

Impact of a SSI Program on Prospective Teachers' Character and Values for Global Citizens

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Abstract

Raising global citizens has been included in education systems, especially in the 21st century objectives. In their education systems, countries have turned towards more global level objectives rather than local level objectives that only meet their own needs. The importance of the character and values expected from the global citizens to be raised has also increased. For this reason, in this study, it is aimed to investigate the change in the character and values of prospective biology teachers as global citizens who are trained with a Socioscientific Issues (SSI) program. The study used a one group pretest-posttest design. The study group of the research consists of 19 prospective biology teachers studying in the first year of a state university in Ankara. A SSI program was used to ensure the development of some desired character and values in the prospective teachers. Character and Values as Global Citizens Assessment (CVGCA) questionnaire was applied before and after SSI program. It has been determined that there is a significant difference between the scores of prospective biology teachers obtained from the CVGVA scale and its sub-dimensions before and after the SSI program. The findings of the study showed that SSI program improved prospective biological teachers' ecological worldview, socioscientific accountability, and social and moral compassion character and values. In addition, it was understood that the characteristics of prospective teachers such as empathy, taking action, producing solutions, and noticing different perspectives became evident.

Keywords: Socioscientific Issues (SSI), Global Citizenship, Character and Value Education, Teacher Education, Environmental Issues

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INTRODUCTION

The idea of “global citizenship” is older than written history and emerges independently in different parts of the world, in different cultures and at different times (Appiah, 2008). Therefore, raising global citizens has also been included in education systems, especially in the 21st century objectives. There are many features of the global citizen that education systems want to train. According to Lee et al. (2012), individuals, who create all their knowledge and abilities according to the requirements of global issues, attach importance to different cultures and values, show social values about acting responsibly in science-related issues around the world and develop an international perspective and character, are global citizens.

The importance of the character and values that global citizens to be raised in the 21st century are expected to have is also considerable. In this context, Choi et al. (2011) proposed three character and values of the 21st century global human model in their study. These are “ecological worldview”, “socioscientific accountability”, and “social and moral compassion”. Ecological worldview stems from the fact that nature is a whole. It is essential that people consider their own behaviors towards the environment and consider how they affect other living things in the world. Accordingly, the global perspective is based on some kind of ecological awareness (Lee et al., 2013). The other character and value recommended for global citizens is socioscientific accountability. One of the main objectives of science education is to enable students to take responsibility for appropriate, responsible, and effective behaviors in social, economic, environmental, and moral ethical issues. Thus, those who have a worldview for the 21st century can define current socioscientific issues (SSI). They may also try to learn to participate in decision-making processes and take action to protect the world they live in (Choi et al., 2011). The third character and value proposed in this context is social and moral compassion. Especially the individuals in rapidly developing technological societies need to be sensitive to the moral and ethical elements hidden in SSI. It is important that they accept and value different perspectives on the issues (Lee et al., 2012). 21st century scientific literacy requires the development of empathy ability to understand other people and to respect other people and living things in the world. It is an individual's valuing cultural differences (Choi et al., 2011).

Ensuring the development of characters and values requires a lot of time and effort. It is critical and important to take advantage of an SSI program in terms of this time and effort in the student's education process. SSI program can be a tool for science educators in the development of scientific literacy by integrating science education with moral, character and citizenship education (Lee et al., 2013). In this sense, it is very important for students to have knowledge about SSI in acquiring scientific literacy (Atabey & Topçu, 2017). SSI teaching enables students to develop high-level thinking skills, such as argumentative thinking, decision making, and understanding the nature of science (Evagorou, Güven, & Muğaloğlu, 2014).

The role of the teacher in SSI is to encourage students to evaluate with evidence-based alternative arguments. The problem that science teachers have to deal with is to enable students to review their belief systems by offering opportunities to create new perspectives. Teachers have the responsibility to provide students with opportunities to test the integrity of their belief systems to connect the real world with the social world (Zeidler & Nichols, 2009). There are many factors that determine the SSI teaching process and are directly related to the teachers. Teachers' understanding of science education and SSI are one of the main factors in terms of their SSI teaching competencies. Similarly, teachers' self-efficacy and field knowledge self-efficacy related to SSI teaching are also important factors in the SSI teaching process (Han Tosunoğlu & İrez, 2019). Therefore, teachers' level of readiness for SSI teaching is very important.

