Informal Learning Behavior Analysis Using Action Logs and Slide Features in E-textbooks

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Abstract—This paper discusses learning behavior analysis using a learning management system (LMS) and an e-textbook system. We collected a large number of operation logs from e-textbooks to analyze the process of learning. In addition, we conducted a quiz to check the level of understanding. In our study, we especially focus on an analysis of the relationship between learning behavior in informal learning and its effectiveness in the corresponding quiz. We apply a machine learning and classification methodology for behavior analysis. Our experimental results demonstrate that students who undertake good informal learning achieve better scores in quizzes.

Keywords—informal learning, learning behavior analysis, action logs, slide features

I. INTRODUCTION

The growth of information and communication technology (ICT) has produced great changes in education. For example, the use of learning management system (LMS) has become widespread in academic institutions. These ICT-based learning systems provide not only convenient and effective educational environments, but also various kinds of learning logs for students, such as when and where they use the system, what they learn, and so on. In addition, learning logs offer great potential for analyzing the process of learning activities, such as learning behavior, quality of learning, etc. Teachers would like to know the learning behavior of students, especially in informal education [2] and/or flipped education [3], [4] where a self-activity is required to the student off-site a classroom. As part of learning behavior analysis, we focus on the learning style of students who use e-textbooks. In this paper, we propose a methodology to analyze how students browse lecture materials during their informal learning.

II. OVERVIEW OF PROPOSED APPROACH

The aim of this study is to analyze learning behaviors in informal learning, and to investigate the effectiveness of informal learning in helping students to understand the contents of lecture materials. We utilize an e-textbook system and a LMS to collect various kinds of logs such as action logs from e-textbooks, quiz scores, etc. We can acquire an understanding of learning behavior, such as how much time each student spends on informal learning, how much time is spent browsing each page of slides, and so on, from the action logs of the e-textbooks. The outcomes of this informal learning are then investigated by the LMS, wherein students take a brief quiz prior to the beginning of the lecture.

We furthermore analyze whether or not a student spends an appropriate amount of time browsing each page of slides during the informal learning period. Our assumption is that good learners spend an appropriate amount of time on each page of slides. In other words, each page of slides has a predetermined informal learning time, and good learners spend the anticipated amount of time browsing the page. To do this, we have to estimate the expected browsing time for each page of slides. Therefore, we extract slide features from each page to measure the contents.

Fig. 1 shows the overview of our strategy. Slide contents, such as characters, pictures, mathematical formulas, tables, and so on, are extracted and represented as slide features by visual image processing. Generally, a presentation slide set contains not only text (e.g., slide title, main slide text/bullets), but also other contents such as mathematical formulas, colorful figures, tables, and so on. Therefore, extracting textual features is not sufficiently informative, and we must consider other features that represent this additional content. That’s why we focus on visual features, in which even the text regions are considered as visual information. Finally, these logs and features are applied to slide classification using SVM(support vector machine) and analysis of learning behavior.

III. EXPERIMENTAL RESULTS

A. Estimation of Browsing Time

We analyzed the learning logs from an “information science” class. In total, 135 students attended the class, which commenced in October 2014. All the lecture materials were prepared as digital textbooks using the BookLooper system [5]. Students browsed the materials using their PCs, tablets, and/or smartphones. The materials consisted of three item groups: A (A-01, ..., A-11), B (B-01, ..., B-15), and C (C-01, ..., C-08). Each item contained several pages of slides. The total number of slides is summarized in Table I.

Slide classification results can be utilized to estimate the browsing time for each item, i.e., A-01, ..., C-08. For example, Fig. 2 shows the classification results for three items, which contain about 30 pages of slides. The classification
results are different for each of the three items. In this study, we assumed that each group requires an adequate browsing time per page as follows.

Group 1  5 sec/slide  
Group 2  20 sec/slide  
Group 3  60 sec/slide

B. Analysis of Informal Learning Efficiency

We analyzed the effectiveness of informal learning. First, we compared the estimated browsing time and actual browsing time of several students for each slide. Fig. 3 illustrates the case for item C-03. The sequence labeled “prediction” represents the estimated time using our proposed method, which is the same as that for “C-03” in Fig. 2. The other sequences represent the actual browsing time of three students. Their browsing time was calculated from the logs of their e-textbooks. Therefore, the three sequences reflect the time actually spent on informal learning before the lecture.

Prior to the beginning of the lecture, the teacher conducted a quiz based on the contents of item C-03. Scores were scaled from 0 to 10 points. The average scores of all students and of students who undertook informal learning (i.e., good learners) were 4.03 points and 6.25 points, respectively. Overall, the scores of good learners were superior to those of the other students, as would be expected.

IV. Conclusion

We proposed a learning behavior analysis strategy using learning logs collected by a LMS and an e-textbook system. We found out that a student who spent an appropriate amount of time on informal learning would achieve better quiz scores.

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REFERENCES


