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Validating an Environmental Education Field Day Observation Tool*

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Abstract
Environmental Field Days are held throughout the country and provide a unique opportunity to involve students in real world science. A study to assess the validity of an observation tool for EFD programs was conducted at the Metro Water Festival with fifth grade students. Items from the observation tool were mapped to students' evaluation questions to determine the degree to which observed characteristics of the field day are aligned with student perception. The data support the conclusion that the observation tool not only captures the perspective of a trained observer on the educational potential of a field day, but also the perceived experience of the field day audience (the students): Despite the fact that the observation tool was designed to capture an expert perspective on effective pedagogy and educational practice (rather than student satisfaction), 20 out of 26 items correlated between the observer's and student's assessment tool.

Keywords: Observation tool, environmental field day, validity study, informal science, empirical research

Introduction

Environmental Field Days (EFD) such as Children's Water Festivals, Conservation Days and Agriculture Days provide a unique opportunity to involve students in real world science to build understanding and skill in science, technology, engineering and mathematics (STEM). Field Day programs involve a variety of agencies and organizations like museums, zoos, nature centers arboretums, departments of natural resources, soil and water conservation districts and cooperative extension services. During a Field Day, students usually visit six to eight stations for about 30 minutes

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each, where they engage in hands-on activities, demonstrations and discussions around STEM or environment-related issues (Poudel, Vincent, Anzalone, Huner, Wollard, Clement, DeRamus, & Blakewood, 2005). The stations are often taught by volunteers, many of whom are scientists working for local, state and federal agencies, or nongovernmental organizations (NGO's). Based on an overarching topic (for instance water quality), these professionals provide six to eight independent experiences at their stations in which students simulate various human impacts (for instance erosion on a water table), active models (for instance students become water droplets zig-zagging through the water cycle), and guided exploration (taking water samples from a local stream). The purpose of designing field days around a set of independent, yet related stations or experiences is to allow students a broad introduction to a topic of real-life significance through problem-based learning. Field days can be considered as highly structured and comprehensive field trip experiences for students and teachers.

Informal educators consider well-structured and executed field trips and field days as starting points for young people to gain first-hand knowledge and experience about science as it relates to the environment (Carlson, 2008; Storksdieck, 2006), and as important contributors to positive attitudes towards science and career aspiration in science (Barney, Mintzes & Yen., 2005; DiEnno & Hilton, 2005; Farmer, Knapp, & Benton, 2007; Knapp, & Benton, 2006). However, there is some concern that the field day practice might not always live up to its potential since EFD experiences are generally facilitated by content experts, who tend to be professionals with little or no background in teaching or education. A variety of researchers have addressed "Best Practices" for informal environmental/stewardship education in extended classroom experiences (NAAEE, 1996; Carlson, 2008; DeWitt and Storksdieck, 2008; Meyer & Pardello (Eds.), 2005, Siemer, 2001; McDonnell, 2001; Fortner, 2001; Stevens and Andrews, 2006). However, *few tools exist to measure the effectiveness* or quality of out-of-school learning experiences in ecologically valid ways. Hence, developing an effective observation tool that captures the "best practices" constructs of informal science education is critical to begin measuring the potential educational quality of EFD programs (Carlson, Heimlich, Storksdieck & Meyer, 2009).

A variety of observation tools or "learning environments inventories" (LEI) have been developed to measure social and psychological aspects of student outcomes in science education through the use of trained observers (e.g., Dorman, 2003; Fraser, 1998; Fraser & Fisher, 1982; Lawrenz, 1987; Talton & Simpson, 1987; Wahyudi & Treagust, 2004). These may include assessments of the extent to which students are supportive of each other, are actively engaged in learning, or the degree to which curricular or lab materials are appropriate. There is no "perfect" inventory for all informal programs. In fact, most appear to be intended for use in formal science

classrooms. For example, Henderson, Fisher and Fraser (1998) documented the use of a validated Environmental Science Learning Environment inventory for in-class purposes. Brown (1996) utilized a Science Laboratory Environment Inventory, again, for the formal classroom. On the other hand, informal settings have been studied by the High Scope Research Foundation (2006) which developed the Youth Program Quality Assessment tool which was developed as a validated instrument to evaluate the quality of youth programs that are not necessarily specific to science programs. Storksdieck, Kaul and Werner (2006) developed a valid, theory-derived field trip teacher feedback form to assess the quality of overall field trip experiences for museums and other types of informal learning environments that, while comprehensive and based on self-assessment of behavior, was lengthy, potentially burdensome to complete, and required teachers to mail back a questionnaire (a considerable impediment to achieving satisfactory response rates).

Carlson and colleagues at the University of Minnesota have developed an observation tool for trained evaluators to assess EFD (Carlson, Heimlich, Storksdieck, & Meyer, 2009). This tool was based on the curriculum, *Best Practices for Field Days: Program Planning Guidelines for Organizers, Presenters, Teachers and Volunteers* (Meyer & Pardello (Eds.), 2005) and a 2008 study by Carlson that noted that EFD took place in over 75% of Minnesota's counties and annually educated more than 10,000 students. The observation tool was designed to capture a variety of field day characteristics that previous research suggested would provide conditions that are conducive for learning, including (among others) the use of proper introductions to the topics being investigated or discussed, effective techniques for engaging students, student engagment itself, aspects of the social and physical environment, etc. Altogether, six overarching constructs known to positively influence the learning potential of field days were included in the observation tool (see Appendix A). Since the purpose of the tool was to provide feedback on the educational quality of the field day for individual instructors and field day organizors, trained observers would capture the student experiences at each individual leaning station as well as for the field day as a whole. The content validity of the tool was established by linking constructs with each item to "best practice" theory (Carlson, 2008), and then validating them through a modified-Delphi study with a range of experts (Heimlich, Carlson, Tanner & Storksdieck accepted). Coder reliability of the tool was established through rigorous rounds of testing and revisions to reach an acceptable modified Kappa for each item (Storksdieck, Heimlich, Figueriredo & Carlson., 2009). Following the psychometrics for observation research (Hintze, 2005), this validation study was conducted where observation data were compared to student's perceptions.

Method

The validation study was conducted at the Metro Water Festival (CWF) in St Paul Minnesota in the fall of 2008 where 44 schools and over 1,200 fifth grade students participated in a one-day Field Day event. The purpose of the study was to determine whether and in what ways the results obtained from multiple observers on the pedagogical quality of the field day experience, strictly an observation tool, aligns with the perceived experience of students who took part in the observed field day. The study did not aim to show that these two different perspectives necessarily overlap; in fact, one would expect for a variety of theoretical reasons that there could be significant differences between the observation and the student perception. However, in crafting student feedback items that were closely aligned with the observation tool, the study aimed at testing (a) whether the observation tool at least partially captured the audience experience, and (b) develop hypotheses about the connection between observed "best education practice" and student experiences. The results we are presenting represent a form of ecological validity: how does the perspective of experts correspond to the experience of learners. Content validity (Modified Delphi) and coder reliability of the observation tool was established the previous years. Items from the observation tool were mapped to students' evaluation questions to determine the degree to which observed characteristics of the field day are aligned with student perception. It is conceivable that they don't align. Students' assessment of their experience is based on factors that have little to do with what educators care about. Significant correlations support the validity from the perspective of the students experience; lack thereof, on the other hand, does not indicate that the tool isn't valid, at least for capturing the quality of field days based on educational theory and education expert perspectives.

The schools that attended CWF were selected from a large pool of interested schools and all agreed to provide program evaluations. There was no cost to students or schools to attend the event and lunch was also included along with bussing for some of the schools. The Children's Water Festival had 31 different learning stations going on throughout the day; students visited 5 to 7 of the learning stations during the day. Student stayed at each station about 30 minutes and then moved on to the next station. The stations that each student would visit were assigned by CWF crews. Students were greeted at their bus when it arrived and guided through the day by volunteers to each of the learning stations, lunch and back on the bus at the end of the day. Learning stations were taught by volunteers and professionals from state and federal agencies along with non-profit organizations.

Of the 44 classrooms, a sample of 16 classrooms, (representing 36%) from 5 schools were selected to be followed each by a trained observer who would be using the observation tool to documnt the experience of the particular class being tracked. Trained observers rated the quality of

instruction at each of the learning stations. They scored station presenters on 26 items and students on four items of engagement. The same observers followed the same class throughout the day. Consent forms for participation in the observation study and for the student study were mailed to principals and teachers and sent home to parents to respond with an "opt out" response request. In addition, all classrooms were given copies of a post field day evaluation survey to be completed by students and were asked to return them by the end of the week. Return rate for the 44 classrooms was 90 %. The 16 classrooms in the study had a return rate of 100%. Data from the post field day survey were used in three ways: (1) to provide feedback to the field day organizers; (2) to compare the research sample to the total field day student population for that field day (estimating bias), and (3) to correlate the sample population's feedback data with those obtained through expert observers using the observation tool (the purpose of collecting the student data). The student feedback questionnaire and the observation tool had very different purposes and measured very different things. The observers' questionnaire measured the quality of the educator/student interaction or teaching-learning exchange (for the entire class) at each of 5-7 learning stations while the feedback questionnaire allowed students to evaluated their own experience once, at the end of the day, and for the overall field day rather than individual field day stations.

One would not expect a great deal of overlap among these two aproaches, despite the best attempt to develop items for the student questionnaire that aligned with the observation tool. Nevertheless, one or more items on both of these instruments addressed the six major constructs of the observation tool *opening the field day experience, expressing age appropriate language* and *instruction*, *using a variety of questioning strategies,creating or using a physical environment that did not distract from learning*, *student's engagement*, and *student's satisfaction* (See sample in Table 1.). A positive relationship between the observation and the student feedback would help establish the utility and validity of these six constructs and thereby the observation tool overall for field day organizers, field day educators, teachers, parents and students. In addition, positive correlations between the two assessment methods would strengthen the case that good educational practice in out-of-school experiences are perceived positively by the audience.

The following table show 3 the basic categories (constructs) and criteria of measurement as it is applied to the observation tool and student survey. Appendix A shows all six major constructs and the questions used to measure each construct.

