An Alternation of University Students' Philosophy of Life after 2011 East-Japan Great Disaster Linking to Students' View of Science and Technology

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ABSTRACT: Many Japanese are now thinking on how to coexist with science and technology after Higashi-Nihon great disaster on 11th March in Japan. The view of young students studying science and technology may be a strong factor to decide the future of Japan which aims at realizing Japan as a scientific and technological nation. In this article, we investigate young students' scientific views in Tohoku University. These views are examined through three inquiries namely a way of thinking on using atomic energy, unexpected accidents, and on the extent of responsibility of scientists. Two types of population, i.e. undergraduate students and graduate students were included. The first population consists of first-year undergraduate students of Faculty of Agriculture, and the second consists of first-year graduate students of School of Agricultural Science. From a comparison between two simple tabulations of the populations, we found that a scientific view, (scientism) was stronger in graduate students than in undergraduate students. Graduate students are more vulnerable in their philosophy of life than undergraduate students. At the same time, we found that scientism made students stable in their philosophy of life as a whole. These contradictive results could be interpreted as a way to examine the relationship between populations and alternations of the view controlling the degree of scientism. In conclusion, specialized lectures and technical training on natural science at university education may influence the scientific views of untutored undergraduate students.

Keywords: 2011 East Japan earthquake disaster, a philosophy of life, scientism

Introduction

Thanks to the development of science and technology after the 20th century, we have obtained material wealth. Western thought based on Christianity has the human-centered view of nature and puts forward that Christianity brought about environmental ethics as a result of "controversy on the view of nature". Adam Smith said, "*to think out a way of producing human benefits using natural resources contributes to human welfare*". Korten (1990) on the other hand described two figures of the future world. They are shown according to the viewpoint of economic growth centrism and anthropocentrism. In the former world, poverty reduces economic growth by industrialization using seemingly unlimited natural resources based on scientific imperialism. In the latter world, various regional communities exist where inhabitants are dependent on limited and recyclable regional resources of the planet. After the unprecedented great disaster called "East-Japan great disaster**"** in 2011, many Japanese began to think over society's dependency on science and technology as a means to survive in symbiosis with nature. Japanese are now called upon to utilize their imagination to feel concern over the future generation standing as a silent majority. This article focuses on the way of thinking of university students on science and technology.

The subjects for this investigation are new undergraduate students of the Faculty of Agriculture and new graduate students of School of Agricultural Science of Tohoku University. The university is located in Sendai city in Miyagi prefecture. The prefecture had recently suffered from a big tsunami.

The way of thinking about science and technology tends to be reflected by professionals because there is a large information gap between technical experts and people in general. We first try to find the differences in the way of thinking about science and technology between undergraduate and graduate students. Although the latter students have taken many lectures on natural science and technical trainings through various scientific experiments in the past four years, the former students have studied only entrance examination

subjects. The latter group is much the same as the former just four years before, for most undergraduate students go on to the lineal graduate school majoring in Natural Science at Tohoku University. We refer to the cultivation of the way of thinking about science and technology through many lectures on natural sciences and experimental trainings in small and laboratory environments.

Student's view of science and technology and hypothesis of the study

To investigate the developmental stage of students' view regarding science and technology, Kawamura (1999) extracted four factor by factor analyses from 47 inquiries on a way of thinking about science and technology among primary, junior high, and senior high school students. The author found that male students, especially senior high school students in the course of natural science; felt more strongly about the utilization of science than female students in general, though there was no obvious difference in this feeling between the sexes among primary or junior high school students. Kawakami *et al.* (2008) collected university students' view of nature with a free description questionnaire and analyzed them with a text mining technique. They extracted six factors and found no difference in view of nature except on the factor "healing nature".

Similar to the above studies, students' view of science or nature was measured by indirect scores using factor analysis on many inquiries of nature, science, and technology in this study. Data was collected via free-descriptions on student's way of thinking about three issues. On each of which we present two typical opinions that conflict clearly with each other and alternations of students' view of daily life, science, and environment just after the tremendous disaster. After using a text mining technique, each student's description was given into three values: "0, 1, or 2" along the axis generated by two conflicting opinions, and an alternation of his/her philosophy of life by reading deeply into their feelings and state of mind.

