# Developing a Scientific Literacy for University Students in Geography Education Branch about Strengthened Greenhouse Effect / Global Climatic Change and Ozone Depletion: It's Validity and Reliability

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**Abstract:** The aim of this study is to develop a survey to measure the level of scientific literacy for university students in Geography Education Branch about strengthened greenhouse effect / global climatic change and ozone depletion. A survey of 20 items was developed in this research and conducted among 150 students. The Cronbach alpha coefficient was .82 for overall survey and Split half coefficient was .67. A factor analysis was used in order to check the variety of the survey and one sub dimension was deleted.

**Key words:** Scientific literacy % university students % strengthened greenhouse effect % global climatic change % ozone depletion % development of a survey

## INTRODUCTION

Although "scientific literacy" has a range of meanings (Laugksch, 2000, this term generally stands for "what the society ought to know about scientific issues and a range of options to tackle the causes of these issues (Durant and Gregory, 1993).

A scientifically and technologically literate citizenry is seen desirable by governments and science educators as it is believed to increase the international competitiveness of an economy and enhance public participation in sophisticated democratic societies. Environmental issues of the 21st century are characterised by a high level of scientific and technical complexity. While struggling with environmental problems which have scientific and technical characteristics, in societies which develop technical models, the decision is placed in the hands of scientists, but in the societies which adopt participatory models, the policies to be followed are determined by the contributions of citizens besides the scientists. Sjoberg (1997, 20) and many writers have commented on the need for a reasonable level of public scientific literacy as a necessity of a democratic society. The rationale for this argument is that the society can then become "good citizens" who are in a position to make informed and more accurate decisions about scientific issues and the interactions between science, technology and society to be fulfilled (Sjoberg, 1997; Spellman, *et al*., 2003).

Many researchers have assessed scientific literacy about greenhouse effect, global climatic change and ozone depletion. These researches in international literature have primarily been directed towards assessing general public understanding (Berk and Schulman, 1995) but also of specific groups such as students in primary, secondary and higher education.

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Ali (1991) has examined primary school children's perceptions of air pollution (Ali, 1991). Boyes and Stanistreet (1992-94) have investigated secondary school student's scientific literacy about the global warming and ozone depletion (Boyes and Stanistreet, 1992). Lord and Rauscher (1991) studied basic biological knowledge of college students (Lord and Rauscher, 1991). Morgan and Moran (1995) examined university student's understanding the greenhouse effect and the ozone shield (Morgan and Moran, 1995). Spellman, Field and Sinclair (2003) assessed higher education student's knowledge of global climatic change in University College Northampton (Spellman, *et al*., 2003). Wilson and Henson (1991) studied knowledge of global warming in US college (Wilson and Henson, 1993).

No studies about "developing a scientific literacy survey about the greenhouse effect / global climatic change and ozone depletion for university students in Geography Education Branch" have been found when the national literature is searched. Çabuk and Karacao–lu (2003) determined both the environmental sensitivity of the students in the Faculty of Educational Sciences in Ankara University and their ideas about the sufficiency of the environmental education in organized education (Çabuk, Karacao–lu, 2003). Erten (2003) assessed the attitudes and knowledge of the students about the subject of garbage reduction. Also he observed their attitudes to see if they change positively or negatively (Erten, 2003). Y¥lmaz, Morgil, Aktu– and Göbekli (2002) examined knowledge of the secondary school and university students attending Hacettepe University, Education Faculty, Chemistry Education Branch about the environment, environmental concepts and problems (Y¥lmaz, *et al*., 2002). In this sense, we have seen the necessity of developing a scientific literacy survey for university in Geography Education Branch about the greenhouse effect / global climatic change and ozone depletion. Bodmer Report (Bodmer, 1985) stressed that it was "clearly a part of each scientist's professional responsibility to promote the public understanding of science". In the face of this argument, with a view to determine dimensions of existing insufficient knowledge and to realize the goal stated above, in this research, a scientific literacy survey about the scientific issues that impinge on daily lives, which include greenhouse effect / global climatic change and ozone depletion, was developed for university students in Geography Education Branch.

## METHODS

This research was conducted among 150 students attending Gazi University, Faculty of Education, Geography Education Branch during the 2006-2007 school year. In this research, a survey which had 20 items was developed by reviewing the literature (Bord, *et al*., 2000; Boyes and Stanistreet, 1992; Boyes and Stanistreet, 1994; Morgan and Moran, 1995; Spellman, *et al*., 2003) which was used with the aim of assessing the scientific literacy of the students in the Faculty of Education in Gazi University about the strengthened greenhouse effect / global climate change and ozone depletion. The survey consists of 10 items related to the greenhouse effect and global climate change and another 10 items related to ozone depletion. For each item, students were instructed to answer whether they "agree" or "disagree". These answers therefore represent the two states "the informed" and "the misinformed". Correct scores were given "2" and incorrect scores were given "1". Instrumentation experts reviewed the survey to establish the content and the face validity. Some modifications were made according to the recommendations made by these experts. Using the data collected during a pilot administration (n = 150), the internal consistency and the construct validity were obtained for the survey. The final survey consists of 20 items.

