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Digitally Enhanced Active Reading in a Learning Analytics Enhanced Environment

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Abstract: Active reading (AR) strategies have learners challenge reading through deep engagement with the content to foster their independence and develop their performance and skills in reading. A number of studies have been conducted to examine the effectiveness of AR, yet there is no research that uses logs obtained from reading activities to scaffold and promote AR learning. Therefore, this study proposes to investigate AR from Learning Analytics (LA) perspectives. An e-book called BookRoll (BR) was used, and the logs obtained from the learning were visualized and shared as feedback. As part of it, we designed and developed Active Reading Dashboard (AR-D). In the framework of our LA-enhanced AR called Digitally Enhanced Active Reading (DEAR), AR experiments in language classes were conducted to reveal its effects. As a result, it was found that the process of AR could be visualized from learning logs, and DEAR could be applied in formal and informal learning contexts. The AR-D was found to influence learners' attitudes or perceptions toward reflecting on their own learning and striving to improve their reading strategies. As future work, continual implementation and verifying its application in different learning contexts are suggested. We shall also consider the importance of stakeholders' engagement in learning environments.

Keywords: Active reading, Learning Analytics, Learning Analytics dashboards, learning logs, e-books

1. Introduction

Reading is a complex process and in order to improve reading comprehension, it is essential to teach reading strategies and provide opportunities for practicing reading. It is said to have two styles of reading: passive reading (PR) and active reading (AR). AR urges learners to read a passage with a purpose or intention, while during PR learners just read word by word from the beginning to the end without any purpose or intention (Sun, 2020). AR shares ideas of cognitive reading strategies such as inferring from context, note-taking, marker use, and summarizing (Ahmadi, Ismail, & Abdullah,2013), and involves ideas of metacognitive strategies such as planning, monitoring, adjusting, and evaluating their own reading (Iwai, 2011; Israel, 2007). Many studies have shown the effectiveness of AR (Aziz, 2020; Khusniyah, & Lustyantie,2017). However, most of the research has been done based on paper texts. Currently in Japan, with GIGA school initiatives (MEXT, 2020), each student is provided one device, and e-books are used as textbooks in many schools. One of the advantages of using e-books is that we can obtain learning and reading logs. Analyzing logs enables us to understand and potentially support the AR strategies of students. However, regarding the effect of using e-books for AR learning, we did not come across any research that used learning logs to visualize and analyze the process of AR. Therefore, an e-book reading browser called BookRoll (BR) was chosen as our main reading platform for this study, since the logs of reading activities performed with BR can be visualized with analysis tools (Ogata et al., 2018). Functions in BR facilitate AR activities, and LA dashboards in the analysis tool enable learners to reflect on their reading-learning behavior. Teachers can monitor their students' reading performance and engagement, and give feedback based on what is visualized (Majumdar et al, 2021). Our study focuses on investigating the effectiveness of LA-enhanced AR which we call Digitally

Enhanced Active Reading (DEAR) and the development and implementation of the Active Reading Dashboard (AR-D). Through the several cycles of the experiments, we have modified and made improvements to the AR strategy and the dashboard in order to answer the following research questions:

1. RQ1: How can DEAR scaffold learners' reading performance and affect their reading-learning behaviors and engagement?
2. RQ2: To what extent can DEAR assist teachers' pedagogical approaches and interventions?
3. RQ3: To what extent can DEAR be applied in the various learning contexts?

2. Proposed Research Work

This study aims to challenge revealing the effect of DEAR and AR-D by following the steps:

Step 1: we aim to support cognitive and metacognitive strategies in AR mentioned earlier within the digital learning environment. Step 2: we aim to evaluate its effect.

BR is an e-book reader within the framework of the Learning and Evidence Analytics Framework (LEAF) system (Ogata et al., 2018). The LEAF system consists of a Learning Management System (LMS) to coordinate the learning activity, BR, Learning Record Store (LRS), and LA dashboards called Log Pallet. For this study, we designed and developed AR-D in Log Pallet in order to implement and visualize AR activities effectively and efficiently. Instructors can upload learning materials in BR, and students can read them using reading-facilitating functions such as markers and memos. Data from reading performed in BR, such as who, when, and how long learners viewed BR, which page they opened, how BR functions such as memos and markers were used, and what was written or marked are stored as logs and can be checked on the dashboards. Students use BR to perform AR, check the logs accumulated by learning, and reflect on their AR learning to improve their reading and learning motivation, reading performance, and skills. Teachers can make decisions on the subsequent actions and reflect on their teaching approaches by looking at the logs. We named this learning design Digitally Enhanced Active Reading (DEAR), and the cycle of DEAR is illustrated in Figure 1.

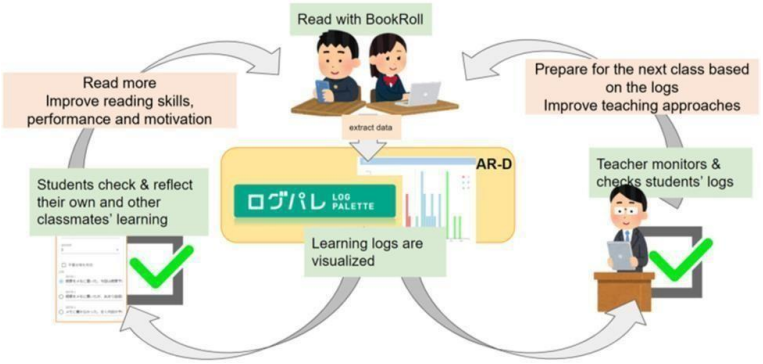

Figure 1. Conceptual framework of DEAR.

