

The Consciousness of Junior High School Students on Energy in Japanese Technology Education

- Analysis by the text mining -

Hikomichi MAMORITA

*Hakusan Municipal Hokusei Junior High School
112-1 Hiraki Hakusan, Ishikawa, Japan*

Kimihito TAKENO

*Faculty of Education, Shiga University
2-5-1 Hiratsu Otsu Shiga, Japan*

Toshifumi YUJI

*Faculty of Education & Culture, University of Miyazaki
1-1 Gakuenkibanadai-nishi Miyazaki, Japan*

Abstract- The purpose of this study is to make clear the consciousness of junior high school students on energy. For that purpose, we targeted junior high school students having learning experience of “Energy Conversion” in Japanese technology education, and investigated via opinion by the free description. We analyzed students’ free description for measurements by coding work with a computer and investigated what junior high school students think is important on energy.

As a result, it could be interpreted that the three consciousness that junior high school students have are; the relation of the generation cost of energy and the load to environment on energy (Group1) and the attitude living in consideration for environment (Group2), the understanding of the generation system and the characteristic (Group3) on energy from analysis results called self-organizing map.

Keywords – Consciousness, Energy Conversion, Japanese Technology Education

I. INTRODUCTION

It is important to learn about energy in Japanese education, when we aim at the realization of the sustainable society. “Energy Conversion” in Japanese technology education has a part of the learning about energy in the junior high school of Japan as much as science and social studies [1].

The concept of energy defines “a source of power” [2]. In this study, “a source of power” was considered to be un-reproducible energy such as oil and renewable energy such as the sun and the wind.

In the study that investigated about learning on energy, teaching materials development and lesson practice of the solar photovoltaic generation [3] and the wind generation[4][5] are performed from the viewpoint of “Energy Conversion” in Japanese technology education and the effect is shown. In addition, in teaching materials development and lesson practice[6] of the difference of temperature generation using the peltier element, Yamamoto and Moriyama and Sumi and Ikegami report consciousness for the energy increases and that junior high school students came to be able to point out a concrete example of the energy saving in oneself. Therefore, it could guess that teaching materials development and lesson practice of renewable energy the solar photovoltaic generation are effective to raise interest on energy to junior high school students. However, a teacher grasps consciousness on energy of junior high school students to perform more effective learning instruction, and need to teach learning on energy.

For examination of the consciousness of junior high school students, Scholars may carry out the investigation of free description in the questionnaire method. Also they may analyze the answer to free description using a technique called text mining. Text mining [7] defines a technique and a system extracting the useful information that it was not found so far by dividing the group of the sentence without the limitation into a word and a phrase using technique of the natural language analysis, and analyzing those appearance's frequency and association.

In this study, we thought that useful knowledge for energy of junior high school students were provided by analyzing the answer to free description by text mining.

Therefore, the purpose of this study is to make clear the consciousness of junior high school students on energy. For that purpose, we targeted junior high school students having learning experience of "Energy Conversion" in Japanese technology education, and investigated via opinion by the free description. We analyzed students' free description for measurements by coding method with a computer and investigated what junior high school students think is important on energy.

II. STUDY METHOD

A Investigation method –

For the purpose of this study is to make clear the consciousness of junior high school students on energy, we performed an investigation. We conducted a main study on the total number of 60 eighth grade students at one secondary school having the learning experience of "Energy Conversion" in Japanese technology education. They had mainly the learning experience about mechanism and maintenance of energy transformation equipment, design and making of the production items which energy conversion is used on "Energy Conversion". Also we asked for an opinion by the investigation of the free description. The question of free description was "Please write what you want to be important on energy through learning of the Energy Conversion".

We conveyed that the investigated results were not related to school results and carried out the answer to investigation in about 15 minutes. The inquiry time took place in March 2014.

B Analysis method –

In this study, we analyzed the answer to free description using a quantitative method. Coding work to quantify data is indispensable to analyze the qualitative data such as the answer of free description for measurements. Coding work of this study used "KH Coder" which Kawabata and Higuchi [8] developed. "KH Coder" comprises most of the functions necessary for coding.

We divided an answer sentence of free description into individual words and added it up every word. And we totaled how many students used which word up and output 115 words that appeared twice or more. And then using these 115 words, we made the scatter diagram of words that closely put on the word that resembled in the appearance pattern.

In this study, we investigated, by analyzing 115 words which appear frequently, what junior high students think is important on energy with the method of the multivariate analysis called self-organizing map.

