A Case Study of ICT Used by Big Data Processing in Education: Discuss on Visualization of RE Research Paper

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ABSTRACT

The latest technologies and information have been introduced one after another at the present field of education. On the other hand, however, it is questionable, whether those technologies and information are understood conveniently. In the case of research papers, for example, is really it true that the paper has been written well about her/his idea, in which the author would like to express? From those questions, we have carried out a survey of research papers.

In this paper, we have an awareness especially concerning with academic writing as our core research question. As one of the problem solving, we have extracted the main problems of writing and found out the solution by referring to visualized RE research paper in the field of mechanical technologies.

We consider that the contents of the visualized RE (Rotary Engine) research paper are written clearly and logically about the latest technologies and information.

CCS Concepts

• Information systems~Graph-based database models • Information systems~Data streams • Information systems~Data structures • Information systems~Stream management • Information systems~Heap (data structure) • Information systems~Cloud based storage • Information systems~Data stream mining

Keywords

Big Data processing, visualization, methodology of clear writing paper, human information processing, cognitive processing, conceptual metaphor

1. INTRODUCTION

As the technology of cloud computing has been advanced, an enormous amount of data for learners, such as interactive

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communication with SNS, portfolio of learning outcome, have been stored. It has been beginning to approach popularly how we process and use such a large amount of data [1][2][3][4].

In this paper, the purpose is to define and find out the clear writing method of research papers in the field of Educational Technology by using Big Data processing. Big Data processing means that the various data has been collected and analyzed for a certain one purpose. It is important how to apply Big Data processing for clear the writing methods of research papers [5][6][7].

Generally, it is said that the method of using Big Data which is still unstructured should be processed and grasped its feature at the first step. In other words, when we would like to find out its feature, we will have to process and make it structured.

One of the methods of the structuralizing data is presented graphically so that we can analyze a correlation visually among various data. It is considered that the visualization of data will help us to make their structure clear. And moreover, it begins to show that we can predict people's behavior by analyzing the correlation among them how they will be changed depending on conditions or situations.

Accordingly, we will survey the clearness concerning with writing of research paper in the field of Educational Technology and find out their problems. As a problem solving, we will refer to the writing method of engineering research paper and show an example of using Big Data processing in Education [8].

2. PROBLEMS

In 2001, Nagano [9] pointed out that it is difficult for researchers to put together a paper well about using ICT in education. As this problem solving, symposiums and workshop, dealing with a subject of writing paper, have begun to be held. It has also begun to revise rules of manuscript submission and points of writing.

In this way, why researchers are required to write paper clearly in the field of Educational Technology (ET) [10]. One of the reasons is that the view of interdisciplinary approaches is required for researchers to improve complicated system of Education concerned with an interaction between human and technology. From this viewpoint, because one researcher or one group would not have completed their study by themselves, it is considered that they need to share their results with each other.

For another reason, the latest technology and information have been introduced in education one after another. It means that potential problems might have always been remained because

most people would not have known them well in detail about advanced technology. Then, we predict in many cases that readers might not understand well about the results of author's study. From those reasons, it is considered that we need to address problems of clear writing methods of research paper in ET, so that we can share our results among researchers interdisciplinary.

3. DEFINING PROBLEMS

3.1 Methodology of Clear Writing

3.1.1 What is Clear Writing?

What is the clear writing of research paper? It is defined the clear writing that anyone can understand easily about issues which authors would like to report their study. In that case, what is understandable for readers? In this section, we will discuss the matter of clear writing from the view of human information processing while they are reading paper, based on the theory of conceptual metaphor which Lakoff and Johnson [11] proposed.

In the theory of conceptual metaphor its supposition is explained about the cognitive processing (human information processing) when people understand something with its concept based on another concept. The human information processing is explained that;

(1) perception, awareness, (2) scanning (input), (3) structuralizing (concept formulation phase) (4) conceptualize (conceptual system) (5) semantic decision

Structuralizing (3) is divided into two levels;

Level A is the basic structural level where is gathered abilities of gestalt perception or mental imagery.

Level B is the structure level of image schema with motion perception.

It is considered that the categorization [12] according to rules or patterns should be realized by metaphorical mapping from the range of physical structures which are simple and happened repeatedly to the range of notional structures.

Next, let us assume reading research paper as human information processing. It is supposed that human information is processing in real time by scanning or scheming continuously while a person has been reading it. In other words, we supposed that the information of paper has been streaming processed by image schema [13].

From those viewpoints, there are assumed two functions of mapping of conceptual metaphor. One is that readers try to understand something about which they have not known well. The other is that the function is used for processing amount of information [14] [15]. Therefore, we assumed that the strategies, which promote reader's information processing or her/his cognitive process might be related to the method of clear writing research paper.

