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Stability of Document Analysis and Recognition for University Evaluation Reports

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Abstract. Multivariate analysis and natural language processing methods for textual information have become popular research techniques which can deepen understanding on of accumulated text data, such as evaluation reports, and also have possibility to lead new knowledge discovery. In this paper we focus on contents of textual information in evaluation reports of National University Corporation Evaluation in Japan. We conducted research on information extracting and text analyzing for grasping global and local features of the evaluation reports. Moreover, we considered stability of the analysis and recognition in case of textual data fluctuation.

Keywords: Evaluation reports, document analysis, recognition, stability.

1. Introduction

Various textual data analysis methods and visualization techniques have been developed so far to grasp and understand document information, such as *Morphological analysis*, *Cluster analysis*, and *Support vector machine* in text mining. Development of these methods leads to deep recognition of document information. In this paper, we focus on textual information of *student learning outcome* in *university evaluation reports*.

In recent years, urgent demand for accountability of higher education institutions [1] has caused necessity for development of public higher education database, where statistics and other information about colleges and universities could be accessed in order to clarify their accountability. Adding to the information of cost data, admissions data, and completion rates of the institution, database should contain the data of student learning outcomes to improve the quality of education [2]. Learning outcomes is described as "Learning outcomes refer to the personal changes or benefits that follow as a result of learning. Such changes or benefits can be measured in terms of abilities or achievements" [3]. However, it is not necessarily clear how to define appropriate indicators for measuring student learning outcomes. In the university evaluation, collecting the data from the objective indicators is substantially important to perform evidence-based evaluation, therefore, we have been trying to recognize indicators for measuring student learning outcomes from the documents of evaluation result (peer-reviewed evaluation reports) of National University Corporation Evaluation in Japan [4].

Generally, in document information such as contents of evaluation reports, there exist various vagueness and uncertainty, such as fluctuations of notations, synonyms, ambiguity of document contents in limited text volume, existence of essential or inconsequential keywords, and so on. Therefore, we confront various difficulties in our interpretation and recognition of evaluation reports. It is considerably important problem how to recognize the results of textual data analysis.

2. Evaluation report and category of indicator

2.1. Peer-reviewed evaluation reports

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We investigated the textual data originated from the results of university evaluation which was performed in fiscal 2008 for all national universities in Japan by National Institution for Academic Degrees and University Evaluation (NIAD-UE) [6]. Schematic process of the evaluation is as follows: Each university corporation created a *performance report* based on the two key documents, NIAD-UE's "Evaluation Guidelines" and "Guidelines for Performance Report", and submitted the report to NIAD-UE. Their performances were examined throughout the evaluation process based on *document analysis* and site visits. Evaluators of committee read the reports and compile necessary information for evaluation, such as rates, performance, and questionnaire. Evaluation committee makes Peer-reviewed evaluation report, documents of the result of education and research evaluation, based on the information. Fig. 1 shows a part of evaluation report [4]. The evaluation report also includes four grade judgments and description of reason of the judgment (e.g., rates are good, performances are excellent, result of the questionnaire to the students are normal.).

In our study, we focus on the data of bachelor degree program (357 faculties of national universities). In the evaluation reports, main descriptions of the student learning outcomes are included in the viewpoint 4-2 of standard 4 "The academic achievements, credentials, and abilities students acquired". We extracted the data from this standard. The document data consists of judgment and the text data describing the reason of judgement (avg. 132.5 characters in Japanese, SD=54.1, Range=49-454).

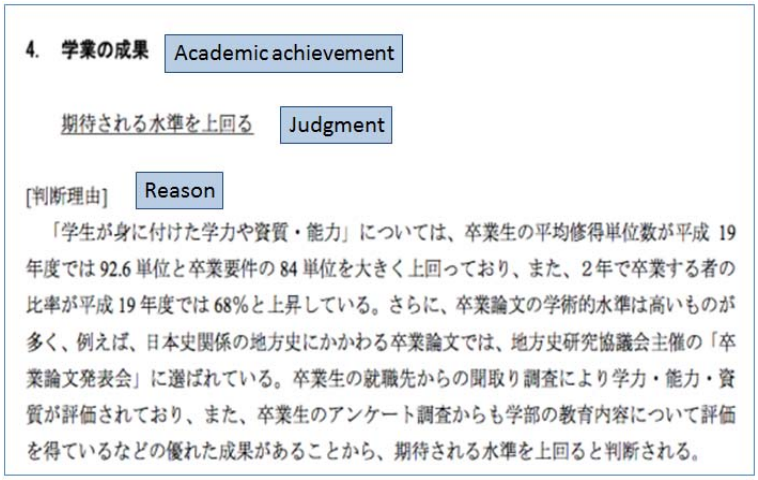

Fig. 1: Peer-reviewed evaluation report.