SSI are very disciplined by nature, so even if such subjects are included in the science curriculum, teachers need to have a solid background among disciplines. Although teachers have sufficient scientific subject knowledge, if they do not have a sound understanding of relevant economic, political and social issues, their ability to use an SSI-oriented curriculum may be restricted (Kara, 2012). Most of the studies show that teachers are aware of the importance of global citizenship education (Goren & Yemini, 2017). In the study by Nida, Rahayu, and Eilks (2020), it was found that

teachers do not use SSI-based science education very often in their classes. Students' lack of competencies, the lack of teacher expertise, the content of the official curriculum, the lack of time in lesson preparation and implementation were given as the reasons. Teachers feel uncomfortable in poorly structured SSI in science classes and need extra support and guidance to deal with it (Ekborg et al., 2013). In their study on the self-efficacy of prospective teachers regarding SSI teaching, Muğaloğlu, Doğança Küçük, and Güven (2016) found a significant difference in the sub-dimension of "personal SSI teaching efficacy" while there was no significant difference in the sub-dimension of "SSI teaching outcome expectancy". Karakaya, Uzel, Gül, and Yılmaz (2019) found that various factors may affect the prospective teachers' readiness for teaching profession. In parallel with these, it becomes clear how important it is for teachers to attain their gains in teaching SSI, especially before embarking on their professional life. For this purpose, the moral, argumentation, risk analysis and pedagogical aspects of SSI-based programs should be included in courses such as science teaching methods in Turkish teacher education (Genel & Topçu, 2016). SSI also provide a good resource for learning and teaching biology content (Nurtamara, Sajidan, & Suranto, 2019). Because the content of biology includes genetics, biotechnology, environment, etc., it is thought that it would be beneficial for teachers to benefit from SSI teaching in their lessons. All these reveal the need and importance of studies on SSI, especially with prospective biology teachers. Providing the development of character and values of the global citizens to be raised in the 21st century through the SSI is also considered important in terms of the literature. For this reason, the aim of this research is to seek an answer to the question of "How is the change in the character and values of the prospective biology teachers as global citizens who are trained with a SSI program in some environmental issues?"

METHOD

Research Design

This experimental study was conducted using the one group pretest-posttest research design. In this design an independent variable is applied to a single group and measurements are made both before and after the experiment (Karasar, 2012). In this research, prospective biology teachers were trained with a SSI program on three environmental issues in accordance with the "ecological worldview", "socioscientific accountability", "social and moral compassion" character and values.

Participants

The participants of the research consist of 19 prospective biology teachers studying in the first year of a state university in Ankara. In accordance with the research problem, criterion sampling, which is one of the purposeful sampling methods, was used to determine the study group. In this sampling, criterion or criteria can be created by the researcher or a previously prepared criteria list can be used (Yıldırım & Şimşek, 2013). The criterion determined in the criterion sampling method in the research is not to have taken the environmental courses of the biology education undergraduate program. According to this criterion, it was determined that it is appropriate to include 1st year prospective biology teachers in the research. There are 19 students in total, 3 boys and 16 girls studying in the determined class. With the informative meeting held, these prospective teachers were informed about the purpose, content, duration of the research and the importance of confidentiality, continuity and volunteering for the participants. In addition, in order to ensure the confidentiality of the identity information of prospective teachers, numbering was performed independent of the research. For this reason, 1st prospective teacher was named as A1, 2nd prospective teacher as A2, and 19th prospective teacher as A19.

SSI Program

In the study, the "SSI program" developed by Lee et al. (2012) and Lee et al. (2013) was used. The purpose of this program is to ensure the development of certain character and values desired in the participants through mutual dialogs and interactions. Three environmental issues were selected as water footprint, solid waste pollution, and endangered species as SSI. These environmental issues are

determined by scanning both national and international literature in the world, which have been noted to be current topics in both in the world and in Turkey. The applications of the research were carried out by the researcher herself. The researcher, who took an active role in designing the research and determining the content of the SSI program, occasionally consulted expert opinions in these processes. In addition, the researcher has studies on character and values education, SSI and programs, and environmental problems.

Three important features were used in the preparation of the SSI program. These are:

(1) Character and values: According to the studies by Choi et al. (2011), Lee et al. (2012), and Lee et al. (2013), the character and values that the global citizen should have consist of three elements: “ecological worldview”, “socioscientific accountability”, and “social and moral compassion”. In the content of the program, three environmental issues were presented according to these character and values. For example, in order to emphasize the “ecological worldview” character and value on the topic of water footprint, information about the amount of water footprints of various products (t-shirts, chocolates, a cup of coffee, etc.) and their effects on the nature are given.

(2) Dialogical and interaction-enriched processes: Small and large group discussions were carried out by ensuring the active participation of prospective teachers. Discussion questions determined within the scope of the study are questions with social, scientific, and environmental aspects. With the discussions, prospective teachers better understand the complexity of the subject, realize different views, and gain a versatile perspective. In addition to this, every week, prospective teachers were given assignments to do research on scientific studies, current news, etc. in the literature. Thus, the candidates were given the opportunity to find scientific bases to defend their views.

(3) Personal, social and global perspectives: Prospective teachers in SSI program evaluate the topics according to personal (matters about themselves, their families or acquaintances), social (matters related to their own community or countries) and global (matters related to international or worldwide effects) aspects.

While an informative meeting was held in the first week and the pretest was applied, SSI program was applied in the next 6 weeks. The study was completed in 8 weeks with the last test done in the week after the program. The implementation of the SSI program took 6 weeks for three topics, 2 weeks for each subject. Two lessons were reserved for weekly applications (one lesson is approximately 50 minutes).