Table 1.:
The framework of observer individual assessment tool and student survey

Basic Categories	Criteria of Measurement	Observer Individual Assessment Tool	Student Survey
Management (Physical Environment 1)	The instructor conveys appropriate voice volume and adjust his or her position to be seen by students when he/she delivers the program	2l. Was seen and heard by all participants nearly all the time	**2h. I could hear and see the presenters at the stations**
Engagement (Student's Engagement)	The instructor and the program attract student's attention all the time	2g. Kept nearly all participants focused on activities most of the time 4a. Listened attentively when expected 4b. Participated fully when expected	**2m. I learned something new at the stations** **2o. I paid attention at the station** **2q. Kids in my class listened when they were supposed to** **2s. Kids in my class really got into the activities at the stations**
Satisfaction(Student's Satisfaction)	Student enjoy the instructor and the learning program during their field trip experience	4c. Showed excitement and enthusiasm	**2g. I enjoyed the presenters** **2t. Kids in my class had fun at the stations** **2p. I found the stations interesting** **3d. I enjoyed being at the Water Festival** **3f. The presenters at the Water Festival were nice to me**

Concurrent validity was tested using the correlation between the observation and student survey items.

Results

A pedagogical framework was created that matched items on the observer assessment tool with student survey questions on the six constructs (see above).. The frameworks six constructs were measured with a total of 12 items from observer's assessment tool and 14 items from the student's feedback survey. For the purpose of analysis, we classified the 26 items into one of the six basic categories (constructs), and each of the six constructs was measured with at least one or mostly several items. Because of the purpose of the items in the category of *expressing age-appropriate language*, we divided this category into two sub-categories, *expressing 1* and *expressing 2*. The questions in "*expressing 1*" examined if the presenter used appropriate language when he or she conveyed his or her message.

The questions in "*expressing 2*" focused on the clarity of instructions during program delivery (see Appendix A or table above.).

A t-test was conducted between the sample group (n=16 classes) and the total population (n=44 classes) to determine sample bias, and none of the classes observed were significantly different from the classes not observed on any of seven student variables used to characterize the field day participants. In addition, reliability (Cronbach's Alpha) was computed if there were more than two items in each basic category of observer's assessment tool and/or student's survey. On the observer's assessment tool, this included only the student's engagement items (α=.81). For the student instrument, the engagement items had an α of .56, and the satisfaction items had an α of .79. In all cases, all items contributed positively to the reliability – that is, when subjected to orthogonal rotation, the reliability α was always higher for the sum than had any item been deleted.

There were some serious limitations with using our data in this fashion. First, the observers and the student were not measuring strictly the same thing. Thus one would not expect a large agreement between students and observers. Observers were measuring the teaching efficacy of each learning station while students were measuring their total experience over the course of the day. In our research design, observers evaluated each learning station that the students from their class experienced. Depending on how many learning stations a class visited, one observer might complete five to seven individual learning station assessment tools. The observers' data were specific to each station visited, while the students' assessment tool was designed to evaluate overall field day experience. Each student completed only one student assessment at the end of the field day. The observers' data needed to be converted into overall means across all students and across the various leaning stations they visited before it could be correlated with the student data. In addition, there might be a recency effect at least on some items or constructs, in that students might focus on their latest experiences rather than equally on all of the experiences as is assumed when correlating the average observer scores with the student scores.

Second, the individual observers' field day assessment tool was designed in a three points scale (i.e. not done, partly done, and done), but students' Metro Children's Water Festival assessment tool was designed using a five points scale (i.e. strongly disagree, disagree, not sure, agree and strongly agree). In the process of analysis, a ceiling effect was found to influence the observers' data, but not student data. The 3 point scales used by the observers did not show sufficient variation, thus resulting in a ceiling effect with the observation data at each learning stations. This effect was mitigated some when averaging the observation scores across 5 observations.

Third, this study had only sixteen observers, which greatly reduced the power of the analyses.

Analysis

Observers' tool: The means were computed for each construct of all the stations that each observer visited, thus evaluating the average pedagogical experience for the class observed. If a construct had more than one item, the items were combined to obtain the means of the construct. The aggregated observers' overall station data were converted into means (summed station scores/# stations/# observers).

Student tool: The item mean from each construct of the student tool was computed. These item means and the overall station data from 16 observers using the individual station assessment tool (5-7 observations) were averaged for the class.

Finally, the observers' class scores were correlated (Table 2.) with the students' class scores. A second theoretical threat, the recency effect, was controlled. As students might have the most vivid memories from the last two stations, these stations' data were aggregated from each observer and compared to the student data overall.

Correlation: Assessment items from observer's assessment tool and student's survey

Pearson's correlation was used to compare the relationships among the items from the two assessment tools (individual observers' field day assessment tool and students' Metro Children's Water Festival survey).

Table 2.
Correlations among items

	All Day Learning Station Observation	Last Two Learning Station Observed
Opening	.118	.331**
Expressing1	-.115	.156
Expressing 2	.191	.364**
Questioning	-.097	-.011
Physical Environment	.562*	.134
Student's Engagement	.627*	.170
Student's Satisfaction	.422	.507*

N=16
* $p \leq .05$
** $p \leq 0.10$

The result showed some interesting phenomena. Even with a small N the assessment items in the basic categories of *physical environment* (r = .562, $p \leq .05$), and *student's engagement* (r = .627, $p \leq .05$) in the all day learning station observation were significantly correlated. Also, if considered that we had a very small sample size (n = 16), the student's satisfaction items from two assessment were also correlated (r = .422, $p <$ .10), with significance at the .1 level, which is acceptable for small population studies. On the other hand, in the last two learning station observations, the results showed that student's satisfaction items from the two assessment tools were correlated (r = .507, $p \leq .05$). Again, if we considered that we had a very small sample size (n = 16), the *opening* (r = .331) and *expressing 2* (r = .364) assessment items from observer's assessment tool and student's survey were also correlated.

Results show that 5 of the 7 measure correlated when using $p \leq .10$. Inaddition, a total of 20 out of 26 items that made up the 7 measures were correlated with strength between the observers' and students' feedback instrument. The two measures in pedagogy that did not correlate, Expressing 1 and Questioning, focued on students understanding the presenters questions and asking questions back to the presenter (Apppendix A.). Because of the limitations dicussed earlier of this instrumentation study, it is reasonable to say that the observation tool is validated when correlated with the student self report.

Discussion and Conclusion

People who organize and conduct field days are rarely researchers or evaluators. Indeed, they are often agency personnel with minimal social science or education background. Being able to measure a program against best practices provides field day organizers with an important opportunity to improve practice and to be accountable to participants. Further, the complexity of a field day itself, with multiple sessions, presenters, and sometimes routes for groups to take within a nature or park-like environment increases the value of having a tested instrument that can provide solid evaluative data across sessions, presenters, and the day.

Developing an observation tool for measuring program elements of a field day based on norm-referenced criteria ("best practices") creates a complex set of challenges. Best practices must be deconstructed and then critically considered in terms of what elements are observable and evaluative. These observations, however, must somehow be related to outcomes of those for whom the field day is offered, in this case, fifth grade students, or else the findings of the observational evaluation may be inherently flawed. In short, educational practices based on "best practices" need to be tied to the audience. To address this concern, the tested observation tool was used by trained observers and compared with, among other self-report measures, *student satisfaction*, considered a low-level

outcome measure that yet captures some of psychological conditions known to support science learing (National Research Council, 2007; 2009).

One finding in this study shed light on the researchers' concern about recency effects that may bias an observation tool towards an artifical objectivity across the entire field day experience. Observers note somewhat objectively over the course of the day the nature of the teaching-learning exchange and the environmental and social conditions under which this exchange occurs; yet, one might reasonably argue that students may put a stronger weight on experiences they have during the end of the field day, i.e., their overall assessment of the day might be biased by the last field day stations they visited. The concern of thepotential recency effect was that it might create a systematic bias in the observation tool or, conversely, in student feedback surveys, which would limit the usefulness of the observation to gauge student impact.

We found only a mild recency effect on two variables (*Opening* and *Expressing 2*), where the all-day observation data did not correlate with student self-report, while the observation data that were averaged across only the last two visited field day station visits showed a weak correlation. More importantly, the results support an interpretation that states just the opposite: the observation tool may more faithfully reflect student self-report when observation data are averaged across the entire day than when they are averaged only across the last two visted field day stations: *Student Engagement* correlated significantly and relatively strongly with all-day observation data (r = .627) while it did not correlate significantly with observation data averaged across the last two visited stations. Similar with the *Physical Environment*: The correlation between all-day observation data and student feedback data was relatively strong and signicant (r=0.56) while those between the observation of the last two visited field day stations and student feedback was not (r = .13). The results for *Student Satisfaction* seem to suggest the opposite, but the correlation coefficients are very close (r = .42 vs r = .51), and if anything, suggest that there is no significant recency effect even in a measure that might reasonably be seen as most sensitive to recency. Overall, these findings suggest that the observers were able across the day to measure the *environment, engagement* and even *satisfaction* in ways that are congruent with student experiences. Moreover, the results indicate that student self-report could be baised toward the novelty in the earlier part of the day, and fatigue toward the end of the day for at least some measures of the field day experience.

The results from this study suggest there is a positive correlation between the two tools for five of our seven measures and that this study validates the observation tool for those measures in terms of concurrent validity and in terms of being able to transfer claims from observation to student engagement. While not designed to do so, the results show that the observation tool can capture some of the felt experience of students. Further, these findings would support the belief that these are, indeed, best

practices that come from and are supported by the informal learning literature (Carlson, 2008, Heimlich, Carlson, Tanner & Storksdieck accepted).

With these findings, it is possible for field day coordinators to use the observational tool in combination with observer training as a valid resource for examining field days against observable best practices. Additionally, if these elements are satisfied, there is a positive relationship to student engagement and satisfaction with the overall field day experience (Wang & Carlson, 2011).

Recommendation for Further Studies

Although the observation tool was validated, data from this and other studies led the researchers to recommend that the observation tool be revised to a 5 point scale with different anchors to prevent ceiling effect and to better reflect the variance found in each construct. In addition, for more rigorous testing of the observation tool students should be tested after each learning station along with an overall evaluation of the day, using items that are closely aligned with the observed elements of the experience and with a cognitive outcome measure. This would allow us to directly compare apples to apples and would create an analysis with less noise in the data. Last but not least, it is recommended that the number of observations (observers and across stations) be increased to strengthen the power of the analyses in comparison studies. For the purpose of documenting field days with the observation tool, however, a limited number of observers may suffice.