2.2. Extraction process and indicator of category

Process of our document analysis is described as follows: *Morphological analysis* was adopted to decompose document into words. However, extraction of important key words or indicators indicating learning outcomes was manually operated owing to no clear definition for indicators of learning outcomes. Some indicators were prepared in "Guidelines for Performance Report" and "University Information Database" [5].

Fig. 2 shows a working sheet in document analysis process and what the data looks like. In each row, data consists of *university*, *faculty*, *textual description of reasons*, and *judgments*. *Categories of indicators* were constructed in exploratory operation by try and error. Reference [6] describes details of qualitative descriptions and quantitative indicators, and relationship between qualitative indicators and rank of evaluation result. Eventually we obtained following 17 categories of indicators (frequency) and categorical data table (faculties x categories):

Graduation and Degree Awarding Requirements (179), State of Credit Acquisition (99), Teacher License (96), Progression to Next Grade (90), Acquisition of other Licenses (80), MD, DD, Pharmacist License (73), Prize and Awards (58), Improvement of Educational Structure, (48), Withdrawal (47), Academic Scores, GPA (40), Graduation Thesis (37), Advancement to Graduate School (33), Published Research Papers, Research Presentation (29), JABEE Certification (25), Questionnaire to Stakeholders (18), CBT (Computer based testing for

medicine) (18), TOEIC, TOEFL (10), and Bar, CPA (certified public accountant) , and Public Official Exam (9).

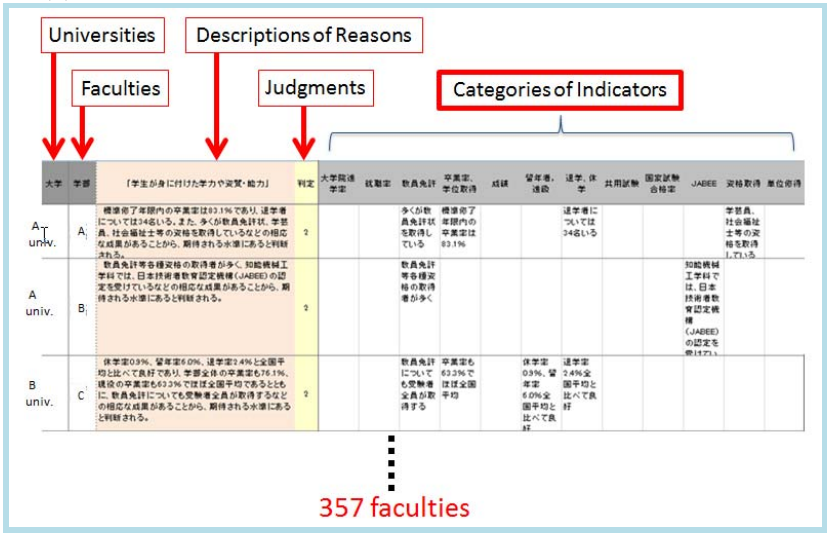

Fig. 2: Working sheet in document analysis process.

3. Document analysis and interpretation

3.1. Qualification method III

Various analysis methods have been developed so far to understand document information. In this section, on the categorical data extracted from evaluation reports, we applied *Qualification method III* [7]. Fig. 3 shows the result of the method in two-dimension scatter plot. We can investigate global tendency of our data which are responded to the 17 categories.

In the first axis (horizontal axis), some apparent features are recognized that many faculties of Medicine, Dentistry, and Pharmaceutical Sciences are located on left side in Fig. 3. Moreover, it is confirmed that same faculty names are gathered at some extent and make clusters, therefore, necessity of analysis with clustered faculties is acknowledged.

