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Evaluation of Student's Notes in a Blended Learning Course

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ABSTRACT

Student's notes are evaluated to trace their learning process in a blended learning course, and the factors affecting the quality of these notes are discussed. As individual note-taking performance may be based on student's characteristics, these contributions are also examined. Some factors about personality and the learning experience are significant, and positively affect the grades given to notes. Lexical features of notes taken were extracted using a text analysis technique, and these features were compared with the grades given. The good note-takers constantly recorded terms independently of the number of terms which was presented during the class. Conceptual mapping of the contents of notes was conducted, and it suggests that the deviation in the features of notes can be explained by the number of terms in a lesson.

KEYWORDS

Note-taking, Blended learning, Learning activity, Learning evaluation, Text analytics

1 Introduction

Information technology supports various types of educational practices in university teaching. Some black board writing has changed to PC slide presentations, and the Internet environment has also given students opportunities to take courses elsewhere, both inside and outside of lecture rooms. Furthermore, a blended learning course, which is a hybrid of face to face lectures and learning using on-line learning materials, can provide a flexible method of teaching university courses. Though student's learning activities are monitored using automated evaluations such as online test scores and access logs for the online learning content, some limitations for students of conducting courses this way have been suggested. Therefore, the actual learning activities of students should be measured to trace their learning process outside of the relationship between course materials and final performance, such as final exams or test scores.

"Note-taking" is a commonly used and time-honored skill, employed in all types of learning situations; even in higher education [17]. The functions and effectiveness of note-taking have already been reviewed and discussed [6, 15]. In particular, "note taking" requires the summarization and understanding of the context of the notes [14]. Learning performance of note takers has been previously confirmed at the university level [13, 7, 12]. Therefore, notes taken may exhibit the process of learning in a class, including in a blended learning session.

Blended learning environments are advancing and do provide paper-less settings for learning, so that students receive fewer printed materials and also encounter fewer opportunities to take

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notes. This problem has been pointed out [5], though some of the influence of the blended learning environment on note-taking activities has also been confirmed using a previous survey of results of learning activities of ordinary students [12]. According to these phenomena, the information technology environment may sometimes influence, and veil students' learning activities. In a sense, introducing note-taking assessments into a blended learning course is useful to trace student's learning activity and their progress. For Japanese students, there are few instructions for taking good notes and learning using on-line learning materials. Some improvement in student's courses and appropriate learning support are required for Japanese universities to improve students' note taking skills. The contents of students' notes taken should be morphologically analyzed to examine the actual situation. Additionally, note-taking activities may depend on the setting, and also on the characteristics of students, because some linguistic information processing abilities are required to take notes. The effectiveness of these factors should be evaluated. The contents of notes taken require the quantification of the features of the notes in order to develop support systems and to improve the teaching methodology.

In this paper, the following topics were addressed in response to the problems mentioned above:

- The relationship between the assessment of the contents of notes taken and student's characteristics was measured to extract factors used in note-taking activities in a blended learning environment.
- The relationship between lexical features of the contents of students' notes and the lecturer's notes which were provided during classes were analyzed to extract the features of the contents of notes.

2 Method

2.1 Blended learning courses

Note-taking activity was surveyed during an information networking system course, which was a blended distance education course in a bachelor level program at a Japanese university. All participants were bachelor students in the Faculty of Economics, and they have already had some experience studying in a blended learning environment.

In this blended learning course, face-to-face sessions with students were conducted every week, and students from the course who participated in this survey gathered in a lecture room. Being a good note taker was expected of all participants during face-to-face sessions. Students were encouraged to take an on-line test for each session of study outside the class room, as a function of the learning management system (LMS). To do well in an on-line test, good notes are preferred. These on-line test scores were referred to when final grades were determined, and students could take the tests repeatedly until they were satisfied with their results. The LMS recorded the final scores. This course required participants to write three essay reports and a final exam. In the essay reports, participants have to synthesize their own knowledge regarding three topics taught during the course. These activities are an important part of the constructivism learning paradigm and may influence comprehension during the course [16].

