Identifying and Analyzing the Learning Behaviors of Students using e-Books

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Abstract: Analyses on students' learning behaviors comprise an important thrust in education research. This study focused on e-books system used in the classroom and this system recorded students' learning logs in their daily academic life. These learning logs can be used to analysis students' learning behaviors. By performing partial correlation analysis, the study found that a number of learning behaviors have a significant relation with students' test scores.

Keywords: Learning analytics, Learning behavior, Learning log, E-books

1. Introduction

By 2020, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan is scheduled to replace all of the textbooks for elementary, middle, and high schools with e-books (MEXT, 2011). Such a move will usher "Educational Big Data," which will comprise learning logs.

As a forerunner to this institutional effort, Kyushu University has supported this work in using BookLooper for e-books beginning in April 2014. BookLooper is a document viewer system provided by a partner to this research, Kyocera Communication Systems Co., Ltd., and can be used on personal computers and smart phones. Thus, students can use it as desired, and their learning log will be collected continuously.

Students can use BookLooper to preview their lessons before class, such as writing questions. They can also take note and mark part of a page as important content during class. After classes, they can review the learning content. All of these learning behaviors will be recorded. Meanwhile, such records will create a large volume of data.

Using these records, educational effectiveness can be verified, and the features of students' learning behaviors analyzed. The present work will analyze learning behaviors and identify students' learning styles by analyzing their learning logs, continuing the work of Yin et al. (2014). By performing partial correlation analysis, the study found that a number of learning behaviors have a significant relation with students' test scores.

2. Related Works

Analyzing learning behaviors is a critical topic in learning analysis. Collecting data is the first step in learning analysis (Yin et al., 2013). Based on the data source, studies on learning behaviors can be classified into three categories:

A) **Analysis using a questionnaire**: In this category, data are collected using a pre-designed questionnaire, such as Ho et al. (2013) used a questionnaire to investigate the teacher behavior of adopting mobile phone messages as a parent–teacher communication medium.

B) **Manual collection data:** In this category, a crowdsourced data collection system is opened to users. Users use the system and consciously leave data on their learning behavior. For

example, Ogata et al. (2011) also provided a system called SCROLL, in which students can share their every data learning log using learning memos, RFID tags, and cameras.

C) **Automatically recorded behaviors:** In this category, learning behaviors are recorded automatically; users leave records subjectively. For example, Hou (2012) explored the behavioral patterns of learners in an online educational role-playing game. The actions (gaming behaviors) conducted by these participants were recorded automatically in the game database.

For categories A) and B), the data are collected consciously. Therefore, data are affected by users' own subjective factors. For category C), the data is collected objectively, removing the subjective factors that affect data authenticity. The present work falls under category C).

Thus far, research on learning logs of learning contents in the classroom has received limited academic attention. The current research is on using e-books to collect students' learning logs throughout the study period and then analyze their learning behaviors.

3. BookLooper Log

In BookLooper, e-books are organized in three layers: bookshelves, books (learning contents), and pages. Users can read, go to next, and return to previous. They can also make bookmarks and leave memos. These actions are logged in the system. One data log contains the date, time, user ID, learning content ID, page number, user action, and other data. Students' reading history will be recorded whenever they use BookLooper. Table 1 lists the actions and their explanation.

Table 1: Action Explanation.

Action name	Explain
Next	While a user goes to next page, he will click "NEXT" button, and the action name will be saved as "Next".
Prev	While a user goes to previous page, he will click "PREV" button, and the action name will be saved as "Prev".
Marker	While a user want to highlight some row in the learning content, he will click "Marker" button, and the action name will be saved as "Add marker".
Memo	While a user want to write some memo in the learning content, he will click "Memo" button, and a textbox will be shown. After he finished writing memo, the action name will be saved as "Add memo".

4. Data Analysis

SPSS was used to find the partial correlation of scores with other variables, such as the number of "Next" and "Prev" actions, Preview Times, Read Pages, and Read Time.
   a) Number of "Next" (NN): How many times a student goes to the next pages
   b) Number of "Prev" (NP): How many times a student goes to the previous pages
   c) Preview Times (PT): The times of previewing the lesson for class. The learning log for "Action Time" shows who has read the learning contents (preview for the lesson) before class. The study calculates the number of times a student conducts previewing for a lesson. Reading Time is used to determine if students preview their lessons or not. The condition is 1 second per page as the learner's Reading Time. The total reading time should exceed 5 munities
   d) Read Pages (RP): The total number of pages that a student has read. The learning log for "Page No" and "Action Time" shows how many pages students read. Many of them repeatedly read specific pages.
   e) Read Time (RT): The total time spent reading the learning contents. The learning log "Action Time" shows how long students read the learning contents. Partial correlation (SPSS) analysis indicates that RT is significantly correlated with RP.

Table 2 presents the results of the partial correlation analysis. The variable Score has a significant correlation with Score RP, as well as with PT, RT, NN, and NP. Further, variable RP has a significant correlation with Score, PT, RT, NN, and NP. A principal component analysis of SPSS also showed that RP has a significant correlation with Score.

Table 2: Partial Correlation Result.

		RP	PT	RT	NN	NP
Score	PCC	0.728	0.417	0.681	0.665	0.532
	SP	0.000	0.000	0.000	0.000	0.000
RP	PCC	1	0.557	0.903	0.955	0.771
	SP	0.000	0.000	0.000	0.000	0.000

PCC (Pearson correlation coefficient)
SP (Significance probability)

5. Conclusion and Future work

Analyses on students' learning behaviors comprise an important thrust in education research. This study focused on e-books used in the classroom. Using the e-book system BookLooper, this work recorded students' learning behaviors in their daily academic life.

The paper presented means for collecting and analyzing learning logs using e-books, as well as the analysis of students' learning behaviors based on these learning logs. By performing partial correlation analysis, the study found that a number of learning behaviors have a significant relation with students' test scores. Especially, the results showed that the number of pages read correlated with students' scores.

This research analyzed students' learning behaviors in general. A future effort may delve into cases of learning behaviors among students. Such a study may also differentiate between learning behaviors used by students for different learning contents.

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