Biographical statements

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APPENDIX A

The framework of observer individual assessment tool and student survey (match up)

Basic Categories	Criteria of Measurement	Observer Individual Assessment Tool	Student Survey
Pedagogy (Opening)	The instructor sets up stage to attract students' attention to the learning program	2b. Introduced self-clearly	**2b. Presenters told us who they were**
Pedagogy (Expressing 1)	The instructor conveys age appropriate language when he/she delivers the program.	2h. Used appropriate language (clearly defining new terms when necessary) 2i. Presented content information appropriate for participants' knowledge and ability	**2c. Presenters asked us questions that I could understand even though I didn't know the answer**
Pedagogy (Expressing 2)	The instructor gives clear instruction when he/she delivers the program.	2j. Provided clear instructions 2c. Stated upcoming activities clearly	**2a. At the learning station, I knew what would happen**
Pedagogy (Questioning)	The instructor applies variety of questioning skills when he/she delivers the program	2m. Used questions that allowed participants to voice what they already knew or just learn (i.e. recall questions) 2n. Used questions that challenged participants to apply knowledge to new situations and/or made them think critically about an issue	**2d. I had a chance to ask my questions**
Management (Physical Environment 1)	The instructor conveys appropriate voice volume and adjust his or her position to be seen by students when he/she delivers the program	2l. Was seen and heard by all participants nearly all the time	**2h. I could hear and see the presenters at the stations**
Engagement (Student's Engagement)	The instructor and the program attract student's attention all the time	2g. Kept nearly all participants focused on activities most of the time 4a. Listened attentively when expected 4b. Participated fully when expected	**2m. I learned something new at the stations** **2o. I paid attention at the station** **2q. Kids in my class listened when they were supposed to** **2s. Kids in my class really got into the activities at the stations**
Satisfaction(Student's Satisfaction)	Student enjoy the instructor and the learning program during their field trip experience	4c. Showed excitement and enthusiasm	**2g. I enjoyed the presenters** **2t. Kids in my class had fun at the stations** **2p. I found the stations interesting** **3d. I enjoyed being at the Water Festival** **3f. The presenters at the Water Festival were nice to me**

Çevre Eğitimi Tatbikat Günü Gözlem Aracı Geçerlik Çalışması*

Stephan P. Carlson**

Joe E. Heimlich

Martin Storksdieck

Özet

Çevre Tatbikat Günü ülke genelinde düzenlenen ve öğrencileri gerçek dünyada bilime dahil etmek için eşsiz bir fırsat sağlamaktadır. Bu çalışma EFD programları için geliştirilen bir gözlem aracının geçerliliğini değerlendirmek için Metro Water Festivali'ne katılan beşinci sınıf öğrencileri ile yapıldı. Gözlem aracındaki maddeler günün anlamı ile öğrenci algısının uyumluluk derecesini belirlemek için öğrencilerin değerlendirme soruları ile eşleştirilmiştir. Elde edilen verilere göre gözlem aracı hem tatbikat gününün eğitim potansiyeli üzerinden eğitimli gözlemcinin bakış açısını yakalar hem de tatbikat günü izleyicisinin (öğrenciler) deneyimini algılar. Gözlem aracı etkin pedegoji ve eğitim uygulamalarında uzman bir bakış açısı yakalamak için tasarlanmış olmasına rağmen v26 maddenin 20'sinde gözlemci ve öğrenci arasında korelasyon bulunmuştur.

Anahtar Kelimeler: Gözlem aracı, çevresel tatbikat günü, geçerlik çalışması, informal bilim, deneysel araştırma

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The Relationship between Environmental Moral Reasoning and Environmental Attitudes of Pre-Service Science Teachers*

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Ozgul YILMAZ-TUZUN

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Abstract
The aim of the present study was to investigate the relationship between environmental moral reasoning patterns and environmental attitudes of 120 pre-service science teachers. Content analysis was carried out on participants' written statements regarding their concerns about the presented environmental problems and the statements were labeled as ecocentric, anthropocentric, and non-environmental according to their meanings. Then, descriptive and inferential analyses were conducted on the calculated frequencies of each moral consideration category and participants' responses to Environmental Attitudes Scale. The results revealed a significant positive correlation between ecocentric moral reasoning and environmental attitudes, whereas there was not a statistically significant relationship between neither of anthropocentric nor non-environmental moral reasoning and environmental attitudes. Findings of the study support the argument that an environmental ethic, which extends moral consideration beyond human beings to the nature as a whole, is necessary to overcome many of the environmental problems.

Keywords: environmental attitudes, environmental moral reasoning, teacher education.

Introduction

Environmental Moral Reasoning and Environmental Attitudes

Today's world in which we live is confronted by increasing number of environmental problems such as deforestation, desertification, loss of

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biodiversity, pollution, and global warming (O'Neill, Holland, & Light, 2008). Moreover, it has long been known that most of the environmental problems are mainly caused by human activities (United Nation the World Commission on Environment and Development [WCED], 1987). Therefore, it can be concluded that in order to find solutions to the environmental problems, one of the prerequisites is creating changes in behaviors of people (Yeung, 2002).

In this respect, many research studying the factors that have influences on people's environmental behaviors have been conducted in all over the world. When these research findings are examined, it is seen that among the factors related to environmental behaviors, ethics and values are frequently highlighted. For instance, in her study, Tilbury (1995) stated that decisions of people to participate in environmental improvement depend mostly on personal motivation resulting from the development of a personal environmental ethic. Similarly, Sosa (1996) stressed the importance of creating changes in beliefs and values of people to guide their behaviors and overcome environmental problems. Moreover, different people may have different motives, or reasons, for valuing nature (Bjerke & Kalternborn, 1999). Accordingly, it is possible to find quite a large number of researches examining human-environment relation and trying to find the underlying factors resulting in differences in people's reasoning regarding their perceptions of this relationship. Kahn and his colleagues (Kahn, 1999; Kahn & Lourenco, 2002) are among the most known researchers who conducted research in this field. The researchers mainly examined how children comprehended and evaluated their relationships with nature by using moral dilemmas on different environmental topics such as impact of throwing garbage into a local river and value of animal life vis-à-vis human life.

Correspondingly, moral reasoning, which is defined as a thinking process with the objective of determining whether an idea is right or wrong (Littledyke, 2004), constituted one of the focus of the present study. More specifically, environmental moral reasoning, which can be defined as the process of determining whether an idea/action is right or wrong for environmental improvement and protection, was investigated throughout the study. In the study, three categories were used for moral reasoning patterns of participant pre-service science teachers for their concerns about the presented environmental problems (i.e. deforestation of Amazon rain forests, electronic waste (e-waste) in China, Exxon Valdez oil spill, melting of glaciers): ecocentric, anthropocentric, and non-environmental. In ecocentric moral reasoning, idea of establishing equivalences between human and non-human life forms and valuing biological life and natural processes is the main concern. Valuing nature for its own sake (Thompson & Barton, 1994; Gardner & Stern, 1996; Karpiak & Baril, 2008), and equivalence and justice in the relationship between humans and the nature (Kahn, 1997), and concern for nonhuman objects (e.g., animals, ecosystems,

biosphere) (Stern & Dietz, 1994) are frequently emphasized by people who exhibit ecocentric moral reasoning. On the other hand, anthropocentric moral reasoning is the belief that nature is important because it is central to human wellbeing and utility to humans (Karpiak & Baril, 2008). Moreover, Thompson and Barton (1994) defined anthropocentric moral reasoning as valuing nature due to its material and physical benefits it can provide for humans. Furthermore, it was defined as the idea that people should care about environmental quality because a degraded environment poses a threat to people's health (Franson & Gärling, 1999). Finally, non-environmental moral reasoning is labeled for people who concentrate on non-environmental aspects of environmental problems such as laws rather than effects of the environmentally damaging actions on humans or on environment itself (Kortenkamp & Moore, 2001).

In addition to moral reasoning, environmental attitude, which is defined as sets of values and feelings of concern for the environment (UNESCO/UNEP, 1978) and accepted to be a powerful predictor of environmental behavior (Kaiser, Wölfing, & Fuhrer, 1999), was the other focus construct of the study. In addition to the important role of values in definitions of both of the constructs, the intimate relationship between environmental moral reasoning and environmental attitudes is also implied by some of the previous research that focused on the underlying moral reasoning of environmental attitudes and ecological belief structures of people (Evans, Brauchle, Haq, Stecker, Wong, & Shapiro, 2007). Furthermore, both of the environmental attitude and environmental moral reasoning constructs were shown to have similar characteristics in that both environmental attitudes (e.g., Schultz, 2000) and environmental moral reasoning (e.g., Berenguer, 2008) were shown to have connections with empathy, which refers to an emotional response congruent with the perceived welfare of another (Berenguer, 2008).

Aside from the importance of the constructs being studied and their relationships, the present study is believed to have additional importance owing to its sample, pre-service science teachers. Madsen (1996) stated that universities have the power and the responsibility to promote environmental awareness and responsible environmental behavior in the society since they are proper places to instill certain values in their learners. Education faculties also have an additional importance in environmental education because teachers of future, who will have active roles in environmental education and be role models for their own students in the future, are educated in these faculties. Thus, if effective environmental education is provided to pre-service teachers, the ultimate goal of environmental education, which is educating environmentally responsible citizens, can be achieved (Culen, 2001).

In sum, as demonstrated by previous research, environmental moral reasoning and environmental attitude constructs are the two important

determinants of environmental behavior and these two constructs have common points. Accordingly, the researchers of the present study sought answers for the research questions of: (1) What are environmental moral reasoning patterns of pre-service science teachers regarding the presented environmental problems? (2) Is there a relationship between environmental moral reasoning patterns and environmental attitudes of pre-service science teachers? Studying the relationship between environmental moral reasoning patterns and environmental attitudes is believed to be important because understanding this relationship will be helpful to clarify the process of environmental moral reasoning, which in turn may contribute to the development of pro-environmental behaviors in the society. In addition, this study will also have important implications for the possible effect of culture on environmental moral reasoning since there is not enough research related to this subject, especially in nonwestern countries.