At the Faculty of Agriculture in Tohoku University, almost all students learn many kinds of biological sciences and undergo trainings or instructions in preparation for managing specific and technical experiments. Unlike a classroom lesson, the manner of learning natural phenomena from laboratory experiments which each student chooses for him/herself may have a large effect not only on his/her view of science and technology but on his/her philosophy of whole life. To research the effect of such a science education, we investigated the way of thinking about science and technology on two groups of students: new undergraduate students who have just entered the faculty of agriculture, and new graduate students who have just entered the graduate school of agricultural science. Almost all new graduate students had just graduated from the same faculty, in other words, they were also new undergraduate students of the faculty of agriculture four years ago.

As Kawamura (1999) said, the way of thinking about science and technology has been cultivated from primary school education to senior high school education. As the scientific view of scientists or engineers has a power to decide the direction of our life plans or has an effect on a wide range of its alternations such as "capability", university students' view of science and technology is one of the most important factors in Japan to make a policy for nation-building on the basis of science and technology.

The reason we took notice of natural science education in the faculty is that students' experience in the present curriculum might make them have a distorted view of science and technology. That is, expressing this distortion as a hypothesis, student's view of science and technology may give rise to a large influence on having a philosophy of life that comes with age, and the influence may be found by means of investigating their consciousness on science and technology just after the big natural disaster which was beyond human understanding.

The first purpose of the study was to construct a scale for university students' view of science and technology. This scale was based on free description data on the following three inquiries:

i. Consciousness on whether we should continue to use nuclear power as part of energy sources to generate electricity.
ii. How to think on the situation beyond the imagination of a great disaster.
iii. Opinion about scientists' responsibility on technology-based accident in the case that he is not directly involved when the concerned technology was developed.

Next, as the fourth inquiry item, students' alternative feelings regarding science, environment and daily life after the disaster were collected. From these collected data, vulnerability issues such as whether they philosophically accepted their losses were identified. Lastly, after extracting a factor from the above three variables, the model as stated in **Figure 1** was verified.

