Student Modeling for Digital Textbook Reader to Increase Engagement

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Abstract: Digitized learning materials are a core part of modern formal education. However, low student engagement on these materials is one of the important problem that effects education system negatively. On the other hand, it is possible to record students' interactions with these learning materials in detail. In this research, I intend to use these interaction data to support an increase in students' engagement and their overall success. Therefore, I propose a student model for digital textbook reader to increase students' engagement with the content.

Keywords: e-book, student modeling, engagement, learning analytics, educational data mining

1. Introduction

The purpose of my research is to develop Student Model for digital textbook system to increase students' engagement and overall success. Student model is a representation of how students are engaging themselves in with the e-Book reader. The proposed model will work as a student modeling service within the Learning Analytics Framework developed in Kyoto University (Flanagan & Ogata, 2017) and will contain following core components (see Figure 1).
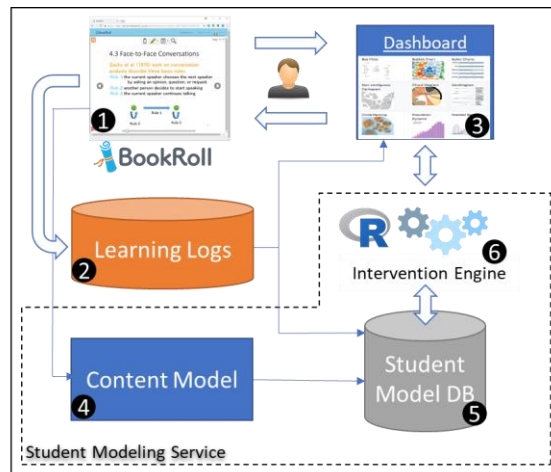

Figure 1. Student Modeling Service

1-BookRoll: BookRoll is a digital textbook reader, and it allows us to collect detailed data about student interactions (e.g. page flip, page jump, highlight, adding memo, search, etc.). *2-Learning Logs*: Every action taken by students while using the BookRoll system is recording in the learning log database as xAPI statements. *3-Learning Analytics Dashboard*: Dashboard is using to give feedback (descriptive statistics or usage graphs) to students and instructors. *4-Content Model*: This is an abstract representation of the content, which shows every knowledge component (topic) in each page of the book. *5-Student Model Database*: This component will store all the data related to

students' level of engagement regarding learning materials and pre-processed data related to their interactions with the learning material. The engagement model will include features related to students activities in BookRoll system (e.g. number of total evet, total time, completion rate, marker and memo counts etc.) and will be updated once a day. *6-Intervention Engine*: Intervention engine will work as a proxy between student model database and learning analytics dashboard. It will provide two important data to the dashboard: One is <u>engagement graph</u> (Figure 2-a), which shows students' level of engagement with the content. Other one is <u>list of at-risk student</u> generated based on machine learning algorithms (Figure 2-b).
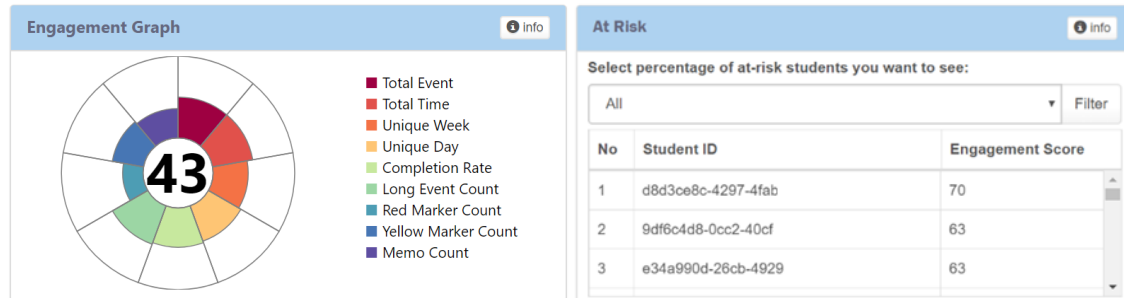

Figure 1. (a) Left: Engagement Graph (b) Right: At-risk Student List

2. Background

Currently, I am analyzing students' digital textbook usage data to understand their reading and usage patterns of the BookRoll system. One of the preliminary analysis, I will present at ICCE2018 (Akçapınar, Majumdar, Flanagan, & Ogata, 2018), help me identify the problem with the current system. In that analysis, I first clustered students based on their engagement in different weeks of the course (none, low, medium, high) and then I calculated transition probabilities among these clusters in different weeks of the course. This transition analysis showed that if the student engagement is low in the beginning of the course, s/he would be followed similar pattern until at the end of the course. Moreover, transition probability between low and high group is 0. In other words, intervention is required to help students in low-engagement group. Proposed student modeling service will make these interventions automatically by using data in a student model. This service will increase students' engagement with the e-book system by giving them individualized feedback about their learning.

3. Conclusion and Future Work

Component 1, 2, and 3 already developed within the current system. The instructors would directly provide component 4 related to developing content model and measuring students' knowledge in accordance with that model and hence kept out of scope of this research. This research will focus on developing the student model, the intervention engine (5 and 6) and modifying the learning analytics dashboard (3) to show the engagement model and interventions to the students. With the help of a proposed system following hypotheses will be tested:

1. Effectiveness of the using student modeling on students' engagement and overall success.

2. Effectiveness of the using student modeling on students' meta cognitive behaviors.

Although student modeling is used in many domains, student-modeling studies for e-book based learning is new. Using machine learning based interventions along with student model is also originality of the proposed research.

Acknowledgements

References

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