Method

Sample

The sample of the study constituted 120 pre-service science teachers who were enrolled in freshmen, sophomore, junior, and senior classes of elementary science education department of one of the largest universities of the country where the study took place. According to the data collected on their date of birth information the mean age of the sample was calculated to be 22 years with a standard deviation of 1.46. The participants were volunteers and no extra credit was given for their participation.

Instruments

In the study, the researchers of the study prepared four cases about four environmental problems (i.e. deforestation of Amazon rain forests, e-waste in China, Exxon Valdez oil spill, melting of glaciers) for collecting data about participants' environmental moral reasoning. The reason for researchers' preference for using real environmental cases rather than hypothetical environmental dilemmas was to eliminate the limitation of the possible difference between people's reasoning toward real-life and hypothetical issues (Kortenkamp & Moore, 2001). In addition, the selection of the four environmental problems was mainly based on the familiarity of the environmental cases to the participants. In order to attract respondents' attention and thus make them respond to the cases in a more enthusiastic way, environmental problems which took place frequently in newspapers, web-pages of non-governmental organizations such as Greenpeace, TEMA, and Doğa Derneği were selected and included in the study. All of the cases except from Exxon Valdez oil spill case (it was taken from Kahn's (1997) study and used with some adaptations) were prepared

by the researchers of the present study in a very iterative process including the detailed review of research conducted to include similar environmental, social, and economical aspects in all of the environmental cases.

Although it is known that providing all the relevant information to the decision maker is impossible (Gore, 1992), while developing the content of the environmental problems, all aspects (e.g., environmental, social, economical) of the problems were tried to be included. After the cases were prepared by the researchers and an agreement was established between them, the final structures of the cases were presented to an expert committee in order to assure the validity. Experts were asked to evaluate the prepared texts in terms of appropriateness of the language and sufficiency of the given information about each environmental problem. Moreover, they were asked whether effects of the environmental problems on people and on environment itself were given equal weight while explaining the problems. According to the taken feedbacks, necessary adaptations were made and the cases were distributed to the participants.

As a second data collection instrument, Environmental Attitudes Scale (EAS) developed by Ebenbach, Moore, and Parsil (1998) was used to measure participants' environmental attitudes. The scale was previously found to have an EAS-Internal Cronbach's alpha value of 0.90 and EAS-External alpha value of 0.85. Moreover, appropriate correlation with other environmental attitudes scales (Dunlap & Van Liere, 1978) and measures of pro-environmental behavior (Maloney & Ward, 1973) was stated to provide evidence for the validity of the scale (Ebenbach, 1999; Ebenbach, Moore & Parsil, 1998).

Data Collection and Analysis

For data collection, four cases about the four environmental problems and Environmental Attitudes Scale (EAS) were distributed to the participants in 2008-2009 Fall semester of the university, where the study was conducted. Environmental Attitudes Scale (EAS) was a 9 point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (9) (On the scale range there was also a title for "neither agree nor disagree" (5)). On the other hand, regarding the distributed environmental cases, the participants were asked to list and explain their considerations that concerned them most about each case in written forms. It took about 40-45 minutes for participants to response to the environmental cases and Environmental Attitudes Scale (EAS).

After data collection, content analysis was carried out on the written statements of the participants and each statement was coded as ecocentric, anthropocentric or non-environmental. Participants' statements, which emphasized the intrinsic value of nature, value aside from its usefulness to humans, were coded as ecocentric; statements that focused on the utility of

the environment for the well-being of people were coded as anthropocentric; statements that concentrated on non-environmental aspects of the given environmental problems such as laws rather than effects of the environmental problems on humans or on environment itself were coded as non-environmental moral reasoning. To test the reliability, data gathered from 40 of the participants (10 participants from each of the four grade level) were coded by two the authors, and percent agreement was found to be 95 %.

Based on the content analyses, frequencies of each statement reflecting ecocentric, anthropocentric, non-environmental moral reasoning were counted for each respondent and entered to Statistical Package for Social Sciences (SPSS) version 15.0 for Windows. Then, mean values of the respondents' statements regarding each of the environmental moral reasoning category were calculated. Further analyses that included data regarding environmental moral reasoning were carried out on these calculated mean values in addition to the participants' responses to Environmental Attitudes Scale (EAS).

Results

Before investigating the correlation between the three environmental moral reasoning patterns (i.e. ecocentric, anthropocentric, non-environmental) and environmental attitudes of the pre-service science teachers, descriptive analyses were carried out in order to investigate their moral reasoning patterns and environmental attitudes in general. Analyses of the responses revealed that participants mostly exhibited ecocentric moral reasoning toward the given environmental problems than anthropocentric and non-environmental moral reasoning respectively.

Moreover, the sequence of moral consideration categories from the most frequent to the least frequent was the same for all of the environmental cases, except from the "Exxon Valdez Oil Spill" case. For " Deforestation of Amazon", "E-waste in China", and " Melting of Glaciers" cases the most frequent moral reasoning pattern was ecocentric moral reasoning, and the least frequent moral reasoning pattern was non-environmental moral reasoning, showing that participants of the study mostly concentrated on the effects of environmental problems on environment. However, for the "Exxon Valdez Oil Spill" case, participants concerns about the effects of the environmental problem on humans (mean value = 1.77) were higher than their concerns about the effects of the problem on environment itself (mean value = 1.73). Nevertheless, it should also be noted that the two mean values are very near to each other. Mean values for ecocentric, anthropocentric, non- environmental, and total moral considerations for each of the distributed environmental cases as well as average values corresponding to them are tabulated in Table 1.

Table1.
Mean Number of Moral Considerations

	Deforestation of Amazon	E-waste in China	Exxon Valdez	Melting of Glaciers	Average
Ecocentric	1.92	2.10	1.73	2.25	2.00
Anthropocentric	1.38	1.33	1.77	1.43	1.48
Non-environmental	0.32	0.21	0.17	0.03	0.18
Total	3.58	3.56	3.65	3.68	3.62

In addition, as have been stated previously, researchers examined the relationship between moral reasoning patterns and environmental attitudes of the participant pre-service science teachers by investigating the corresponding Pearson Correlation values. Analyses resulted in a statistically significant positive correlation between ecocentric moral reasoning and positive environmental attitudes, which means that participants who have more ecocentric concerns and thus value nature without considering its usefulness to humans had higher positive environmental attitudes.

On the other hand, according to the analyses there was not such a statistically significant relationship between neither of anthropocentric moral reasoning nor non-environmental moral reasoning and environmental attitudes of the pre-service science teachers. Pearson Correlation (r) values for the relationships between environmental attitudes (EAS), ecocentric moral reasoning (M.R.eco), anthropocentric moral reasoning (M.R.anthro), non-environmental moral reasoning (M.R.NE), and total environmental concerns (M.R.total) are given in Table 2.

Table2.
Correlations between Moral Reasoning Patterns and Environmental Attitudes

	EAS	M.R.eco	M.R.anthro	M.R.NE	M.R.total
EAS	1.000	.266(**)	.053	-.040	.213(*)
M.R.eco	.266(**)	1.000	-.035	-.122	.742(**)
M.R.anthro	.053	-.035	1.000	-.127	.565(**)
M.R.NE	-.040	-.122	-.127	1.00	.061
M.R.total	.213(*)	.742(**)	.565(**)	.061	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Discussion and Conclusions

Findings of the study reveal that pre-service science teachers who participated in the present study mostly believe that nature merits moral consideration owing to its intrinsic value, which is its value aside from its usefulness to humans. Then, they concentrate on the effects of environmental problems on humans and think that environmental quality is important because a degraded environment possesses a threat to the well-being of people. Finally, it is seen that they pay minimum attention to the non-environmental aspects of these issues such as being illegal. When the related literature is reviewed, it is seen that these findings are contrary to the findings of some other studies. For instance, in their study, Kortenkamp and Moore (2001) found that their participants exhibited mostly non-environmental moral reasoning toward the presented environmental dilemmas. Moreover, their participants, who were also college students as in the present study, had more anthropocentric concerns than ecocentric concerns. Although there may be various reasons for the differences found in these moral reasoning patterns, they may also be an indication of the effect of culture on environmental moral reasoning patterns because the study of Kortenkamp and Moore (2001) was conducted in a western country whereas the participants of the present study belong to a non-western culture. On the other hand, the low frequency of the stated non-environmental concerns in the present study may be due to participants' unawareness about the presence of the environmental laws or the deficiencies in the implementation of these laws in the country.

Moreover, in the study a statistically significant positive correlation between ecocentric moral reasoning and positive environmental attitudes of the participants was found whereas there was not such a significant relationship between positive environmental attitudes and anthropocentric or non-environmental moral reasoning. Therefore, it can be stated that participants of the study who gave more attention to the effects of environmental problems on environment itself had higher positive attitudes toward environment than the ones who concentrated more on environmental problems' effects on humans or problems' other aspects such as being illegal. In fact, this finding has important implications such as the necessity of improvement in the coverage of environmental issues in mass media and environmental education. Accordingly, it can be concluded that promoting ecocentric concerns in people results in higher positive attitudes toward environment. Similarly, in the literature, research show that information enhancement about the effects of environmental issues on environment, results in more ecocentric moral reasoning (Kortenkamp & Moore, 2001), and increased knowledge about environment establishes higher pro-environmental attitudes in the society (Ramsey & Rickson, 1976). Therefore, if we emphasize impacts of environmental problems on nature itself and educate students who value nature due to its intrinsic

value, not for its usefulness for humans or the damages people have to face due to degradation of environment, we can develop higher positive environmental attitudes and environmentally friendly behaviors in the society.

This approach may have additional importance for the environmental education programs implemented in universities, which are accepted as places that have fundamental responsibility to promote environmental awareness and responsible environmental behavior in the society (Madsen, 1996). Furthermore, as have been stated previously, more emphasis should be given in the implementation of environmental education programs and necessary revisions should be made accordingly in education faculties because teacher candidates who graduate from these faculties will have active roles in the education of their own students when they begin their profession.