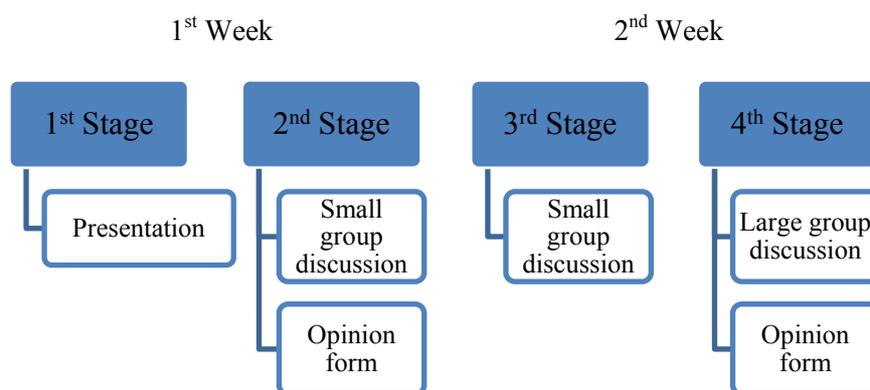


Figure 1. Schematic representation of the implementation stages of the SSI program for a subject

In the first week of SSI program, stage 1 and 2; and the second week, stage 3 and 4 were carried out (Figure 1). In the first week, an introductory scientific presentation was made for each

topic, and prospective teachers were informed about the topic. In particular, various sources (videos, newspaper reports, articles, etc.) were used for different aspects of the topic. Prospective teachers were encouraged to share their feelings and thoughts regarding these aspects (Stage 1). Considering the total number of prospective teachers, they were divided into 5 groups, which were randomly determined, as 4 people in 4 groups and 3 people in 1 group. In addition, the group members were constantly changed for three topics, thus giving them the opportunity to share different thoughts as a group with different people each time. Prospective teachers were given the first discussion question on the topic. Each group was asked to reach a common opinion by discussing among themselves, but this was not presented as a condition. Prospective teachers were motivated to benefit from all kinds of information, documents, films, advertisements, books, documentaries, etc. to strengthen their views for the coming week. It was highlighted for them that the more evidence they offer to refute the other party's ideas, the stronger they will be. In the end, prospective teachers were asked to write down their post-discussion views, which were strengthened and weakened, by explaining the reasons (Stage 2).

In the second week, prospective teachers were given second discussion questions. Again, each group was asked to reach a common opinion if possible by discussing with each other. In the first week, they were motivated to defend their views with evidence and refute opposing views with evidence in parallel with their homework (Stage 3). First, each group was given the opportunity to come together and gather their views, and they were asked to choose one of them as a spokesperson. Then, all the students, who advocate similar thoughts, were allowed to sit in a circle where they could see each other. With the start of the spokesperson of the requesting group, each group presented the common opinion of the group with its reasons, or if there was no common opinion, they presented differences in opinions along with the reasons, and all the group presentations were completed. Then a large group discussion was held. Finally, they were asked to write down their ideas, which were strengthened and weakened following the small and large group discussions, along with their reasons (Stage 4).

While each topic was presented to prospective teachers in SSI program, its relationship with nature, its current situation, past problems and possible negative situations in the future were mentioned. Prospective teachers were encouraged to use different sources to defend their views. In addition, they were asked to evaluate and share their obtained knowledge, emotions, and experiences about the topics in terms of individual, family, close environment, hometown, country or the world. The main purpose of all these is to ensure the development of prospective teachers' "ecological worldview", "socioscientific accountability", and "social and moral compassion" character and values.

Data Collection Tools

Quantitative and qualitative approaches were used to collect research data. In the quantitative stage, Character and Values as Global Citizens Assessment (CVGCA) questionnaire, which was developed by Lee et al. (2013) and adapted to Turkish by Karişan and Yılmaz-Tüzün (2017), was used. The original CVGCA scale consists of 20 items and 4 dimensions. Following the construct validity study performed in the Turkish adaptation, seven items were removed from the scale. The final form consists of 13 items and the items are in five-point Likert type. In the scale involving four sub-dimensions, the sub-dimension of "sustainable development" reflects ecological worldview; the sub-dimension of "willingness to act" reflects socioscientific accountability; the sub-dimensions of "empathetic concerns" and "moral and ethical sensitivity" reflect the social and moral compassion character and values. These four factors explain 57.7% of the total variance. The Cronbach alpha value calculated for the reliability of the scale was obtained as .832. In addition, confirmatory factor analysis was carried out as the validity study, and compliance values were reported to be at a sufficient level. The minimum score to be taken from the scale is 13, and the maximum score is 65.

In the qualitative phase of the research, prospective teachers' three large group discussions held for three environmental topics were recorded as videos. Each large group discussion took an average of 35-40 minutes. In addition, opinion forms were created in which they wrote their views on each discussion question. The opinions of the prospective teachers were taken 6 times for a total of 6 discussion questions consisting of two discussion questions for each topic.