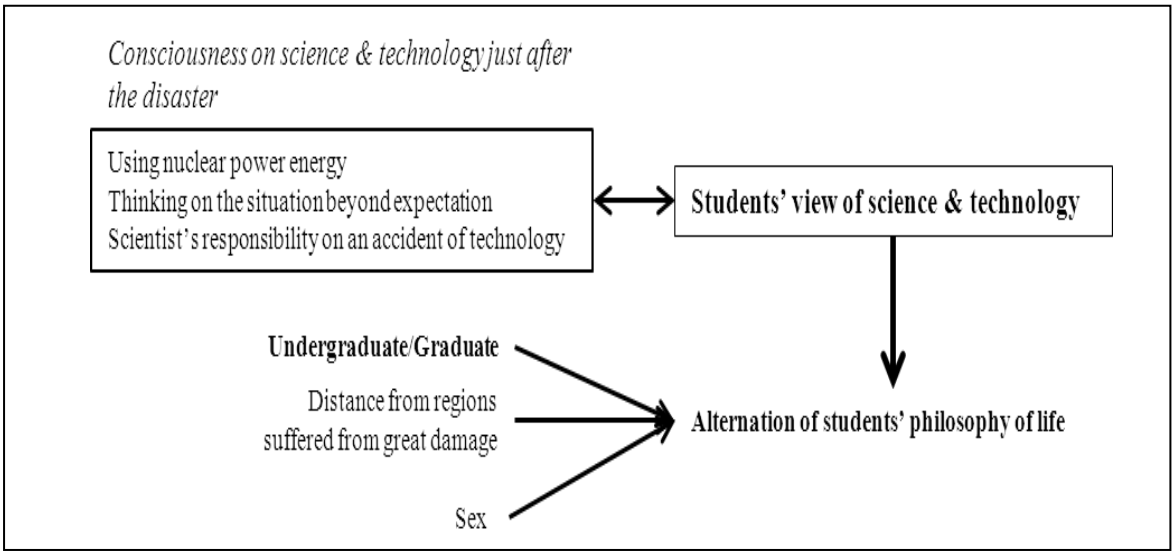

Figure 1: The model for our analysis

Outline of the survey and simple tabulation

Overview of basic attributes of students

Tohoku University held an entrance ceremony for 2011 on May 6th, just a month later than usual because of the great disaster. Every year, one of the authors of this current research gave a lecture on a required subject to all first-year undergraduate students of faculty of agriculture, all graduate students of school of agricultural science, and conducted a questionnaire survey in each class.

The date of the survey was May 20th 2011 for undergraduates, and May 13th 2011 for graduates. The surveys were carried out about two months after the disaster. About 80% graduates of the Faculty of agriculture of Tohoku University went on to the graduate school of agricultural science of the same university, and the others were graduates of other universities or were overseas students. Basic attributes of students are shown in **Table 1** and **Table 2**.

Table 1: Basic attributes of students (sex)

Under graduate	The number	Rate (%)	Graduate	The number	Rate(%)
Male	85	53.8	Male	66	60.0
Female	73	46.2	Female	44	40.0
Total	158	100.0	Total	110	100.0

Table 2: Basic attributes of students (birth place or home town)

Under graduate	The number	Rate(%)	Graduate	The number	Rate(%)
Tohoku*	49	31.2	Tohoku	32	36.8
(3 prefectures)	(46)	(27.4)	(3 prefectures)	(22)	(25.2)
Kanto**	57	36.3	Kanto	17	19.5
The other regions	51	32.5	The other regions	23	26.5
Total	157	100.0	Foreign countries	15	17.2
Not clear	1		Total	87	100.0
			Not clear	23	

*Tohoku district is located at the north-east of the main island of Japan, and especially 3 prefectures (Iwate, Miyagi, and Fukushima) in the district suffered from tremendous tsunamis and a serious accident of nuclear power plant.
**Kanto district is located at the south-east of the island which involves Tokyo. This district also was not a little damaged by the disaster.

More than 40% of the entire samples were female students. This fact resulted from the characteristics of the agricultural science course. Tohoku University is one of the former Imperial Universities where young students gather from all over Japan. The number of students who come from Tohoku region is one-third of all, especially the number of students who come from Iwate, Miyagi, and Fukushima prefecture. The disaster particularly severely damaged one-fourth of the Tohoku region. We call the region "Tohoku three prefecture" here after. In each item of the questionnaire, opposition axes are shown as follows:-

Q1. On using nuclear power as part of energy sources to generate electricity

-It is necessary to promote using the power while improving security of the nuclear plants to contribute to economic development
-It is necessary to change our life style from depending excessively on electric energy.

Q2. On the way of thinking about an accident beyond expectations

-It is natural that using the scientific technology of any kind causes such accidents, so we should develop the technology so that an accident never happens again.
-To defend such an accident by being unexpected is not acceptable. We need to have a preparation for the loss generated by scientific technologies.

Q3. Are natural science and technology neutral in terms of value?

-As scientific knowledge is a set of observable facts and we cannot put a value on it, scientists cannot be responsible for their findings.
-A scientist is responsible for all application of his findings to society even if he is not involved in it.

And the last question,

Q4. Have you changed your view of life, science, and environment after the disaster?

-Nothing in particular
-I've changed. (What kind of change?)

In the first three inquiries, each student locates his/her position on the opposite two ways of thinking shown, describes his/her opinion freely, and answers the last question on whether or not he/she has altered his/her view of life, science, and environment.

Scoring students' free descriptions and its simple tabulation

Figure 2.1 to 2.4 show the result of simple tabulation on the four inquiries after a text mining. Between the two opposite ways of thinking shown in Q1, Q2, and Q3, intermediate positions can be also considered. In Q1, students who share the first opinion is labeled "2", those who share the second opinion is labeled "0", and those who have intermediate positions such as "using nuclear power is not unfavorable but inevitable" is labeled "1".