To conclude, the present study contributes to the literature with its findings including the effect of culture on environmental moral reasoning patterns owing to the found differences from some other research carried out in different countries such as the study of Kortenkamp and Moore (2001). Furthermore, it supports the argument that a new environmental ethic, which extends moral consideration beyond human beings to non-human world, is needed (O'Neill, Holland, & Light, 2008) and should be utilized in environmental education, including education for pre-service teachers owing to the importance of teacher education for an overall success in environmental education. On the other hand, some important points should also be discussed while interpreting the findings of the study as well as their implications. First of all, the respondents who participated in the study were limited to 120 pre-service science teachers enrolled in one of the universities of Turkey. In addition, the obtained environmental moral reasoning patterns are valid within the framework of the environmental cases used in the study and it is possible to find different patterns in the use of different environmental cases. Therefore, further research with broader and more diverse samples is required in order to explain environmental attitude and environmental moral reasoning constructs as well as the nature of their relationships in a more sound way and make generalizations properly.

Biographical statements

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Fen Bilgisi Öğretmen Adaylarının Çevreye Yönelik Ahlaki Muhakeme ve Çevreye Yönelik Tutumları Arasındaki İlişki*

Busra TUNCAY**

Ozgul YILMAZ-TUZUN

Gaye TUNCER-TEKSOZ

Özet

Bu çalışmanın amacı, 120 fen bilgisi öğretmen adayının çevreye yönelik ahlaki muhakeme ve çevre tutumları arasındaki ilişkinin araştırılmasıdır. İçerik analizi, ilgili katılımcıların yazılı belgeleri üzerinden yürütülmüştür. Sunulan çevre sorunları anlamlarına göre çevreye duyarlı, insan merkezli ve çevre dışı olarak sınıflandırılmıştır. Sonra her bir ahlaki kategori ile katılımcıların Çevresel Tutum Ölçeğine verdikleri cevapların frekansları üzerinden tanımlayıcı ve çıkarımsal analizler yapılmıştır. Sonuçta hem insan merkezli hem de çevre dışı ahlaki muhakeme ile çevre tutumları arasında istatiksel bir ilişki saptanmazken, çevreye duyarlı ahlaki muhakeme ile çevre tutumları arasında anlamlı bir positif korelasyon saptanmıştır. Çalışmanın sonuçları, çevresel etiğin çevre sorunlarının üstesinden gelmek için çok gerekli olduğunu desteklemektedir.

Anahtar Kelimeler: Çevreye yönelik tutumlar, çevreye yönelik ahlaki muhakeme, öğretmen eğitimi

* Bu çalışma, IX. Ulusal Fen ve Matematik Eğitimi Kongresi'nde bildiri olarak sunulmuştur.

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Preparing Attitude Scale to Define Students' Attitudes about Environment, Recycling, Plastic and Plastic Waste*

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Yunus ALBOGA

Abstract
The aim of this study is to introduce an attitude scale in order to define students' attitudes about environment, recycling, plastics, plastic waste. In this study, 80 attitude sentences according to 5-point Likert-type scale were prepared and applied to 492 students of 6th grade in the Kastamonu city center of Turkey. The scale consists of cognitive, affective, and psychomotor skills domains. After the factor analysis it was found that they have 3, 4 and 5 factors accordingly. After the reliability analysis the alpha values for cognitive, affective and psychomotor scales are .854, .871 and .826 respectively. As a result, it is found that the scale can be used to define cognitive, affective and psychomotor attitudes.

***Keywords*:** Environmental education, environmental attitude scale, plastic waste

Introduction

Environment is the area where all living and non living things interact. Environmental education is the regular studies which enable the human beings to make the interaction easier and thus minimizing the possible problems rising from the interaction.

Energy, environment and recycling should be truly understood by the every section of society (science, policy, education, media and people) for sustainable development and inhabitable environment. And these issues should be evaluated within the framework of basic citizenship, which will affect the people's future life more than today and will be a central theme.

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In order to deal with environmental problems and/or to minimize them, the most effective way is raising environmentally conscious and sensitive individuals who should be equipped with necessary knowledge to develop positive attitudes for it. Therefore, education presents crucial importance. Otherwise, damages given to environment cannot be prevented. These issues exist in the curriculum of Ministry of Education which enables the students to develop attitudes towards possible positive and negative environmental problems while preparing the individuals for society (Uzun, & Sağlam, 2006).

The interactions of environment and humans cannot be directly revealed. However, they can be revealed by techniques such as observation, survey and interview (Büyüköztürk, 2008). The situations based on human's emotions, thoughts, behaviors are difficult to analyze due to the improbability measure directly and quantitatively. Instead, qualitative methods are used.

In this study an attitude scale was prepared to present what individuals know about the recycling and environment terms, awareness of comparative effectiveness of recycling of different materials, prejudices against plastics, what they feel about the pollution and what kind of behaviors they adopt about the pollution. Moreover, comparisons about the socio-economic conditions are planned to be made in the following sections of the study. By means of conclusive results, some of the problems of environment education can be pointed out clearly and solution ways will be looked for.

There are several developed attitude scales on environmental education. Fraser (1998), has investigated nine different attitude scales and differentiated them. Also, Trapha (1999), has applied NEP scales to the bachelor students who called themselves major in environment. And he found that their attitudes were weak towards this subject. Furthermore, Larijani and Yeshodhara (2008), have compared the teachers of secondary stage primary schools of Iran and India with the Taj Environmental Attitudes Scale. There are also several studies applied in Turkey such as Atasoy, 2005; Kabaş, 2004; Mert, 2006; Özpınar, 2009; Sağır et al., 2008; Sama, 2003, Yıldırım, 2008. However these cited studies are executed in the perspectives of biology. Obviously, the other perspectives of environment are missing. Therefore, our study is complementary to the development of environmental attitude scale in chemistry perspective.

Method

Method of Research

The scale consisting of four parts was prepared in order to measure sixth grade primary school students' attitudes about the recycling, impacts of plastics and plastic wastes on environment. Cognitive, affective, psychomotor skills domains which are the three dimensions of the term

attitude were studied separately. Additionally, socio economic conditions affect the mentioned skill domains.

The universe of the research consists of primary school 6th grade students at the city center of Kastamonu. A school from each administrative street was chosen randomly to represent Kastamonu within the boundaries of city center. 492 students of these schools were included in the study. 247 of them were male (50.2%), 245 of them were female (49.8%).

Preliminary Study

Essay type interviews were made in three predetermined schools to define what students know about the issues. Depending on these interviews, 80 attitude sentences according to 5-point Likert-type scale were prepared. Since environment is the common intersection research area of many disciplines, a group of eight specialists from physics, chemistry, biology, geography and education sciences studied on the sentences. Attitude sentences were modified accordingly to specialists' view. The first practice of the scale was carried for 50 students and the points leading to confusion were determined and resolved. Moreover, new supporting sentences were written for the questions which lower the reliability. In brief, 5-point Likert-type attitude scale was prepared to be practiced with total 74 attitude sentences containing cognitive, affective and psychomotor skills domains.

Reliability of the Attitudes Scales

The data gathered was processed on the SPSS programme. Reliability results for each scale are as follows: for cognitive scale Cronbach's reliability coefficient is .330. The sentence which lowers this value was taken out from the scale. After this operation the value was found as .854 and content consistency was determined as sufficient. The reliability of affective scale was found as .857 and reliability coefficient was increased to .871 by taking out the sentence lowering the reliability. And the reliability value for the psychomotor scale was found as .803 and by taking out the sentence lowering the reliability this value was increased to .826.

Consequently, the sentences lowering the reliability were removed and finally attitude scale consists of 59 attitude sentences.

Findings

The attitude scale was analyzed in three sections; 1- cognitive attitudes about environment, plastics, plastic waste and recycling, 2- affective attitudes about these issues, 3- psychomotor attitudes. Sentences of attitude were classified by taking three sections and results were analyzed separately as "Environment cognitive scale", "Environment affective scale" and "Environment psychomotor scale".

Results of the Factor Analyses of Cognitive Scale

Table 1.
The results of the factor analysis for environment cognitive scale

Article Number	Load values of factors		
	1. Factor	2. Factor	3. Factor
1	.840		
2	.819		
3	.747		
4	.719		
5	.702		
6	.696		
7	.692		
8	.621		
9	.606		
10	.602		
11	.577		
12	.558		
13	.473		
14		.676	
15		.631	
16		.624	
17		.543	
18		.534	
19		.483	
20			.676
21			.665
22			.597
	26%	11%	8%

Coefficient of Keiser-Meyer-Olkin (KMO) and Barlett Sphericity tests which were made in order to analyze the conformity of significance of factor analysis. Coefficient number was .898 and significance for Barlet test was confirmed as $p<.05$. KMO's values which are higher than .600 are conformed and, the scale is suitable for factor analysis (Büyüköztürk, 2002).

It is seen that cognitive scale consists of three factors after the results of factor analysis. The first factor explains 26% of the total variance. The first 13 items of environment knowledge scale represent the first factor, 14-19 items represent the second factor and 20-22 items represent the third factor.

It was confirmed that load values of the first factor was between .473 and .840, second factor was between .483 and ,676 and third factor was .597 and .676.

After the meaning of contents of the items had been analyzed, the phrasal sentences were given to factors. In the first factor of cognitive scale there are attitude sentences such as "Turning the waste into valuable materials is called recycling", "Recycling leads to save", "Recycling protects the environment" and "Plastics pollute the soil". Therefore, first factor is called recycling and environment problems.

In the second factor of cognitive scale there are attitude sentences such as "The most polluting part of the plastics is that they cover too much space". This factor is generally concerned with plastic waste and the problems they cause. Thus second factor is called the hazardous effect caused by plastics.

Third factor of the cognitive scale consists of sentences such as "Plastics were made of oil" and energy comes when plastics are burned. Therefore third factor is called plastics used as energy resource.

Results of the Factor analysis of the Affective Scale

Table 2.

Results of the Factor analysis of the Environment Affective Scale

Article Number	Load values of factors			
	1. Factor	2. Factor	3. Factor	4. Factor
1	.829			
2	.802			
3	.742			
4	.707			
5	.662			
6	.561			
7	.561			
8		.764		
9		.747		
10		.602		
11		.528		
12			.752	
13			.717	
14			.519	
15				.857
16				.698
17				.679
	23%	13%	12%	11%

The significance for KMO coefficient number .886 and Sphericity test was defined as $p<.05$. The scale is conformed for factor analysis according to the results. As a result of the factor analysis affective scale consists of 4 factors. The first factor explains the 23% of the total variance.

