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LA-ReflecT: A Platform for Data-informed Reflections in Micro-learning Tasks

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Abstract: Micro-learning experiences are built with short, focused activities in a technology-enhanced learning environment and also incorporates an assessment. While there are different operationalizations of the activity, it aims at learning byte-sized contents. The research initiates a design of LA-ReflecT, a platform for conducting micro-learning activities with a data-informed reflection cycle. Activities can have multiple short tasks which can have different multimedia and interaction elements. User interactions are logged in standardized xAPI format. Processed logs are presented in a dashboard to enable student's in-activity reflection. We present an initial draw implications of standardized interaction tracking that the application enables for further research on an embodied narrative of learning.

Keywords: Microlearning, LA-ReflecT, Learning Analytics, Learning Platform

1. Introduction and Motivation

Application of learning analytics aims at understanding a learning episode and supporting its continuous improvement. For the two key stakeholders, learner and teacher, involved in the learning episode, this would mean enabling - a) Knowing-in-action and Knowing-on-action and b) Reflection-in-action and Reflection-on-action (Baumgartner, 2013). Specifically in the context of Computer Science Education, research has shown the effectiveness of reflective prompts to help the learner to achieve the problem-solving skills in Introductory programming courses (Loksa et. al., 2016; Loksa & Ko, 2016). A learning design that involves such prompts can be considered as a sequence of smaller learning tasks where the learner interacts with the individual piece of content, designed by the instructor, reflects and builds on his/her existing knowledge and understanding. This is in alignment with usage of microlearning to describe shorter episodes of learning while dealing with specific task (here Problem solving task) where the learner is engaged in small and conscious steps (through reflective prompts) (Hug & Friesen, 2007). While many of the online learning platforms incorporate a learning dashboard to provide a view of the analytics, one issue remains that there is no workflow designed that lets the learners and teachers to actively review their learning and teaching activities within that dashboard (Reflection-in-action and Reflection-on-action). Hence utilization of the dashboard often remains low.

To address this issue this research aimed to design and develop a platform that enables authoring of micro-learning activities with multimedia components. Interaction of the learners and artefacts created are logged and then aggregated in a dashboard.

2. LAReflecT System Design

Learning Analytics' enhanced Reflective Task (LA-ReflecT) platform has two main components: an authoring tool where the teacher can create a microlearning activity and a viewer where the learner can attempt that activity. The platform can be linked to any learning management system (LMS) with standardized learning tool interoperability (LTI) protocol. Figure 1 presents a system architecture diagram of the platform. The user with a teacher role in the LMS has access to the authoring tool in the platform. Once they create an activity then they have to publish it to make it available in the activity viewer. The viewer has an activity attempt interface. It also logs the data of the users interactions and then can visualize the data in the dashboard.

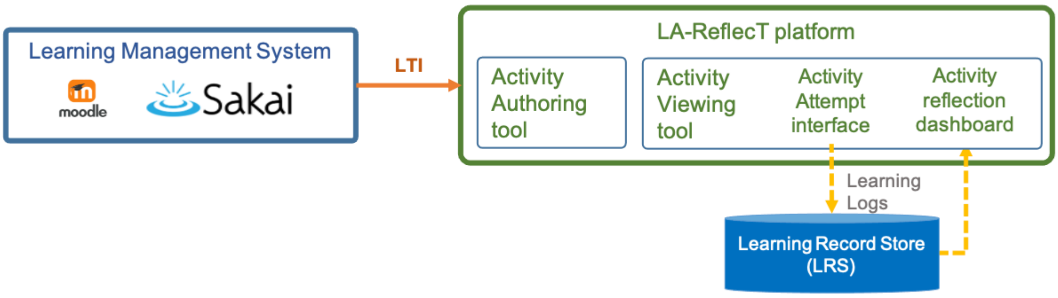

Figure 1. System architecture of LA-ReflecT platform

2.1 *Activity Authoring tool*

The authoring tool provides the teachers to create activities. Each activity can have multiple tasks. In a task the contents are organised as an element.