3.1.2 Close resemblance to ET

As we have said in previous section, the function of conceptual metaphor is considered that mapping would be possible to make concepts expanded or transformed between different fields when their elements are equivalent with each other. Upon this, we will search the method of clear writing by comparing with close resemble field to ET.

At first, we will examine the adequacy of writing elements whether they are similar in ET, for example, study objectives, methodologies, and research subjects. In terms of study objectives and methodologies, it might be similar in the study field of engineering concerning with an improvement and an optimization of their systems because ET has taken the theory from engineering. In the case of study objectives, however, there is difference between ET and engineering, for example, the former is a human and the latter is a substance or a thing.

Accordingly, in the case of study in mechanical engineering (ME), their subjects are both human and machine, like computers, robots, cars, and planes. In this point, it is similar to ET.

3.1.3 Types of Writing

Generally, there are several types of writing, for example reports, essays, theses, paper, articles, and so on. It is assumed that each technology or strategy for writing must be different from each other.

In the case of research paper, it is considered that the rule of manuscript submission or points of writing which are shown by the institution of journal where paper will be published must have an influence on the methods of writing.

3.2 Comparing Clear Writing Methods between Similar Two Studies

From the viewpoint of previous section, we presumed that some facts of clear writing methods would be contribution rules and points of writing. And then, we have surveyed them which were announced in August 2003 by ET (Japan Society for Educational Technology) and ME (The Japan Society of Mechanical Engineers).

The results of our survey, the points of writing are shown in more detail in ME than in ET, for example, the method of making graphs, tables and numerical expressions, and instructing fonts.

Next, we extracted manuscripts of ME in 2013 so that we will compare clear writing methods between ET and ME. We have found out from the result of analysis that it was more easily to read and understand contents of EM paper than those of ET because of the coherent form, graphs and tables. Moreover, the contents of EM have been explained carefully for readers who are different fields in study.

3.3 Survey of Clearness

3.3.1 Purpose of Survey

We considered which is the problem remained concerning with clearness of paper in ET, should be found out. So, the purpose, which we carried out the survey of clearness for readers, is to find out the problem solving of the clear writing method in ET.

3.3.2 Method of Proceedings

We predicted that the rule of manuscript submission or points of writing might have effects on strategies or methods of clear writing. From this viewpoint, we have divided into three periods for survey along with their revisions [16], so that we can compare clearness among them. We have chosen two types of paper, Full Paper and Technical Information.

- (1) The first period . . . in 1998, 20 manuscripts
 - (2) The second period . . . in 2000, 21 manuscripts
 - (3) The third period . . . in 2005, 35 manuscripts
 - (4) The fourth period . . . in 2011, 25 manuscripts
- Total: 101 manuscripts

Firstly, individual cards for each paper have been prepared. Each card has blanks to fill in a title and a table of contents, which would make us to know its structure, flow, and elements of paper on sight.

Secondly, we have made the list of items for one hundred and one papers which titles were fill in one column, and five objectives with three items each (total: fifteen items) in the context to be entered the evaluation of papers along with the criteria of the measurement [Appendix 1], which we will show in the next section.

3.3.3 Clearness points of references

(1) Five objectives of evaluation for clearness points

- [A] novelty, [B] aim, [C] credibility,
- [D] validity/ acceptability, [E] structure

The measurement of objectives has seven levels of clearness.

Cf. quite clear, very clear, clear, unclear, very unclear,
quite unclear

Each objective point is from 3 to -3 (Fig. 1).

Total objective point is from 15 to -15.

(2) Each objective has three items for check (a), (b), (c)
Three items of each object are different from other object items.

The measurement of each item has three levels of clearness/

Cf. clear, understandable, unclear

Each item point is from 1 to -1.

Total item point is from 15 to -15

3.4 Results and Analysis of Survey

The result of the distribution analysis for the total item point in the fourth period is the smallest spread comparing with other periods. The rang of the total items points of eleven Full Papers is from seven points to fifteen points. The lowest total item point is higher than the other periods. Moreover, there is higher proportion of perfect scores than other periods (5/11) (Fig. 2).

From those results, the revision for rules of manuscripts submission and points of writing must have effects on writing strategies and help authors to write full papers clearer. Concerning with Technical Information manuscripts, the distribution in the fourth period is the smallest spread (Fig.3). Then, it is also said that the improvement of papers has also been shown in the fourth period.

Each objective point is higher than normal points except [D] validity/ acceptability in the fourth period.

In terms of this objective point, however, there happens a paper, which is evaluated very unclear. In other periods, the potion of paper, which are evaluated unclear in the item of [D] validity/ acceptability is also higher than the other items (Fig.1).

3.5 Defining Problems

What the meaning of “validity/ acceptability” is, when we consider clear writing.