Data Analysis

For the analysis of quantitative data, SPSS 22 statistical software was used. The CVGCA scale was applied before and after SSI program. Sample size is important in deciding the analysis to be applied. Especially in studies where the number of participants in the groups is $n \leq 20$, the power of parametric statistics is also weak (Pituch & Stevens, 2016). In order to determine whether there is a difference in the character and values of prospective teachers before and after SSI program, Wilcoxon Signed Rank Test, which is one of the non-parametric tests, was used. Wilcoxon Signed Rank Test is used to test the significance of the difference between the scores of the two related measurement sets (Büyükoztürk, 2013). In addition, graphs were used to show the scores of prospective teachers for each sub-dimension of CVGCA scale.

The research has two qualitative data sources. The first one is video recordings of large group discussions. Video recording provided clues to the researcher on the issues, such as the participants of the dialogues in discussions, all kinds of reactions or unresponsiveness of prospective teachers, and their general body movements and moods. The video recordings of prospective teacher teachers were first transcribed, and then the three volunteers were asked to read and confirm their documents. If the researcher records the detailed field notes with a high quality recorder and transcribe them, the reliability of the study increases (Creswell, 2013). The second qualitative data source is the opinion forms in which prospective teachers wrote their opinions after six discussion questions. The expressions of prospective teachers in these qualitative data sources were used through direct quoting while presenting the quantitative data of the character and values. Taking an active role in designing the research and determining the content of the socioscientific program, the researcher carried out all the implementations. Prospective teachers know the researcher in advance, and this helped them express themselves easily during the implementations. In addition, the repetition of SSI program for each three topics separately supported long-term interaction. In order to increase the internal validity (credibility) of the research, it is suggested that the researcher should interact with data sources for a long time (Yıldırım & Şimşek, 2013).

FINDINGS

In this study, the changes in the character and values of prospective biology teachers as global citizens, who were trained with SSI program on water footprint, solid waste pollution, and endangered species, were investigated. For this purpose, CVGCA scale was applied before and after SSI program. Wilcoxon Signed Rank Test was used to see if there is a significant difference between the scores of prospective biology teachers from CVGVA scale and its sub-dimensions before and after the SSI program.

Table 1. Comparison of prospective biology teachers' scores regarding CVGCA scale and its sub-dimensions before and after SSI program

Questionnaire		N	Mean rank	Sum of ranks	Z	p
CVGCA	Negative ranks	2	1.50	3.00	-3.705	.000
	Positive ranks	17	11.00	187.00		
	Ties	0				
Sustainable development	Negative ranks	2	3.50	7.00	-3.443	.001
	Positive ranks	26	10.25	164.00		
	Ties	1				
Willingness to act	Negative ranks	1	9.50	9.50	-3.212	.001
	Positive ranks	16	8.97	143.50		
	Ties	2				
Empathetic concerns	Negative ranks	2	5.50	11.00	-3.267	.001
	Positive ranks	16	10.00	160.00		
	Ties	1				
Moral and ethical sensitivity	Negative ranks	0	.00	.00	-3.625	.000
	Positive ranks	17	9.00	153.00		
	Ties	2				

It is understood that the difference between the scores of prospective biology teachers from CVGCA scale before and after SSI program ($Z=-3.705$; $p<.05$) and from the sub-dimensions of “sustainable development” ($Z=-3.443$; $p<.05$), “willingness to act” ($Z=-3.212$; $p<.05$), “empathetic concerns” ($Z=-3.267$; $p<.05$), and “moral and ethical sensitivity” ($Z=-3.625$; $p<.05$) is significant (Table 1).

Graphical presentation of the scores obtained from four sub-dimensions of CVGCA scale before and after SSI program and direct quotes of prospective biology teachers obtained from large group discussions and opinion forms are presented below.

Prospective teachers’ scores on sustainable development, which is the first sub-dimension of the CVGCA scale, before and after SSI program are given in Figure 1.

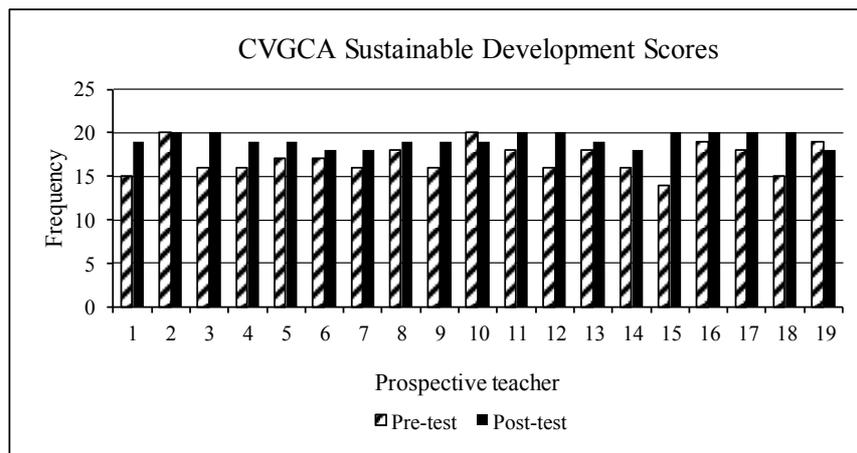


Figure 1. Prospective teachers’ CVGCA scores on sustainable development scores before and after SSI program

