. It is stated that individuals who adopt innovativeness are successful and have problem-solving skills at a high level, and individual’s burn out at a low level [44].

Adopting innovations in education depends on the support of followers. The stronger and more common this support is, the more valuable the innovation will be. Innovation becomes real as a result of intense interaction and communication; innovating potential becomes real through effective interactions, and it increases. The realization of innovations in educational organizations is closely related to teachers' adopting the innovation culture and possessing the level of skill and knowledge this culture requires.

Innovator teachers are those who can develop themselves in their fields, increase the number of activities students can participate in via new teaching-learning strategies, try new approaches and methods, perform different methods to increase student participation, and provide new skills to be acquired for changing habits [45]. It was also determined that innovator teacher's students are questioning, use technology efficiently, are open to innovations, and can become opinion leaders [46–48].

Tests have shown that the level of personal innovativeness of teacher candidates does not indicate a significant difference in terms of their gender and the university they graduated from; individuals whose undergraduate grade point average was high possessed personal innovativeness at high levels. A study showed that to provide teachers in training with qualifications, especially pre-service education, must have features such as being open to innovations, adopting innovations, and improving oneself. The problems that teacher candidates encounter in acquiring, accessing, structuring, and reaching information must be removed [49].

In this study, prospective teachers' views on sustainable development and individual innovation levels were examined. There is a strong relationship between sustainable development and education. Education of sustainable development requires various teaching methods in terms of being holistic, value-focused, participant, regional, and applicable; prompting critical thinking. Education for Sustainable Development (ESD) carried out several studies across the world under the leadership of UNESCO for ten years. ESD is a process of social transformation, aiming to constitute more sustainable communities. ESD is concerned with every dimension of education systems, such as planning, developing policy, financing, education programs, teaching and learning, evaluation, and the management process. It is important to describe the attitudes of teacher candidates who have the potential to train the next generation on this matter, in terms of considering teacher training policies.

In addition, no literature search has been conducted with teachers or prospective teachers to directly understand perceptions of sustainable development and individual innovation. It was thought that examining teacher candidates' beliefs about education for sustainable development and their individual innovation perceptions will guide us in developing teacher training curricula. It is thought that the results of our study will reveal the attitudes of prospective teachers who will direct future generations to education for sustainable development and will be important in terms of teacher training policies.

In light of the above information and opinions, answers to the following research questions were sought:

1. Is there any difference in terms of individual innovation and sustainable development perceptions according to gender, class, and academic achievement levels of teacher candidates?
2. Is the relationship between prospective teachers' perceptions on individual innovation and sustainable development significant?
3. Do prospective teachers' perceptions of individual innovation predict their perceptions of sustainable development education?

2. Method

The study is a quantitative study, and two questionnaires were applied. In this study, the relationships between prospective teachers' individual innovation and sustainable education beliefs were examined in terms of some variables. In this context, Beliefs in Sustainable Development Education Scale and Individual Innovation Scale were used.

2.1. Research Group

This research was carried out with 527 participants, 342 women and 185 men, who were studying at an education facility and responded appropriately to the questions in the data gathering tools used within the scope of the research.

The distribution of the personal features of the participants is presented in Table 1.

Table 1. Distribution of teacher candidates according to personal features.

Variables	Group	n	%
Gender	Female	342	64.9
	Male	185	35.1
Grade	1	76	14.4
	2	45	8.5
	3	91	17.3
	4	259	49.1
	Graduate	56	10.6
Formation	Undergraduate	438	83.1
	Formation	89	16.9
Academic Success	Bad	36	6.8
	Medium	261	49.5
	Good	20	38.3
	Very Good	28	5.3

According to Table 1, 64.9% ($n = 342$) of the participants were women, and 35.1% ($n = 185$) were men; 14.4% ($n = 76$) were at grade 1, 8.5% ($n = 45$) were at grade 2, 17.3% ($n = 91$) were at grade 3, 49.1% ($n = 259$) were at grade 4, and 10.6% ($n = 56$) were graduate students. It is seen that 83.1% of the participants took formation education during the undergraduate process, and 16.9% of them took formation.