## RESULTS AND DISCUSSION

In this section, findings and interpretations about the study of validity and reliability of the survey was assessed.

**Findings about the Study of Reliability of the Survey:** Item analysis was used for item reduction and internal consistency (Büyüköztürk, Ô. 2005). Item analysis consisted of the adjusted item-to-total correlation. Analysis of results for item-to-total correlation values are presented in Table 1.

Table 1: Item-to-total correlation values and factor loadings of survey items

| Items | Item-to-total correlation values | Factor loadings |
|---|---|---|
| 1. Increasing amounts of carbon dioxide in the atmosphere contributes to strengthened greenhouse effect (True) | 0.51** | 0.49 |
| 2. Clearing of tropical rainforests is likely to intensify the strengthened greenhouse effect (True) | 0.55** | 0.54 |
| 3. Strengthened greenhouse effect would probably lead to global warming (True) | 0.53** | 0.53 |
| 4. Recent observations strongly suggest that violent volcanic explosions have insignificant effect on global climate (False) | 0.41** | 0.38 |
| 5. Scientist predict that the burning of fossil fuels will enhance the strengthened greenhouse effect (True) | 0.44** | 0.44 |
| 6. If global warming occurs, it will probably have little, if any, impact on crop and timber production in Turkey (False) | 0.32** | 0.30 |
| 7. When climate changes, it changes in the same way everywhere on the planet (False) | 0.35** | 0.33 |
| 8. Without water vapor in the atmosphere, the planet's surface would be considerably cooler (True) | 0.65** | 0.67 |
| 9. The United State is the largest producer of greenhouse gases in the world (True) | 0.42** | 0.40 |
| 10. Switching from fossil fuels to alternative energy such as solar panels or geothermal energy may contribute to strengthened greenhouse effect (False) | 0.31** | 0.30 |
| 11. Without stratospheric ozone in the atmosphere, life on earth, as we know it, would be impossible (True) | 0.51** | 0.52 |
| 12. Midday is the ideal time to sunbathe to lessen the risk of photo-aging (False) | 0.68** | 0.71 |
| 13. To adequately protect yourself against the sun's harmful rays, experts recommend a heavy application of a sunscreen with a skin protection factor of at least 15 (True) | 0.44** | 0.45 |
| 14. Greater exposure to ultraviolet radiation increases the risk of contracting skin cancer and developing sight defects (True) | 0.49** | 0.48 |
| 15. Skiing at high mountain elevations without goggles exposes the face to more intense ultraviolet radiation than sunbathing at sea level does (True) | 0.44** | 0.44 |
| 16. The number of cases of skin cancer in Turkey has steadily declined over the last decade (False) | 0.50** | 0.52 |
| 17. Most scientists predict that increasing stratospheric ozone levels are result in greater human exposure to ultraviolet radiation (False) | 0.53** | 0.54 |
| 18. The most serious threat to the layer of ozone in the stratosphere is from a group of chemicals, collectively known as chlorofluorocarbons (True) | 0.47** | 0.49 |
| 19. Scientists have yet to find evidence that suggest that the amount of ozone in the stratosphere over Turkey is declining (False) | 0.56** | 0.57 |
| 20. Because of the long stay of chlorofluorocarbons in the atmosphere, strospheric ozone level is probably to decline for some time even after worldwide production of chlorofluorocarbons ceases (True) | 0.46** | 0.45 |

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

Using the 150 participants of the research, the internal consistency assessment yielded the coefficient alpha value: .82. Split half coefficient was .67 ( part 1: r = .66, part 2: r = .75).

**Findings about the Study of Validity of the Survey:** For study of validity of the survey, a factor analysis has been used in order to check the variety of the scientific literacy survey about the greenhouse effect / global climatic change and ozone depletion for university students in Geography Education Branch and one sub dimension has been deleted. A principle component factor analysis (PCA) and varimax rotation method performed on the data for the 20 items. As a result, 20 items with factor loading greater than .30 were found. Analysis of the items extracted one component with eigenvalues greater than 1.0; total variance explained, 58 %. 20 items corresponded to the "strengthened greenhouse effect" dimension. Factor loadings range from .30 to .71 and item-to-total correlation values range from .31 to .68.