The first 7 items represent the first factor, 8-11 items represent the second factor, 12-15 items represent the third factor, and 16-18 items represent the fourth factor.

Load values of the first factor are between .561 and .829, second factor is between .528-.764, third factor is between .590 and .752, and fourth factor is between .679 and .857.

After the analysis of the contents of the items, phrasal sentences were adopted to factors. The first factor of the affective scale consists of the sentences such as "If there was a world without any pollution, it would be better", "plastics thrown away to streets look bad", and "I wish I could live in a cleaner environment". Therefore the first factor was called the desire to live in clean environment.

Second factor of the affective scale consists of sentences such as "It makes me happy when plastic bags are reused", "It would be beneficial for the economy if the plastics were collected and sold", and "it makes me happy to see when the bottles are refilled". Thus second factor was called reuse of the plastics.

The third factor of the affective scale consists of sentences such as "If I see plastic water bottles thrown to road, I get sad". "People avoid giving harm to the environment". "Therefore the third factor is called how plastics affect us".

The fourth factor of the affective scale consists of sentences such as "Reuse of the plastic bottles is harmful to health", "Since the glass bottles aren't cleaned sufficiently; reuse of them is harmful for health". Therefore the fourth factor is called the effect of the reuse of plastic and glass on people's health.

The results of the analysis of environment psychomotor scale

Table 3.

The analysis of environment psychomotor scale

Article Number	Load values of factors				
	1. Factor	2. Factor	3. Factor	4. Factor	5. Factor
1	.744				
2	.735				
3	.676				
4	.672				
5	.658				
6	.617				
7	.609				
8	.585				
9		.822			
10		.797			
11		.712			
12			.863		
13			.842		
14			.631		
15				.750	
16				.710	
17				.662	
18					.761
19					.668
20					.664
	26%	12%	7%	6%	5%

The significance for KMO coefficient number .851 and Sphericity test was defined as $p<.05$. The scale is conformed for factor analysis according to the results. As a result of the factor analysis psychomotor scale consists of 5 factors. The first factor explains the 26% of the total variance.

The first 8 items represent the first factor, 9-11 items represent the second factor, 12-15 items represent the third factor, 16-18 items represent the fourth factor, and 18-20 items represent the fifth factor.

Load values of the first factor are between .585 and .744, second factor is between .712-.822, third factor is between .631 and .863, fourth factor is between .662 and .750, and fifth factor is between .664 and .761.

After the analysis of the contents of the items, phrasal sentences were given to factors. The first factor of the psychomotor scale consists of the sentences such as "I participate the activities about the environment voluntarily", "I buy materials that does not give harm to the environment", and "I do not hesitate to warn somebody throwing plastic bottle away". "Therefore the first factor was called works for protecting environment".

Second factor of the psychomotor scale consists of sentences such as "I collect the plastics at home and if needed, I walk for 30 minutes and I put them in recycle bin". Thus second factor was called use of the recycle bin.

The third factor of the psychomotor scale consists of sentences such as "After using the plastic bottles of water, I throw them away". "Therefore, third factor is called" the desire to throw the garbage away".

The fourth factor of the psychomotor scale consists of sentences such as "After shopping I save the plastic bags to be reused". Therefore the fourth factor is reuse. The fourth factor of the psychomotor scale consists of sentences such as "After shopping I save the plastic bags to be reused". Therefore the fourth factor is called reuse. The fifth factor of the psychomotor scale consists of sentences such as "I put the white material used to protect the white equipment in basket" Therefore, fifth factor is called litter bin.

The attitude scale was prepared which demonstrates primary school students' interaction with environment from several perspectives. It is possible to define students' cognitive, affective and psychomotor attitudes about environment, recycling, plastics, and plastic waste. It should be emphasized that affective skill attitudes which is lack in many similar studies, was accommodated.

Conclusion and Recommendations

Teaching and learning environment is an important issue for sustainable environment. Students who are the basic pillars of society are not only today's citizen but also the citizens of future who are going to shape our future (parents, engineer, politician, teacher, unemployed, etc.).

The attitude scale was introduced to define students' attitudes about environment, recycling, plastics, plastic waste. Firstly, scale was prepared for preliminarily according to experts' views. Then, new sentences were attached to the existing ones which have low reliability. Afterwards, sentences which the students had difficulty understanding were corrected after first practice. 492 students in Kastamonu city center were inquired. Resultantly, the scale consisting of three basic domains of the attitude was prepared.

The education that the students get about the environmental problems is crucial to prevent environmental problems. Therefore, the data gathered from the preparation of the attitude scale demonstrates students' attitudes about the environmental problems. And the results direct the way of environment education.

Affective attitude scale was also included in the study which makes it different from other accompanying studies. The scale may also be applied to high school and university students.

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APPENDIXA

SEVGİLİ ARKADAŞLAR; BU UYGULAMA BİR ARAŞTIRMA İLE İLGİLİDİR. YAŞANABİLİR BİR ÇEVREYİ AMAÇLAMAKTADIR.
SİZE UYGUN OLAN SEÇENEĞİ İŞARETLEYİNİZ.

	Çevre Bilgi Ölçeği	Tamamen Katılmıyorum	Katılmıyorum	Az Katılıyorum	Katılıyorum	Tamamen Katılıyorum
1	 Bu işaret, geri dönüşümü ifade etmektedir.	O	O	O	O	O
2	Geri dönüşüm tasarruf sağlar.	O	O	O	O	O
3	Etrafa saçılmış plastik maddeler bir çevre sorunudur.	O	O	O	O	O
4	Atıkların değerli ürünlere dönüştürülmesine geri dönüşüm denir.	O	O	O	O	O
5	Plastikler toprağı kirletirler.	O	O	O	O	O
6	Geri dönüşüm çevreyi korumayı sağlar.	O	O	O	O	O
7	Plastikler yandığında havayı kirletir.	O	O	O	O	O
8	Plastikler sağlığımızı olumsuz etkiler.	O	O	O	O	O
9	Poşetler plastik maddelerdir.	O	O	O	O	O
10	Plastikler yalıtkandır.	O	O	O	O	O
11	Toprağa karıştırılan cam çevre kirliliğine neden olur.	O	O	O	O	O
12	Modern toplumlarda tüketim artmaktadır.	O	O	O	O	O
13	Toprağa atılan plastikler yüz yılda bozulur.	O	O	O	O	O
14	Plastik maddelerin en kirletici yönü çok yer kaplamalarıdır.	O	O	O	O	O
15	Plastik kullanımının yaygınlaşması, ağaçların daha az kesilmesi anlamına gelir.	O	O	O	O	O
16	Toprağa atılan kâğıt, toprağın verimini arttırır.	O	O	O	O	O
17	Plastikler sıkıştırılarak çöpe atılırsa çevreyi daha az kirletirler.	O	O	O	O	O
18	Yiyecek ve içeceklerin plastik kaplarda saklanması onların bozulmasını önler.	O	O	O	O	O
19	Çevre kirliliği ile ilgili en büyük sorun atıkların çok yer kaplamalarıdır.	O	O	O	O	O
20	Plastik maddeler petrolden üretilir.	O	O	O	O	O
21	Plastikler yakıldığı zaman enerji açığa çıkar.	O	O	O	O	O
22	Plastikler yenilenebilir enerji kaynağı olarak kullanılabilir.	O	O	O	O	O

	Çevre Duygu Ölçeği	Tamamen Katılmıyorum	Katılmıyorum	Az Katılıyorum	Katılıyorum	Tamamen Katılıyorum
1	Temiz bir çevrede yaşamak isterdim.	0	0	0	0	0
2	Çevreyi kirletmek kötü bir davranıştır.	0	0	0	0	0
3	Orman yangınları ülke açısından kötüdür.	0	0	0	0	0
4	Çevreye zarar vermekten kaçınırım.	0	0	0	0	0
5	Çevrenin hiç kirlenmediği bir dünya olsa iyi olurdu.	0	0	0	0	0
6	Sokağa atılmış plastikler görüntü açısından kötü duruyor.	0	0	0	0	0
7	Plastiklerin evlerden toplanıp geri dönüştürülmesi iyi olurdu.	0	0	0	0	0
8	Plastik poşetlerin yeniden kullanıldığını görmek beni sevindiriyor.	0	0	0	0	0
9	Plastik su şişelerinin tekrar doldurulabilmesi beni sevindiriyor.	0	0	0	0	0
10	Plastik oyuncakların bozulduğunda çöpe atılması beni üzüyor.	0	0	0	0	0
11	Plastikler toplanıp satılsaydı ekonomik açıdan yararlı olurdu.	0	0	0	0	0
12	Yol kenarına atılmış plastik su şişelerini görsem üzülürüm.	0	0	0	0	0
13	Plastik poşetlerin etrafta uçuşuyor olması beni üzüyor.	0	0	0	0	0
14	İnsanlar çevreye zarar vermekten kaçınırlar.	0	0	0	0	0
15	Cam şişelerin tekrar tekrar kullanılması sağlığa zararlıdır.	0	0	0	0	0
16	Plastik şişelerin tekrar tekrar kullanılması sağlığa zararlıdır.	0	0	0	0	0
17	Cam şişeler yeterince temizlenemediği için tekrar kullanımı sağlığa zararlıdır.	0	0	0	0	0

SOSYO- EKONOMIK DURUM OLÇEGI

1	Cinsiyetiniz:	A) Erkek B) Kız
2	Ailenizin yaşadığı yer:	A) Müstakil Ev B) Apartman C) Site
3	Ailenizin aylık gelir durumunu:	A)1000 TL den az B)1001-2000 TL C)2001 TL ve üstü
4	Ailenizde çalışan sayısı:	A)Kimse çalışmıyor B)1 kişi C) 2 kişi D) 3 kişi E) 3'ten fazla kişi
5	Annenizin öğrenim:	A) Okur-yazar değil. B) İlkokul mezunu C)Ortaokul mezunu D) Lise mezunu E)Üniversite mezunu
6	Babanızın öğrenim durumunu:	A) Okur-yazar değil. B) İlkokul mezunu C)Ortaokul mezunu D) Lise mezunu E)Üniversite mezunu
7	Ailenizdeki birey sayısı (siz dahil):	A)2 kişi B)3 kişi C)4-5 kişi D)6 veya daha fazla
8	Oturduğunuz evin ısıtma sistemi:	A) Soba B)Kombi C) Merkezi kalorifer sistemi D) Kat kaloriferi sistemi
9	Babanızın mesleği:	A) İşçi D) Doktor B) Çiftçi E) Öğretmen, Öğretim Görevlisi C)Memur F) Serbest meslek G)İşsiz
10	Annenizin mesleği:	A) İşçi D) Doktor B) Ev hanımı E) Öğretmen, Öğretim Görevlisi C)Memur F) Serbest meslek
11	Fen ve teknoloji öğretmeninizin cinsiyeti:	A) Erkek B) Kız
12	5. sınıf Fen ve Teknoloji dersi notunuz:	A) 1 B)2 C) 3 D) 4 E) 5
13	Okulunuz saatleri dışında başka bir yerden dersleriniz ile ilgili yardım alıyor musunuz?	A)Dershane B)Özel ders C)Okul kursu D)Almıyorum E)Diğer(...)

