35th International Conference on Organizational Science Development
March 16th – 18th 2016, Portorož, Slovenia

Postgraduate Students' Attitudes about Sustainable Development Goals: a Case Study of Delphi Method

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Abstract
In the context of growing concern over the sustainability issues, the purpose of this paper is to shine light on the attitudes of postgraduate students about sustainable development, and its 17 urgent goals. The authors chose postgraduate students as an example of educated expert group in order to evaluate their levels of acquired knowledge at the Master studies and to point out the importance of the role of properly formally educated working citizens for the sustainable development of every country. In order to evaluate postgraduate students' attitudes we used the Delphi method. We suggested the usage of the Delphi method, having in mind that a lot of authors agree that this method has high applicability for sustainability foresight, as well having in mind the fact that it is one of the best-known qualitative methods of forecasting in the long run, especially when quantitative methods are not adequate, as it happened when debating on sustainable development, its goals and the possibilities of their achievement. The obtained results of our research have an important role in giving necessary feedback in the process of improving the curriculum of courses that are developed on a wide scale of scientific and practical knowledge of science about sustainable development.

Keywords: sustainable development, sustainable development goals, postgraduate students' attitudes, Delphi method

1 Introduction

Today, the Education for Sustainable Development represents a necessary education to shape a sustainable future. This means that the Education for Sustainable Development must include key sustainable development issues into the curriculum of the subject, with clear goals in order to motivate the student not only to learn, but to change their attitudes, behaviour and take actions for sustainable development (UNESCO, 2016).

In light of the above, the authors of the paper chose to do their research on how environmentally educated students value goals of a new sustainable development agenda.

For the panel group the authors chose postgraduate students enrolled at the Management of Environmental Protection course at the University of Ljubljana – Faculty of Administration, the Republic of Slovenia. For the purpose of this research the authors used the Delphi method for measuring students' attitudes about 17 sustainable development goals

2 Sustainable development and sustainable development goals

Sustainable development (SD) has been discussed extensively in the theoretical literature since the concept was adopted as an overarching goal of economic and social development by UN agencies, by the Agenda 21 nations, and by many local governments and private-sector actors (WCED, 1987). The literature includes many alternative theoretical and applied definitions of sustainable development. The theoretical work spans hundreds of studies that are based on economic theory, complex systems approaches, ecological science and other approaches that derive conditions for how development paths can meet SD criteria (IPCC, 2007).

Several definitions have been presented to describe the principle of sustainable development; the most frequently quoted being the one presented in the Brundtland Report (Brundtland, 1987). According to this report sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

More operational principles of sustainability were presented by the former Chief Economist for the World Bank, Herman E. Daly. These principles are known as Daly's rules and they define the condition of ecological sustainability:

- renewable resources such as fish, soil, and groundwater must be used no faster than the rate at which they regenerate;
- non-renewable resources such as minerals and fossil fuels must be used no faster than renewable substitutes for them can be put into place; and
- pollution and wastes must be emitted no faster than natural systems can absorb them, recycle them, or render them harmless (Smith, 2010).

The General Assembly of the United Nations adopted the new resolution on 25th September of 2015. This resolution is a new sustainable development agenda for the period of 2015-2030: Transforming our world: the 2030 Agenda for Sustainable Development: "The 17 Sustainable Development Goals and 169 targets which we are announcing today demonstrate the scale and ambition of this new universal Agenda. They seek to build on the Millennium Development Goals and complete what they did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental." (UN, 2015)

The 17 Sustainable development goals are (UN, 2015):

- Goal 1: End poverty in all its forms everywhere.
- Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Goal 3: Ensure healthy lives and promote well-being for all at all ages.
- Goal 4: Ensure inclusive and quality education for all and promote lifelong learning.
- Goal 5: Achieve gender equality and empower all women and girls.
- Goal 6: Ensure access to water and sanitation for all.
- Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all.
- Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.
- Goal 10: Reduce inequality within and among countries.
- Goal 11: Make cities inclusive, safe, resilient and sustainable.
- Goal 12: Ensure sustainable consumption and production patterns.
- Goal 13: Take urgent action to combat climate change and its impacts.
- Goal 14: Conserve and sustainably use the oceans, seas and marine resources.
- Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.
- Goal 16: Promote just, peaceful and inclusive societies.
- Goal 17: Revitalize the global partnership for sustainable development.