III. ANSWER TO FREE DESCRIPTION ITEM ANALYSIS

A Words with many answers –

First, the example of the obtained a free description answer is given.

The example:

I want to make water power generation important.

In this study, such as these free description answers were, we got 164 sentences. We inputted all free description answers by text format. This data is thrown in a coding program called "KH Coder", and it is a pause to a word about an answer sentence automatically. And it is shown in the outputted data which respondent used which word. For example, the result that a respondent of the example1 used words such as "water power", "generation", "important", "be" is outputted. Also the result totaled for every word is shown in Table 1. The total number of words

used in extraction is 1469 words and the different number of words is 329 words and the number of sentences used is 164.

We totaled how many students used what kind of word to grasp consciousness on energy of junior high school students. The result that showed 115 words that there was much number of the appearances is shown in Table 2. Junior high school students often used “think” (121 times) and “energy” (115 times), “important” (72 times) when we watched words with a large number of the appearances. Because it uses these words in the question sentence of free description, we thought that these words appeared considerably a lot. In addition, junior high school students used “nuclear power” (15 times) and “thermal power” (14 times), “hydraulic power” (11 times) that showed the generation system. We teach junior high school students the learning contents of the generation system using energy resources on “Energy Conversion” in Japanese technology education. As a result, we suggest that the words related to the generation system are pervasive in junior high school students.

Table 1 Numerical data extracted

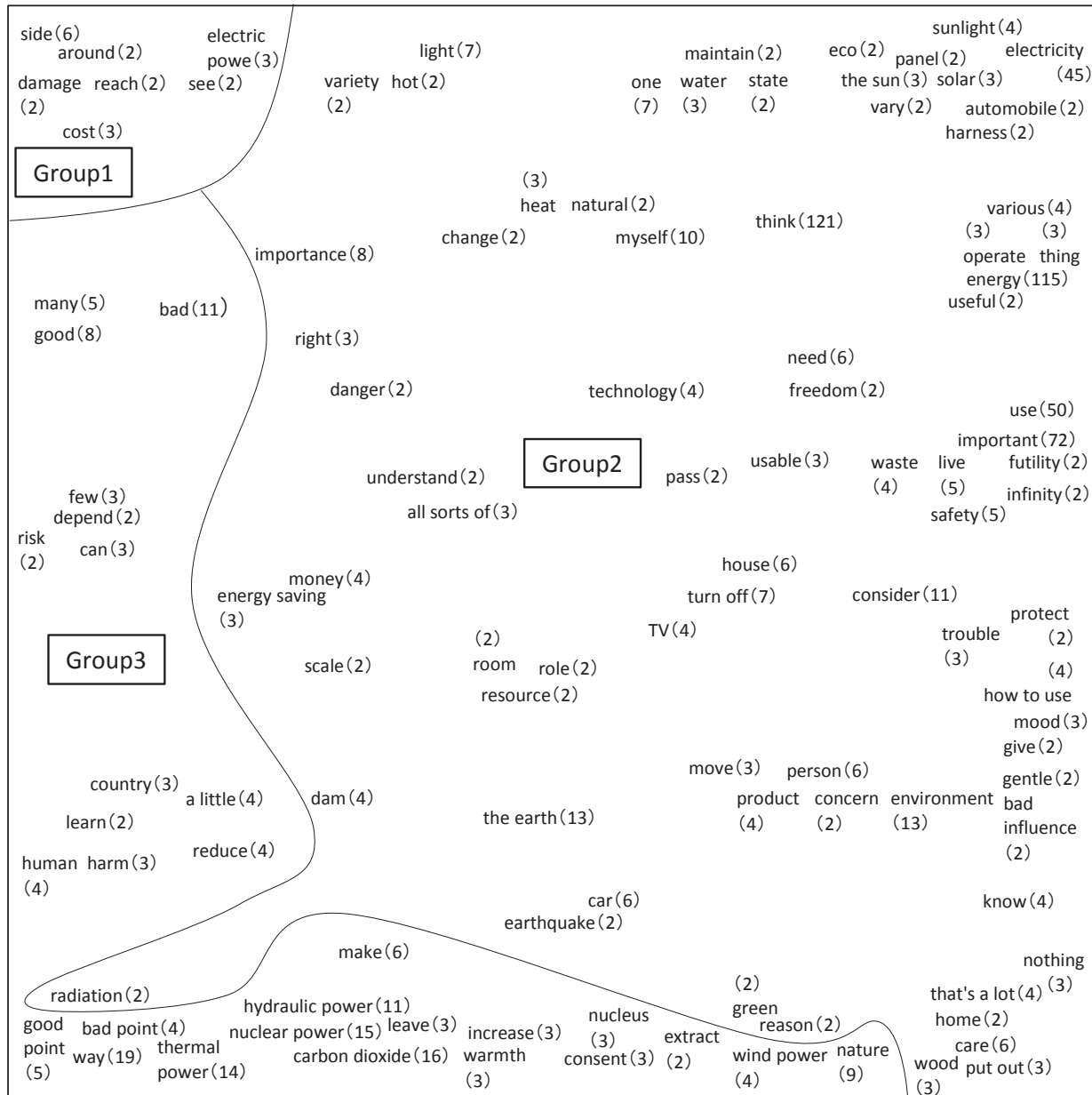
n (students)	60
The total number of words used extraction (words)	1469
Number of sentences (sentences)	164
Different number of words (words)	329

