



Character and Values for Global Citizens: A Study with Preservice Science Teachers

Küresel Vatandaşlar için Karakter ve Değerler: Hizmet öncesi Fen Bilimleri Öğretmenleri ile Bir Çalışma

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Abstract

The main purpose of this paper was to investigate preservice science teachers' sense of character and values as global citizens; namely their ecological worldview, social and moral compassion and socioscientific accountability. Convenience sampling was used and Character and Values as Global Citizens Assessment Questionnaire was administered to 201 preservice science teachers across different grade levels. Factor analysis extracted five main factors of the questionnaire: Interconnectedness, moral and ethical sensitivity, perspective-taking, empathic concerns, and feeling of responsibility under three components of ecological worldview, social and moral compassion, and socioscientific accountability. Besides, preservice science teachers scored moderately high on the components, ecological worldview, social and moral compassion and socioscientific accountability. The participants scored highest on Empathic concerns dimension and lowest on Feeling of responsibility dimension. The implications of the findings were also presented.

Keywords: Global citizenship, socioscientific issues, values, character, preservice teacher.

Öz

Bu çalışmanın temel amacı fen bilgisi öğretmen adaylarının küresel vatandaşlık kapsamında karakter ve değerler bileşenlerinden olan ekolojik dünya görüşü, toplumsal ve ahlaki merhamet ve sosyobilimsel hesap verebilirliklerini araştırmaktır. Çalışmanın verileri, uygun örnekleme yöntemi ile 201 fen bilgisi öğretmen adayından Küresel Vatandaşlık için Karakter ve Değerler Ölçeği kullanılarak elde edilmiştir. Faktör analizi, ölçeğin beş faktörlü olduğunu ortaya koymuştur: Birbirine bağlılık, ahlaki ve etik duyarlılık, bakış açısı alma, empatik kaygılar ve sorumluluk duygusu. Bunun yanı sıra, betimsel analizler fen bilgisi öğretmen adaylarının ekolojik dünya görüşü, toplumsal ve ahlaki merhamet ve sosyobilimsel hesap verebilirlik bileşenlerinden yüksek ortalamalar elde ettiklerini göstermiştir. En yüksek ortalama empatik kaygılar boyutunda görülürken, en düşük ortalama sorumluluk duygusu boyutuna aittir. Çalışmada elde edilen sonuçlara dair tartışmalara da yer verilmiştir.

Anahtar sözcükler: Küresel vatandaşlık, sosyobilimsel konular, değerler, karakter, hizmet öncesi öğretmen.

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Introduction

The tremendous advancements in science and technology have brought many challenges to humankind in 21st century. One of the most salient challenges is to make decisions on local and global controversial issues. These complex and ill-structured societal issues are related to science and technology, and are called socioscientific issues (SSIs) (Sadler & Zeidler, 2005). Nuclear power usage, gene cloning and genetically modified foods are the examples of SSIs which do not possess clear-cut solutions.

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Resolving these issues may not be very straightforward for the individuals. Researchers argue that we, as global citizens, need to find solutions to complex SSIs in just and equitable ways (Lee et al., 2013). To achieve this, individuals need to be able to collaborate and communicate effectively (Lee, Chang, Choi, Kim, & Zeidler, 2012; Lee et al., 2013) and consider the complex issues from multiple perspectives and values (Lee et al., 2012). This means that global citizens of the 21st century need to develop a degree of moral reasoning and decision-making skills.

Raising global citizens who are able to make informed decisions by taking moral and ethical considerations into account requires the integration of character and values, namely morality and citizenship education into science education (Hodson, 2003; Lee et al., 2012; Sperling & Bencze, 2010; Zeidler, Sadler, Simmons, & Howes, 2005). In parallel with this idea, new visions of scientific literacy have been suggested and accordingly the central goal of science education have been revisited in recent years (e.g. Choi, Lee, Shin, Kim, & Krajcik, 2011; Roberts, 2007, 2011; Santos, 2009). For example, according to Santos (2009), basing on Paulo Freire's humanistic perspective, science education should incorporate the three aspects; "1-discussion of socially relevant themes by SSIs, 2-establishment of a dialogical process in classroom, and 3- engagement of students in sociopolitical actions" (p. 373). Santos (2009) considered encouraging students to take sociopolitical actions as an important way to solve global issues. Sharing a similar concern of incorporating social values in science education, Choi et al. (2011) developed a new framework for scientific literacy basing on an extensive literature review. This new framework included the five dimensions of content knowledge, habits of mind, character and values, science as a human endeavor, and metacognition and self-direction (Choi et al., 2011). The dimension of character and values in this recently developed framework mainly stressed the importance of developing future generations' character and values as global citizens so that they have knowledge and ability to make sound decisions about today's complex science related social issues, and show empathy and compassion towards different cultures. Choi et al. (2011) described three main components of character and values for global citizens: 1- ecological worldview, 2- socio-scientific accountability, and 3- social and moral compassion. In the next section, each of the three components of character and values for global citizens were explained in detail.