In Turkey, teacher education has been performed according to two different programs in education faculties since 2010: Undergraduate Program and Pedagogical Formation Program. The undergraduate program includes students who begin education faculty with a university exam after high school education. On the other hand, a pedagogical formation program consists of final year students or students who completed their education in a field. The reason why the pedagogical formation group was included in the study is that this group will be teaching in high school level as a priority. Having ESD vision is important at this level because considering the fact that high school students will transfer into community life as adults, it can be evaluated that high school is a level where perspectives of students regarding sustainable development take shape best.

Academic Success indicates grade point average as a result of undergraduate education. At this point, according to a grading system over 100 points, those who had an 85–100 grade point average were determined as Very Good, those who had a 75–84 point average were determined as Good, those who had a 50–74 point average were determined as Medium, and those who had a 49 and less point average were determined as Bad.

2.2. Data Gathering Tools

2.2.1. Scale of Beliefs Regarding the Education of Sustainable Development

The scale, which was developed by Şahin and Sağdıç, is a Likert type ranging from 1 to 5: (1) definitely disagree; (2) disagree; (3) indecisive; (4) agree; (5) definitely agree. The scale consists of 32 items and contains three factors. The first factor was named as “beliefs regarding the education of sustainable development applications (SDA)” as it covers the teaching methods related to sustainable development education, its importance in education programs and the potential benefits of this

education. (Sample items: “ESD improves the students’ ability to make decisions for the future”, “ESD provides the knowledge, values and abilities that we can use in daily life”). Since the second factor emphasizes the difficulties arising from the nature of sustainable development education and teaching practices, it is named as “beliefs regarding the education of sustainable development restrictions (SDR)” (sample items; “It is difficult for students to understand ESD”, it is difficult to apply ESD”). It was understood that following three items “Education provided in schools is sufficient to develop awareness for sustainable development among students”, “Activities in textbooks are sufficient for sustainable development education and sustainable development”, and “Sufficient information is provided for teachers regarding education of sustainable development” are related to the condition of sustainable development education in the current system. In the main application, with the participation of teachers considering the combination of these three factors in a common and different factor, it was included in a scale under a factor named as “beliefs regarding the efficiency of sustainable development education in elementary education (SDEE)” [2].

Confirmatory factor analysis ($X = 937.85$, $df = 457$, $p = 0.000$; $CFI = 0.92$, $RMSEA = 0.71$) and discriminant and convergent validity analysis indicate that the sustainable development scale is valid for evaluating beliefs regarding education. Within the reliability analyses carried out regarding the education of sustainable development (ESD) and its sub-dimensions, for ESD, $\alpha = 0.888$; for “beliefs regarding the education of sustainable development applications (SDA)”, $\alpha = 0.917$; for “beliefs regarding the education of sustainable development restrictions (SDR)”, $\alpha = 0.806$; and for “beliefs regarding the efficiency of sustainable development education in elementary education (SDEE)”, $\alpha = 0.802$.

2.2.2. Personal Innovativeness Scale

The personal innovativeness scale, developed by Hurt, Joseph and Cook [34], was used in this research to measure the willingness of teacher candidates to try new things. This scale, which is a 5-point Likert type and has 20 items, was adapted for Turkish culture by Kılıçer and Odabaşı [3]. The reliability coefficient of the original scale, which has the five sub-dimensions innovative, pioneer, inquiry, sceptical, and traditional, is 0.88. Of the items on the scale, 12 are positive and 8 are negative. The total innovativeness score can be obtained by subtracting the total number of negative items from the total of positive items and adding 42. Those who score more than 80 are classified as “innovator”, those who score 69–80 as “pioneer”, those who score 57–68 as “inquiry”, those who score 46–56 as “sceptic”, and those who score under 46 as “traditional”. The reliability coefficient of the scale adapted for Turkish was determined as 0.82. In addition, its KMO (Kaiser-Meyer-Olkin) value was found to be 0.836, and it was also found that the Bartlett’s sphericity test was significant [3]. Rotated factor load values ranged between 0.36 and 0.78.