2.2 *Activity Viewer*

The viewer enables the user to interact with the elements of the task. It also logs the interactions, the artefact generated and the time spent on each element.

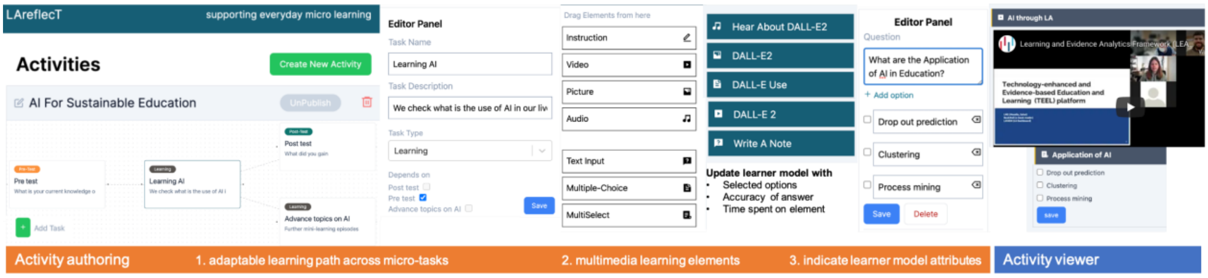

Figure 2. Workflow and interface in the LA-reflecT platform

2.3 *Learning Logs and Dashboard*

The interaction logs are stored in the LRS and provided in the learning dashboard.

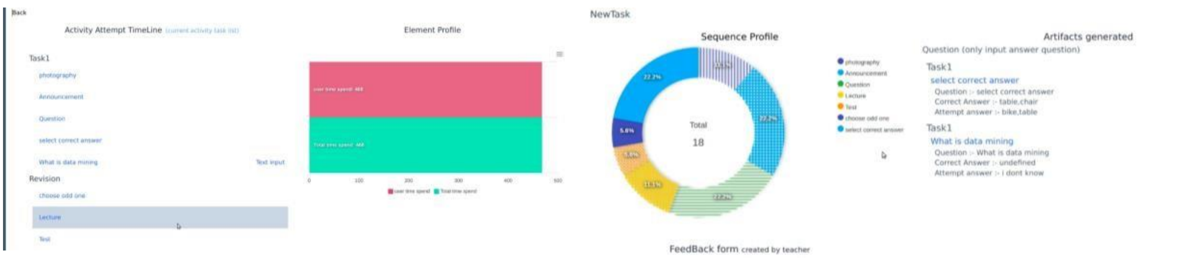

Figure 3. Dashboard visualizing interaction logs and artefacts generated

3. Pilot activity

3.1 Context

We used the LA-Reflect platform in an online Algorithms course. This course was part of an online degree program offered by an R1 university in India. In this course, learners were introduced to fundamental algorithms such as searching and sorting algorithms and algorithm techniques like divide and conquer, greedy algorithms etc. Each week, learners went through video lectures and attempted programming assignments which tested their understanding of the concepts they learnt that week.

In a programming assignment, learners were given a problem prompt, and test cases which contained an input and the corresponding required output. Learners were required to write code for the problem prompt in the learning portal. They could then run the code, and the portal showed how many test cases passed. If some test cases failed, it meant that certain parts of their solution were incorrect, or they might have missed checking some boundary conditions in their code.

We consider such programming assignments as micro-learning tasks. However, apart from feedback about the number of test cases which were passed by the system, learners do not get opportunities to reflect on how they are going about solving the problem. This is particularly important, as recent studies have shown that providing explicit reflection scaffolds to learners leads to improvement in programming skills (Loksa, 2016). Hence, we modified this programming assignment and included additional scaffolds whereby learners can reflect on how to go about solving the programming problem.

