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Piloting Multimodal Learning Analytics Platform at a Japanese High School

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Abstract: This practitioner's report describes how researchers and educators collaboratively implemented a micro-learning platform, LA-ReflecT, that is enabled with multimodal analytics as a pilot in a Japanese high school. A team of high school teachers created three learning tasks, which were then authored in the learning platform. The paper highlights the three learning designs that can be linked to those activities and the affordances of the system to implement them. Further, by integrating multimodal data, such as interaction traces on designed learning activities and eye gaze heatmaps, we want to investigate how shared reflection among instructors and researchers supports actionable insights into student learning processes and facilitates evidence-informed dialogue. This collaborative implementation is a stepping stone towards extracting evidence from multimodal learning analytics in the actual classroom setting.

Keywords: Co-design, Multimodal Learning Analytics, Learning Design, High School

1. Introduction

With the GIGA school project in Japan, there is access to ICT infrastructure in the schools, and the Ministry of Education has also introduced policies to guide the integration of Generative AI into K-12 education (MEXT, 2024), prompting schools to align their technologies and pedagogies accordingly. However, teachers still face challenges in redesigning existing learning activities to effectively incorporate AI technologies, particularly within the time constraints of their daily schedules. At the same time, educational technology designers and researchers who design the learning tools, if in isolation, cannot estimate various issues in implementation. Hence, this practitioner's paper highlights the collaboration between researchers and teachers from a high school to understand their educational practices and then incorporate a lesson design that utilizes an AI-integrated learning platform. One of the other unique challenges in this context was the multi-cultural members that was part of the teaching and research groups.

2. Learning environment and Task design

2.1 *Learning Platform: LA-ReflecT*

The learning platform used in this study is LA-ReflecT (Majumdar et al. 2023). It had the feature of authoring the activity as well as tracking data of the user's attempt. While the previous version (Majumdar et al. 2024c) had the option to import sensor data through a data upload interface, the web-based eye-tracking function was added to this version of the platform. The teacher could enable eye tracking in a particular task while authoring, and then the students, while attempting, had further control to pause the tracking.

Within each task, the teacher could arrange various elements, for instance, textual instructions, links to resources such as video and pictures, as interactive consumables that the students could view in the interface and interact with to consume the information and knowledge. An addition in this version was the iframe element, which enabled embedding any external site directly in the interface. Another type of element included is one where the learner generates artefacts, such as text input and answers to multiple-choice questions. In this version of LA-ReflecT, we also implemented an API-based link to develop feedback modules and a chatbot powered by an LLM like ChatGPT. Hence, during authoring, the teacher could configure a prompt to which the learner's input will be augmented and sent to the LLM to get feedback. For the chatbot element, the teacher's prompt will be considered for the first conversation.

The interactions and the artefacts generated in the viewer, as well as the eye movement data, are logged and aggregated in a reflection dashboard. The teacher has access to all the students' data, while the student can access their data just after completing one task. The interaction logs, artefacts generated, and the eye gaze heatmap on a particular task are presented in the dashboard. The teacher can also author an input element in the dashboard, such as multiple choice and text input, which the learner can answer while looking at the information in the dashboard. All the above consists of the multimodal data that the platform provides. However, engaging in the sense-making process with such data remains challenging. This work aims to illustrate that process.

2.2 *Learning Design in Three Topics*

The pilot study was conducted with three teachers who designed activities for topics related to Experimental methods, Information security, and Energy conservation. The activities selected were typical activities that the teacher conducts in their class. In the first phase, the objective was to transfer the learning activities to the online platform as microlearning tasks such that the students could attempt them in a self-regulated manner at their own pace.

For instance, the experimental methods activity was divided into three tasks: writing an experimental method, describing the results of an experiment, and conducting a short review test. The activity was set up in the LA-ReflecT platform, and Figure 1 shows the authoring interface where the teacher could create the three sequential tasks. Each task could enable eye tracking (on the editor panel on the right).

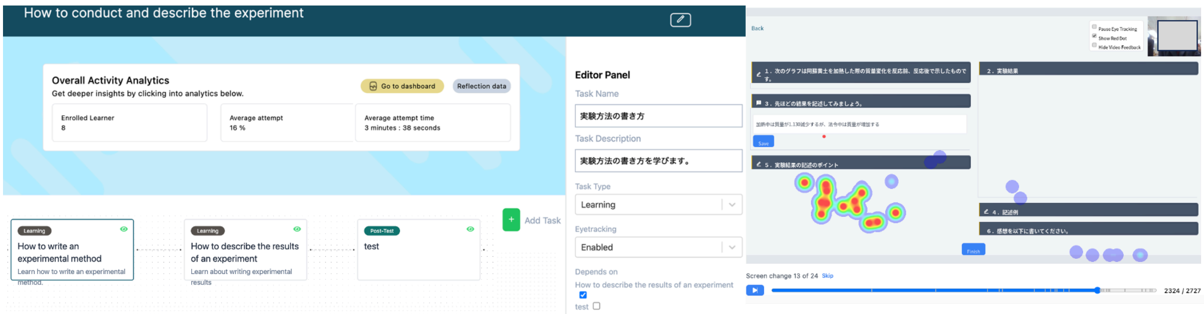

Figure 1. Activity design with tasks, eye tracking enabled. Learner task interface (right).