After SSI program, it is understood that the CVGCA sustainable development scores of prospective biology teachers increased in 16 students, decreased in 2 (A10, A19) and did not change in 1 (A2) (Figure 1). As a result of the Wilcoxon Signed Rank Test, which was employed to determine whether the change in prospective teachers’ scores was statistically significant or not, a significant increase was observed (Table 1). In parallel with their opinions, a section from the group discussions on water footprint is given below.

A19: Because the water footprint is large, closing this factory means many people will be unemployed. The big problem for the country's economy is that they cannot take care of their families and cannot send their children to school.

A12: We need to close the factories. Because economic problems can be resolved over time, but due to running out of water, we cannot create water from nothing. If water runs out or becomes too low, providing water will economically shake people more. What if aquatic ecosystems decrease? Of course, all living things suffer from this. Nature's balance is disturbed.

A10: You cannot tell hungry people to save water. People's priority is to survive. They have to make money for this; they need to think about their families.

A15: Economic troubles and financial hardship can scare people, you are right. But let's suppose that the factory continued to work, 1 or 2 years later, the child of the worker who worked in this factory got sick and died. Can money bring the child back? There are always other ways to make money, but all living things pay for the damage of killing the nature. Man is also part of this nature.

It is understood from the discussion section given above that prospective teachers are trying to convince each other on whether to close a factory with a large water footprint due to economic concerns such as unemployment. Examples of the expressions used by prospective teachers in explaining their views on the discussion questions regarding water footprint, solid waste pollution, and endangered species are presented below:

A3: If the factory, whose water footprint is too large, is not closed, the water resources will be exhausted very quickly. There is no life in a place where there is no water. Life and liveliness will end after a while (Water footprint).

A1: Just like paying for the grocery bags. When it first comes out, people react to putting quotas in their rubbish, but when some families pass the quota and have to pay money, they will not exceed their quota by choosing to follow this solution. Environmental cleaning will be ensured with this application. Both soil and water will not be polluted and nature will remain clean (Solid waste pollution).

A18: The extinction of a species means disruption in the entire food chain. Protecting endangered species is important for diversity and ecological balance. When we spoil the natural life, the species is endangered. For this reason, we must protect the nature consciously without having to remove living things from their natural environment (Endangered species).

According to the expressions of prospective teachers given above as an example, they evaluate the issues with an approach pointing out the integrity of nature, the importance of protecting nature, and people's responsibility for nature, etc.

Prospective biology teachers' scores for the second sub-dimension of the CVGCA scale before and after the SSI program, named willingness to act, are given in Figure 2.

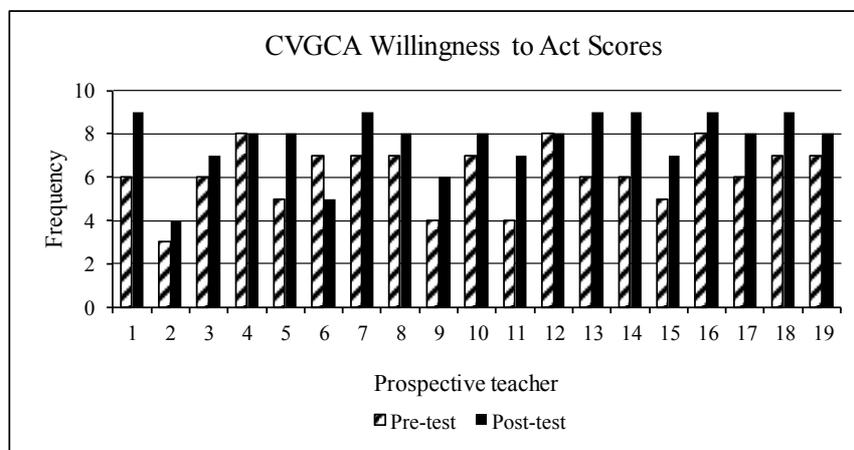


Figure 2: Prospective teachers' CVGCA willingness to act scores before and after SSI program

When CVGCA willingness to act scores were examined, it was found that after SSI program, scores of 16 prospective biology teachers increased, 1 decreased (A6) and 2 did not change (A4, A12) (Figure 2). The result of the Wilcoxon Signed Rank Test performed to determine whether the increase in prospective teachers' scores was statistically significant was also found to be significant (Table 1). A section from the prospective teachers' views on the sub-dimension of willingness to act, which were obtained in the group discussions on solid waste pollution, is given below.

A11: Fines can be imposed for people to make them dispose their garbage in a recyclable manner. The one that makes a lot of garbage and the one that makes less cannot be considered the same. Therefore, those who have a lot of garbage should be fined.