Character and Values for Global Citizens

Ecological worldview refers that individuals possess the belief of embeddedness in and interconnection with nature (Choi et al., 2011; Lee et al., 2012; Lee et al., 2013). Namely, individuals with an ecological worldview are expected to make decisions and behave in accordance with the environment, consider the consequences of their actions in terms of environmental impacts, and appreciate the beauty of the natural world (Smith & Williams, 1999). According to Bowers (1999), having such a consciousness direct individuals to take responsibility for the environment.

The second component, social and moral compassion means showing empathy and respect for human beings and all living things (Lee et al., 2012; Ruiz & Vallejos, 1999). Social and moral compassion component is considered very crucial for 21st century citizens living in a society where technology is changing very quickly. These people need to develop skills to resolve complex societal problems, value and accept the multidimensional perspectives on the problems, show empathy towards others and take responsibility for the resolution of problems (Lee et al., 2013). Therefore, the development of social and moral compassion is necessary for global citizens to live in harmony in a changing and multicultural world.

Finally, the component of socioscientific accountability means accountability and personal responsibility to take sociopolitical action regarding SSIs (Lee et al., 2013). 21st century citizens are expected to possess some skills to resolve complex SSIs and make decisions regarding them. In parallel, one of the main goals of science education has been considered to help students gain the knowledge and necessary skills to take sociopolitical action regarding social, environmental, economic and moral-ethical issues (Hodson, 2003; Choi et al., 2011). According to researchers, 21st century citizens; 1- lead personally fulfilling and responsible lives, 2- compassionate toward other human beings and to take responsibility to defend human rights, 3-know the impact of personal action and how it contributes to personal, societal, and global concerns (Choi et al., 2011; Elmore & Roth, 2005; Hodson, 2003; Roth, 2003; Roth & Lee, 2014). Therefore, developing the sense of socioscientific accountability among individuals is crucial for global citizenship education.

In the present study, the main purpose is to investigate preservice science teachers' (PSTs') sense of character and values for global citizens. Namely, the participants' ecological worldview, social and moral compassion, and socioscientific accountability were examined. Besides, exploring the factor structure of the used instrument, Character and Values as Global Citizens Assessment Questionnaire, was the other purpose of the study. The questionnaire was originally developed by Lee et al. (2013) and was first translated and adopted into Turkish by Karisan and Yilmaz-Tuzun (2017). Then in another study (Yilmaz-Tuzun, Öztürk, & Cakiroglu, 2017) the Turkish version of the questionnaire was revised and the version in the study of Yilmaz-Tuzun et al. (2017) was used in the present study. In Yilmaz-Tuzun et al. (2017), the factor structure of the questionnaire was not revealed; therefore, in this study, validity and reliability analysis of the questionnaire were carried out. Another reason to explore the factor structure of the

questionnaire in Turkish sample is the effect of culture on individuals' value judgments and perspectives regarding SSIs (Ozturk & Yilmaz-Tuzun, 2017). Considering that the original questionnaire was developed and implemented in Korean context, seeking for factor structures in Turkish sample could be of importance. The research questions in the present study are 1- "What factor structure does the data obtained by Character and Values as Global Citizens Assessment Questionnaire reveal?" and 2- "What are PSTs' ecological worldviews, socioscientific accountability, and social and moral compassion values as global citizens?"

Method

Participants and Sampling

In this survey research, convenience sampling was utilized. The target population of the study constituted 320 PSTs enrolled in a public university located in the Central Anatolian region of Turkey. Of these teachers, 201 PSTs were reached as the sample of this study. Thus, the sample of the study involved 63% of the target population. Participation to the study was based on voluntariness. The participants were selected from different grade levels: sophomore (year 2) (35.3 %), junior (year 3) (37.3 %), and senior (year 4) (27.4 %).

Instrument

Character and Values as Global Citizens Assessment Questionnaire, which was originally developed by Lee et al. (2013), was used to collect data. As mentioned before, the questionnaire was first translated and then adopted into Turkish by Karisan and Yilmaz-Tuzun (2017). Then in another study (Yilmaz-Tuzun et al., 2017) the Turkish version of the questionnaire was revised. In this revision process, language check was done by language experts and expert opinion was taken from two professors in the field of science education (Yilmaz-Tuzun et al., 2017). In Yilmaz-Tuzun et al.'s (2017) study, some of the items were changed in the final version based on the suggestions from experts. In the present study, the Turkish version formed in Yilmaz-Tuzun et al.'s (2017) study was used.