Table 2 115 words which appeared frequently more than two words in an answer

Extraction word	The number of appearances	Extraction word	The number of appearances	Extraction word	The number of appearances	Extraction word	The number of appearances
think	121	live	5	put out	3	see	2
energy	115	many	5	leave	3	resource	2
important	72	good point	5	can	3	automobile	2
use	50	various	4	few	3	freedom	2
electricity	45	money	4	energy saving	3	around	2
way	19	dam	4	various	3	state	2
carbon dioxide	16	TV	4	water	3	earthquake	2
nuclear power	15	waste	4	right	3	natural	2
thermal power	14	technology	4	increase	3	hot	2
environment	13	reduce	4	the sun	3	extract	2
the earth	13	how to use	4	electric power	3	damage	2
bad	11	a little	4	operate	3	room	2
consider	11	human	4	move	3	understande	2
hydraulic power	11	product	4	heat	3	change	2
myself	10	sunlight	4	thing	3	vary	2
nature	9	that's a lot	4	nothing	3	maintain	2
impotence	8	bad point	4	wood	3	radiation	2
good	8	know	4	eco	2	protect	2
one	7	wind power	4	panel	2	infinity	2
light	7	cost	3	risk	2	futility	2
turn off	7	consent	3	bad influence	2	role	2
house	6	solar	3	home	2	useful	2
make	6	warmth	3	pass	2	gentle	2
car	6	harm	3	learn	2	give	2
care	6	nucleus	3	harness	2	variety	2
person	6	mood	3	concern	2	depend	2
need	6	country	3	danger	2	reason	2
side	6	usable	3	scale	2	green	2
safety	5	trouble	3	reach	2		

B Making of the self-organizing map –

As the stage of the computer coding, we used 115 words which appeared frequently that we showed in Table 2, we made the scatter diagram of word that closely put on the word that resembled in the appearance pattern. The diagram which divided a part considered the words that resembled closely gathered in a line is shown Figure 1. In addition, we gave each part which we divided in a line the name from Group1 to Group3. The three groups were



(The inside of a parenthesis is the number of appearances of a word. Drawing is based on an author.)

Figure 1. Self-organizing map of 115 words which appeared frequently

shown in Figure 1 when we greatly distributed it as the group which resembled closely of the appearance pattern.

We want to explain the details of these three groups sequentially as follows.

Group1 gathers the words which are related to the relation of the generation cost of energy and the load to environment such as “electricity”, “cost”, “around”, “damage”. As a real answer example, that was “For example, nuclear power generation can bring about the much electric power with little generation cost, but on the other hand, if we are contaminated, damage will reach us. Such as this, when we see only good side and act, it may be too high cost or damage may attain the surroundings. Therefore, I thought it is important to understand bad side”.

Group2 gathers the words which are related to the attitude use energy to be necessary in living a life such as “energy”, “important”, “use”, “necessary” as the words with much number of the appearances. As a real answer example, that was “I thought I wants to value that I do not do waste trainers because the energy is very important to live”. In addition, Group2 gathers the words which are related to the attitude of using energy safely such as “safety”, “accident”, “how to use”. As a real answer example, that was “I study accidents to happen by how to use of the energy and I want to be important how to use safe energy”. Furthermore, Group2 gathers the words which are related to the attitude use renewable energy such as “sunlight”, “solar”, “state”, “maintain”. As a real answer example, those were “I think that solar power is important for us. I think that the solar panel gets the sunlight, and then it is generated. Also it becomes eco. Because it is energy saving, I think that it is important” and “I thought it was great that energy is transformed into different energy. For example, it generates electricity from sunlight or it generates electricity using the water no longer needing, and I think that they are an energy transduction into many energy transduction” I think that having to value in such energy transduction is maintaining this state. Although possibly there were many things regarded as it having to correct about present environment and society, I thought it very important to maintain the current state. Therefore, we can be interpreted that Group2 is a set of the words which are related to the attitude living in consideration for environment.

