

Measurement of Critical Viewing Skills in Web Browsing using Correspondence Analysis

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Abstract

The purpose of this study is to develop a measure of Critical Viewing Skills (CVS) in web browsing using correspondence analysis. To assess their CVS, children were asked to write comments about how to identify the reliability of web pages, by considering a commercial site related to dieting. Using a category system for analysis, children's and students' comments were converted to categorical data. To identify the structure of CVS categories, we used category plotting based on multiple correspondence analysis. As a result of analysis, it was found out that structure of CVS was explained with three dimensions. First dimension shows "whether an attempt is being made to view information from various perspectives". Second dimension shows "appropriateness of information point". Third dimension shows "content and media"

Using correspondence analysis, the possibility was shown of being able to use correspondence analysis in evaluations without damaging CVS data obtained from students. The author would wish to develop the use of correspondence analysis in pre and post tests and an evaluation system using correspondence analysis for evaluating and improving critical viewing training programs.

Introduction

With the spread of Information Technology, the importance of media education has increased. The

development of Critical Viewing Skills (CVS), the ability to make judgments about the reliability, bias and accuracy of information, has been considered to be a crucial factor in media education (e.g., D. Buckingham, 2004; DCMS, 2001). It is especially important to evaluate the effectiveness of media education. On the other hand, the evaluation of CVS is a difficult problem (H. Ruminiski, & W. Hanks, 1997). To respond to the above, the authors developed a measurement of CVS using category analysis (Y. Gotoh, 2007). To assess their CVS, children were asked to write comments about how to identify the reliability of web pages, by considering a commercial site related to dieting. We developed a category system for analysis. For example, 'reliability of source of information', 'meta-information from the web', 'support information from media', 'support information from persons', 'importance of multi-point' and so on. Using this category system we could evaluate children's CVS into four levels; inappropriate description or no answer, list of either media or information, list of both media and information, and list of suitable media, adequate sources and useful information. Our measurement system is useful, but it has only four categories. To clarify the effectiveness of media education, we need more sensitive and practical measurements. In this study, the authors try to solve this problem using correspondence analysis. Correspondence analysis is one of the multivariate analysis techniques. Using response

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data, we can analyze the following two points. Firstly, the distance of each category can be shown in three dimensions. It looks as though the distances between each category are not equally spaced. For example, 'importance of multi-point', 'support information from multi-point media' and 'support information from multi-point persons' seem to be similar. Using multiple correspondence analysis, we find that similar categories plot close together and dissimilar categories plot further apart, which allows us to understand intuitively the structure of the CVS. Secondly, distances between children can be shown in three dimensions. Differences in CVS levels would be shown as distances between children. Compared with the four-category system, this system is more sensitive to individual differences in CVS levels. In future, we also aim to develop a measurement for pre-post differentials using this technique. By comparing the pre-position and post-position of individuals, the effectiveness of media education could be shown clearly and objectively.

Method

Sample and Investigation period

Questionnaires were given to 557 elementary school children, 377 junior high school students, 385 senior high school students and 387 university students. Homeroom teachers gave the questionnaires to their classes. Students were asked to comment on how to identify the reliability of information from commercial web pages. A "comic" style was used in order to encourage students to write. Using a category system for analysis, children's and students' comments were converted to categorical data. Correspondence analysis was applied. To identify the structure of CVS categories, we used category plotting based on multiple correspondence analysis. Relationships and distances between each category could be shown. To identify individual differences in CVS, we also used

sample plotting. Individual differences in CVS were shown by distances between plotting data. SPSS 17.0J and SPSS categories were used as a statistical analysis package.

Measure

Ennis (1987) divided Critical thinking into disposition and ability. Many kinds of critical thinking assessment tools have been developed to evaluate disposition and ability in critical thinking; for example, the Watson-Glaser Critical Thinking Appraisal Test, the Cornell Critical Thinking Test and the California Critical Thinking Skills Test. Ruminski & Hanks (1997) used these assessment tools to evaluate students' critical thinking in media education. Measures of CVS skills in web browsing are developed by referring to these former researches.

Firstly, the author developed measures using the Watson-Glaser Critical Thinking Appraisal Test style.

Comparison of television news programs and internet news web pages: One day, a television news program reported that there was a traffic accident and 10 persons were injured. After that, the Internet news web page reported that there was a traffic accident and 20 persons were injured.