As the course included face-to-face sessions, the lecturer could talk freely about course topics, and students could take notes of the impressions they received there.

2.2 Note-taking assessment

All participants were asked to take their own notes, and to present their notebooks to the lecturer every week. The lecturer quickly reviewed and assessed each student's notes after the weekly sessions, then returned the notebooks to students as soon as possible. Prior to doing so, all notes were scanned by the lecturer and stored as images in a PC.

The contents of the notes created by the lecturer when the course sessions were designed can be used as a standard for the notes taken in every class. Therefore, these notes can be used as the criterion for evaluating students' lecture notes. The individual content of students' notes was evaluated using a 5-point scale (0-4), 4:Good, 3:Fair, 2:Poor, 1:Delayed, 0:Not presented. If a student reproduced the same information in his or her notebook, the note taking was rated as "Fair". "Fair" note-taking is the reproduction of transmitted information given as instructions. If any information was omitted, the rating given was "Poor". In a sense, "Poor" note-takers failed to reproduce the information transmitted. When students wrote down additional information from the lecture, the note-taking was rated as "Good". The "Good" note-takers included those who integrated this knowledge with relevant prior knowledge [8], as some pieces of knowledge are related to each other, and some pieces of knowledge are related to relevant prior knowledge. At this point, several kinds of constructivistic learning activities were occurring.

The number of valid subjects was 20. As mentioned above, the students did not have any special training with regard to Note-taking skills. The Note-taking skills they exhibited were their own.

2.3 Characteristics of students

To analyze note-taking performance in this study, the student's characteristics were focused on, since precise note-taking may be concerned with some personality traits. The summarizing process may be affected by the student's level of information literacy, while a degree of familiarity with the blended learning environment also enhances their academic performance. According to the hypothesis, the student's characteristics were measured using three constructs. These constructs were: personality [3, 4], information literacy [11] and learning experience [10].

1. Personality: For the first construct, the International Personality Item Pool (IPIP) inventory [4] was used. Goldberg [3] lists five personality factors which are called the "Big 5" and for this construct, there are five component scores: "Extroversion", "Agreeableness", "Conscientiousness", "Neuroticism" and "Openness to Experience".
2. Information literacy: Fujii [2] defined and developed inventories for measuring information literacy. For this construct, the survey had 32 question items, and 8 factors were extracted: interest and motivation, fundamental operation ability, information collecting ability, mathematical thinking ability, information control ability, applied operation ability, attitude, and knowledge and understanding. The overall mean of factor scores was used to indicate each student's information literacy level. This inventory was originally developed to

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measure information literacy among high school students in many countries. It can also be used to measure the information literacy level of university students [2].

3. Learning experience: Students' learning experiences in a blended learning environment were measured using a 10-item Likert-type questionnaire. This construct measures students' attitudes to blended learning environments. As in previous studies, three factors were extracted: Factor1 (F1): overall evaluation of the e-learning experience, Factor 2 (F2): learning habits, and, Factor 3 (F3): learning strategies [10].

2.4 Text analysis of the notes taken

As already mentioned, notes taken by all twenty subjects in every weekly session were scanned and stored as image files. All images of notes taken were converted into digital text files by reading and manual data entry, because some written characters needed to be read by the human eye to be entered correctly.

Figures were excluded. The texts of student's and lecturer's notes were classified into noun and adjective terms using a Japanese morphological term analysis tool [9], then by synthesizing a term-document matrix (X), term frequency vectors were created for each class session. Latent semantic indexing (LSI) was used to classify documents according to the degree of similarity between them [1]. The features of the terms and the course sessions were extracted from the term-document matrix of the notes taken in each class using SVD (singular value decomposition analysis) [1] as follows: $X = TSD'$. The term feature matrix (T) contains feature vectors of each term.