For Information security activity, three video resources were the main learning content. Each video had a set of reflection questions. Figure 2 shows the authoring interface of the task, where the teacher can drag and drop the elements and set their specific values in the editor panel.

The activity related to the energy conversion topic was conceptualized as an interactive activity with embedded simulations. The students were given a problem to solve, and the task elements had the resources required to solve it. Figure 3 shows the viewer interface where the students can attempt the activity.

The activities were attempted by 5 students recruited from the chemistry club at the high school. After completion of the activity at their end, the students had a co-design session where they shared their experience with the learning task and the workflow in the platform. An ideation session also gathered the design opportunities from their perspectives.

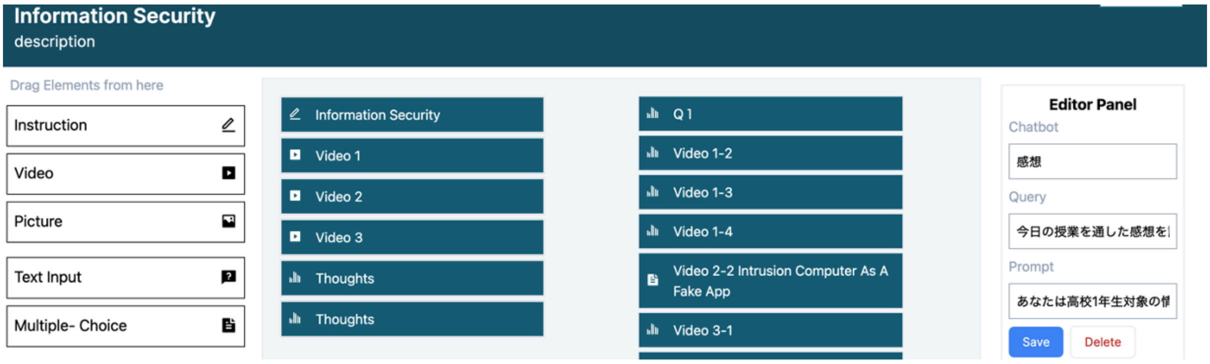

Figure 2. Task design interface to add various elements to a task using drag and drop.

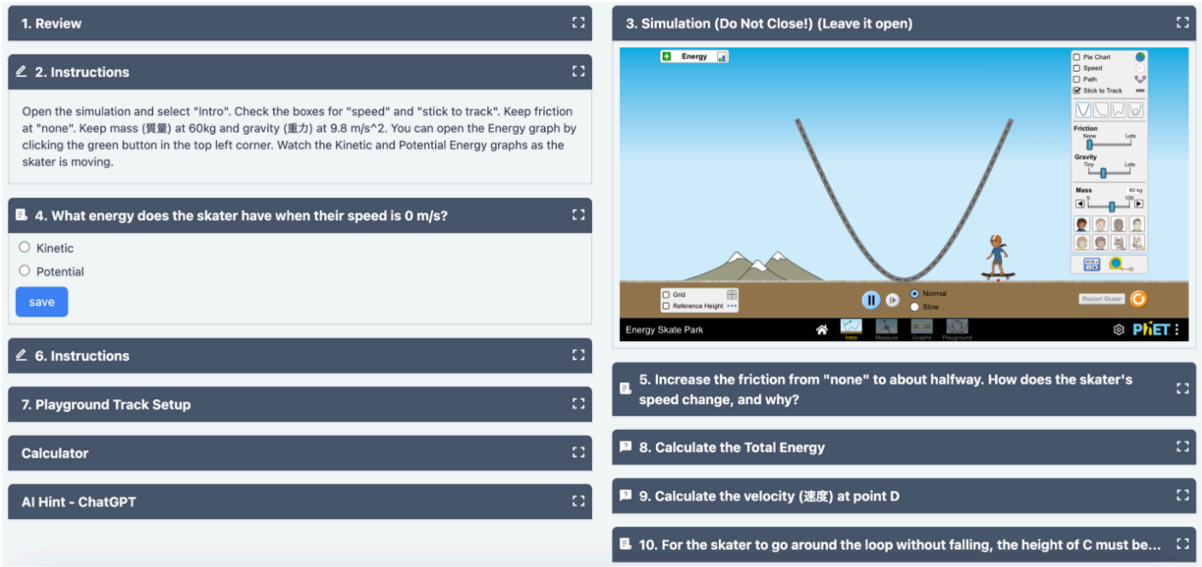

Figure 3. Task review interface for the teachers to check the user interactions.

