Note-Taking Evaluation using Network Illustrations based on Term Co-Occurrence in a Blended Learning Environment

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ABSTRACT

Note contents taken by students during a blended learning course were evaluated, to improve the quality of university instruction. To conduct a quantitative comparison of the contents of all notes for effective instruction from lecturer to students to occur, the contents were mathematically compared and evaluated using two ways of summarizing the frequency of term co-occurrences. In order to evaluate visually the differences between the contents of notes taken, an adjacency matrix and Levenshtein distance metrics were employed to represent noun co-occurrence in the notes. In comparing notes between the lecturer and students, insufficient distance and additional distance are defined and measured for all participants during the course. In the results, students recorded additional nouns to replace the nouns given by the lecturer, and introduced new nouns of their own as substitutes as well. There are significant correlation relationships between the above mentioned distances and the ratios, such as between the word ratio and coverage, which have been defined in previous studies. Also, summarizing ways of co-occurrence frequency did not affect any of the relationships. Finally, possible applications for visualizing learning activities of the lecturer and students are discussed.

KEYWORDS
Adjacency Matrix, Blended Learning, Distance, Note Assessment, Term Co-Occurrence

INTRODUCTION

Educational methodology using Information Communication technology (ICT) is spreading to various teaching styles, and in particular this trend is becoming significant in courses at higher education institutions (Twigg 2005). Regarding this development, education assessment procedures are required to improve the educational effectiveness of ICT. Even in the most modern learning environment, known as Massive Open Online Courses (MOOCs), student’s learning activities have been surveyed in order to improve learning performance (Seaton et al. 2014a, 2014b).

Conventionally, note-taking activity can be used as a significant index of the learning process (Kiewra 1985, 1989, Kobayashi 2005) since the activity promotes constructivistic learning (Piolat et al. 2005). There is also a relationship between note-taking activity and learning performance (Nye et al. 1984, Kiewra et al. 1995), as reviews of the contents of student’s notes taken affect their autonomous learning (Kiewra 1985, 1989).
In an assessment of the contents of student’s notes taken during online learning courses, various factors were analyzed, including the contribution of student’s characteristics, the contribution of note-taking toward test scores, and the terms recorded in student’s notes (Nakayama et al. 2010, 2011, 2013a, 2013b). In particular, text analysis of student’s notes has revealed how much information students can extract from the contents of a lecture presented during one session of a blended learning course (Nakayama et al. 2011, 2013a). These analyses show the degree of content transformation between the lecturer’s presentation and the student’s notes, with regards to the assessment of student’s notes.

The term frequencies in notes taken by students may represent their note-taking activity. The information about concurrent term frequencies can indicate meanings recorded in notes, since most descriptions consist of short sentences. To extract semantic information such as the connections between terms, network analysis is often used (Jin 2009). During the analysis, the network can be illustrated as a graph which is a method of presentation similar to the concept mapping method (Novak and Canas, 2008). The visualized information can be used for efficient evaluation because graph illustrations contain quantitative information in addition to textual analysis of the notes. This procedure can provide a technique for the comparison of the contents of notes, including the comparison of semantic structures (Nakayama et al. 2014b).

However, there are still some questions, such as the analysis of the contents of notes taken and a comparison of the methodologies used to study term co-occurrences (Jin 2009). It is not easy to determine whether the concepts the lecturer has presented are recorded in student’s notes. Though the contents of notes taken can be compared using features of texts, it is not clear whether the same benefit of analysis for texts can be obtained when two major approaches are employed, such as bi-directional term co-occurrence or sequential co-occurrence. These detailed approaches are discussed in a later section. Therefore the analytical methodologies used to compare the contents of notes taken should be studied.

In this paper, the analytical visualization procedures used for concurrent occurrences of terms in the lecturer’s and student’s notes are compared using sequential terms such as two-word patterns and all two-word connections between terms. Also, the development of evaluation methodologies using term co-occurrences is assessed, in order to extract concepts and linked information, which are presented by the lecturer and recorded in notes taken by students.

The purpose of this paper is to determine the effectiveness of illustrating term networks visually using two methods to evaluate metrics of graph presentations. The following topics are addressed in this paper:

- The procedures used to illustrate a network of terms which represent co-occurrences of concepts in notes taken are compared between the two procedures, namely two sequential terms and all connections between terms in a sentence. Visualization and comparison techniques are also developed.
- The assessment of the degree of reproduction of term networks as concepts using graph metrics, and the evaluation of the relationships between text features and graph metrics are conducted.

For these purposes, the contents of notes which have been previously reported are re-analyzed. The detailed methodologies used are described in the following section.

METHOD

Blended Learning Courses

A note-taking survey was conducted during an information networking system course, which was a blended learning course using a distance education system in a bachelor level program at a Japanese university. The course consisted of weekly face-to-face sessions with students and online tests of
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