A4: So what happens if people snatch their trash, try to destroy them in another way, so as not to pay money? I think they might develop worse methods because of the fear of paying the fine.

A11: Well, if they care so much about money, why not start following the rules so as not to pay money, or what about providing extra training to explain how helpful it is to do so? Think about it: If the names of people, housing estates, neighborhoods that make the least garbage are announced, if this is encouraged, don't you think people will like it?

A8: Municipalities can offer complaint lines.

A16: Project competitions can be held in schools or campaigns can be organized. The use of disposable plastics can be reduced; glass bottles can be used instead of plastic bottles. We use glass bottles over and over again.

In their discussion on preventing solid waste pollution, prospective teachers seem to have developed suggestions, such as using the method of punishment to reduce their litter, organizing campaigns and project competitions, offering complaint lines, etc. In addition, some of the expressions used by the prospective teachers in their views regarding the discussion questions are given below:

A5: I would use alternative watering methods to reduce the water footprint. I can use rainwater for example. Those around me can see from me and use these new methods, then it will become widespread (Water footprint).

A7: Our goal is not to punish people and earn money. We can raise awareness of our people and awaken them. We can raise awareness with various events, animations, or short films (Solid waste pollution).

A17: To stop hunting, very radical decisions can be made and penalties can be imposed. Those who report to the complaint lines can be rewarded for preserving species because it stops the killers and save the life of creatures, this will be very nice (Endangered species).

From the expressions used by prospective biology teachers in their responses to the discussion questions, it is seen that they propose various activities/solutions for the solution of environmental problems related to the sub-dimension of willingness to act. These suggestions are applicable to the country or the world, as well as to the individual level.

Prospective biology teachers' scores for the third sub-dimension of CVGCA scale, called empathetic concerns, before and after SSI program are shown in Figure 3.

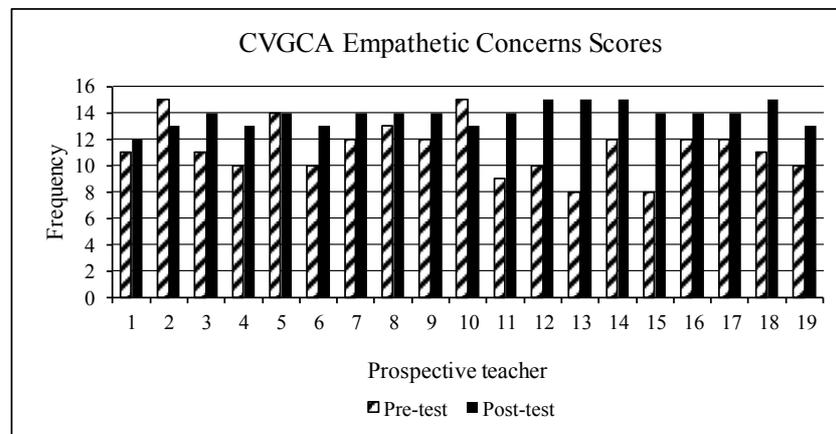


Figure 3. Prospective teachers' CVGCA empathetic concerns scores before and after SSI program

According to the CVGCA empathetic concerns scores obtained after SSI program, it was observed that scores of 16 prospective biology teachers increased, 2 decreased (A2, A10) and 1 did not change (A5) (Figure 3). Whether this difference in the scores of prospective teachers was statistically significant was investigated with the Wilcoxon Signed Rank Test and the difference was found to be significant (Table 1). A section from the prospective teachers' views on the sub-dimension of empathetic concerns, which were obtained in the group discussions on endangered species, is given below.

A5: It did not make sense to separate the animals from their natural habitats and to reproduce them artificially. Because even if we ensure that these creatures are reproduced under certain conditions, it will not be the same as they breed in the natural environment.

A3: Being trapped in a place, being separated from the place they adopt to, getting used to another place is also difficult for animals. For example, when someone who has always lived in big cities is assigned as a teacher to a rural area, it is difficult for this person to adapt. But that person can make himself happy by making sacrifices, helping the people there. Considering the future life of animals, their offspring, other creatures and the ecosystem, we can conduct such a work.

A11: I would feel bad if they took me from my natural environment. But I would have endured this in order to continue my generation, not to be alone, to have people of my own kind. Sometimes good things need suffering.

A15: They are alive too, and we have no right to restrict their freedom. If I were the endangered creature, if they intervened with me, I would never want to stay there because nature is my right. Nature and freedom are the rights of all living things.

.....

A9: A zoo in Australia has implemented a breeding program for endangered turtles. One third of nearly 600 turtles that have hatched in the last 25 years are left back to the wild. Do you know how many adult turtles they had when they first started? Only 11.

In the discussion of prospective teachers on the establishment of breeding farms to keep endangered species alive, they put themselves in their shoes or provided personal examples of this situation to understand them. In addition, sample expressions used by the prospective teachers in their views regarding the discussion questions are given below.