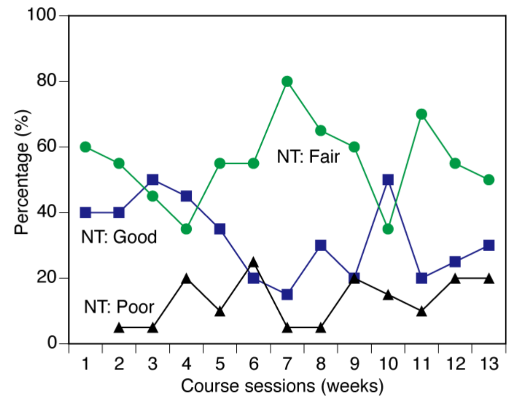

Figure 1. Grades of notes assessed across weeks (n=20).

The feature vectors of note documents (N) for each class session (i) were calculated for the lecturer and for each student using a summation of term feature vectors (T) which was weighted by term frequency (F_i) in a class (i), therefore, $N_i = TF_i$.

3 Result

3.1 Note-taking assessment

3.1.1 Grades of notes assessed

The assessment scores of each set of notes taken were gathered and summarized in Figure 1. According to the figure, percentages for "Fair" are almost always higher than the other ratings during almost all weeks. The percentage of note takers rated "Good" in the first five weeks of the course is relatively higher than the percentages for the remaining weeks. This suggests that students cannot create "Good" notes as the course progresses. Also, the percentages for "Poor" ratings are almost always the lowest.

3.1.2 Effectiveness of student's characteristics

One of the hypotheses of this paper, that the influence of student's characteristics

Table 1. Learning performance between two groups of note assessment scores.

	Note assessment score	
	High(n=11)	Low(n=9)
Report score	0.59(0.27)	0.67(0.18)
On-line test score	289.7(85.0)	254.3(79.7)
Final exam score	49.5(7.3)	44.9(7.3)

() indicates SD.

may affect the quality of notes taken, is examined in this section. The sums of assessment scores for note-taking during the course are calculated using a 5-point scale, to evaluate each student's note-taking ability. To emphasize the differences in the note-taking abilities, the students are then divided into two groups consisting of high and low scores. The scores of the two groups are compared, to measure the contribution of student's attributes and characteristics to note-taking activities.

First, students' learning performance from report scores, on-line test scores and final exam scores of the two groups was summarized in Table 1. Though there are no significant differences between the two groups, scores of on-line tests and final exams for the group of note takers with high scores are higher than those for the group with low scores, while report scores for the low score group are higher than those for the high score group. As a result, note-taking scores did not contribute to learning performance in this course.

The contribution of learning experiences such as subjective evaluation was examined, and three factor scores are summarized in Table 2 using the same format as in Table 1. The third factor, learning strategies, is significantly higher for the low score group than it is for the high score group. This consists of two question items: "I have my own method and way of learning" and "I have my own strategies on how to pass a course".

Table 2. Learning experience between two groups of note assessment scores.

Factors of learning experience	Note assessment score	
	High(n=11)	Low(n=9)
Overall evaluation of the Learning experience	2.82(0.58)	3.17(0.65)
Learning habits	2.09(0.63)	2.50(0.97)
Learning strategies	3.00(0.71)	3.67(0.61)*

5-point scale, () indicates SD.
significance level *: p<0.05

Table 3. Scores of personality factors between two groups of note assessment scores.

Personality Factors	Note assessment score	
	High(n=11)	Low(n=9)
Extroversion	3.29(0.61)*	2.52(0.73)
Agreeableness	3.58(0.35)*	3.10(0.63)
Conscientiousness	3.37(0.47)*	2.88(0.51)
Neuroticism	3.34(0.60)**	2.38(0.75)
Openness to Experience	3.74(0.76)	3.23(0.64)

5-point scale, () indicates SD.
Significance level *:p<0.05, **:p<0.01

Therefore, the purpose of note-taking may affect the scores of note-takers.