3. Methodology

The concept of Design-Based Research (DBR) was adopted for this study. DBR is an approach to validate the method in real-world settings with collaboration between researchers and practitioners, based on contextual design and theory (Wang, & Hannafin, 2005). We chose SQ4R (Survey, Question, Read, Record, Recite, Review) AR strategy as the fundamental of the reading theory. SQ4R is a reading procedure for efficiently understanding the content of the text (Khusniyah, & Lustyantie, 2017). Our research follows the cycle of the DBR principle: setting an objective and designing the method of an experiment based on the SQ4R theory, implementing AR with BR, analyzing the logs obtained from AR activities, sharing the logs with students and teachers, evaluating and giving feedback, reviewing

the results, and setting goals for the next experiment. Based on the findings, we reviewed and modified the experiment designs and AR strategy. Regarding the AR strategy, we simplified and refined the SQ4R AR strategy to fit the current form of AR using BR and logs throughout the experiments. Based on it, AR-D was developed and embedded into LA dashboards to visualize each phase of AR. The process of an experiment with the DBR approach is illustrated in Figure 2.

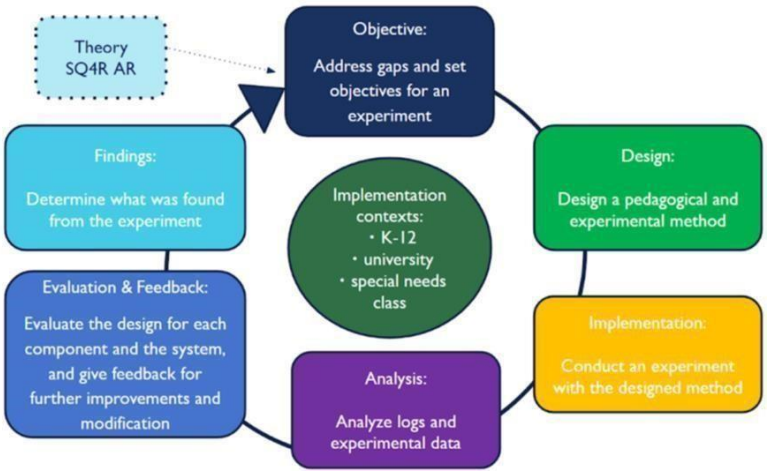

Figure 2. The process of an experiment based on the DBR approach.

So far multiple cycles of experiments were conducted in different learning contexts including junior high school, high school, and university English classes. Experimental designs include individual and group AR in class as formal learning settings and flipped learning as informal learning settings. Before and after each experiment, a pre-quiz for measuring participants' prior vocabulary knowledge and post quiz for their reading performance achievement were conducted. A pre- and post-survey were also conducted to obtain feedback from participants, such as impressions and opinions regarding AR, ARD, and BR and its functions. This research will include both quantitative and qualitative methods to collect data as shown in Table 1.

Table 1. *Experimental contexts, participants, and data sources for the research*

	Context	**Participants**	**Data sources**
High school 2020	English classes 1st and 2nd grade 5 days	76 1st grade (2 classes) 68 2nd grade (2 classes)	Logs from BR Pre and post vocabulary quizzes Pre and post surveys
College 2021	English AR class Freshmen 3 months	16 (1 class)	Logs from BR Pre and post quizzes Monthly and final tests Small group discussion Pre and post survey
Jr. high school 2021	English class 2nd grade 1 class	123 (3 classes)	Logs from BR Pre and post quiz Pre and post survey
High school 2021	English class 2nd grade 5 days	109 (4 classes)	Logs from BR Pre and post quiz Pre and post survey

4. Preliminary Findings

In the progress of our research so far, it was revealed that the process of AR was visualized by using BR which was not possibly done by using paper-books and e-books without analysis tools and LA dashboards. DEAR positively provided learning contexts in which not only learners could improve their

reading performance and skills, but also allowed them to be aware of their own learning behaviors, reflect, and expand and deepen their learning. In addition, by using BR in flipped learning, the disadvantage of the learning approach in which it was difficult to visualize efforts of learning at home was resolved. Furthermore, it provided an environment for teachers to monitor their student's learning status, organize and adjust class content, and make decisions if any interventions are necessarily based on the logs.

5. Conclusion and Future Works

We have investigated the effects of DEAR and AR-D and the effectiveness of visualizing the reading process using LA dashboards. We still have some improvements to make. We have conducted experiments only in English classrooms; therefore, we shall consider other learning contexts besides language classes. Continual implementation is also required. We will proceed with research to make improvements based on the principle of the DBR while putting a value on stakeholders' engagement in evaluating learning designs and the system in order to meet individual learners' needs.

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