Character and Values as Global Citizens Assessment Questionnaire involved 20 items under three components: Ecological worldview, social and moral compassion, and socioscientific accountability. The items are in Likert type ranging from 1-never to 5-always. In the original questionnaire, there are dimensions under each of the conceptual components. Ecological worldview component involves two dimensions: Interconnectedness and Sustainable development; Social and moral compassion component involves three dimensions: Moral and ethical sensitivity, Perspective-taking, and, Empathic concerns; and finally, Socioscientific accountability component was comprised of two dimensions: Feeling of responsibility and Willingness to act (Lee et al., 2013). The details about the original questionnaire (Lee et al., 2013) were given in Table 1. Lee et al. (2013) calculated the alpha reliabilities for each dimension ranging from .42 to .69 ($\alpha = .65$ for Interconnectedness, $\alpha = .50$ for Sustainable development, $\alpha = .42$ for Moral and ethical sensitivity, $\alpha = .63$ for Perspective-taking, $\alpha = .64$ for Empathic concerns, $\alpha = .64$ for Feeling of responsibility, and $\alpha = .69$ for Willingness to act). Validation process of the original questionnaire involved detailed examination of the related literature, iterative internal discussions among the researchers and factor analysis (Lee et al., 2013).

Data Collection and Analysis

Data collection was carried out over one semester (2017-2018 Fall). Participation to the study was on a voluntary basis. Before the administration of the instrument, each participant was informed about the purpose of the study and necessary information and directions regarding the instrument. Administration of the instruments took about 10-15 minutes and was done by the same researcher under similar circumstances to ensure the consistency of data collection procedure.

Data analysis included preliminary analysis, factor analysis, and descriptive statistics. IBM SPSS Statistics 22 and IBM AMOS 21 were used to analyze the data. IBM SPSS Statistics 22 was used to conduct preliminary analysis, descriptive analysis and exploratory factor analysis (EFA), and IBM AMOS 21 was utilized to perform confirmatory factor analysis (CFA) of the instrument. For ensuring the validity of the factor structure, several model fit indices were utilized (e.g. Kline, 2011; Tabachnick & Fidell, 2007). Besides, Chi-square statistics, GFI, RMSEA, and RMR were used to determine the validity of the specified models (Kline, 2011; Tabachnick & Fidell, 2007).

Table 1

Details about the Original Questionnaire

Conceptual component /Dimension	Items involved	Example item
Ecological Worldview		
Interconnectedness	1, 2, 3	If human beings manipulate and change nature (or life) for their benefits, it might cause devastating results.
Sustainable development	4, 5, 6	I believe human beings should follow the laws of nature as they are part of it.
Social and Moral Compassion		
Moral and ethical sensitivity	7, 8	I believe social issues (ex: Stability of GMO food, embryo cloning and dignity of human life) caused by development in life science can raise ethical concerns and conflicts.
Perspective-taking	9, 10	I try to consider the diverse opinions and perspectives involved, when I decide which sides to take on social issues (ex: Stability of GMO food, embryo cloning and dignity of human life) caused by development in life science.
Empathic concerns	11, 12, 13	I feel sorry for those who are suffering (ex: from famine or incurable diseases) without enjoying benefits of life science technology.
Socioscientific accountability		
Feeling of responsibility	14, 15, 16	I feel responsible for causing social issues related to the genetic technology.
Willingness to act	17, 18, 19, 20	I will participate in supporting inter-country cooperation and international convention to resolve social issues related to life science.

Findings*Validity and Reliability Analysis of “Character and Values as Global Citizens Assessment Questionnaire”*

After the administration of Character and Values as Global Citizens Assessment Questionnaire, data were undergone preliminary analysis. The preliminary analysis was done for data cleaning and checking whether the data meet the assumptions for factor analysis. Namely, the assumptions missing data, outliers, normality, linearity, and singularity and multicollinearity were checked. Since there were a very small number of missing data in the data set (<1%), the missing values were replaced by the mean values. In addition, the outliers were excluded from the data set.

Once the data were ready for the analysis, in order to examine the factor structure of Character and Values as Global Citizens Assessment Questionnaire EFA with principle component analysis method with varimax rotation was conducted. For evaluating the items, minimum factor loading for an item was selected as .50. In EFA, the factor number was not restricted. Descriptive analyses were conducted to interpret the emerging factors and their implications. Both of the Kaiser-Meyer-Okin (.62) and the Barlett's (1954) Test of Sphericity ($p = .00$) values confirmed factorability of the data. The output revealed five factors with eigen values greater than one. The five derived factors explained 70.70 % of the sample variation.