3 Delphi method

Technology forecasting in developed countries is a process focused on recognizing critical generic technologies, and most likely it will exert great influence on economic, environmental, and social development in general. However, for underdeveloped and developing countries, the role of technology forecasting is of great importance for identifying technology niches – technology domains in which it is possible to accomplish a competitive position on the world market (Albright, 2002). Technology forecasting began to play an important role in companies' strategic planning, as well as in their race for comparative advantage. Technology forecasts use different methods among which is the Delphi method that presents one of the most widespread methods for intuitive forecasting.

Delphi method is the most commonly known forecasting method that is based on series of written questionnaires with feedback and re-voting (Popper, 2008). There are two participant roles: the design group (sometimes just one person) that makes the questionnaires and the consensus of the expert group, and the expert group – a panel that answers the questionnaires. The members of the panel do not meet face-to-face; they are characterized by three important conditions: anonymity, iteration with controlled feedback, and statistical response. This is not an opinion survey, but rather, a way of systematically finding out and summarizing expert judgment in successive rounds of the Delphi forecasts (Mullen, 2003).

Despite some limitations, it has been recommended that studies employing the Delphi should be continued in order to further refine the technique and to explore its application. The first idea for applying the Delphi method in forecasting events in education came from the article “The Delphi Technique: A Possible Tool for Predicting Future Events in Nursing Education”

by Bramwell L. and Hykawy E. in which the authors have presented the potential use of the Delphi method in this area (Bramwell & Hykawy, 1999). Despite the limitations they indicated, one suggestion supported by the panellist in the study was important, which is of special interest for the society in transition. They have suggested that the Delphi method seemed to have promising application as a tool for teaching people to think and discuss about the future in a more complex way than they ordinarily would.

The Delphi method is one of the best-known qualitative methods of forecasting in the long run, especially when quantitative methods are not adequate. It is applied for forecasting the probability and time of the emergence of future events. In order to give a prognosis, a group of experts identifies and defines the given event, the probability of its development and possible time of future event. Delphi method is also important because of the impartiality of participants bearing in mind that opinions and presumptions of forecasting experts are based on collecting data through polls, i.e. on filling out the questionnaires. Experts fill out questionnaires independently of each other, which gives this method the impartial character when it comes to judgment (Makridakis, Wheelwright, Hyndman & 1998).

The Delphi method is an attractive method for graduate students completing masters and PhD level research. It is a flexible research technique that has been successfully used in our paper to explain Postgraduate Students' Attitudes about Sustainable Development Goals. Delphi studies have been useful in educational settings in forming guidelines, standards, and in predicting trends (Skulmoski & Hartman, 2007). The Delphi method works especially well when the goal is to improve our understanding of problems, opportunities, solutions, or to develop forecasts.

Delphi studies have been useful in educational settings in forming guidelines, standards, and in predicting trends. The Delphi Technique will be useful for educators in developing curricula and learning experiences to prepare our students for future careers. Delphi studies are extremely useful for collecting data from students and alumni regarding the curriculum, and information science trends, and funding (Green, 2014).

4 Postgraduate students' attitudes about sustainable development goals – a case study

For our research we chose the students of the University of Ljubljana – Faculty of Administration, which have in the November of 2014/2015 school year attended the course Management of Environmental Protection, and which joined the research only when they have successfully finished the course.

At this course, a framework and a curriculum for good environmental higher education are developed on a wide scale of scientific and practical knowledge of environmental science and sustainable development as a good benchmark for the adequate improvement of students' knowledge at postgraduate level, as well as a promotion of higher order thinking skills in a cooperative context for learning and evaluation (Petrovic et al., 2014). Having this in mind, the curriculum of this subject accents the following topics: the resources of the Earth, particularly soil, water, minerals, etc., the implications of the resource distribution in determining the nature of societies and the rate and character of economic development, the role of science and technology in the development of societies and the impact of these technologies on environment, cooperative international and national efforts to find solutions

to common global issues, and to implement strategies for a more sustainable future, processes of planning, policy-making and action for sustainability by governments, businesses, non-governmental organizations and the public (NAAEE, 1996; Petrović, 2012; FOS, 2016).

4.1 Methodology

In this paper, we discussed the application of the Delphi method in evaluation of postgraduate students' attitudes about 17 sustainable development goals by using a five point scale (1 – *the most significant*, 2 – *very significant*, 3 – *significant*, 4 – *not so significant*, 5 – *the least significant/insignificant*).