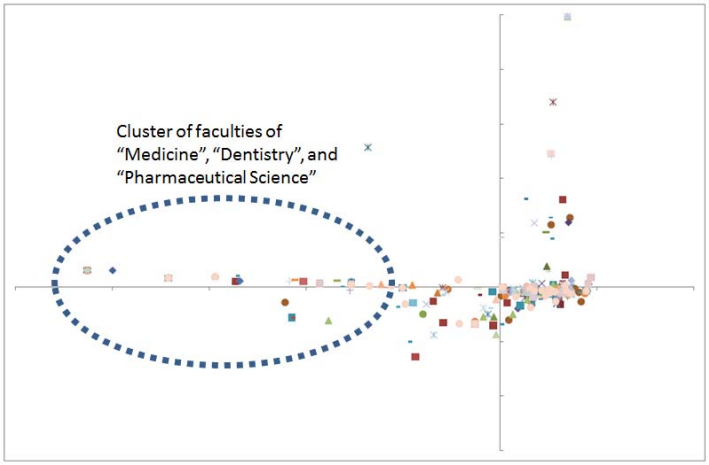

Fig. 3: Analysis by Qualification method III.

3.2. Correspondence analysis

In order to investigate the tendency of categorical data precisely, we classify the data into 10 major faculties:

Faculty of Letters, Education, Law, Economics, Medicine, Dentistry, Pharmaceutical Sciences, Science, Agriculture, Engineering.

In this faculty classified process, we exclude some combine-named faculties such as “Science-Engineering”. Therefore, the total number of data reduced to 75 percent of the original data. We applied *Correspondence analysis* [8] on the data as shown in Fig. 4.

As expected, along the first axis (horizontal axis) we clearly recognize the faculties of “Medicine, Dentistry, Pharmaceutical Sciences”, and also the categories of “MD, DD, Pharmacist License” in left side. We can see another feature of the data in the second axis (vertical axis), the category of “Bar, CPA, and Public Official Exam”, “JABEE Certification” and faculty of “Engineering”.

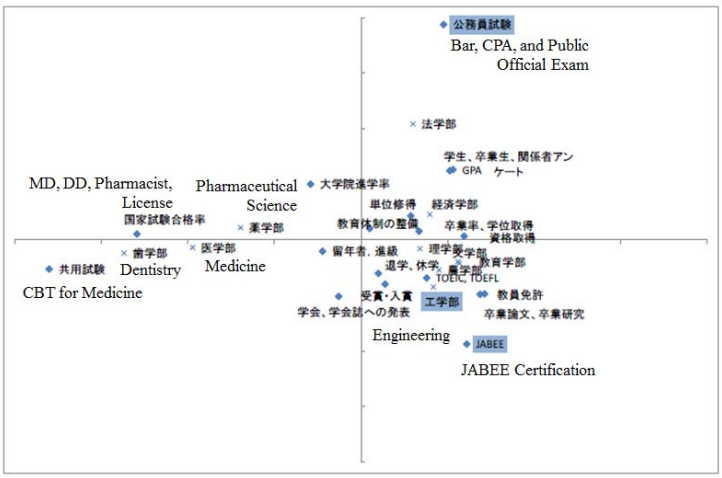

Fig. 4: Correspondence analysis.

3.3. Cluster analysis

We investigated *proximity* in faculties and categories by *Hierarchical cluster analysis* [9]. Two kinds of results from cluster analysis show hierarchical proximity as shown in Fig.5 and 6. These figures show more intensive proximity tendencies, i.e., the faculty of Medicine, Dentistry, Pharmaceutical Sciences, and Economics and Law, and so on.

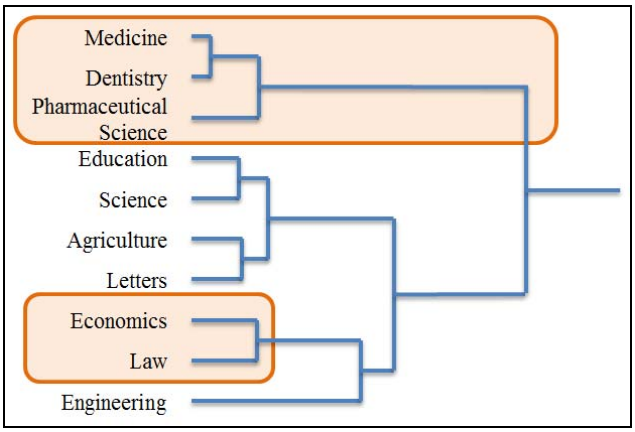

Fig. 5: Cluster analysis (Faculties).