The relationship between a student's personality and note-taking performance was measured. The note-taking scores are summarized across 5 personality factors in Table 3. As shown in the table, the scores for the high score group are significantly higher than those for the low score group across all personality factors except the "Openness to Experience" factor. This result suggests that learning personality positively affects note-taking activity. These aspects should be considered when out-of-class assistance is provided to students to improve their note-taking skills.

The contribution of information literacy is also measured using the same format. In Table 4, the scores of note-takers are summarized across 8 factors of information literacy. Additionally, the scores are summarized in response to the two secondary factors and a summation of information literacy is given. There are significant differences in note-taking scores for "Fundamental operation ability" and "Knowledge and understand-

Table 4. Scores of information literacy between two groups of note assessment scores.

	Note assessment score	
Information literacy Factors	High(n=11)	Low(n=9)
Interest and motivation	3.84(1.00)	4.22(0.49)
Fundamental operation ability	4.52(0.49)#	3.92(0.88
Information collecting ability	3.57(0.98)	3.11(0.93)
Mathematical thinking ability	2.86(0.85)	3.17(1.31)
Information control ability	3.09(1.10)	2.86(0.79)
Applied operation ability	3.11(1.06)	2.89(1.11)
Attitude	3.00(0.85)	2.69(0.69)
Knowledge and understanding	3.68(0.79)#	2.97(0.81)
Grand total	3.46(0.61)	3.23(0.65)

5-point scale, () indicates SD.
Significance level #:p<0.10

ing" at a 10% level of significance. All factor scores for information literacy for the high score group are higher than the scores for the low score group, except for the factor "Interest and motivation". Study of the contribution of information literacy to note taking should be continued using larger samples.

3.2 Features of notes

In order to compare the number of terms in notes between the lecturer and students, mean numbers of terms are summarized in Figure 2. Because the numbers of terms which appear in lectures is different across course sessions, the volume of notes taken by students may depend on the lecturer's notes. In Figure 2, the horizontal axis shows the number of terms the lecturer has presented in each course session, and the vertical axis shows means of terms students have written down. Therefore, the diagonal line in the figure shows the same numbers of terms which the lecturer and note-takers have written. The error bar shows the standard error of the mean. The number indicates a series of course sessions. The means are calculated for "Good" and "Fair" note takers respectively.

Both the numbers and means of terms for "Good" note takers are always higher than the numbers and means for "Fair" note takers, while the number of terms for "Fair" note takers is almost the same as the number of terms written by the lecturer, because these plots are distributed on a diagonal line. In particular, the number of terms for "Good" note takers stays high even when the number of terms in the lecturer's notes is low.

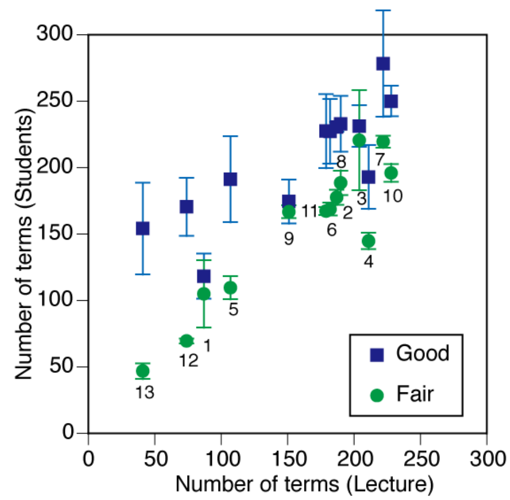

Figure 2. Relationship between the number of terms in notes of lecturer and students (The number of students = 20).