Final versions of the factor structure and factor loadings of each item were presented in Table 2. As can be seen in Tale 2, the items were loaded in the factors with high factor loadings (ranged from .87 to .74). The five derived factors, after omitting the items 6, 19, 20, 18, 17, 5, 3, 4, and 14 were: Empathic concerns (Factor 1), feeling of responsibility (Factor 2), perspective-taking (Factor 3), interconnectedness (Factor 4), and moral and ethical sensitivity (Factor 5).

Table 2

Factor Structure of Character and Values as Global Citizens Assessment Questionnaire

Item no	Empathic concerns	Feeling of responsibility	Factor loading Perspective-taking	Interconnectedness	Moral and ethical sensitivity
12	.825	.079	.130	-.032	.090
13	.751	.105	-.101	-.011	.084
11	.748	-.025	.203	.146	-.004
15	.003	.879	.008	.053	.004
16	.145	.845	.098	.036	.104
10	.140	.145	.848	-.086	.039
9	.042	-.034	.837	.165	.171
1	.038	-.009	.073	.832	.088
2	.036	.095	-.007	.799	.117
8	.127	.030	.145	.047	.828
7	.023	.072	.050	.170	.810

After EFA, to confirm and cross-validate the obtained factor structure, confirmatory factor analysis was conducted. The model obtained from CFA analysis was presented in Figure 1. Examination of the model fit indices obtained from CFA indicated that the data showed good model fit for this sample ($\chi^2/df = 1.08$, GFI = .97, AGFI = .94, CFI = .99, RMSEA = .02, RMR = .03) (Baumgartner & Homburg, 1996; Browne & Cudeck, 1993; Kline, 2011; Schermelleh-Enger & Moosbrugger, 2003). The Cronbach's alpha reliabilities for each dimension were calculated as .70, .70, .66, .56, and .60 respectively. According to Pallant (2007), when the number of items in the dimensions is less than 10, mean inter-item correlations may be computed for checking the reliability of the scores. The suggested optimal range for mean inter-item correlations were reported as .15 to .50 (Clark & Watson, 1995). Considering this suggestion, in addition to Cronbach's alpha reliabilities, mean inter item correlations were also computed for each of the dimensions. The mean inter-item reliabilities of the scores in each extracted dimensions were calculated as .43, .53, .50, .40, and .42 respectively. Lee et al. (2013) has found the range of reliabilities in their studies between .42 and .69 and Karisan and Yilmaz-Tuzun (2017) reported the range of mean inter-item reliabilities extracted in Turkish context between .45 to .70.

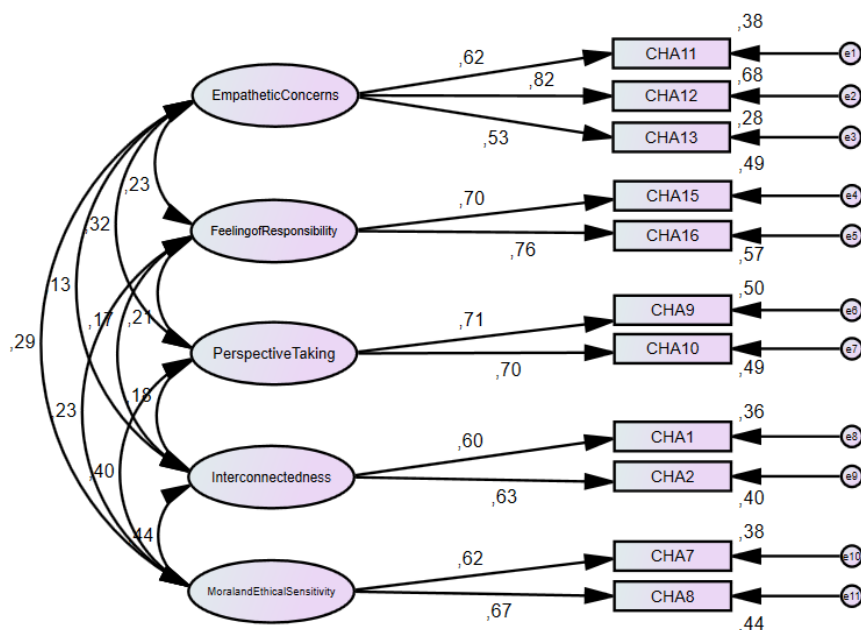


Figure 1. Five factor model derived from CFA analysis.