A19: I think being unemployed is more real than water footprint. How can I survive if I cannot support my home, meet my child's needs, pay my bills? Countries such as Venezuela, Sudan, where unemployment is high, do not have water footprint (Water footprint).

A14: It is necessary to keep the quota of a developed country high. Because the living standards of the people living there are shaped according to them. Personally, I would not want to be restricted when I already had such a life. After all, I might contribute to the world in another way (Solid waste pollution).

A2: I am an endangered species and I am traveling with a GPRS device on my foot. My friends in the group are looking at me and laughing, I look very funny. It seems like I am leaving the herd and feel like mixing with other communities. But this also scares me a lot. I get pain in my head from thinking, "What if they kill me and make me food for dinner?" Believe me; this is much more difficult than carrying the device on my foot... I would not want it to be attached on me (Endangered species).

From the expressions used by prospective biology teachers in their answers to the discussion questions, it is understood that they think about the empathetic concerns sub-dimension by putting themselves in the position of the person / animal in that situation.

Prospective biology teachers' scores for the 4th sub-dimension of the CVGCA scale, called moral and ethical sensitivity, before and after SSI program are shown in Figure 4.

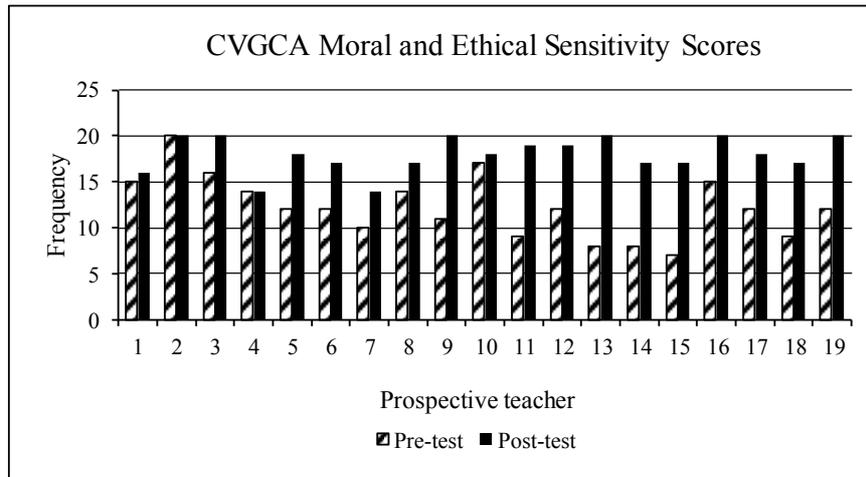


Figure 4. Pre-service teachers' CVGCA moral and ethical sensitivity scores before and after SSI program

When CVGCA moral and ethical sensitivity scores of prospective biology teachers after SSI program were examined, it was found that the scores of 17 people increased and the scores of 2 people did not change (A2, A4) (Figure 4). With the Wilcoxon Signed Rank Test, it was examined whether this difference in the scores of teacher candidates was statistically significant and the difference was found to be significant (Table 1). A section from the prospective teachers' views on the sub-dimension of moral and ethical sensitivity, which were obtained in the group discussions on endangered species, is given below.

A2: So what is right about forcing a species that has the right to live in nature freely to breed in artificial environments?

A16: Of course, it cannot be like his natural life, but it cannot be worse than his death. After all, there is a bad course of events ahead of us and we create solutions for them. Shall we let a species extinct completely?

A14: I think the most natural conditions can be explored to make them comfortable. Of course, nothing can be like nature, but it is better than losing the right to live. The conditions in which they are most comfortable are provided, special trainings can be given to the people who care for them, and private living space of each is respected.

A2: I think it would be unfair to try everything to find the right way by claiming it is for their good. If I were an endangered species, I would never want another species to put me in a place like a factory or a prison to produce. How it would limit my freedom. Moreover, animals are the freest creatures.

From the expressions used by prospective biology teachers in their responses to the discussion questions, it was understood that the conditions such as right to live, freedom and living conditions of animals were taken into consideration in the moral and ethical sensitivity sub-dimension. In addition, some of the expressions used by prospective teachers in their views regarding the discussion questions are given below.

A12: The water is not just ours; people all over the world have the right to use this water. The borders of countries cannot divide nature, and do not give us the right to do what we want. Water does not only belong to people, it also belongs to plants and animals (Water footprint).

A13: I would not give high waste quota to Turkey. Because the world is not just ours and I think privilege is a wrong move (Solid waste pollution).

A6: Actually, I see the establishment of breeding farms as an effort to relieve our own conscience. When we look at it, we look like we are protecting the endangered ones, but we are already causing the extinction. We both cause the extinction and take away their habitat (Endangered species).

From the expressions used by prospective biology teachers in their responses to the discussion questions, it was observed that they emphasized the rights, equality and ethical approaches for human beings and other living things in the moral and ethical sensitivity sub-dimension.