Öğrencilerin Çevre, Geri Dönüşüm, Plastik ve Plastik Atık Hakkındaki Tutumlarını Açıklayıcı Tutum Ölçeği Çalışması*

Cagri AVAN

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Özet

Bu çalışmanın amacı, çevre, geri dönüşüm, plastik, plastik atıklar hakkında öğrencilerin tutumlarını belirlemek amacıyla tutum ölçeği hazırlamaktır. Çalışmada Türkiye'de Kastamonu İl merkezinde okuyan 492 altıncı sınıf öğrencisine tutumlarına yönelik 80 cümle 5'li likert tipinde ölçekle yöneltilmiştir. Ölçek bilişsel, duyuşsal ve psiko-motor beceri alanlarını içerir. Faktör analizi sonrasında ölçeğin 3,4 ve 5 faktörlü yapıya sahip olduğu belirlenmiştir. Güvenirlik çalışması sonucunda bilişsel, duyuşsal ve psiko-motor alana ait hesaplanan alpha değerleri sırasıyla .854, .871 ve .826 olarak hesaplanmıştır. Sonuç olarak geliştirilen ölçek bilişsel, duyuşsal ve psiko-motor tutumların ölçülmesinde kullanılabilir.

Anahtar Kelimeler: Çevre eğitimi, çevresel tutum ölçeği, plastik atık

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A Study on Primary and Secondary School Students' Misconceptions about Greenhouse Effect (Erzurum Sampling)

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Abstract
The aim of this study is to determine what level of primary and secondary school students' misconceptions related to greenhouse effect is. Study group consists of totally 280 students attended to totally 8 primary and secondary schools (4 primary school, 4 secondary school) which were determined with convenient sampling method from center of Erzurum. To collect data, a scale was used by utilizing from literature. Scale consisted of totally 22 items, 20 items of which were scored on a three-point Likert scale and 2 items left obtained information on demographic variables. The findings indicated that the students had fewer misconceptions than those specified in the literature related to "events depending on increasing of greenhouse effect", events getting bigger greenhouse effect" and "events to reduce greenhouse effect".

Keywords: Primary school, secondary school, greenhouse effect, misconceptions.

Introduction

In recent years, ecological balance have been damaged by especially anthropogenic influences and therefore environmental problems have been increasing rapidly (Orbay et al., 2009). Continued environmental problems consist of global warming, acid rains, thinning of the ozone layer, marine pollution and more local environmental problems (Selvi & Yıldız, 2009).

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Today, global warming and climate change caused by global warming is at the head of the environmental problems. Earth's climate has exposed sometimes warm and sometimes cold periods for centuries and today relatively cold period must be entered. But today, it seems that earth's climate is at a dangerously warm period in contrast to the cold period. The biggest cause of this situation is no doubtly global warming (Orbay et al., 2009).

The most important reason of the global warming and relatively climate changes is "Greenhouse Effect". Greenhouse effect means that short wave radiations from sunshine, after striking to earth's surface, are re-reflected by greenhouse gases to earth's surface at shape of long wave radiations (Orbay et al., 2009).

Because of increasing in greenhouse effect, earth has faced to global warming and as a result of this, the areas covered by glaciers in polar regions have been reduced gradually. In this way, it is likely to remain under water a large part of pieces of land on earth in later years. In addition, it may be showed that some events (a rise in water levels, drought in some areas, coastal erosions, increase in flood etc.) have occured (Bozkurt & Cansüngü, 2002).

Environmental protection against this type of environmental problems and delaying disasters at least can be provided with the training of individuals who impress it most. In addition, tha aim of this training should be giving behaviors with which individuals can deal with environmental problems and reach solution (Köse, 2010).

Environmental issues are taught at different stages of formal education. For example in Turkey, the information towards greenhouse effect is taught in 7^{th} classes for primary school and 8^{th} classes for secondary school.

The periods when students is given the information about environment is important because students develop environmental awareness during these periods. But, it is obvious that the information obtained in this period is not sufficient to interpret the abstract and complex issues such as greenhouse effect (Oluk, 2007). A lot of research have showed that youth and children cannot obtain accurate and consistent information about greenhouse effect, the factors increasing the greenhouse effect, environmental problems created by greenhouse effect and reduction or prevention of the greenhouse effect. These researches have also showed youth and children have constructed their information by obtaining from families, written and visual media generally and thus they can develop erroneous ideas which are inappropriate scientific understanding (Darçın vd 2006; Jeffries et al., 2001; Kahraman et al., 2008).

These erroneous ideas named "misconceptions" are very crucial obstacles for an effective science and environmental education. For

combating with these obstacles and removing them, it should be determined how the students constructed these conceptions in their minds. These determination is prerequisite for preparing an efficient learning environment (Bozkurt & Cansüngü, 2002).

In the light of these information, the aim of this study is to determine what level of primary and secondary school students' misconceptions related to greenhouse effect is.

Method

Research Approach

This sudy is a descriptive study which is aimed what level of primary and secondary school students' misconceptions towards "Greenhouse Effect" subject is.

Study Group

Study group consists of totally 280 students attended to totally 8 primary and secondary schools (4 primary school, 4 secondary school) which were determined convenient sampling method from center of Erzurum. It iwas taken into account that the students previously learned subject of greenhouse effect in their syllabus. Table 1 shows demographic characteristics of students.

Table 1.

The demographic characteristics of students in study group

	Primary school	Secondary school	Total
Female	72	98	170
Male	48	62	110
Total	120	160	280

Research Instruments and Analysis Techniques

In this study, an 16-item' Likert type scale which previously Bozkurt & Cansüngü (2002) prepared by adopting Boyes & Stanisstreet (1993)' study was utilized to collect data. And then, this scale was reorganized by researchers by adding 4 Likert type items and 2 items towards demographic characteristics. According to this, finally scale consisted of totally 22 items. 20 items were scored on a three-point Likert scale: "agree", "disagree", "undecided". 2 items obtained information on demographic variables such as gender, education level.

The scale was applied in the fall term of 2008-2009 academic year. SPSS statistical packet program was used to analyze the data. In this study, the data were analyzed by frequency analysis.

Findings

The findings of this study are given at Table 2, 3 and 4.

The findings related to events depending on increasing of greenhouse effect

Table 2.

The findings related to events depending on increasing of greenhouse effect

Expressions	Group	Agree		Disagree		Undecided	
		f	%	*f*	%	*f*	%
1. If the greenhouse effect gets bigger, people will be poisoned from foods.	P.S.	24	20.0	20	**16.7 ***	76	63.3
	S.S.	62	38.8	14	**8.8***	84	52.5
2. If the greenhouse effect gets bigger, there will be more flooding.	P.S.	42	**35.0 ***	30	25.0	48	40.0
	S.S.	70	**43.8 ***	24	15.0	66	41.2
3. If the greenhouse effect gets bigger, there will be more desertification.	P.S.	68	**56.7 ***	16	13.3	36	30.0
	S.S.	92	**57.5 ***	12	7.5	56	35.0
4. If the greenhouse effect gets bigger, the polar ice mountains will dissolve.	P.S.	64	**53.3 ***	10	8.3	46	38.3
	S.S.	88	**55.0 ***	12	7.5	60	37.5

"*****" It means correct answer for expression, " P.S."primary school students, "S.S." Secondary school students

It is presented in Table 2 that 20% of the primary school students (P.S.) and 38.8% of the secondary school students (S.S.) have misconcceptions for expression "**if the greenhouse effect gets bigger, people will be poisoned from foods**". In the second expression "**if the greenhouse effect gets bigger, there will be more flooding**", it is seen that 25% of P.S. and 15% of S.S. have misconcceptions. In addition, 13.3% of P.S. and 7.5% of S.S. for expression "**if the greenhouse effect gets bigger, there will be more desertification**" and 8.3% of P.S. and 7.5% of S.S. for expression "**if the greenhouse effect gets bigger, the polar ice mountains will dissolve**" have misconcceptions. According to these findings, P.S. have given more wrong answer than S.S. for expression 2, 3 and 4.

The findings related to events getting bigger greenhouse effect (Table 3)

Table 3.