Group3 gathers the words which are related to the generation system such as “nuclear power”, “thermal power”, “hydraulic power”, “way”. Also Group3 contains the words which are related to the characteristic of the generation such as “good point”, “bad point”. As a real answer example, those were “I understand that the energy used while we are living is built by various methods. Although Japan generates electricity, provides electricity and there was also a safe field, the dangerous field also got to know a certain thing, and thought it important to carry out the right use”, and “I want to utilized their good point because there are thermal power generation and hydraulic power generation, nuclear power generation have both the good point and the bad point” Therefore, we can be interpreted that Group3 is a set of the words which are related to the understanding of the generation system and the characteristic.

IV.CONCLUSION

The purpose of this study is to make clear the consciousness of junior high school students on energy. For that purpose, we targeted junior high school students having learning experience of “Energy Conversion” in Japanese technology education, and investigated via opinion by the free description. We analyzed students’ free description for measurements by coding method with a computer and investigated what junior high school students think is important on energy.

As a result, it could be interpreted the three consciousness that junior high school students have the relation of the generation cost of energy and the load to environment on energy (Group1) and the attitude living in consideration for environment (Group2), the understanding of the generation system and the characteristic (Group3) on energy from analysis results called self-organizing map.

In this study, they had mainly the learning experience about mechanism and maintenance of energy transformation equipment, design and making of the production items which energy conversion is used on “Energy Conversion”. We can check that the consciousness of junior high school students on energy are included in the learning contents mechanism and maintenance of energy conversion equipment on junior high school course of study commentary technology and home edition [9]. In particular, we can check that Group 1 and group 3 are the learning contents mechanism of energy conversion equipment, and Group 3 is the learning contents to consider about technological appropriate evaluation and utilization [9]. Therefore, we can suggest that junior high school students in this study had the attitude which considers in the environment and lives with understanding energy conversion technology.

Investigation of this study was conducted for 60 eighth grade students at one secondary school. And we could analyze students' free description for measurements by coding method with a computer and investigated what junior high school students think is important on energy. However, as we could not get the enough knowledge which can be generalized, we would like to do as next study task that we increase the total number of the investigation schools and students, and grasp conversantly of the consciousness of junior high school students on energy.

REFERENCES

- [1] The Ministry of Education, "Junior high school course of study commentary technology and home edition", Kyouiku Tosyo, pp.14-15, 2008.
- [2] S. Wehmeier, "Oxford Advanced Learner's Dictionary", Oxford University Press, p.482, 2000.
- [3] H. Okura, N. Sumi, S. Ueda, "Development and Application of a Solar Pursuing Equipment in Teaching the Basic Princile of Energy Conversion", Journal of Japan Society of Technology Education, Vol.35 No.2, pp.141-148, 1998.
- [4] T. Ogawa, H. Yoshida, H. Kawasaki, "Development of a Wind Turbine System as One of the Teaching Materials of Energy Conversion", Journal of Japan Society of Technology Education, Vol.29 No.3, pp.9-19, 1987.
- [5] M. Kato, "Development of a Wind Turbine Generator for Energy Conversion Learning", Journal of Japan Society of Technology Education, Vol.48 No.2, pp.101-1109, 2006.
- [6] T. Yamamoto, J. Moriyama, K. Sumi, Y. Ikegami, "Development and Lesson Practice of Experimental Device with Peltier Element to Learn Thermal Energy Conversion", Journal of Japan Society of Technology Education, Vol.49 No.4, pp.315-322, 2007.
- [7] T. Ueda, "Text Mining to Learn in An Example", kyouritu Syuppan, pp.62-69, 2008
- [8] A. Kawabata, K. Higuchi, "Observations on what and how people think about the Internet: Analyzing open-ended questions", Graduate School of Human Sciences, Osaka University, Vol.29, pp.162-181, 2003.
- [9] The Ministry of Education, "Junior high school course of study commentary technology and home edition", Kyouiku Tosyo, pp.23-27, 2008.