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Data-informed Teaching Reflection: A Pilot of a Learning Analytics Workflow in Japanese High School

Taro NAKANISHI[a*], Hiroyuki KUROMIYA[a] , Rwitajit MAJUMDAR[b] & Hiroaki OGATA[b]
[a]*Graduate School of informatics, Kyoto University, Japan*
[b]*Academic Center for Computing and Media Studies, Kyoto University, Japan*
*nakanishi.taro.26r@st.kyoto-u.ac.jp

Abstract: The use of ICT devices in the classroom for teaching has become more relevant in secondary education. However, the use of data driven technologies for supporting pedagogical practices are still limited in the Japanese school context. Promoting the use of ICT in the classroom is an important part of improving the quality of education. In this paper, we introduce the workflow of using e-book reader and learning analytics dashboard to improve teaching of a junior-high school Mathematics class in Japan. We recruited a teacher and forty students for the research and introduced the simple dashboard for daily teaching and learning in their class. An end of the study period survey results showed that the dashboard prompted a change in the way of teaching in the class and also the teacher became more positive towards using data-driven technologies for reflecting on teaching practices.

Keywords: Learning analytics, evidence-based education, secondary education, ebook reader, LEAF

1. Introduction

In recent years, the use of ICT in education has become more popular around the world (Majumdar, 2015). This adoption comes with numerous benefits. For example, the use of ICT promotes positive motivation (Harandi, 2015), teachers can also teach proactively and cooperatively (Aristovnik, 2012). Moreover, it leads to achieving individual learning and improving the quality of education. On the other hand, it is known that the effectiveness of ICT depends on the ability of teachers (Hernandez, 2017). However, one study (Tasaki, 2017) found, Japanese teachers have the lowest rate of use of digital devices among OECD countries . One solution to this problem is to promote teachers' skills in using ICT in the classroom and to develop a positive attitude towards the value of ICT in education (Gil-Flores et al., 2017). On the other hand there are benefits of data driven approaches in education (Tempelaar et al., 2021) which can be realised once the teacher adopts the practices.

The main aim of this research is to investigate the effect of data-driven teacher reflection supported by a learning analytics (LA) technology framework. In this paper, we propose a workflow for teachers to improve their teaching based on data provided in a LA dashboard with a case study of a high school mathematics teacher in Japan. This pilot observation was guided by the following research question: How does the proposed teachers' workflow affect practice in a regular classroom context?

2. Methods

2.1 Teachers' Workflow to Improve Practice

The workflow consists of 6 different steps (see Figure 1.). The teachers register the date, unit, content, strategy, details in the system and then proceed to teach the class. To collect the data, the students do their homework on the tablet. Teachers then check the analysis results of the homework through the system. This is followed by a reflection on the class about the level of the problems covered in the

lesson and homework, the difference between the teacher's expectations and the students' level of understanding, and points for improvement. Finally, based on reflection, the teachers make the next lesson plan. There are two advantages of this workflow. First, the system can help to aggregate the students interactions and responses regarding the homework tasks and presents that information in the dashboard. Teachers can focus on how to improve their teaching from the result. Second, they can check the results of the improvements in each lesson. Therefore, they can adjust their lesson plans and teaching to meet the understanding of their students.