We suggested the use of the Delphi method, having in mind that Bramwell and Hykawy (1999) have suggested that the Delphi method seemed to have promising application as a tool for teaching people to think and discuss about the future in a more complex way than they ordinarily would. It can be concluded that this method has high applicability for sustainability foresight, as well as it is one of the best-known qualitative methods of forecasting in the long run, especially when quantitative methods are not adequate, as it happened in this case.

4.2 Instruments

In order to evaluate the results of the questionnaire, we used statistical analysis for calculation of the arithmetic mean rating, variance and standard deviation:

- Calculation of the arithmetic mean rating (t_n) was made using the following equation :

$$t_n = \frac{1}{n}\sum_{i=1}^{k} f_i \cdot t_i \quad (1)$$

where k is the number of different rating scores, f_i is a number of experts that evaluated observed item with rating score t_i, and n represents the total number of experts ($n = \sum_{i=1}^{k} f_i$).

- Calculation the variance and standard deviation were made using the following equations:

$$\sigma^2 \quad \frac{1}{n}\sum_{i=1}^{k} f_i t_i^{\,2} - t_n^{\,2} \quad (2)$$

$$\sigma_n = \sqrt{\sigma_n^2} \quad (3)$$

where σ_n^2 is variance and σ_n is standard deviation.

4.3 Results and discussion

After calculating the results of students from the first questionnaire, arithmetic mean and variance were calculated. Summarized results of the first questionnaire are given in Table 1. As a significant agreement in responses has been detected, the second round of questioning was not necessary.

No.	Sustainable development goals	Arithmetic mean (t_n)	Variance (σ^2_n)
1.	End poverty in all its forms everywhere	1.47	0.77
2.	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	1.13	0.25
3.	Ensure healthy lives and promote well-being for all at all ages	1.6	0.91
4.	Ensure inclusive and quality education for all and promote lifelong learning	1.93	0.61
5.	Achieve gender equality and empower all women and girls	2.13	0.79
6.	Ensure access to water and sanitation for all	1.13	0.12
7.	Ensure access to affordable, reliable, sustainable and modern energy for all	1.67	0.48
8.	Promote inclusive and sustainable economic growth, employment and decent work for all	1.67	0.48
9.	Build resilient infrastructure, promote sustainable industrialization and foster innovation	2.33	0.90
10.	Reduce inequality within and among countries	2.20	0.96
11.	Make cities inclusive, safe, resilient and sustainable	2	0.67
12.	Ensure sustainable consumption and production patterns	2.27	0.58
13.	Take urgent action to combat climate change and its impacts	1.87	0.50
14.	Conserve and sustainably use the oceans, seas and marine resources	1.67	0.48
15.	Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss	1.73	0.60
16.	Promote just, peaceful and inclusive societies	2.13	0.53
17.	Revitalize the global partnership for sustainable development	2.27	0.58

Table 1: The results of the first questionnaire

Based on the responses gathered, we can conclude that, in the opinion of the respondents, the most important goals of sustainable development are to:

1. Ensure access to water and sanitation for all – with the arithmetic mean of 1.13, and variance of 0.12 which is more than a good mark and shows a fair compliance when it comes to the students' attitude.
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture – with the arithmetic mean of 1.13, and variance of 0.25 which again shows the same complient attitudes as before.
3. The third place "share" the following goals - to ensure access to affordable, reliable, sustainable and modern energy for all and to promote inclusive and sustainable economic growth, employment and decent work for all and to conserve and sustainably use the oceans, seas and marine resources – with their arithmetic mean being 1.67, their variance 0.48, which are excelent marks and present a fair compliance between the students.

5 Conclusion

The key aim of the research presented in this paper has been to provide an idea of implementing the Delphi method in evaluating postgraduate students' attitudes about sustainable development goals, and proving that the Delphi method could be a good tool for the measurement of environmental education and the education for sustainable development achievements as well.

Gained results from our research pointed out that this kind of use of the Delphi method can provide good results having in mind that the results gathered, not only show a compliance in the students' responses, which speaks of the good background knowledge they gained during their studies at the course of Management of Environmental Protection, but also that the Delphi method can be used for further analysis of the reasons behind their assigning high marks to specific goals of sustainable development, which depicts the image of the students' attitudes towards these goals.

A more in depth analysis of these results demands a larger number of respondents, and not students from only one university, but instead conducting a broader and more detailed research, which should be a possible direction of future research, especially when having in mind that "a basic premise of education for sustainability is that just as there is a wholeness and interdependence to life in all its forms, so must there be a unity and wholeness to efforts to understand it and ensure its continuation" (UNESCO, 2012).

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