After reading this, students were asked to choose the most suitable answer from the following four items.

- a) Information on Internet News Web pages is right.
- b) Information on Internet News Web pages is probably right.
- c) Information on Internet News Web pages is probably wrong.
- d) Information on Internet News Web pages is wrong.
- e) We need more information in order to judge.

The author expected that students would choose item a). because I believed that Internet News Web pages were a relatively new type of information. However, the results of the pre-test showed that students chose various items. The author decided that the Watson-Glaser Critical Thinking Appraisal Test style was not suitable for measuring critical viewing in web browsing.

Secondly the author modified the measure. For example, comparison of television news programs between two countries: A television news program report about the war between A country and B country. Both are belligerent and broadcast different information. The news program in A country emphasized that there were many innocent children killed or injured in an attack by the troops of B country. On the other hand, the news program in B country refused to admit this. Please tell me how to judge which information seems to be right.

Students were asked to write a comment. Here, some political or historical knowledge would be required. This case was not suitable for elementary school children. The author therefore developed over 40 types of measures and selected a web commercial situation on the basis of advice from researchers and educational practitioners.

Web commercial: One day, Akiko discovered the commercial pages of DIET-s. Medical scientists on these pages declared that 'DIET-s is expensive, but we guarantee the product's effectiveness.' Furthermore, there were recommendations from three customers with their experiences. Kenta then told Akiko how to confirm the effectiveness of DIET-s. Please play the part of Kenta, and tell Akiko how to confirm this information. Which information is useful? How do you obtain such information?

Students were asked to comment on how to identify the reliability of information from web pages. A comic style was used in order to

encourage students to write.

Analysis

Previously, the author had developed a category system for analysis (Gotoh, Y. 2006b). This category system was used for the present analysis.

The comments of students taking part in the experiment were read and it was determined whether or not the above analysis categories applied. The row categories are the students and the column categories are the analysis categories. Correspondence analysis was carried out on the basis of the data obtained.

Results

Determination of number of dimensions

Symmetric normalization was used as the normalization method. Symmetric normalization was selected because it was concerned with the difference and degree of similarity in both the row categories (students) and the column categories (analysis categories).

Three-dimensional representation was adopted on the basis of two points: interpretation potential of figure and proportion of cumulative inertia (Table 2). Nevertheless, even in three-dimensional representation the proportion of cumulative inertia was less than 40 per cent. This point will be discussed under issues for the future.

Interpretation

First × second dimensions

Figure 2 shows the plot of the analysis categories for the first x second dimensions. The first dimension takes media-single point, person-single point, inappropriate description-source, inappropriate description-method, etc. as one pole, and media-multi points and importance of multi points as the other pole. In terms of critical viewing, what is required is to assemble multi-faceted information from multiple points (i.e. sources), to judge which information points can



Figure 1.

Table 1 Category system for analysis (Gotoh, Y. 2006b)

	Category		Example of comments
Reliability of source of information	Author	Listing	'Information about the author'
		Background	'We need information about author's profession, achievements and fame.'
	Organization	Listing	'Information about the company'
		Background	'We need information about Products of organization and Social evaluation.'
Meta-information on the web			'On the web pages, Contact address and phone number should be needed.'
Information about the product		Listing	'Information about the product'
		Background	'We need information about materials, a side effect and how to make it.'
Support information	Media	Single point	'We can use Internet, book and TV.'
		*Multi points	'We need information from the web page provided from the third person'. 'Web pages produced by the customer.'
	Person	Single point	'We can advice from our parents.'
		*Multi points	'We need advice from profession who has special knowledge about diet.'
	*Importance of multi points		'To judge the reliability, we should use various source such as scientists, government, society and consumer organization.'
Critical Thinking			'The number of person of a successful isn't enough. We also need the number of person that failed in. A ratio of both is important.'
An inappropriate description	Method		'Buy and try it.'
	Source		'We can ask the corporation in detail'