According to Figure 2, the "Good" note takers record more terms. The number of terms these students record is almost always higher than the number of terms provided by the lecturer. The next question is whether the terms students recorded actually covered the terms which the lecturer presented. To evaluate this degree of coverage, a coverage ratio was

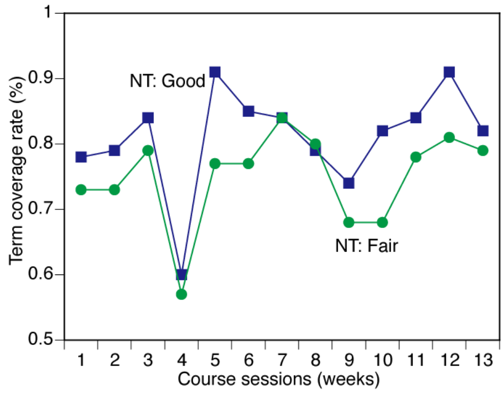

Figure 3. Coverage ratio of terms in student's notes compared to lecturer's notes (n=20).

calculated as a percentage of terms which were recorded by students. The coverage ratios of terms for each session are summarized in Figure 3. As the figure shows, there are some differences in coverage rates between "Good" and "Fair" note takers. The differences are almost always small, while the ratios are almost always over 70 %. The possible reasons why coverage rates are relatively low in the 4th and 9th sessions may be because it is not easy for students to pick up additional terms while the lecturer displays figures.

The above analyses suggest that all subjects record almost all terms the lecturer presents during the class. This means that all students can reproduce the conceptual contents of the lecture. Also, choosing to record the rest of the terms presented by the lecturer may affect the grades of notes taken. To confirm this phenomenon, features of each note are calculated using the term frequency of the session and feature vectors of terms which are extracted from the LSI model mentioned above. The features of all notes of all 20 students in 13 course sessions are illustrated two-dimensionally in Figure 4, using two principal components of the feature vectors. The horizontal axis shows the first component, and the vertical axis shows the second component. The features of notes for "Good", and "Fair" note takers and for the lecturer are displayed separately. Also, the number of sessions is indicated. The distances between the features of notes show a degree of similarity between them. The degree of separation of the plots of these session notes represents certain aspects of note taking. As

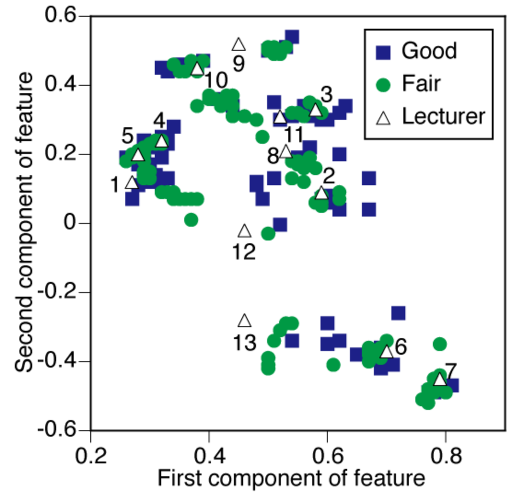

Figure 4. Conceptual map for students and lecture notes for all sessions (n=20).

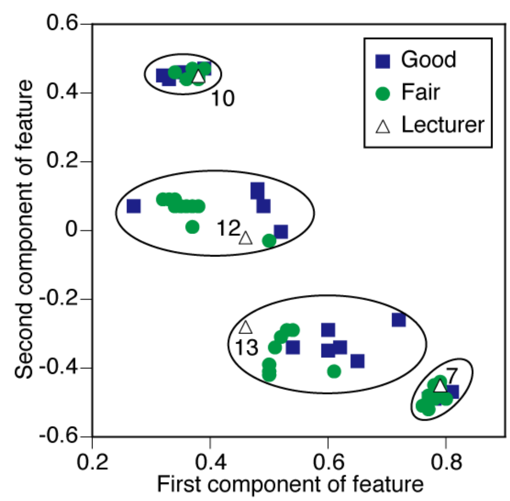

Figure 5. Conceptual map for students and lecture notes for typical sessions (n=20).

the figure shows, there are clusters for each class session. For some sessions, features of notes for students and features of the lecturer's notes overlapped each other.

To make the relationship clear, four typical sessions are extracted in Figure 5. The four sessions consist of sessions 7 and 10, which have the highest number of terms taken, and sessions 12 and 13, which have the lowest number of terms taken, as shown in Figure 2.