PSTs' Character and Values as Global Citizens

PSTs' character and values as global citizens were measured through Character and Values as Global Citizens Assessment Questionnaire. In the original questionnaire (Lee et al., 2013) there were seven factors under three components; however, in the present study, five factors under three components were extracted as a result of factor analysis. More specifically, the conceptual components and dimensions obtained in this study were: Ecological worldview (Interconnectedness), social and moral compassion (Moral and ethical sensitivity, Perspective-taking, Empathic concerns), and socioscientific accountability (Feeling of responsibility).

As displayed in Table 3, PSTs scored highest on the empathic concerns dimension and lowest on feeling of responsibility dimension. The mean scores corresponding to each dimension were above the midpoint of 2.50. The descriptive findings revealed that comparing to ecological worldview, and social and moral compassion, the mean scores corresponding to socioscientific accountability dimension was lower. This result indicated that the participants are more likely to feel that they are embedded and connected to nature and at the same time to show empathy and respect for human beings, but all living things are less likely to feel responsible for global SSIs.

Table 3

Descriptive Results Regarding PSTs' Character and Values as Global Citizens

Conceptual component /Dimension	M	SD	Min	Max
Ecological Worldview				
Interconnectedness	3.47	0.81	1.50	5.00
Social and Moral Compassion				
Moral and ethical sensitivity	3.41	0.72	2.00	5.00
Perspective-taking	3.68	0.75	1.00	5.00
Empathic concerns	4.10	0.69	2.00	5.00
Socioscientific accountability				
Feeling of responsibility	3.15	0.91	1.00	5.00

Discussion

The present study aimed to reveal the factor structure of Character and Values as Global Citizens Assessment Questionnaire in Turkish context and PSTs' sense of character and values for global citizens. Different from Karisan and Yilmaz-Tuzun's (2017) study in Turkish context, the data in this study extracted five main dimensions: Interconnectedness, moral and ethical sensitivity, perspective-taking, empathic concerns, and feeling of responsibility under three components of ecological worldview, social and moral compassion, and socioscientific accountability. In Karisan and Yilmaz-Tuzun's (2017) study, the dimensions, sustainable development, empathic concern, moral and ethical sensitivity, and willingness to act emerged. Although some of the extracted dimensions are different from each other, what is similar in both studies is the existence of the three components.

Overall, the higher mean values of the questionnaire dimensions revealed that PSTs have a developed sense of character and values. When examined in detail, despite that the differences are not big among the mean values, PSTs scored highest on empathic concerns dimension and lowest on feeling of responsibility dimension. The dimension empathic concerns aimed to measure whether the participants have an understanding of what others experience and feel. According to the results, the participants in this study show empathy towards others. On the other hand, it can be said that the participants' sense of responsibility is somehow less developed. Feeling of responsibility dimension in this study refers to individuals' feeling of responsibility to take sociopolitical action regarding social, environmental, economic and moral-ethical issues. According to Wilks and Harris (2016), young peoples' ideas about environmental responsibility is a significant factor on the importance they put on environmental issues such as global warming. Therefore, promoting the sense of feeling responsibility among PSTs might be an effective way to encourage them for taking action about the resolution of complex SSIs. Similar to the findings of the present study, Lee et al. (2013), investigating the effects of an SSIs intervention program on high school students' character and value development, also reported that the participants' feeling of responsibility was lower at the beginning of the intervention. Sternang and Lundholm (2011) also revealed that students are tend to avoid taking responsibilities regarding sensitive issues. One way to promote students and PSTs' sense of responsibility can be exposing them to carefully prepared SSIs intervention programs in which they may have the opportunity to engage in resolving complex issues. Supporting this, Lee et al. (2013) revealed in their study that implementation an SSIs unit on genetic modification technology through 3-4 weeks increased the participants' sense of responsibility toward social, environmental, economic and moral-ethical issues. The researchers pointed out the importance of preparing SSI intervention programs in a way to involve everyday issues and to provide individuals to take real actions on certain controversial issues. Thus, incorporating courses related to SSIs in teaching programs in middle and high schools and teacher training programs would be

useful to promote individuals' sense of responsibility toward social, environmental, economic and moral-ethical issues.

The present study has some implications for both research and practice in the field of environmental education and SSIs research. SSIs have shown to be an appropriate context for developing character and values of learners (Lee et al., 2012, 2013). The study also reported validity and reliability analyses of Character and Values as Global Citizens Assessment Questionnaire and the scores obtained by using this questionnaire in Turkish context. These findings are believed to be useful for researchers aiming to assess the sense of character and values for 21st century citizenship in terms of the components; ecological worldview, social and moral compassion, and socioscientific accountability.

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