Table 2 Inertia per dimension

Dimension	Proportion of Inertia				Confidence Singular Value		
	Singular Value	Inertia	Accounted for	Cumulative	Standard Deviation	Correlation	
						2	3
1	1.196	1.430	.169	.169	.023	.418	.402
2	1.026	1.053	.124	.294	.014		.227
3	.902	.814	.096	.390	.019		
4	.886	.784	.093	.483			
5	.830	.688	.081	.564			
6	.781	.611	.072	.636			
7	.773	.598	.071	.707			
8	.710	.504	.060	.767			
9	.664	.440	.052	.819			
10	.599	.359	.042	.861			
11	.585	.342	.040	.901			
12	.545	.297	.035	.937			
13	.523	.273	.032	.969			
14	.497	.247	.029	.998			
15	.127	.016	.002	1.000			
Total		8.455	1.000	1.000			

be relied on, and to avoid adhering to information from a single point. From this, it would seem that the first dimension shows “whether an attempt is being made to view information from various perspectives.”

The second dimension takes media-single point, media-multi points, importance of multi points and so on as one pole while the other pole is inappropriate description-source and inappropriate description-method. Inappropriate description-source and inappropriate description-method both involve direct questioning of the person who must judge the reliability of information. In contrast, media-multi points and importance of multi points involve questioning of someone other than the person who must judge the reliability of information, hence the second dimension shows “appropriateness of information

point.”

Figure 3 shows a plot of samples. By looking at it we can see 1) sample group close to media-single point, 2) sample group close to inappropriate description-source, 3) sample group close to origin and 4) groups associated with media-multi points and importance of multi points. Sample group 1) close to media-single point is just the group where media are simply listed as a method for judging the reliability of information. Sample group 2) close to inappropriate description-source is the group which questions the seller, as a method of judging reliability, and actually purchases. These two groups must be made to understand the necessity of assembling multi-point information and the importance of using appropriate information points. On the other hand, sample group 4) close