When the results of exploratory factor analysis were examined, it was seen that the Turkish version of The Individual Innovation Scale had a four-factor structure. These factors were named as “resistance to change”, “opinion leadership”, being open to experience”, and “taking risk” in the context of the literature and the characteristics of the articles. The common variances of the four factors related to the items ranged from 0.415 to 0.628. “The Resistance to change” dimension, which consists of negative items in the scale, constitutes an important part of the explained variance regarding the scale. The items collected under this dimension are generally composed of items that reflect individuals’ concerns about change and innovation. In terms of variance explained by the scale, items collected under the “Opinion leadership” dimension, which is the second important dimension, are composed of items that reflect the characteristics that make individuals ahead of other individuals in the group they belong to. In terms of the variance explained by the scale, items gathered under the dimension of “the being open to experience”, which are the third important dimension, are composed of items that reflect individuals’ desire to seek and try innovation. Finally, the items collected under “the taking risk” dimension, which is the fourth important dimension in terms of variance explained by the scale, are composed of items that reflect the intimidation of individuals against uncertainties. As a result, it can be interpreted that

the items in the first dimension of the scale measure the response to innovation in general, and the items in other dimensions reflect the reactions of individuals to more specific situations.

The reliability analysis regarding the personal innovativeness scale and its sub-scales showed the following Cronbach alpha (α) coefficient: personal innovativeness scale: $\alpha = 0.823$; "Resistance to change": $\alpha = 0.790$; "Opinion leadership": $\alpha = 0.826$; "Being open to experience": $\alpha = 0.867$; "Taking risk": $\alpha = 0.403$.

2.3. Data Analysis

A total of 527 teacher candidates studying at an education facility participated, and the data obtained were subjected to comparison, multilinear correlation analysis, and multi-regression analysis. The results of the personal innovativeness scale and sustainable development education scale showed that all values were under 0.05, so the data were not distributed normally. In the research, nonparametric statistics were considered, and the data obtained by the questionnaire technique were analyzed by SPSS 23.0 for Windows.

3. Findings

The descriptive statistics regarding the personal innovativeness scale and sustainable development education and sub-scales are presented in Table 2.

Table 2. Descriptive statistics regarding personal innovativeness scale and sustainable development education with subscales.

Scales and Sub-Scales	M	SS	Minimum	Maximum
Personal Innovativeness Scale (PIS)	57.14	5.466	37.00	94.00
Resistance for Change (RC)	25.35	5.945	9.00	40.00
Opinion Leadership (OL)	10.34	4.123	5.00	25.00
Openness to Experience (OE)	20.49	4.085	5.00	25.00
Taking Risk (TR)	7.05	2.660	2.00	48.00
The Education of Sustainable Development (ESD)	3.77	0.604	1.78	5.95
The Beliefs Regarding the Education of Sustainable Development Applications (SDA)	4.02	0.795	1.27	7.27
The Beliefs Regarding the Education of Sustainable Development Restrictions (SDR)	3.50	0.781	1.00	5.00
The Beliefs Regarding the Education of Sustainable Development Efficiency in Elementary Education (SDEEE)	2.56	1.062	1.00	5.00

Note: means (M); sum of square (SS).

As seen in Table 2, the average for the general personal innovativeness scale was calculated as $M = 57.14$, which indicates that the participants are in the "inquiry" category. Sub-scales show the following averages: "Resistance to change": $M = 25.35$ (traditional); "Opinion leadership": $M = 10.34$ (traditional); "Openness to experience": $M = 20.49$ (traditional); and "Taking risk": $M = 7.05$ (traditional). In the dimension of Personal Innovativeness, Resistance to change was higher than others; this indicates that the priority of teacher candidates are traditionalist and shy about taking risks besides being open to the experience.

For the ESD, the general average value was calculated as $M = 3.77$; the averages regarding sub-scales show the following: "Beliefs regarding the education of sustainable development applications" (SDA): $M = 4.02$; "Beliefs regarding the education of sustainable development restrictions": (SDR) $M = 3.50$; and "Beliefs regarding the education of sustainable development efficiency in elementary education" (SDEE): $M = 2.56$.

The Mann–Whitney and Kruskal–Wallis test results for the personal innovativeness scale and the education of sustainable development scale are presented in Table 3.