In Q2, though it is ambiguous to discern students' degree of scientific view, scoring is defined as follows; respondents who have positions such as "an accident beyond expectations cannot be permitted and we must be prepared for such an accident if we continue to develop science and technology", "an accident beyond expectations is permitted but should be small as possible as we can", and "accidents beyond expectations naturally happen and science and technology develop thanks to these accidents, are labeled as "0", "1",and "2" respectively.

In Q3, respondents who share the first opinion is labeled "2", those who share the second opinion is labeled "0", and those who have intermediate positions such as "though a scientist is not responsible for an application of his/her findings to society, he/she must only give due consideration to it" is labeled "1".

In students' descriptions for the last question, we explored a state of alternation in their mind. To have high conscious on surviving such as saving energy, storing provisions, or setting up hardware and software systems for disaster prevention can be considered as a kind of alternation based on rationality to avoid from difficulty and was labeled as "1". We posit that such descriptions express a change of students' superficial behavior or attitudes, not of their mind. On the other hand, expressing their thoughts such as feeling loneliness, hopeless, or evanescence on human life, to take good care of his/her friends, are such descriptions express a change of students' mind and we consider they have caused an alternation on their philosophy of life. Students who did not alter their view were labeled "0".

Summary of results

As a whole, there were many differences between undergraduate and graduate students. Graduate students tended to give support to promoting the use of power of the nuclear plants (Q1), to develop science and technology while accepting an accident beyond expectations (Q2). Undergraduate students thought that scientists must take the responsibility for his/her findings in society much more strongly than graduate students (Q3). Graduate students seemed to have altered their philosophy of life largely (Q4). This result was deemed as there was a greater psychological shock in graduate students than in undergraduates.

To sum up, we can describe the next two propositions:
-"Scientism" has penetrated in graduate students more than in undergraduates.
-Graduate students have altered their philosophy of life largely than undergraduate after the disaster.

Analysis based on the model

Factor extraction to catch a view of science and technology

Correlation coefficients between the variables of any two inquiry items defined above were very large, especially between Q1, Q2 and Q3. The analysis showed that these three variables can be summarized by one factor as a whole. Analyzing using the principal factor method, the first factor was extracted. The factor's contribution is 53.2% (maximum eigenvalue is 1.60) in undergraduate students' data and 60.7% (maximum eigenvalue is 1.82) in graduate students' data. After here, we interpret a student with a high score in the first factor defines his/her level of "scientism".

Alternation of students' philosophy of life coming from Tohoku three prefectures

The alternation of students' philosophy of life is considered largely in students coming from regions that had suffered from great damage. Although the magnitude of graduate students' alternation is larger than that of undergraduates' as shown in **Figure 1**, undergraduate students who suffered from more great damage (whose hometowns are located at the three prefectures) have also altered their philosophy of life. Almost all undergraduate students might have stayed around their hometowns while most graduate students might have stayed at the university campus in Sendai city when the disaster happened.

Relationship between scientism and philosophy of life

To investigate the influence of scientism on the alternation of a philosophy of life, we performed regression analysis. Students' sex and hometown locations discriminated between the Tohoku three prefectures and the other regions were added as explanatory valuables. The results are shown in **Table 3** and **Figure 2**. It was noted that alternation of philosophy of life has been affected by scientism.

Table 3: Determinant variables of philosophy of life on students

Under graduate students

Explanatory valuable	Regression coefficient	S.E.	β-coefficient	t-value	p-value
constant	0.360	0.226		1.592	0.114
Scientism	-0.240	0.071	-0.297	-3.3782	0.001
Sex	0.155	0.143	0.095	1.087	0.279
Tohoku 3 prefectures	0.310	0.151	0.165	2.016	0.046
				R^2=0.159 F=7.981	(p=0.000)