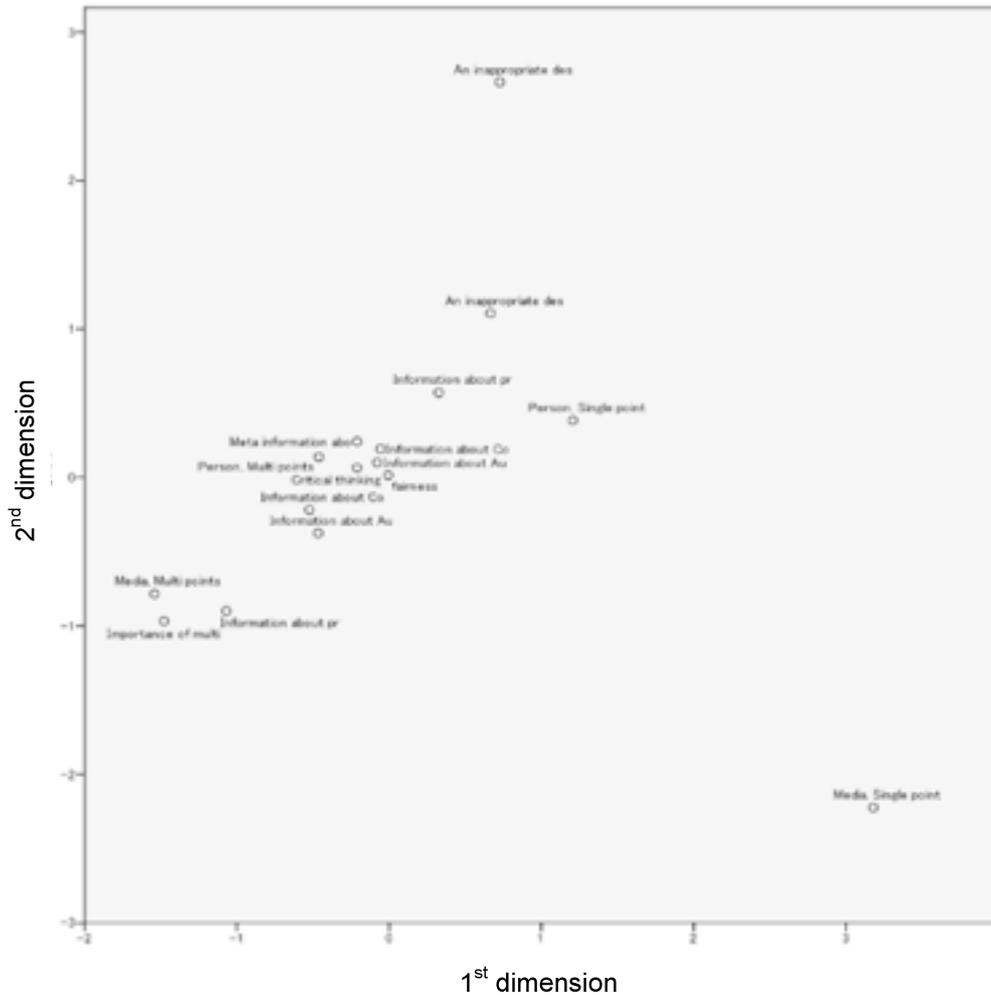


Figure 2. Plot of analysis category (first and second dimensions, principal normalization)

to media-multi points and importance of multi points selects appropriate information points, uses multi-point information and attempts to judge the reliability of information, which is a desirable trend. Group 3) close to the origin can be viewed as in a transitional situation between the sample groups in 1) and 2) and the sample group in 4).

First × third dimensions

Figure 4 is a plot of the analysis categories for the first x third dimensions. The third dimension takes media-multi points, importance of multi points and person-multi points as one pole while information about the product background is

plotted at the opposite pole. Since it concerns categories relating to media and categories relating to information content, the third dimension can be taken as the “content and media” axis.

Figure 5 is a plot of samples in the first x third dimensions. Unlike the 1x2 dimension plot, the groups are not greatly separated. We can see that the sample groups close to media-multi points, importance of multi points and person-multi points tend to indicate the importance of using media from multiple points, while the sample group close to the opposite pole of information about product background tends to indicate

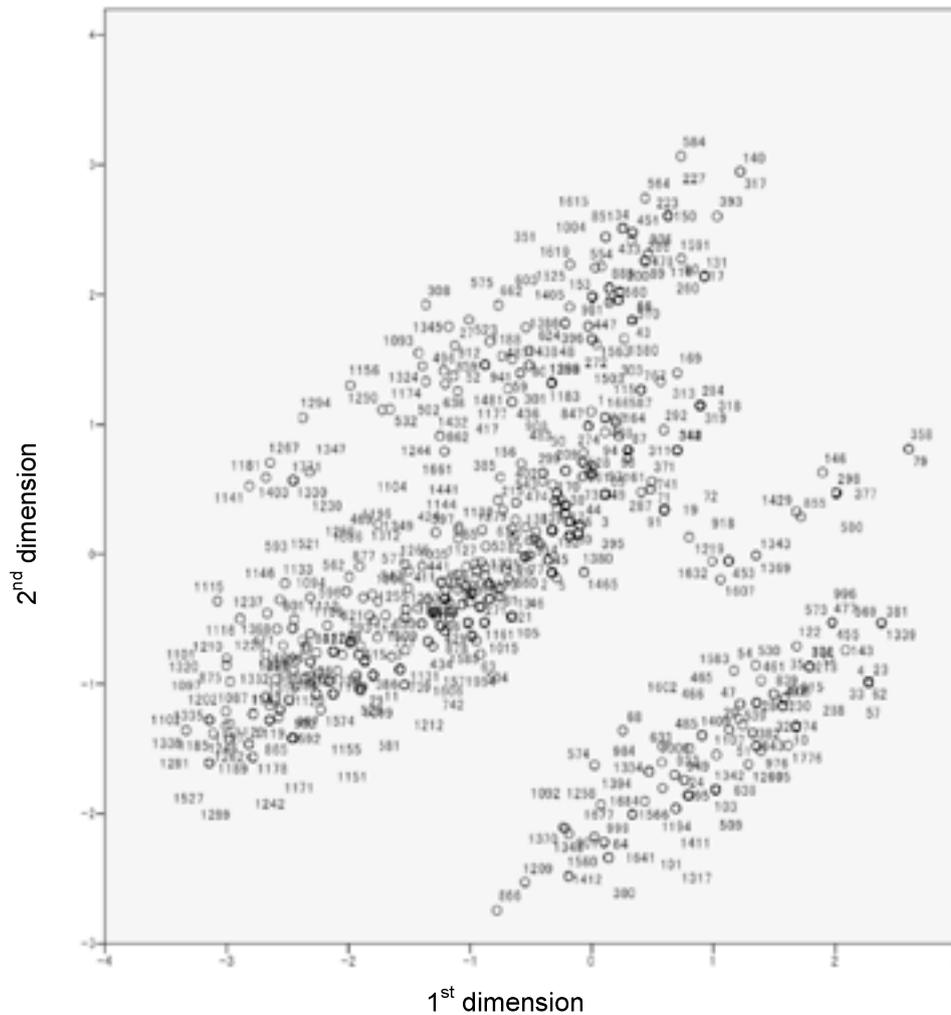


Figure 3. Plot of sample (first and second dimensions, principal normalization)

information relating to the product itself.