In this figure, plots for sessions 7 and 10 produce a small cluster, which means that all notes are similar to each other. This suggests that all students can reproduce the lecturer's notes, though their notes are classified into two grades. On the other hand, plots for sessions 12 and 13 are distributed in the same plane, but plots for the student's notes are disparate from the lecturer's notes. From a detailed inspection of the clusters for sessions 12 and 13, we can observe that the plots for "Fair" notes surround the lecturer's notes in close proximity, but the plots for "Good" notes are more widely distributed around both the lecturer's and the "Fair" notes. When the number of terms is large, most notes include almost all major features, so that all plots are mapped around a common point. The rest of the terms and the structure of student's note-taking may affect their note-taking grade, however, because the lecturer had classified their notes as "Good" and "Fair". When the lecturer presents a small number of terms, the plots of "Good" note takers are disparate from the plots of the lecturer's notes, since they wrote down some additional, related terms, and some of these were to explain the terms presented by the lecturer i.e. they recorded more terms than the lecturer presented, as shown in Figure 2. The "Fair" note takers skipped some terms presented by the lecturer and added inappropriate terms to their notes in place of missed words, because they recorded the same number of terms presented by the lecturer in Figure 2. However, the coverage ratios of the terms were not as high as in Figure 3, since their plot positions are different from those of the lecturer. Again, both plots of "Good" and "Fair" note takers are disparate from the lecturer's notes, but the reasons for this are different between the two grades. This point should be taken into consideration to ensure that the development of student's note taking skills is supported and improved.

To compensate for this learning condition, designs for the structure of classes and student support programs should be considered carefully. These points will be subjects of our further study.

4 Discussion

Since their note-taking performance depends on the content of the weekly courses, students' note-taking abilities were evaluated using the sums of their assessment scores graded on a 5-point scale across the 13 weeks of the course. Twenty students were divided into two groups using the scores. To determine the contribution of each student's characteristic metrics, the scores of metrics are compared between the two groups. In the results, there are significant differences in learning strategies depending on the kind of learning experience, and significant differences in the four factors about personality. There are also some differences in the two factors which concern the information literacy of students between the two groups. Therefore, note-taking ability may be affected by these factors. When note-taking skills are taught to students or students are supported in the improvement of their skills, their characteristics should be considered in order to achieve better performance, since student's aptitude often affects their learning performance.

According to the lexical analysis of student's notes, "Good" note takers constantly record the same number of terms, even if the lecturer presented a small number of terms. "Fair" note takers often record the same number of terms as the lecturer presented, even when the lecturer has presented many terms or only a small number of terms. However, if the coverage ratios of lecture's terms are not high, then the lexical concepts are slightly different from the ones the lecturer presented, particularly when the number of terms the lecturer presented is small. As the number of terms "Fair" note takers recorded increased with the number of terms the lecturer presented, it may be that the lecturer presented as many terms as possible when trying to explain a concept. Also, the lecturer should ask students to take notes carefully in blended learning sessions or in lectures using information technology aids.

These results are based on Japanese university students who have almost no previous note-taking skills or experience. Also the results suggest that the information technology environment affects student's note-taking performance in spite of their insufficient skills for note-taking during lectures. To improve students' performance and to help them adapt a more positive attitude toward studies in a blended learning environment, appropriate instruction and support to enable students to take sufficient notes during lectures is required. The methodology for this should be discussed with a wide range of university faculty and staff.

5 Conclusion

To improve the learning progress and to develop a support program for use in a blended learning environment, the assessment of note-taking ability as an important learning activity was conducted during a blended learning course.

The relationships between note-taking activity and student characteristics were examined. According to the results of a comparison of scores between "Good" and "Fair" notes taken, student's characteristics, such as personality and one of three factors regarding the learning experience affect the contents of their notes. Some lexical features of the notes taken were extracted, and the relationship between these features and the grades of the note takers were discussed. The "Good" note-takers constantly record terms for their own notes independent of the terms presented by the lecturer.

From the results, a set of possible instructions should be proposed. The development of a supporting methodology will also be a subject of our further study.

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