DISCUSSION AND CONCLUSION

In this study, prospective biology teachers were trained on environmental issues through an SSI program and it has been concluded that there is a significant increase in the character and values as a world citizen according to the CVGCA scale. The findings of the research show that SSI program improves these character and values of prospective biology teachers. It was also understood that the characteristics of prospective teachers such as empathy, taking action, producing solutions, and noticing different perspectives became obvious.

Lee et al. (2012) applied an SSI program to prospective teachers in their study to develop ecological worldview, socioscientific accountability, and social and moral compassion character and values. It was determined that prospective teachers show these three character and values. Uzel (2014) found that there was a post-application difference in the opinions of prospective teachers who were trained according to character and values of ecological worldview, socioscientific accountability, and social and moral compassion with SSI program. Similarly, following the community-based SSI program conducted with middle school students, Kim and Lee (2019) concluded that there was a statistically significant increase in ecological worldview, socioscientific accountability, and social and moral compassion scores according to CVGCA scale results. In the study by Hadjichambis et al. (2019), it was understood that the results of the CVGCA scale showed a significant difference in the active citizenship module applied on the students' controversial SSI. Gao, Mun, and Kim (2019) researched the development of students' character and values with the CVGCA scale through SSI program they implemented. They found that the character and values of students developed significantly with SSI program. In the study by Öztürk (2019), as a result of the CVGCA scale applied to prospective teachers, the scores of ecological worldview, socioscientific accountability and social and moral compassion character and values were high. These studies support the conclusion that character and values can be improved by applying SSI program.

In their study, Lee et al. (2013) applied an SSI program on genetic modification technology to ninth-grade students and a significant increase in social and moral compassion character and values was determined according to the CVGCA scale scores of the students while no significant increase was detected in ecological worldview character and value. In the study by Kim, Ko, and Lee (2020), there was no significant difference in the ecological worldview scores of the CVGCA scale results of the middle school students who were applied the community-based SSI program while a significant difference was found in socioscientific accountability and social and moral compassion scores. Likewise, in order to improve the character and values of college students, Ko and Lee (2017) implemented an SSI program in which students would explore different perspectives on five topics, share and explain their own ideas, and develop appropriate solutions. There was a significant difference in CVGCA scale pretest-posttest scores in social and moral compassion and socioscientific accountability character and values. These studies in the literature show that there may be limitations regarding the development of ecological worldview character and value. There may be different reasons for this; one of them may be the content of the topics given to students, especially environmental issues may affect the development of this character and value more positively. In fact, ecological worldview character and value is seen to be more prominent in SSI where environmental

issues are dominant. Jang et al. (2012) determined that students' ecological worldview scores were higher in their study with three SSI (nuclear power generation, biotechnology, climate change).

In this research, an SSI program was used to improve the character and values of prospective biology teachers, and SSI program was found to be effective. Research findings of Wardell and Zeidler (2017) also supported that using SSI is a key pedagogical strategy in the development of character and values to become a global citizen. Similarly, in the study by Ko and Lee (2017), it was understood that SSI program is a good teaching method that can be integrated into character education through science education. In addition, Sadler, Romine and Topçu (2016) found that the use of SSI as a teaching tool was effective for students in learning science content.

In SSI program of the present study, discussions were used to develop character and values. Especially in direct quotes taken from prospective teachers' discussion dialogs and opinion forms, it was understood that the characteristics of the prospective teachers such as empathy, argument formation, and moral and ethical approach came to the fore. In parallel, in the study by Kara (2012) conducted with prospective biology teachers, giving them the opportunity to examine and reflect their own values was emphasized. The importance of professional development, particularly with regard to the moral and ethical dimensions of controversial social and personal issues, science and technology was also highlighted. As a result of the study by Sperling and Bencze (2010), in which they supported their projects on waste management with class discussions, they observed that students' tendency to become participatory citizenship increased. In their study on environmental SSI, Herman, Zeidler and Newton (2018) benefited from the CVGCA scale and found that students' emotive reasoning was significantly more concerned with people and nature. While Berenguer (2010), on the other hand, found that students who empathized with the situations they faced were able to present a greater number of moral arguments to dilemmas about specific environmental issues. In parallel, Fowler, Zeidler, and Sadler (2009) found an increase in moral sensitivity of high school students who were trained with SSI content. In their study that investigated students' moral approaches through SSI, Sternäng and Lundholm (2011) found that students took a more distant approach on the grounds that it would be difficult for them to find alternatives for the solution of sensitive problems. Similarly, in their study, Chen and So (2017) investigated the ethical reasoning of biology teachers with SSI, and it was found that they approached SSI issues more personally rather than national or global perspective.

In this research, the focus was on gaining certain character and values that global citizens should have according to Choi et al. (2011). Research findings supported that this was feasible with the SSI program used. However, due to the limitations of this research such as the number of participants, geography, duration, etc., the generalizability of the study data is low. For this reason, it is suggested that the issues addressed in this study, which may be an example for further research, should be used in different topics, in different countries, with larger groups, with longer periods of repetition and contribute to the literature.

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