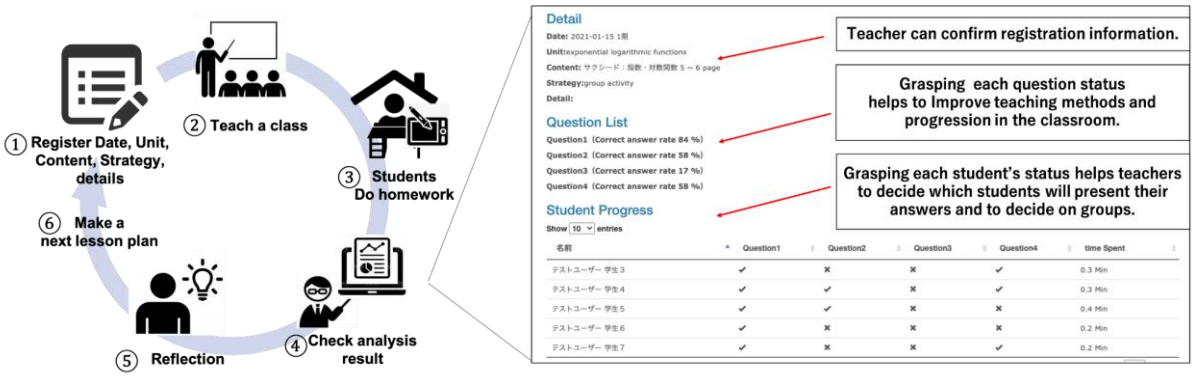

Figure 1. Teachers Workflow to Improve Practice.

2.2 Technical Design

In our research, we use an e-book system, BookRoll (Ogata et al., 2018) to enable students and teachers to view and interact with the learning materials. Teachers can upload teaching material in pdf format and make quizzes on BookRoll. Students can access the BookRoll system through a standard web browser. When they interact with a page in a learning material (move page, click, add marker, add memo, answer quizzes etc.), the system monitors and collects log data.
The Analysis Tool (Akçapınar et al., 2019) analyzes the log data from the database and displays the results on the dashboard. We developed and integrated a class planning system on Analysis Tool. This system has two functions. First, teachers can register class information (date, unit, content, strategy, details.) (for step 1 in Figure 1) . Second, after students view teaching materials and do their homework on BookRoll, the class planning system displays the response rate, percentage of correct answers, and average time to answer. The teachers can also view detailed information on individual students.

3. Initial Pilot in a High School Mathematics Class

This research involved the first grade Mathematics class at a high school in Japan. A teacher and 40 students from the first year high school class were involved in this research for 1 month. These participants have been using the tablet to learn on a daily basis for 1 year. The teacher was also accustomed to working with the mobile devices and used the ebook reader to upload teaching materials and check analysis results in the LAViEW dashboard. The students received instruction in a unit on exponential logarithmic functions over 10 lectures over a period of about one month.

3.1 Perceived and Observed Effects

A questionnaire was administered to the period before and after the demonstration. The results showed that the teacher was able to use concrete data to improve their teaching and to understand their teaching skills compared to before the demonstration. The teacher was particularly interested in the percentage of correct responses from each student when considering interventions to improve their teaching. Specifically, the teacher explained questions with low correct answers during class, and asked students who answered correctly to explain how to solve the question. The teacher wanted to improve the daily lesson content according to the students' level of understanding, but this had been difficult in the past due to time constraints. However, he responded that the new system allowed him to monitor each

student's level of understanding in a short period of time and that it was easier to make improvements because he could continue to see the level of understanding on a daily basis.

4. Conclusion

In this paper, we have presented a workflow for teachers to improve their teaching based on usage of learning analytics driven technology. The aim of the research was to design a data-driven teacher reflection workflow and support it by a learning analytics technology framework. The initial deployment and observation in one class showed changes in teachers' teaching style, such as changing questions according to student's understanding and explaining questions with low percentages of correct answers over a month. In addition, teacher's awareness of data-driven teaching increased and their positive attitude towards the use of ICT was also observed. However, these initial interactions with the teacher and students also let us realise some importanaspects. For instance quantitative evaluation of any improvement in teaching would require further studies and validated metrics for measurements. Also there needs refinement of how to introduce any such data-driven system and its workflow to the students as well as the teachers. The results of this research show that data-driven interventions by teachers can contribute to raising teacher's awareness of ICT and to improve their teaching. Repeated data-driven interventions and monitoring of their effectiveness by teachers will enable them to improve both their ICT skills and their teaching skills. Our future work will involve supporting teachers to select effective interventions based on recommendation from the data.

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