Application for evaluation

The objective of this research is to develop a scale for measuring more highly sensitive critical viewing skills (CVS). For the application of pre and post tests, virtual data were used and examined. Analysis categories and samples were plotted up to 3.2. In the virtual data, while only media-single point could be indicated in the pre test, media-multi points, importance of multi points and person-multi points could be indicated in the post test (Table 3). On the basis of these

results, the following virtual data were plotted. The scores for each dimension in the pre test and the post test are as shown in Table 4.

In Figure 6, the shift between pre and post was first interpreted from the plot of the first dimension x the second dimension. The pre position was close to media-single point. In the post test, it was clear that the position had shifted to one close to media-multi points, importance of multi points and person-multi points. For the first dimension, the dimension score changed from 1.611 to -0.659, showing that students had become able to indicate the necessity of judging the

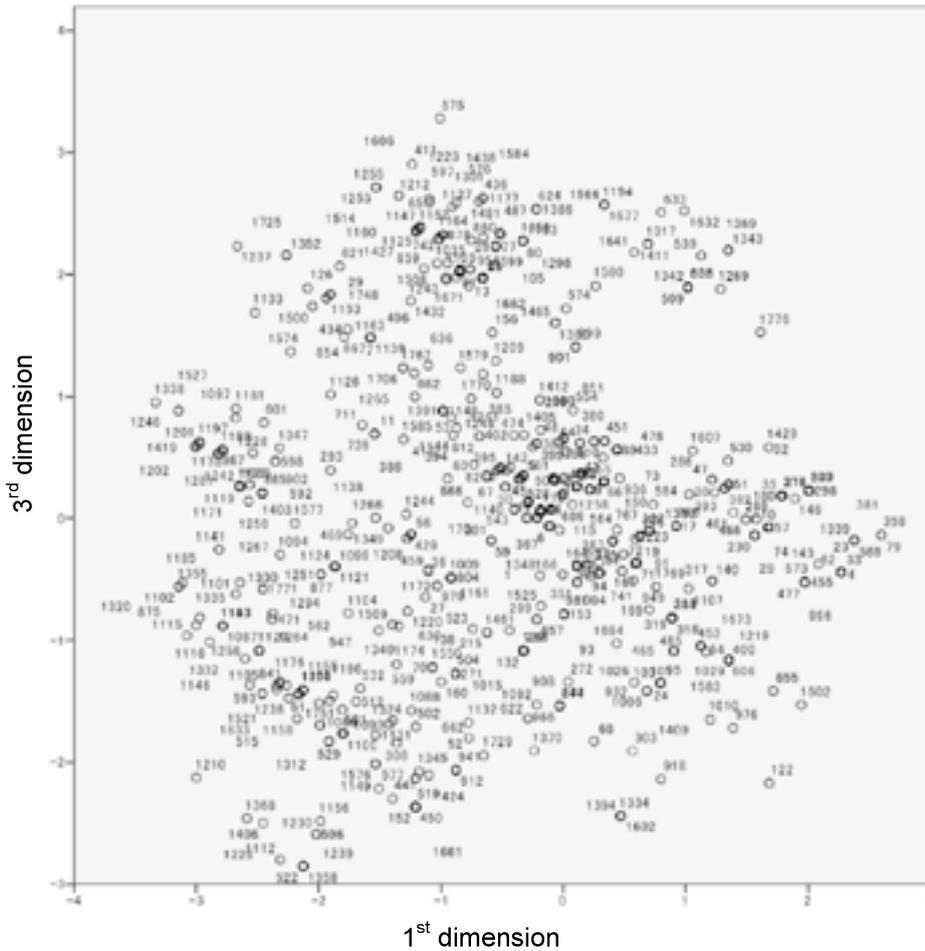


Figure 5. Plot of sample (first and third dimensions, principal normalization)