The criteria of evaluation for clearness are;

- (a) Points of the paper would be understood with graphs.
- (b) Points of the paper would be understood with tables or

charts.

(c) Discussion of the paper would be understood clearly.
three items by each observation.

The first two items (a), (b) will be evaluated by judging whether the paper might make readers to connect contents which they have understood by graphs, tables and lists with points of the paper which the author would like to emphasis. The last item (c) will be evaluated by judging the correlation between the structured concepts by previous items and the discussion.

According to those reasons, the problems of validity/ acceptability might have influenced readers who would not always be able to make mapping by image schema between contents and graphs or tables.

Figure 1. Average Points of Evaluation for Objectives.

Figure 2. Distribution of Total Point for Items.

Figure 3. Distribution of Validity Point.

From the results of evaluations, the problem concerning with clearness have been defined. It means that we must find out solutions of this problem caused by disturbing readers' structuring concepts. Authors will have to consider cognitive processing of readers and improve graphs or charts so that they become able to be aware of patterns or rules from them.

4. PROBLEM SOLVING

4.1 Resemblance between ET to EM

As we have mentioned, the field of EM study about computer, robots, and cars is similar to ET because both fields involved complex elements as their systems are structured by an interaction between men and machines.

Moreover, in the case of ET, as it is difficult to observe the learning process which we need to find out the problems with changing learners' mind, the facts of clear writing paper might have strongly an effect on clearness.

When we think about RE study, it is the same as ET because of the problems which they are not able to observe the process of combustion in rotary housing. Then, RE is more similar to ET than other EM studies. From those reasons, we will find out problem solving of validity/ acceptability for clear writing, comparing RE to ET.

4.2 The Feature of RE Development

The development of RE has begun about in 1960. Why they had to find out problem solving for the development. One of the reasons, the combustion processing of conventional reciprocating engines is observed from outside because their pistons moving up and down.

On the other hand, in the case of RE, because four kinds of processing for the combustion in a rotary housing are continuously executing, it is difficult for us to predict their performance in detail the same as human brain. It was, however, important for researchers of RE to find out its problems. Then, they have developed the experimental engine with a sapphire glass at the front of it.

4.3 Resemblance between ET to EM

What is the feature of visualized RE paper for readers. Before they explain about the experiments, elements of the whole systems structure and their connections are explained with graphs and tables so that readers from other fields would be able to understand clearly. Readers have learnt about fundamental pattern and rules of RE by those explanations [17] [18].

It is considered that readers might be able to structuralize their abstract concepts of information so that they will be able to understand the next explanation for the experiments. We can say that RE paper is considered for readers along with their cognitive/ information processing. When the devices of experiments are explained, they have shown and explained about their system of experiments and measuring instruments with charts in details.

It is also figured out for the method of the measurement so that they will obtain reliability from readers related to the probability of reproducible experiments and getting their acceptability. The method of experiments has been considered that readers would be able to comprehend easily, according to the result of the simulation in previous studies in which conditions and situations for the present proceeding of experiments had been decided. It is predictable that readers might be feel the most difficult to

understand the results of the experiment for the combustion processing of RE.

The idea of expression for this combustion processing is the creative and effective way for readers. For example, they try to express the temperature with gray scales, which had measured by colors of the combustion with the data of video film. Moreover, authors had addressed making graphs with Big Data processing and analysis for expressing results of experiments in real time. In other words, the data which had been gathered in experiment, for example the temperature and conditions, had been processed by streaming technology.

The visualized graphs had been made separately by conditions and situation, with the crank angle on x-axis and rotary position on y-axis. It makes graph making successfully because readers would be able to compare combustion patterns with graphs depending on conditions of the number of plugs and positions, and consequently understand which condition is the most effective. From those analysis of clear writing methods, we presume how readers are processing information of data which have inputted and acquired from paper.

It is considered that readers might have constructed their conceptual system of RE, which they had not known before, by structuring with image schema from pattern and rules of the combustion or rotary from their already known fact.

5. CONCLUSION

We have shown the case of ET concerning with clear writing paper methods by finding out the problems and solution. RE example will be referred to how we can use Big Data processing for writing paper visually along with human information processing. Consequently, the method of writing clearly must bring readers that they can understand teams easily, and then they might be able to transfer and reconstruct their concepts.