3. Potential of Multimodal Analytics in the Task and Future Directions

While previous learning design in LA-ReflecT followed reflective learning tasks (Majumdar 2024a, 2024b), this pilot explored inquiry learning activities with the integration of generative AI feedback and chatbots. Three different microlearning task designs emerged in the initial pilot. The first involved demonstration of procedural knowledge, specifically in the context of a science experiment and its reporting. The teacher could prompt LLM to provide feedback about the structure of the reporting. The post-test also helps the student to practice one exercise after they engage in the learning activity. The multimodal data related to eye gaze could provide the point of focus while the student interpreted the result. The interaction log can provide response time for each of the attempts.

The second task involved gathering conceptual knowledge from the information security lecture video. In the first version, the provided question, along with the video, elicited the learner's answers as text. While modifying and including the chatbot, the activity was proposed to be inquiry-based learning, specifically *Controlled Inquiry* (Mackenzie, 2016), where the teacher chose the topics and identified the resources students would use to answer the questions. The answering element in this context was a chatbot, which was then prompted to initiate a further question of inquiry. The multimodal data here included the interaction logs with the video and the answers generated by the students. It could provide the interaction patterns that the learner followed to complete the task.

The third activity related to Energy conservation also followed a controlled inquiry design. The task had an explicit help corner that was implemented through the chatbot. With the interaction data in the platform, it will be possible to extract patterns of different task achievement groups (similar to Majumdar 2024a) and understand if any specific trends exist. Further, learners' help-seeking behavior with the chatbot can also be analyzed.

Various socio-technical aspects also emerged during this pilot. Firstly, the team of researchers and the teachers in this project also had multiple cultural backgrounds, which was also a unique situation that encouraged continuous communication and updating the system and the task. Involving an intermediate research coordinator was assistive. Secondly, regarding the integration of ChatGPT, teachers highlighted the need to interact with the chatbot before and refine the prompt, as the desired feedback was not generated when the learner submitted their answers. The ease of updating the prompt in the authoring tool was an important feature that helped to change the feedback while executing the activity in class. Thirdly, issues of low accuracy are already known for web-based eye tracking. However, as eye tracking model improvement is out of the scope of this research, during the pilot, we tried to identify some factors that can be controlled. Users attempting the task were standing in a laboratory setting (for the experimental methods activity), and so they could be instructed to sit and attempt the task on a laptop rather than a handheld mobile device. Based on the pilot, we later also implemented an on-demand calibration that was possible to initiate at the user end, and an instruction to let the learner check if the face bounding box was green to ensure a high accuracy of tracking. We conducted a classroom study later, focusing on the Information security task. The eye-tracking data collected there was utilized to form groups to investigate learning behaviors (Majumdar et al. 2025). Currently, further data analysis is underway.

This pilot work is a stepping stone to establishing continuous collaboration with the high school and university. The MEXT initiative, such as the super science high school, also supports a framework for such collaboration.

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References

Mackenzie, T. (2016). Dive into inquiry: Amplify learning and empower student voice. California: EdTechTeam Press

Majumdar R., Liang C., Ocheja P. and Li H. (2025) A Cooperative Learning Framework with Joint Attention and Interaction Data in the LA-ReflecT Platform. In 2025 Symposium on Eye Tracking Research and Applications (ETRA '25), May 26-29, 2025, Tokyo, Japan. ACM, New York, NY, USA, 4 Pages. https://doi.org/10.1145/3715669.3726825

Majumdar, R., Prasad, P., & Sane, A. (2024a). Mining Epistemic Actions of Programming Problem Solving with Chat-GPT. In Proceedings of Educational Data Mining Conference.

Majumdar, R., Prasad, P., Kadam, K., Gatare, K., & Warriem, J. M. (2023). LA-ReflecT: A Platform Facilitating Micro-learning and Its Multimodal Learning Analytics. In European Conference on Technology Enhanced Learning (pp. 731-735). Cham: Springer Nature Switzerland.

Majumdar, R., Singh, D., Chen, M.R.A. (2024b) Designing Structured Reflections for Guiding Learners' Interactions With Generative AI. In CELDA 2024.

Majumdar, R., Singh, D., Rajendran, R., Narayanan, S., Gatare, K. (2024c) LA-ReflecT platform's affordances for distributed multimodal learning analytics. In CollabTech 2024.

Mejeh, M., Sarbach, L. Co-design: From Understanding to Prototyping an Adaptive Learning Technology to Enhance Self-regulated Learning. Tech Know Learn (2024). https://doi.org/10.1007/s10758-024-09788-5

MEXT (2024) Use of Generative Artificial Intelligence, MEXT Policy https://www.mext.go.jp/a_menu/other/mext_02412.html

MEXT Super Science High School, https://www.mext.go.jp/a_menu/jinzai/gakkou/1309941.htm