Table 3. Comparison of personal innovativeness scale and education of sustainable development scale according to demographic attributes of participants.

Variables	RC	OL	OE	TR	PIS	SDA	SDR	SDEE	ESD
Gender									
Female	25.84 ± 5.91	10.19 ± 4.17	20.61 ± 4.121	6.95 ± 2.99	57.36 ± 7.57	4.11 ± 0.77	3.57 ± 0.76	2.46 ± 1.03	3.84 ± 0.58
Male	24.45 ± 5.90	10.61 ± 4.02	20.26 ± 4.019	7.24 ± 1.89	56.76 ± 7.27	3.85 ± 0.80	3.35 ± 0.78	2.73 ± 1.08	3.64 ± 0.61
MWU	27,405.000	29,050.000	29,388.500	27,879.500	30,648.500	24,149.000	26,486.000	27,103.500	24,831.000
<i>p</i>	0.013 *	0.133	0.209	0.023 *	0.702	0.000 *	0.002 *	0.008 *	0.000 *
Grade									
1. Grade	24.81 ± 5.38	11.88 ± 4.75	19.52 ± 4.60	6.63 ± 1.73	57.64 ± 7.76	3.55 ± 0.80	3.34 ± 0.72	2.91 ± 0.81	3.45 ± 0.59
2. Grade	25.02 ± 5.27	9.97 ± 3.91	20.51 ± 3.18	6.97 ± 1.93	56.35 ± 5.78	4.07 ± 0.66	3.30 ± 0.77	2.58 ± 0.97	3.76 ± 0.52
3. Grade	25.38 ± 5.79	10.29 ± 4.41	20.37 ± 4.68	7.59 ± 4.72	57.89 ± 8.41	3.93 ± 0.82	3.46 ± 0.82	2.57 ± 1.04	3.70 ± 0.63
4. Grade	25.54 ± 6.35	9.85 ± 3.61	20.94 ± 3.61	7.11 ± 1.99	56.92 ± 7.24	4.22 ± 0.72	3.62 ± 0.77	2.38 ± 1.11	3.92 ± 0.55
Graduate	25.44 ± 5.61	10.87 ± 4.66	19.91 ± 4.79	6.53 ± 2.11	56.98 ± 7.76	3.85 ± 0.83	3.38 ± 0.77	2.82 ± 1.04	3.65 ± 0.65
KW	1.246	11.054	4.855	8.809	0.891	45.326	16.524	23.838	40.547
<i>p</i>	0.870	0.026 *	0.302	0.066	0.926	0.000 *	0.002 *	0.000 *	0.000 *
Success Status									
Bad	24.55 ± 6.81	11.77 ± 3.87	18.88 ± 4.47	6.69 ± 1.87	57.75 ± 7.18	3.67 ± 0.82	3.27 ± 0.76	2.61 ± 1.01	3.48 ± 0.66
Medium	24.55 ± 5.50	10.68 ± 3.82	20.29 ± 3.82	7.00 ± 1.84	56.74 ± 7.18	3.95 ± 0.76	3.38 ± 0.77	2.62 ± 1.07	3.70 ± 0.56
Good	26.39 ± 6.22	9.86 ± 4.32	20.91 ± 4.10	7.16 ± 3.58	57.70 ± 8.00	4.14 ± 0.81	3.62 ± 0.76	2.53 ± 1.05	3.87 ± 0.61
Very Good	26.39 ± 5.59	8.75 ± 4.81	21.35 ± 5.13	7.17 ± 2.10	56.17 ± 6.26	4.30 ± 0.71	4.01 ± 0.69	2.07 ± 0.93	4.03 ± 0.57
KW	12.831	14.176	10.993	1.396	1.758	15.576	13.600	1.092	19.130
<i>p</i>	0.002 *	0.001 *	0.004 *	0.497	0.415	0.000 *	0.001 *	.579	0.000 *

Note: * $p < 0.05$, ** $p < 0.01$; KW: Kruskal Wallis test; MWU: Mann Whitney Analysis. Resistance for Change (RC); Opinion Leadership (OL); Openness to Experience (OE); Taking Risk (TR); The Education of Sustainable Development (ESD); The Beliefs Regarding the Education of Sustainable Development Applications (SDA); The Beliefs Regarding the Education of Sustainable Development Restrictions (SDR); The Beliefs Regarding the Education of Sustainable Development Efficiency in Elementary Education (SDEEE).