Graduate students

Explanatory valuable	Regression coefficient	S.E.	β-coefficient	t-value	p-value
constant	0.954	0.344		2.771	0.007
Scientism	-0.291	0.113	-0.315	-2. 570	0.013
Sex	0.037	0.236	0.019	1.155	0.877
Tohoku 3 prefectures	0.128	0.048	-0.033	-0.265	0.792
				R^2=0.099 F=2.226	(p=0.094)

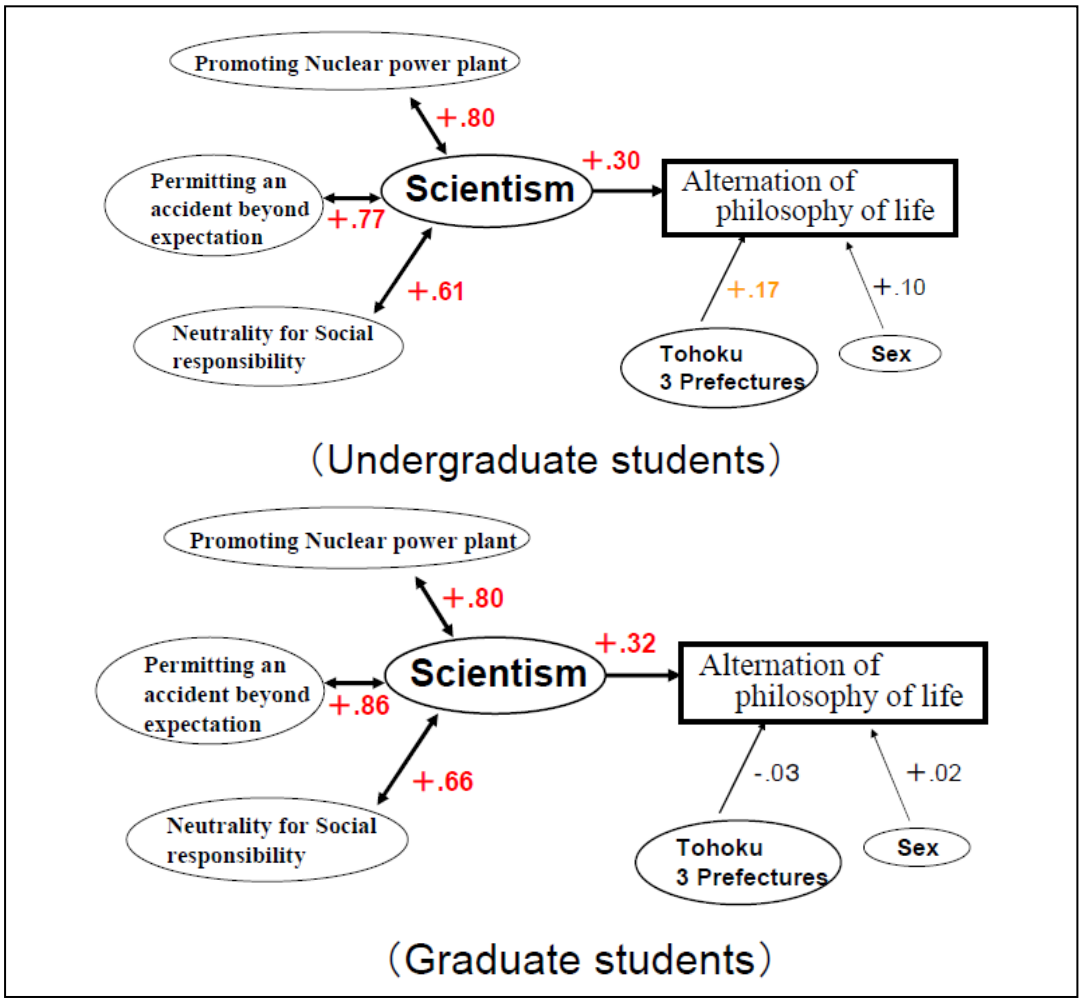

Figure 3: Verification of the model after factor analysis and regression analysis