**CONCLUSIONS**

The purpose of this research was to develop a survey to measure the level of scientific literacy for university students in Geography Education Branch about strengthened greenhouse effect / global climatic change and ozone depletion. The sample included 150 university students ( 54 females and 46 males ) from Faculty of Education in Gazi University. These students were from first, second, third, fourth and fifth classes. The survey consisted of 10 items related to the greenhouse effect and global climate change and another 10 items related to ozone depletion. For each item, students were instructed

to answer whether they "agreed" or "disagreed". Instrumentation experts reviewed the survey to establish content and face validity. Some modifications were made according to the recommendations made by these experts. Using data collected during a pilot administration (n = 150), the internal consistency and the construct validity were obtained for the survey. The final survey consisted of 20 items. Using the 150 participants of the research, the internal consistency assessment yielded the coefficient alpha value: .82. Split half coefficient was .67 ( part 1: r = .66, part 2: r = .75). In the study of validity of the survey, a factor analysis has been used in order to check the variety of the survey and one sub dimension has been deleted. Data analysis indicated that the survey developed in this study has satisfactory validity and reliability measures.

Employing the simple quantitative survey approach, the following topics will be assessed in supplementary research by using the survey developed in this study: Determining the scientific literacy of university students in Geography Education Branch concerning environmental issues that impinge on daily lives which include strengthened greenhouse effect, global climate change and ozone depletion, establishing dimensions of existing problems of scientific illiteracy and the need to solve these problems and pointing out the missions of media and education in promoting scientifically and environmentally literate students.

New survey development researches would be conducted in order to establish different samples' scientific literacy and to apply it to university students from different branches so as to compare them in terms of their scientific literacy level.

## REFERENCES

Ali, I.M., 1991. How do English pupils understand pollution? Environmental Education and Information, 10: 203-220.

Berk, R.A. and D. Schulman, 1995. Public perceptions of global warming. Climatic Change, 29: 1-33.

Bodmer, W., 1985. The Public Understanding of Science. London: Royal Society.

Bord, R.J., R.E. O'Connor and A. Fisher, 2000. In what sense does the public need to understand global climate change? Public Understanding of Science, 9: 205-218.

Boyes, E. and M. Stanistreet, 1992. Students' perceptions of global warming. International Journal of Environmental Studies, 42: 287-300.

Boyes, E. and M. Stanistreet, 1994. The ideas of secondary school children concerning ozone layer damage. Global Environmental Change, 4: 311-24.

Büyüköztürk, Ô, 2005. Sosyal Bilimler ¤çin Veri Analizi El Kitab¥ (Beĩnci Bask¥). Ankara: Pegem A Yay¥nc¥¥k

Çabuk, B. and C. ve Karacao–lu, 2003. Üniversite Ö–rencilerinin Çevre Duyarl¥¥klar¥n¥n ¤ncelenmesi. Ankara Üniversitesi E–itim Bilimleri Fakültesi Dergisi, 36: 189-198.

Durant, J. and J. Gregory, 1993. What is Scientific Literacy? Science and Culture in Europe. London: Science Museum.

Erten, S., 2003. 5. S¥n¥f Ö–rencilerinde "Çöplerin Azalt¥lmas¥"Bilincinin Kazand¥¥lmas¥na Yönelik Bir Ö–retim Modeli. Hacettepe Üniversitesi E–itim Fakültesi Dergisi, 25: 94-103.

Fortner, R.W., J.Y. Lee, S. Romanello, J. Bonnell, B. Luthy, C. Figuerido and N. Ntsiko, 2000. Public understanding of climate change; certainty and willingness to act. Environmental Education Reseach, 6: 127-141.

Laugksch, R.C., 2000. Scientific literacy: A conceptual overview. Science Education, 84: 71-94.

Lord, T.R. and C. Rauscher, 1991. A sampling of basic life science literacy in a college population. American Biology Teacher, 53: 419-424.

Morgan, M.D. and J.M. Moran, 1995. Understanding the greenhouse effect and the ozone shield: An Index of scientific literacy among university students. Bulletin of the American Meteorological @ BIBLIO = Society, 76/7: 1185-1190.

Sjoberg, S., 1997. Scientific literacy and school science-arguments and second thoughts. Science Technology and Citizenship. Oslo: NIFU.

Spellman, G., K. Field and J. Sinclair, 2003. An Investigation into UK Higher Education Students' Knowledge of Global Climatic Change. International Research in Geographical and Environmental Education, 12: 6-17.

Wilson, K. and B. Henson, 1993. Learning About Global Warming; A Study of Students and Journalists. Learning about Science Easily and Readily series. National Center for Atmospheric Research.

Y¥lmaz, A., ¤ Morgil, P. Aktu−and ¤ Göbekli, 2002. Ortaö−retim ve Üniversite Ö−rencilerinin Çevre, Çevre Kavramlar¥ ve Sorunlar¥Konusundaki Bilgileri ve Öneriler. Hacettepe Üniversitesi E−itim Fakültesi Dergisi, 22: 156-162.