Table 3 shows a significant difference between the education of sustainable development scale with all its sub-dimensions and gender according to the participants' gender ($p < 0.05$). It was determined that a significant difference ($p < 0.05$) was seen between the "Resistance to change" ($p = 0.013$) and "Taking risk" ($p = 0.023$) sub-dimensions of the personal innovativeness scale according to the gender of the participants. It was determined that according to participants' grade levels, a significant difference ($p < 0.05$) was seen between the "Opinion leadership" ($p = 0.026$) sub-dimension of the personal innovativeness scale and the education of sustainable development scale and its sub-dimensions. According to the success status of the participants, it was determined that a significant difference ($p < 0.05$) was seen between the "Resistance to change" ($p = 0.002$), "Opinion leadership" ($p = 0.001$) and "Openness to experience" ($p = 0.004$) sub-dimensions of the personal innovativeness scale, and the education of sustainable development scale and its sub-dimensions "Beliefs regarding the education of sustainable development applications" ($p = 0.000$) and "Beliefs regarding the education of sustainable development restrictions" ($p = 0.001$).

Table 4 shows the correlation coefficients of the relationship between the scores of personal innovativeness and sustainable development education. Generally, it can be seen that there are significant relationships between personal innovativeness and sustainable development education dimensions. According to the results of the analysis, there is a positive relationship at a high level between the "Resistance to change" dimension of personal innovativeness and beliefs regarding restrictions in the education of sustainable development ($r = 0.315$; $p < 0.05$); a negative relationship at a high level with beliefs regarding the education of sustainable development efficiency in elementary education ($r = -0.165$; $p < 0.05$); and a relationship at a high level with the sustainable development education scale ($r = 0.124$; $p < 0.05$).

Table 4. Correlation coefficients between personal innovativeness scale and education of sustainable development scale.

	RC	OL	OE	TR	PIS	SDA	SDR	SDEE	ESD
RC									
OL	-0.080 0.067								
OE	0.142 ** 0.001	-0.724 ** 0.000							
TR	0.016 0.717	-0.324 ** 0.000	0.391 ** 0.000						
PIS	0.767 ** 0.000	0.444 ** 0.000	-0.263 ** 0.000	0.140 ** 0.001					
SDA	0.069 0.113	-0.414 ** 0.000	0.498 ** 0.000	0.136 ** 0.002	-0.163 ** 0.000				
SDR	0.315 ** 0.000	-0.177 ** 0.000	0.240 ** 0.000	0.101 * 0.020	0.165 ** 0.000	0.356 ** 0.000			
SDEE	-0.165 ** 0.000	0.075 0.086	-0.129 ** 0.003	0.081 0.062	-0.080 0.068	-0.238 ** 0.000	-0.406 ** 0.000		
ESD	0.124 ** 0.004	-0.412 ** 0.000	0.497 ** 0.000	0.165 ** 0.000	-0.114 ** 0.009	0.967 ** 0.000	0.538 ** 0.000	-0.165 ** 0.000	

Note: * $p < 0.05$, ** $p < 0.01$.

It was determined that there was a negative relationship at a high level between the positive "Opinion leadership" dimension of personal innovativeness and beliefs regarding the education of sustainable development applications ($r = -0.414$; $p < 0.05$); a negative relationship at a high level with beliefs regarding restrictions in the education of sustainable development ($r = -0.177$; $p < 0.05$); and a negative relationship at a high level with the general sustainable development education scale ($r = -0.412$; $p < 0.05$).

It was determined that there was a positive relationship at a high level between the “Openness to experience” dimension of personal innovativeness and beliefs regarding the education of sustainable development applications ($r = 0.498$; $p < 0.05$); a positive relationship at a high level with beliefs regarding restrictions in the education of sustainable development ($r = 0.240$; $p < 0.05$); a negative relationship at a high level with beliefs regarding the education of sustainable development efficiency in elementary education ($r = -0.129$; $p < 0.05$); and a positive relationship at a high level with the general sustainable development education scale ($r = 0.497$; $p < 0.05$).