Strong scientism might have made students stable in their philosophy of life, and this fact seems to show that graduate students have stronger scientism and smaller alternation of the philosophy than undergraduate students. However, it is premature to interpret it in this way. On the contrary, the alternation on graduate students may be larger than undergraduate students as seen in **Figures 3.1-3.4.**

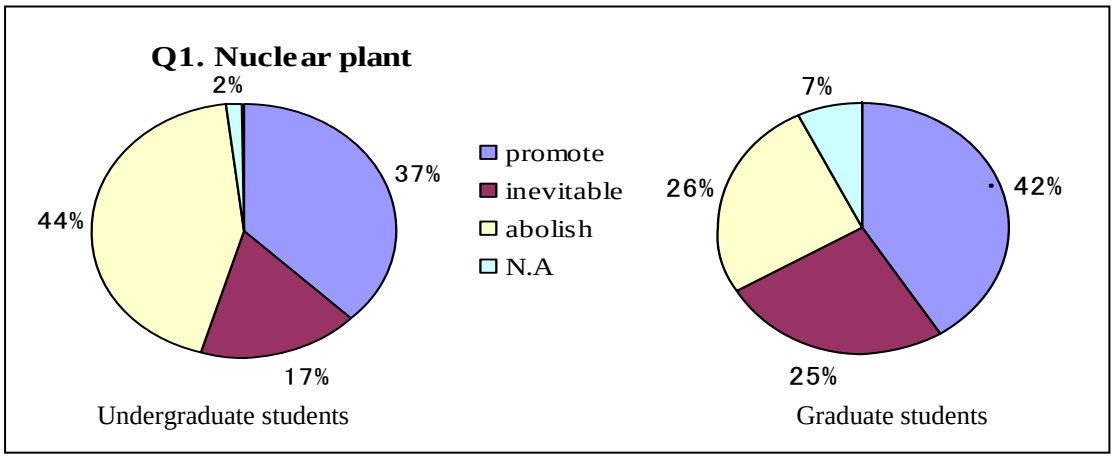

Figure 3.1: Aggregation of students' answers on question one

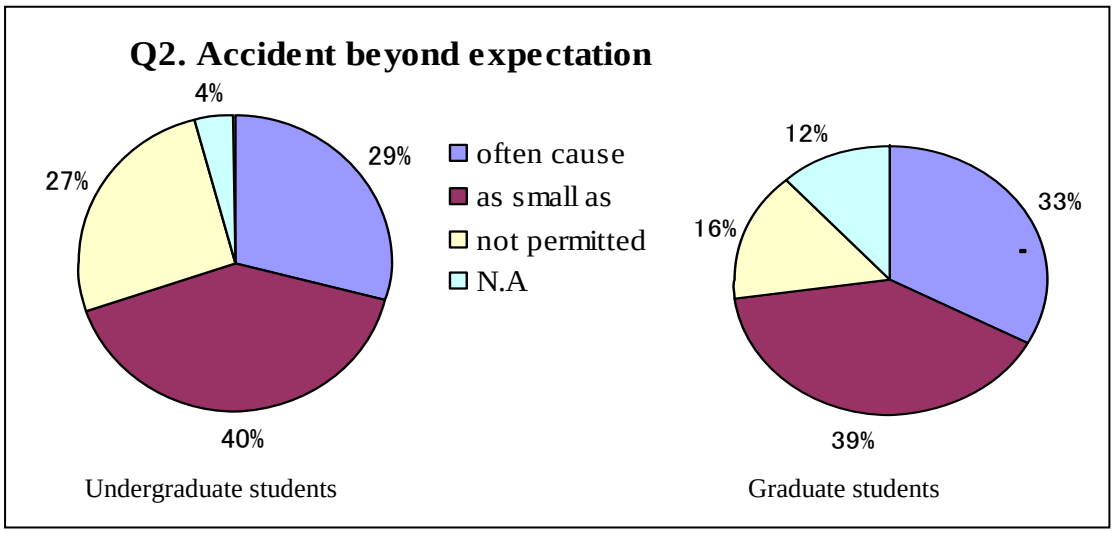

Figure 3.2: Aggregation of students' answers on question two