The findings related to events getting bigger greenhouse effect

Expressions	Group	Agree		Disagree		Undecided	
		f	%	f	%	f	%
5. The waste evacuated into streams and rivers increases greenhouse effect.	İ.Ö.	40	**33.3 ***	26	21.7	54	45.0
	O.Ö.	68	**42.5 ***	24	15.0	68	42.5
6. If the waste evacuated into the sea increases, the greenhouse effect will get bigger.	İ.Ö.	36	**30.0 ***	22	18.3	62	51.7
	O.Ö.	62	**38.8 ***	22	13.8	76	47.5
7.Increasing of CO_2 in atmosphere increases the greenhouse effect.	İ.Ö.	66	**55.0 ***	8	6.7	46	38.3
	O.Ö.	94	**58.8 ***	10	6.2	56	35.0
8. Increasing of CH_4 (methane) in atmosphere increases the greenhouse effect.	İ.Ö.	44	**36.7 ***	16	13.3	60	50.0
	O.Ö.	82	**51.2 ***	12	7.5	66	41.2
9. Hole in the ozone layer and greenhouse effect is the same phenomenon.	İ.Ö.	28	23.3	52	**43.3 ***	40	33.3
	O.Ö.	38	23.8	44	**27.5 ***	78	48.8
10. If the amount of garbage produced by humans increase, the greenhouse effect will get bigger.	İ.Ö.	44	**36.7 ***	30	25.0	46	38.3
	O.Ö.	74	**46.2 ***	30	18.8	56	35.0
11. Unconsciously, the destruction of vegetation increases the greenhouse effect.	İ.Ö.	58	48.3	16	**13.3**	46	38.3
	O.Ö.	84	52.5	4	**2.5**	72	45.0
12. Gases from spoilt waste increases the greenhouse effect.	İ.Ö.	66	**55.0 ***	16	13.3	38	31.7
	O.Ö.	96	**60.0 ***	8	5.0	56	35.0
13. Gases from nucleer power stations increases the greenhouse effect.	İ.Ö.	56	46.7	8	**6.7***	56	46.7
	O.Ö.	62	38.8	82	**51.2 ***	16	10.0
14. If the amount of acid in rain increase, , the greenhouse effect will get bigger.	İ.Ö.	40	33.3	22	**18.3 ***	58	48.3
	O.Ö.	52	32.5	8	**5.0***	100	62.5
15.CFC (chlorofluorocarbon) from spray products increases the greenhouse effect.	İ.Ö.	62	**51.7 ***	8	6.7	50	41.7
	O.Ö.	68	**42.5 ***	12	7.5	80	50.0

It is presented in Table 3 that 21.7% of the primary school students (P.S.) and 15% of the secondary school students (S.S.) for expression "**the waste evacuated into streams and rivers increases greenhouse effect**" and 18.3% of P.S. and 13.8% of S.S. for expression "**if the waste**

evacuated into the sea increases, the greenhouse effect will get bigger" have misconcceptions. Besides, 6.7% of P.S. and 6.2% of S.S. for expression "**increasing of CO_2 in atmosphere increases the greenhouse effect**" and 13.3% of P.S. and 7.5% of S.S. for expression "**increasing of CH_4 (methane) in atmosphere increases the greenhouse effect**" have misconcceptions. In addition, 23.3% of P.S. and 23.8% of S.S. for expression "**hole in the ozone layer and greenhouse effect is the same phenomenon**", 25% of P.S. and 18.8% of S.S. for expression "**if the amount of garbage produced by humans increase, the greenhouse effect will get bigger**", 43.3% of P.S. and 52.5% of S.S. for expression "**unconsciously, the destruction of vegetation increases the greenhouse effect**" and 13.3% of P.S. and 5% of S.S. for expression "**gases from spoilt waste increases the greenhouse effect**" have misconcceptions. Finally, 46.7% of P.S. and 38.8% of S.S. for expression "**gases from nucleer power stations increases the greenhouse effect**", 33.3% of P.S. and 32.5% of S.S. for expression "**if the amount of acid in rain increase, , the greenhouse effect will get bigger**" and 6.7% of P.S. and 7.5% of S.S. for expression "**CFC (chlorofluorocarbon) from spray products increases the greenhouse effect**" have misconcceptions. According to these findings, P.S. have given the wrong answer than S.S. for expression 5, 6, 7, 8, 10, 12, 13 and 14.

The findings related to events to reduce greenhouse effect (Table 4)

Table 4.

The findings related to events to reduce greenhouse effect

İfadeler	Group	Agree		Disagree		Undecided	
		f	%	f	%	f	%
16. The establishment of nuclear power plants instead of thermal power plants reduces the greenhouse effect.	İ.Ö.	30	**25.0 ***	32	26.7	58	48.3
	O.Ö.	26	**16.2 ***	22	13.8	112	70.0
17. Prevent the use of nuclear bombs reduces the greenhouse effect.	İ.Ö.	60	50.0	12	**10.0 ***	48	40.0
	O.Ö.	62	38.8	24	**15.0 ***	74	46.2
18. To keep clean coast reduces the greenhouse effect.	İ.Ö.	40	33.3	30	**25.0 ***	50	41.7
	O.Ö.	60	37.5	24	**15.0 ***	76	47.5
19. Being protected of reduced plant and animal species reduces the greenhouse effect.	İ.Ö.	36	30.0	28	**23.3 ***	56	46.7
	O.Ö.	56	37.5	30	**18.8 ***	74	46.2
20. Unnecessary use of motor vehicles reduces the greenhouse effect.	İ.Ö.	52	**43.3 ***	44	36.7	24	20.0
	O.Ö.	48	**30.0 ***	58	36.2	54	33.8

It is presented in Table 4 that 26.7% of the primary school students (P.S.) and 13.8% of the secondary school students (S.S.) have misconcceptions for expression "**the establishment of nuclear power plants instead of thermal power plants reduces the greenhouse effect**". For expression "**prevent the use of nuclear bombs reduces the greenhouse effect**", it is seen that 50% of P.S. and 38.8% of S.S. have misconcceptions. In addition, 33.3% of P.S. and 37.5% of S.S. for expression "**to keep clean coast reduces the greenhouse effect**", 30% of P.S. and 37.5% of S.S. for expression "**being protected of reduced plant and animal species reduces the greenhouse effect**" and 36.7% of P.S. and 36.2% of S.S. for expression "**unnecessary use of motor vehicles reduces the greenhouse effect**" have misconcceptions. According to these findings, P.S. have given the more wrong answer than S.S. for expression 12, 13 and 16.

Conclusion and Recommendations

This study is important to be able to determine level of primary and secondary school students' misconceptions towards "Greenhouse Effect" subject and to guide future works towars removing these misconceptions.

Global environmental problems such as greenhouse effect is based on "abstract" concepts which are difficult to revive in mind. Therefore, learning this type of issues or concepts in a meaningful way depends on students' learning by doing and living (Darçın et al., 2006). The findings from this study have indicated that primary and secondary school students have insufficient knowledge and a lot of misconceptions about greenhouse effect. Smilarly, Bahar (2000)'s study indicated that the students at the university have not knowledge about this subject and they also have the inaccurate information.

An important finding for the mojority of expressions directed to students about greenhouse effect is that primary school students (P.S.) have more misconceptions than secondary school students (S.S.). As mentioned earlier, the subjects related to greenhouse effect is taught in 7^{th} classes for primary school and 8^{th} classes for secondary school. This study was carried out with 8^{th} class of primary school and 9^{th} class of secondary school. Therefore, the reason why the primary school students have more misconceptions than secondary school students is likely that they may have forgotten the subject more in the 1-year period. But, unlike similar studies in previous years (Bozkurt & Cansüngü, 2002; Kışoğlu et al., 2010; Koulaides & Christidou, 1999; Mohapatra & Bhadauria, 2009; Şahin et al., 2004; Yardımcı & Kılıç, 2010), it is quite pleasing that the percentage of students with misconceptions is a lower rate in this study. This finding can be thought as an indicator which they can be associated with expressions about greenhouse effect correctly.

As stated by Cin (2005), some of the students'misconceptions may be occured as a result of student's mixing any environmental problem with another environmental problem. For examle, similarly to Cin (2005)'s study, the students in this study perceived as if greenhouse effect and hole in the ozone layer was a single problem in many ways. According to Cin (2005), the reason for this stuation may be students to highlight the common characteristics of these two concepts rather than the distinctive features of them.

One of the reasons for students'misconceptions may be observations and experiences spent out at school (Halloun & Hestenes, 1985). For example, a study by Arsal (2010) has showed despite the fact that the earhquakes don't connected to weather and climate events which occured as greenhouse effect and consequence, teacher candidates connected to the earhquakes with greenhouse effect by mistake. As regarding this subject, especially Jeffries et al. (2001) and Kahraman et al. (2008) have emphasized that students' daily life and media (television, radio, internet etc.) was the probable reasons for students'misconceptions. Taking into account all of these studies, in future studies, it may be useful to do applications towards determining from which sources the students obtain their knowledge in daily life.

Some of the students'misconceptions may be caused that greenhouse effect is an abstract concept. Therefore, as stated by Selvi & Yıldız (2009), concrete models can be used in teaching these concepts. Especially, in teaching issues of this type, it may be useful to carry out the lessons with student-centered methods and activities (Darçın et al., 2006).

Some of the students'misconceptions may also be caused by the teachers. As regarding this subject, Groves & Pugh (1999) stated that misconceptions seen in teachers may be likely to have students. Therefore, it is important to correct the teachers'misconceptions and increase their knowledge levels with in-service training both before starting to work (Cin, 2005) and during working. At this point, as stated by Pekel et al. (2007), for increasing the teachers' knowledge levels by eliminating their misconceptions about the greenhouse effect, it may be very useful to organize seminars or renovation courses in all cities.

For reaching to the desired level, the future generations' literacy level about greenhouse effect, the presence and level of the misconceptions is important to determine exactly. Therefore, , it is to be useful to do studies towards determining both students and teachers' knowledge levels about current environmental issues in the each education level. However, in the future studies, if the questions towards uncovering awareness of society about the greenhouse effect can be prepared, much more useful results will be obtained.

Biographical statement

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İlköğretim ve Ortaöğretim Öğrencilerinin Sera Gazı Etkisi Hakkındaki Kavram Yanılgılarına Yönelik Bir Çalışma (Erzurum Örneği)

Seyda GUL*

Selami YESİLYURT

Özet

Bu çalışmanın amacı, sera etkisi ile ilgili ilköğretim ve ortaöğretim öğrencilerinin kavram yanılgılarını düzeyi ne olduğunu belirlemektir. Çalışma grubunu uygun örnekleme yöntemi ile belirlenen Erzurum merkezinde yer alan toplam 8 ilköğretim ve ortaöğretim okullarında (4 ilköğretim okulu, 4 ortaöğretim okulu) eğitim gören toplam 280 öğrenci oluşturmaktadır. Veri toplamak için literatürden yararlanılarak bir ölçek hazırlandı. Ölçekte toplam 24 soru yer almaktadır. 20 soru üçlü likert tipinde olup, kalan 2 soru demografik değişkenler hakkındadır. Bulgular, öğrencilerin "sera gazı etkisinin artışına bağlı olaylar", "sera gazı etkisini arttıran olaylar" ve "sera gazı etkisini azaltan olaylar" ile ilgili literatürde belirtilenden daha az yanlış yaptığını göstermiştir.

Anahtar Kelimeler: İlköğretim, ortaöğretim sera gazı etkisi, kavram yanılgısı

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