6. REFERENCES

- [1] Higuchi, Tomoyuki. Data scientist: a key factor in innovation driven by big data, *Journal of Information Processing and Management* 56(1), 2-11, Japan Science and Technology Agency, (2013).
- [2] Amano, Toru, Points of Statistics Education in Big Data Era, *Computer & Education*, Vol. 40, pp. 85-90, (2016).
- [3] Terasawa, Takafumi. Special Reports on "Learning Analytics and Educational Cloud", Significant potentials of big data in education and risks for academism: Importance of further cooperation between computer science and social science, *Computer & Education*, Vol. 38, pp. 28-38, (2015).
- [4] Terasawa, Takafumi. Method for Discovering Meaningful Information in Educational Big Data—Behavioral Prediction Based on Cognitive Psychological Findings—*Transactions of Japanese Society for Information and Systems in Education*, Vol. 33, No. 2 p. 67-83, (2016)..
- [5] Tsujioka, Keiko. How to Write Explicit Research Papers in Study of Educational Technology: Examination by Visualizing Process of Internal Combustion on Rotary Engine, *The 33rd Annual Conference of Japan Society for Educational Technology*, pp. 619-620, (Sep. 2013).
- [6] Tsujioka, Keiko. A Case Study of ICT Used by Big Data Processing in Education, *JSiSE research report* 29(1), 11-16, (May 2014).

- [7] Tsujioka, Keiko. A Case Study of ICT Used by Big Data Processing in Education: Discuss of Visualization of RE Research Paper. JSiSE research report 29(2), 65-72, (Jul. 2014).
- [8] Tsujioka, Keiko. A Case Study of ICT Used by Big Data Processing in Education: Discuss on Visualization of RE Research Paper the 39th Annual Conference of JSiSE, pp.381-382, (Sep. 2014).
- [9] Nagano, Kazuo. Information and Communication Technology in Learning Activities. Japan journal of educational technology 25(2), 159-161, (Sep. 2001).
- [10] Nakano, Terumi. Problems of Defining Educational Technology, Japan Journal of Educational Technology Vol. 2, No. 2 p. 43-48, (1977).
- [11] Lakoff, George and Mark Johnson. 1980. *Metaphors We Live By*, University of Chicago Press, Chicago and London, (1980).
- [12] Lakoff, George: "Women, Fire and Dangerous Things. 1987. *What Categories Reveal about the Mind*, University of Chicago, Press, Chicago and London, (1987).
- [13] Schmidt, R. A. A schema theory of discrete motor skill learning. Psychological Review, 82(4), 225-260. (1975).
- [14] Kunioka, Takahiro, Study on analogy in mathematics education (2) Analysis of mathematics learning by conceptual metaphor, Journal of JASME 15(2), 17-27, (2009).
- [15] Naoki Kotani, A Verification of Reinforcement Learning with Knowledge Transfer and Knowledge Selection in Multitask Learning, Transactions of the Institute of Systems, Control and Information Engineers, Vol. 29, No. 3 p. 152-154, (2016).
- [16] Japan Society for Educational Technology <https://www.jsiet.gr.jp/letter/index.html>(2017).
- [17] Takahashi, Yoshitomo. 2010. Influence of Spark Plug Position on flame Propagation of a Rotary Engine. Journal of the Society of Mechanical Engineers 113(1105), 924-925, (Dec. 2010).
- [18] Okui, Nobunori. Takahashi, Yoshitomo. Kagawa, Ryoji. Tabata, Michihiko. Moriue, Osamu. Murase, Eiichi. 2009. Ignition and Combustion of Rotary Engine: Effect of spark-plug arrangement on flame propagation, Review of automotive engineering 30(4), 379-385, (Oct. 2009).

Appendix 1. Criteria of Assessment

Objectives		Assessment	
A	Novelty	•to make one's standing clear with previous studies	(a) to show the direction of previous studies
		•not to consider seriously about the degree of novelty but examine whether one's paper is characterized well or not	(b) to show the relevance between one's paper and previous studies
		•to evaluate how much one's explanation is clear about the survey or facts	(c) to make the position of one's research clear
B	Aims	•to make one's explanation based on the previous studies	(a) to make the point of one's study clearly
		•to make the method of problem solving clear	(b) to show the point of issue in the background of one's study
		•to examine how points both the goal and solving are useful for education and learning	(c) to show the method of problem solving
C	Credibility	•To make one's explanation based on the previous studies	(a) to show one's prediction of results
		•to explain clearly about one's hypothesis testing on the model with examinations or practices •to faithfully reproduce results.	(b) to show one's prediction based on the theory
		• To bring reproducible results faithfully	(c) to show the results of the hypothesis testing by experiments or practice
D	Validity	• to explain one's points visually with clear graphs	(a) to take one's points connected with graphs visually
		• to explain one's points visually with clear tables, and charts	(b) to take one's points connected with tables and charts
		• to be expected usefulness of one's study purposes by own discussion	(c) to understand points of discussion clearly
E	Structure	• to make the flow of the paper clearly and understandable	(a) to understand the research contents from the titles of thematic chapters and theme of section
		• to understand points clearly from the title of chapters and sections	(b) to make the stream of thematic chapters smoothly
		• not to make a leap of topics	(c) not to make a leap from one point to another.