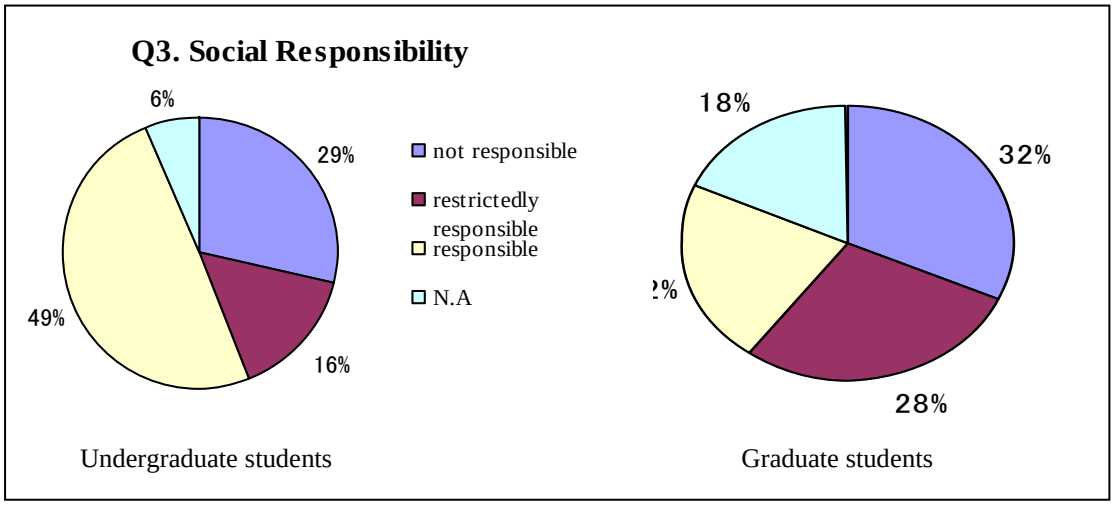

Figure 3.3: Aggregation of students' answers on question three

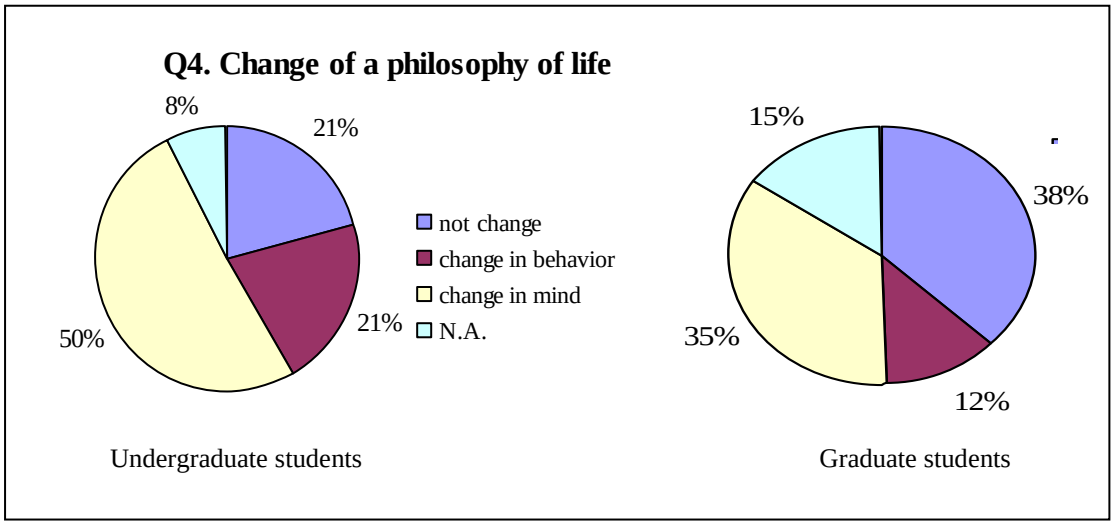

Figure 3.4: Aggregation of students' answers on question four

As a way to give an explanation for this result, we proposed the next interpretation. Although graduate students began to take a stand for scientism, their philosophy of life becomes vulnerable when the relative level of scientism is controlled to be the same as undergraduate students' data. The level of scientism here is defined by the score of the first factor indicating the view of science and technology (Q1~Q3) in the total sample.