Table 3 Virtual samples

Pre test	Media-Single point
Post test	Media-Multi points
	Importance of multi points
	Person-Multi points

Table 4 Scores of dimension

	1 st dimension	2 nd dimension	3 rd dimension
Pre-test	1.611	-1.472	1.528
Post-test	-.659	-.483	1.970

is an important point. At the stage prior to embarking upon the present analysis, questions were asked about contents and methods for

verifying the reliability of information and so it was assumed that simple two-dimensional analysis, relating to the content dimension and the

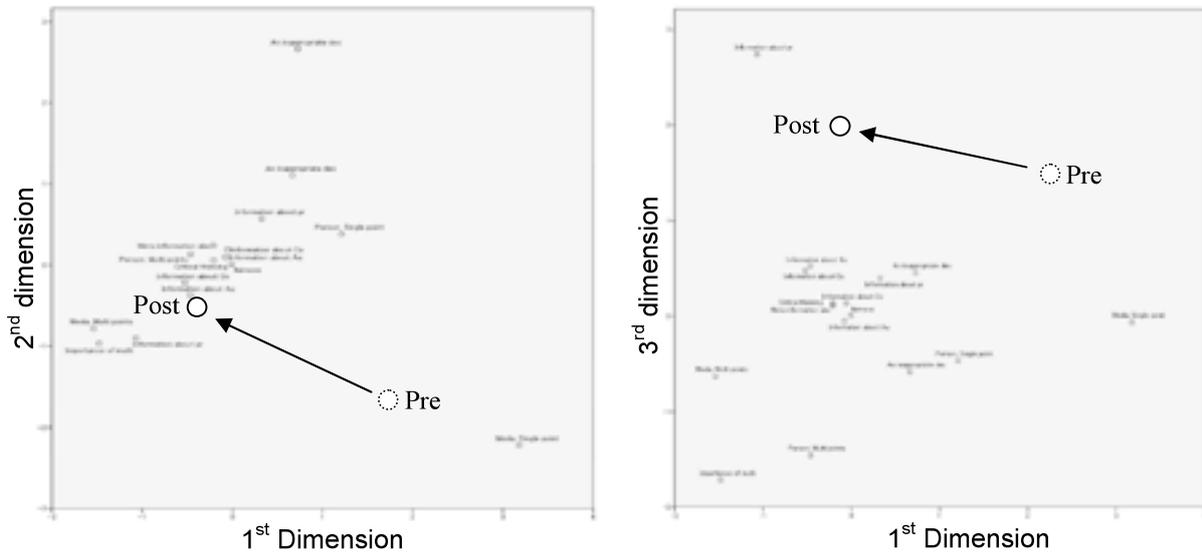


Figure 6. Difference between pre and post tests according to virtual data

method, could be obtained. In the analysis results, while the first dimension concerned method and the second dimension concerned contents, the proportion of inertia did not exceed .294. This suggests that the CVS structure is more complex than originally assumed. This point will be examined in future.

The problem of relative evaluation and absolute evaluation

In other words, the evaluation system using correspondence analysis shows the relative position within the samples and does not show what stage this is with regard to a supposedly ideal situation. This is the difference between relative evaluation and absolute evaluation. Ideally, the educational objectives to be achieved and lower objectives for the sake of achieving these higher ones should be clarified, and evaluation of the lower objectives should be carried out. An example of this is the criterion-referenced test. Although in CVS, there is an education objective, namely, “the methods and contents for verifying the reliability of information can be understood,” it is not clear

what sort of lower objectives exist. This research attempts to obtain a foundation for these data from the relative position of the CVS data obtained from students. However, there is no evidence that the CVS data themselves, i.e. the CVS data obtained from students, which would constitute such a foundation, are sufficient. For this reason, it will be necessary to repeat the examination carried out on this occasion on numerous samples.

The examination of the necessity and sufficiency of the analysis categories

On this occasion, analysis was attempted using three-dimensional expression. However, the cumulative inertia was less than 40 per cent. In analyses such as factor analysis, analysis using five-dimensional expression must be performed in order to exceed the criterion of 50 per cent. However, analysis is difficult when multiple dimensions are involved. One of the reasons for this is the complexity of the analysis categories. The authors wish to attempt another analysis, concentrating on necessary and sufficient content by consolidating the analysis categories.

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