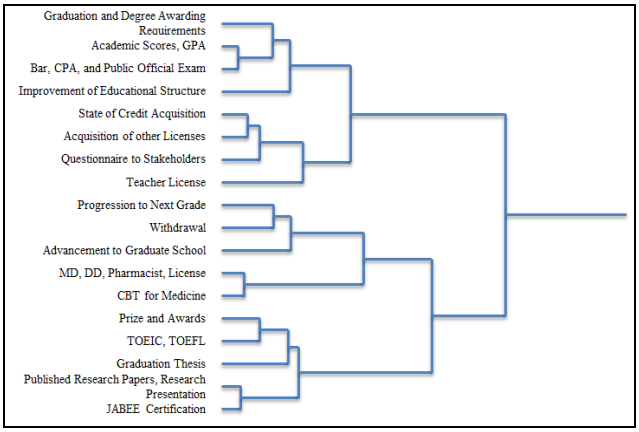

Fig. 6: Cluster analysis (Categories).

4. Sensitivity analysis

As mentioned in introduction of this paper, we should consider various *vagueness* and *ambiguity* in the document analysis and recognition. In order to cope with this difficult issue, we apply *Sensitivity analysis* due to the data fluctuation of document. Mathematical analysis was developed and described in reference [10].

Figure 7 shows sensitivity for data fluctuations; red arrows in the figure mean variations of faculties, and green arrows mean variations of clusters due to fluctuation on the data of (“Faculty of Engineering”, “Bar, CPA, and Public Official Exam”).

Especially, in the right side in the figure, we can find considerable fluctuations. Actually when the number of elements of (“Faculty of Engineering”, “Bar, CPA, and Public Official Exam”) is increased by 10

percent (+5 elements), the result is shown in Fig. 7. Some elements in Fig. 4 moved to the location in Fig. 7. These movements are expected as we calcurate and show in Fig. 8. Adding to this influence of variation, we can find other variation, such as "JABEE Certification" and so on. As seen in this section, we should consider sensitivity for correspondence analysis and its influence to interpretation of evaluation reports. Therefore, we should always acknowledge integrated interpretation including sensitivity analysis.

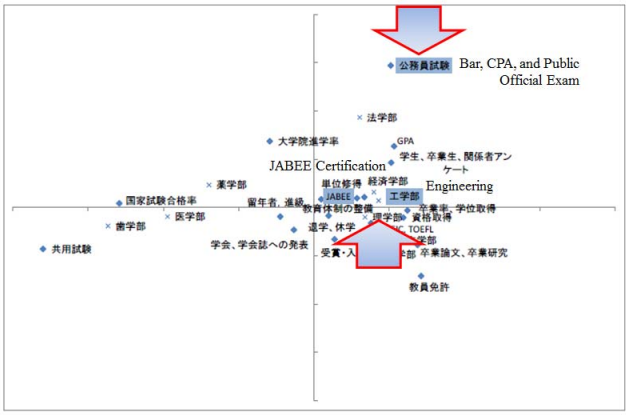

Fig. 7: Influence of fluctuation.

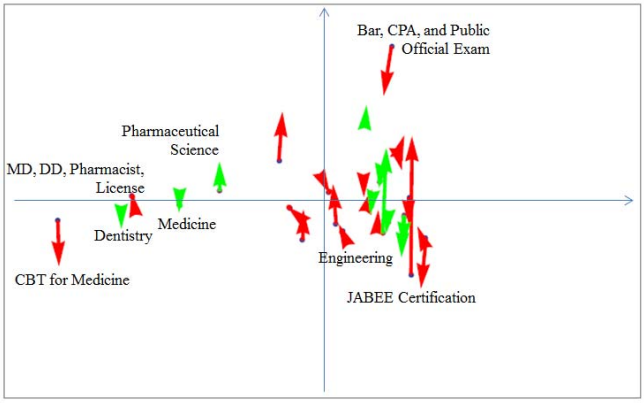

Fig. 8: Sensitivity analysis for data fluctuation.

5. Conclusion

In this paper, we focus on document information in evaluation reports of National University Corporation Evaluation in Japan. We conducted our research on information extracting and text analysing for grasping global and local characteristics of the report. Moreover, we considered stability of interpretation in case of data fluctuation.

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