To investigate the relationship between students' grades and alternations of their philosophy of life, a regression analysis based on the whole data was performed again except for foreign students and social science major students. For this analysis, all respondents were graduate students (n=19). In the **Table 4**, we found a positive effect on student's grades on their philosophy of life. This fact means that when the level of scientism is controlled, graduate students are certainly vulnerable in their philosophy of life.

Table 4: Regression results of philosophy of life applied to the whole data

Explanatory valuable	Regression coefficient	S.E.	β-coefficient	t-value	p-value
Constant	0.053	0.257		0.205	0.838
Scientism	-0.276	0.061	**-0.319**	**-4.541**	0.000
Undergraduate/Graduate	0.427	0.130	**0.231**	**2.506**	0.001
Sex	0.102	0.122	0.059	0.837	0.404
Tohoku 3 prefectures	0.005	0.041	0.008	0.120	0.904
				R^2=0.146 F=8.190	(p=0.000)

To clarify the situation, cross tables are shown between students' grade and an alternation of philosophy of life for students with low and high level of scientism (**Table 5**). We found that graduate students altered their philosophy of life more largely than undergraduates, although they had a higher score of scientism in general and these scores caused the stability of their philosophy of life.

The criticism on using nuclear power as a part of electric energy has been increasing in the public opinion after the disaster in Japan. According to the investigation published by Member of Gallup International Association (October 2011), about one third of the Japanese people thought that using nuclear power should be stopped completely and two thirds of the people approved of decreasing usage of power just after the disaster. This tendency of opinion against nuclear power plants has gotten stronger as time passes.

Table 5: Relationship between attribute of students and philosophy of life controlled by the level of scientism

Level of scientism	Attribute of students		Alternation of philosophy of life			Total
			Not	In behavior	In mind	
Factor score ＜0	Undergraduate	Freq.	**28**	18	21	67
		(%)	**(41.8)**	(26.9)	(31.3)	
χ^2＝12.52 (p=.002) Peasons'R=.254 (p=013)	Graduate	Freq.	8	1	**19**	28
		(%)	(28.6)	(3.6)	**(67.9)**	
	Total	Freq.	36	19	40	95
		(%)	(37.9)	(20.0)	(42.1)	
Factor score < 0	Undergraduate	Freq.	**46**	11	8	65
		(%)	**(70.8)**	（16.9）	（12.3）	
χ^2＝6.57 (p=.038) Peasons'R=.227 (p=018)	Graduate	Freq.	**23**	6	14	43
		(%)	**（53.4）**	(14.0)	(32.6)	
	Total	Freq.	69	17	22	108
		(%)	(63.9)	(15.7)	(20.4)	

We found that although scientism might reduce the vulnerability on students' philosophy of life, graduate students, who must have formed scientism through university science education, may be more vulnerable than undergraduate students. We may interpret this fact as a kind of age effect, for the oppositional view that we found on using nuclear power among Japanese late teenagers drastically become stronger among Japanese in their early twenties. For example, 23.7% of Japanese late teenagers oppose the use nuclear power in order not to have a bad influence on economic activities, while 41.8% of Japanese in their twenties had the same opinion.

This result implies that if we had given undergraduate students an education on environmental ethics or humanity seriously, the extravagance of scientism might have been suppressed, and graduate students' philosophy of life would have been more strongly influenced by the disaster. University education for young students in natural science and technology programmes might suppress a natural alternation of human being on his/her philosophy of life.

Scientism may contribute to the stability on people's philosophy of life, but it is not necessarily desirable to form it extravagantly by university education because the level of scientism which scientists or technical experts have is probably inconsistent to the public's philosophy of life. To make young students susceptible to nature, we think that the education system for university students, especially undergraduate students; should be re-constructed from the viewpoint of environmental ethics.

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