Seamless Learning Infrastructure for Finding Relationships Between Lectures and Practical Training

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Abstract: This paper describes an infrastructure for seamless learning analytics to bridge digital textbook learning and practical training such as programming and conceptual modeling education. To realize the infrastructure for seamless learning analytics, we propose the integration of a digital textbook system into a software learning support system. By using our proposed infrastructure, all learning data will be sent by xAPI and collected in an independent LRS. We believe that analyzing and visualizing the relationships between the learning in the digital textbook system and practical training in the software learning support system leads to improving the quality of learning and teaching.

Keywords: Digital textbook, seamless learning, xAPI

1. Introduction

Seamless Learning is defined as an approach "when a person experiences a continuity of learning and consciously bridges the multifaceted learning efforts across a combination of locations, times, technologies or social settings" (Wong et al., 2015). So far, several researchers have pointed out that mobile and ubiquitous technologies have enabled learners to learn continuously across different contexts (Chan et al., 2006; Uosaki et al., 2014; Milrad et al., 2013). According to Wong et al., they defined the main characteristics of seamless learning as follows: (1) Encompassing formal and informal learning, (2) Encompassing personalized and social learning, (3) Across time, (4) Across locations, (5) Ubiquitous knowledge access, (6) Encompassing physical and digital worlds, (7) Combined use of multiple device types, (8) Seamless switching between multiple learning tasks, (9) Knowledge synthesis, (10) Encompassing multiple pedagogical or learning activity models (Wong & Looi, 2011).

With the emergence of seamless learning, several researchers have focused on the development of modular systems that can be linked together by standards-based protocols and analyzing and visualizing the learning logs in a seamless learning environment (Mouri et al., 2015, 2017, 2018b). For example, Brendan et al., proposed a learning analytics platform for seamless learning to bridge digital textbook learning and real-life learning (Brendan et al., 2018). By constructing the learning analytics platform, we can analyze and visualize the learning data that occurs across disparate systems that are used in formal and informal settings.In the other hand, researchers in the software engineering areas have focused on developing software learning support systems such as programming and conceptual modeling. So far, little attention has been paid to analyzing data in order to improve learners' making processes in the programing and conceptual modeling. To improve their making processes, it is necessary to analyze not only the data regarding practical training but also the data regarding lecture or class.Therefore, this paper introduces

seamless learning analytics for analyzing the relationships between lecture and practical training. We believe that there are several advantages that make it easier to introduce digital textbook learning and practical training.

2. Overview of our seamless learning analytics

Figure 1 shows the overview of our seamless learning analytics. To analyze and visualize the relationships between lectures and practical trainings, we propose to integrate main three systems: Learning Management System (LMS), Digital textbook system called "Smart E-textbook Application" (Mouri et al., 2018) and Software learning support system called "KIfU 3.0" (Tanaka et al., 2018a, 2018b). Figure 2 shows SEA interface.
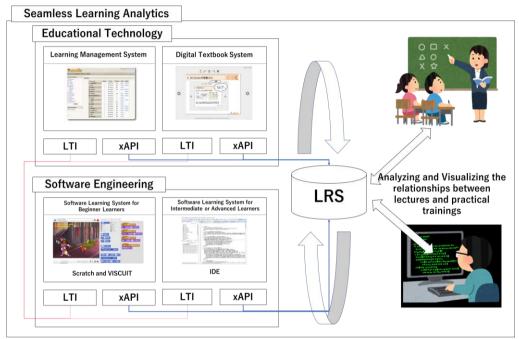

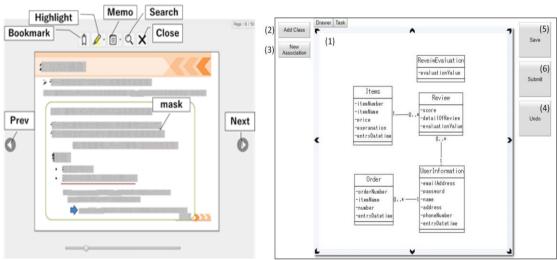*Figure 1.* Infrastructure for Seamless Learning Analytics