It was determined that there was a positive relationship at a high level between the “Taking risk” dimension of personal innovativeness and beliefs regarding the education of sustainable development applications ($r = 0.136$; $p < 0.05$); a positive relationship at a high level with beliefs regarding restrictions in the education of sustainable development ($r = 0.101$; $p < 0.05$); and a positive relationship at a high level with the general sustainable development education scale ($r = 0.165$; $p < 0.05$). According to these findings, it was observed that as long as the willingness and openness-to-experience of teacher candidates’ taking risk increases in the context of personal innovativeness, their beliefs regarding sustainable development increases concordantly. Especially in university education programs, innovativeness, managing change, sustainable development, talents that reveal originality, and performing activities that make students aware of their adequacies are not only important in terms of teachers but also for the students who will be educated by these teachers.

Table 5 shows that the predictive power of the participants’ sustainable development education of the resistance to change, opinion leadership, openness, and taking risk dimensions of personal innovativeness was statistically significant ($F = 45.110$; $p < 0.001$). With all of its dimensions, personal innovativeness explains 45% of the participants’ attitudes towards sustainable development education ($R = 0.508$; $R^2 = 0.258$). The openness to experience ($\beta = 0.423$; $p < 0.05$) dimension of personal innovativeness predicts the participants’ attitudes towards sustainable development education significantly in a positive direction. Resistance to change ($\beta = 0.053$; $p > 0.001$), opinion leadership ($\beta = -0.115$; $p > 0.05$), and taking risk ($\beta = -0.040$; $p > 0.05$) dimensions are not significant predictors of participants’ attitudes towards sustainable development education.

Table 5. Analysis results regarding prediction of sustainable development education of participants.

Variable	B	Sh	β	t	p
Stable	2.596	0.249	-	10.433	0.000
Resistance to Change	0.005	0.004	0.053	1.379	0.168
Opinion Leadership	-0.017	0.008	-0.115	-2.087	0.037
Openness to Experience	0.063	0.008	0.423	7.406	0.000
Taking Risk	-0.009	0.009	-0.040	-0.974	0.331

Note: $F = 45.110$, $p < 0.001$, $R = 0.508$, $R^2 = 0.258$.

4. Discussion

All in all, it can be seen that there are significant relationships between personal innovativeness and the dimensions of sustainable development education. The teacher candidates at the Uludağ University education facility, with a general average of $M = 57.14$ on the personal innovativeness scale, were categorized as “inquiry”. In the research of Oktuğ and Özden [24], a positive relationship was found between individualism and personal innovativeness tendency.

In Korucu and Olpak’s study, which investigated teacher candidates’ personal innovativeness features in terms of different variables, it was revealed that personal innovativeness perceptions of students who study in the same department at different education facilities have regional differences [50]. Variables such as the interactive environment of teacher candidates in terms of questioning, the opportunities provided by their education institutions, economic aspects, the status of adopting the occupation, and eagerness, can affect the questioning of features of their personal innovativeness [26,27,29,38].

As a result of Akçöltekin's study investigating the relationship between high school teachers' personal innovativeness perceptions and attitudes towards education research, a positive significant relationship was found between the attitudes of teachers regarding education research and their personal innovativeness perceptions [30].

In research on the "Resistance to change" dimension, $M = 25.35$ (traditional) was found. Teacher candidates can resist change with the concern over whether the current knowledge and efforts will be valuable in the new situation afterwards. In the context of resistance to change, internal and external institutional factors can determine the direction, content, and limits of change. The individual and institutional contributions and values that change can provide can determine the force of resistance to change. Seçkin et al.'s study, which is descriptive research on perceiving the change process, concluded that resistance not only can be based on rational reasons but also can emerge because of irrational reasons [51]. There are similar findings and information in the studies of Jager and Bubshait [52,53].

Innovators are visionary people who like trying new ideas and taking risks. Pioneers possess attributes that guide and inform other individuals in society about the innovations [28].