Figure 2. SEA interface

Figure 3. KIfU 3.0 interface

By using SEA, learners can use several functions such as next, prev, bookmark, highlight and memo. In addition, unlike previous digital textbooks systems (Kiyota et al., 2016), SEA can collect which positions of the pages learners were browsing in digital textbooks using mask processing. KIfU 3.0 is software learning support system to make and collect data of learners' thinking during their artifact making processes in conceptual modeling. Figure 3 shows KIfU 3.0

interface. By using KIfU 3.0, learners can make UML (Unified Modeling Language) class diagram.These digital textbook logs and making processes logs of learners will be sent by an xAPI and collected in an independent LRS (Learning Record Store). The LRS can collect all logs from LMS, SEA and KIfU 3.0 and analyze and visualize them to enhance the quality of learning and teaching.

3. Conclusion and Future Work

This paper describes an infrastructure for seamless learning analytics to bridge digital textbook learning and practical training such as programming and conceptual modeling education. We anticipate discovering the relationships between digital textbook learning and practical training.In the future work, we consider that analyzing and visualizing the logs collected by our proposed infrastructure using analysis methods such as social network analysis, non-negative matrix factorization, association analysis and decision tree (Mouri et al., 2016, 2018a).

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References

Brendan, F. and Ogata, H. (2018). Learning analytics Infrastructure for Seamless Learning, Companion Proceedings of the 8th International Conference on Learning Analytics and Knowledge (DesignLAK2018), in press.

Kiyota, M., Mouri, K., Uosaki, N., & Ogata, H. (2016). AETEL: Supporting seamless learning and learning log recording with e-book system. In Proceedings of the 24ndInternational Conference on Computers in Education, Bombay, India, 306–314.

Looi, C.K., Sun, D. & Xie, W. (2015). Exploring students' progression in an inquiry science curriculum enabled by mobile learning. IEEE Transactions on Learning Technologies, Vol. 8, No. 1, 43–54.

Milrad, M., Wong, L. H., Sharple, M., Hwang, G. J., Looi, C.K., & Ogata, H. (2013). Seamless learning: An International perspective on next generation technology enhanced learning. In Z. L. Berge & L. Y. Muilenburg (Eds.), Handbook of mobile learning, Chapter 9, 95–108.

Mouri, K. and Ogata, H. (2015). Ubiquitous learning analytics in the real-world language learning, Smart Learning Environments, Vol. 2, No. 1, 1–15.

Mouri, K., Ogata, H. and Uosaki, N. (2017). Learning analytics in a seamless learning environment, International Learning Analytics & Knowledge Conference, 348–357.

Mouri, K., Okubo, F., Shimada, A. and Ogata, H. (2016). Bayesian network for predicting students' final grade using e-book logs in university education, International Conference on advanced Learning technologies, 85–89.

Mouri, K., Shimada, A., Yin, C. and Kaneko, K. (2018a). Discovering Hidden Browsing Patterns Using Non-Negative Matrix Factorization, International Conference on Educational Data mining, in press.

Mouri, K., Ogata, H. and Uosaki, N. (2018b). Learning Analytics for Supporting Seamless Language Learning using E-book with Ubiquitous Learning System, Journal of Educational Technology 6 Society, Vol. 21, No. 2, 150–163.

Wong, L. H., & Looi, C. K. (2011). What seams do we remove in mobile-assisted seamless learning? A critical review of the literature. Computer & Education, Vol. 57, 2364–2381.

Wong, L. H., Milrad, M., & Specht, M. (2015). Seamless learning in the age of mobile connectivity. Singapore: Springer.

Tanaka, T., Hashiura, H., Hazeyama, A., Komiya, S., Hirai, Y. and Kaneko, K. (2018a). Learners' self-Checking and Its Effectiveness in Conceptual Data Modeling Exercises, IEICE Transaction on Information and Systems, in press.

Tanaka, T., Mouri, K. and Kaneko, K. (2018b). Pattern analysis of Learners' Artifact Making Processes and Errors in Conceptual Modeling Exercises, Information Engineering Express, Vol. 4, No. 1, 77–86.

Uosaki, N., Ogata, H., Li, M., Bin, H. and Mouri, K. (2013). Guidelines on Implementing Successful Seamless Learning Environments, International Journal of Interactive Mobile Technologies, Vol. 7, No. 2, 44–53.