In the research, the teacher candidates' "Opinion leadership" was determined as $M = 10.34$ (traditional). It is in a structure that contributes to individuals' being trained in an innovative way and paving the way for innovators in terms of being opinion leaders and role models and having a good education and social structure. The research of Oktuğ and Özden determined that there were differences in terms of openness to new ideas and creativity, individualist and collectivist cultures [33]. They determined that as long as the collectivist characteristics of individuals increase, their innovativeness and creativity decrease. Individuals value the wishes and expectations of their families, the society they live in, and the groups they belong to above their own personal desires, and they focus on the aims and objectives of the society. The study states that this situation puts pressure on their creative abilities over time.

Inquirers behave carefully in the face of innovations. Individuals in this category not only dislike taking risks but go through an intense thought process about the steps they will take. Also, it can be said that they are of average age and have an average education level. The teacher candidates' "Taking a risk" was found to be $M = 7.05$ (traditional). It is seen that they are quite shy about taking risks.

Sceptics indicate shyness and sceptical behaviour towards innovations. Unlike inquirers, sceptics show withdrawn behaviour towards innovations. Instead of using social communication devices, they prefer interpersonal communication. Sceptics are represented by an older age group compared to innovators, pioneers, and inquirers.

"Openness to experience" showed a value of $M = 20.49$ (traditional). Traditionalists consider change with prejudice and tend to adopt innovations last. Also, before adopting, traditionalists want the innovation to be tried by others first, and they want to observe the results.

The average value for the education of sustainable development is $M = 3.77$. This finding indicates that sustainable development education is closely related to sustainable development. Furthermore, regarding the averages of the sub-scales of ESD, it was seen that a very high rate emerged with "Beliefs regarding the education of sustainable development applications" (SDA), $M = 4.02$, with the education of sustainable development, their beliefs regarding this can be applied was reinforced. With "Beliefs regarding restrictions in the education of sustainable development restrictions" (SDR), $M = 3.50$, it may be thought that issues such as timing regarding education, financial resources, willingness to participate, and resistance may be considered as restrictive factors. Considering "Beliefs regarding the education of sustainable development efficiency in elementary education" (SDEE), $M = 2.56$, the value was lower compared to other sub-dimensions; however, in general terms, there is a perception that can be noted in terms of beliefs regarding the education of sustainable development efficiency in elementary education.

5. Conclusions

In conclusion, for development-based education, teacher candidates need to be aware of sustainable education in the undergraduate process and have access to psychological counselling and guidance services to access the required knowledge, skills, and attitudes [54]. To give sustainable education service, teacher candidates are expected to possess critical thinking, be analytic, innovative and flexible, and have a high level of awareness. In this sense, sustainable development-based education involves personal innovativeness [55]. An individual who is not personally innovative is not expected to be flexible, adapt to change and develop awareness constantly and transfer it. In this context, for the continuity of sustainable education, teachers and teacher candidates must possess personal innovative attributes.

In every situation, administrators, as change agents, must revise the performance deficits and start planning changes to fix them. This kind of starting point is similar to a situation Senge [56] defined as “creative tension”. When people see the difference between “reality” and “vision points they want to reach”, they indicate a desire to fix this deficit. However, the difference between the point they are at and the point they want to reach creates tension. The desire to fix this deficit is a source of energy at the same time. The tension that supports these activities directed to fixing the deficit is thought of as “creative tension”. Individuals and organizations increase their “creativity and mastery” or decrease their vision in order to decrease their stress and tension as their accessing condition to the point, the vision they want to reach, is delayed. Decreasing vision, minimizing objectives and giving up reflect situations individuals and organizations encounter in real life.

While educational institutions are affected by the change, they also function as a means of change. Generally, increasing knowledge in various areas, and developing technology, new inventions, and discoveries accelerate change. Individuals must be provided with opportunities for sustainable education regarding both increased social skills and the technological harmony of the information age. Therefore, the realization of individual and institutional change and product development requires researchers and innovative individuals. These individuals are mostly provided through education. In this context, individuals must possess problem-solving skills.

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