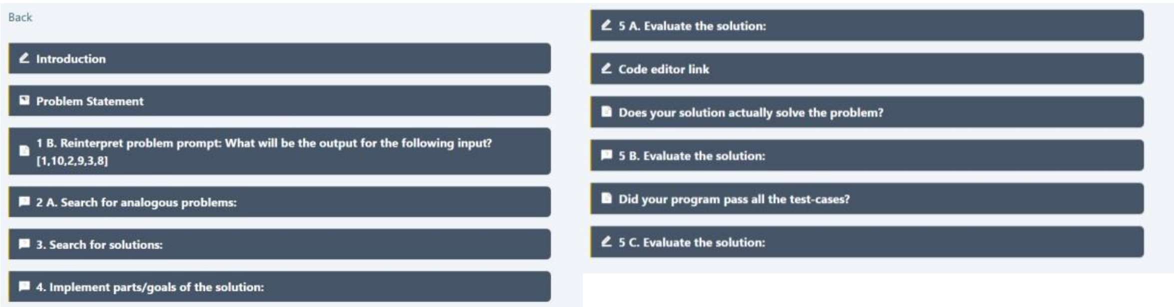

Figure 3. The Micro-learning task with additional reflection scaffolds in the LA-Reflect Platform

We used the LA-Reflect platform and added additional reflection steps for a given programming problem, as shown in Figure 3. In addition to reading the problem statement, we take learners through 5 key stages in programming problem solving, as identified by Loksa et al. (Loksa, 2016). In the micro-learning task, we make learners attempt 5 sub-tasks, namely - 1. Re-interpreting the problem prompt, 2. Searching for analogous problems, 3. Searching for solutions, 4. Implementing parts of the solution, and 5. Evaluating the solution. Learners are provided with multiple choice or open-ended response questions for each sub-task. For example, to help learners search for a solution, we provide the following prompt to learners - *"For the similar problems that you outlined before, think of how you solved those problems. What are certain characteristics of these solutions that you can use here?"*

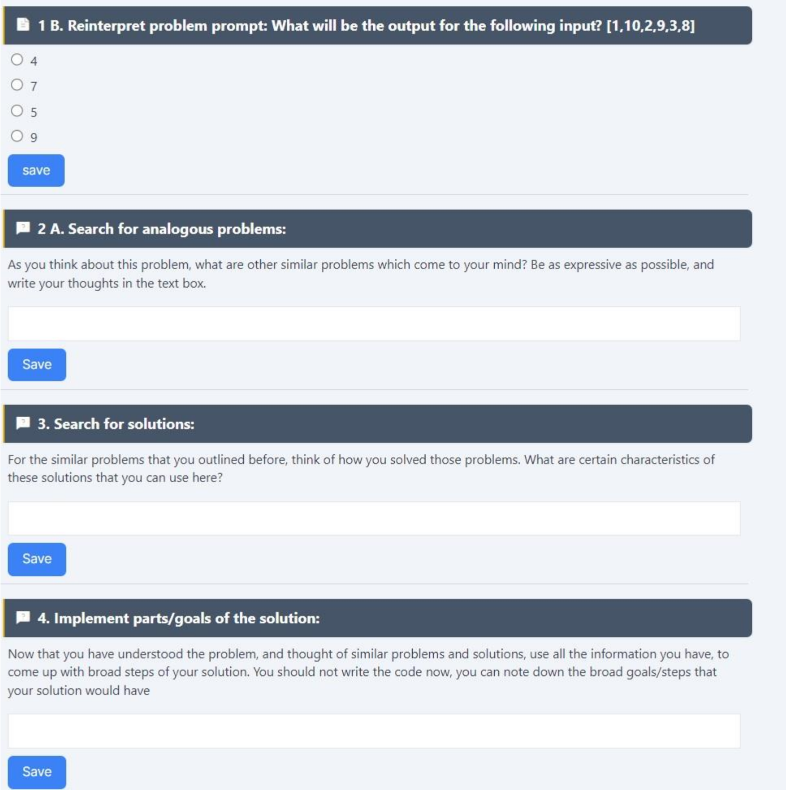

Figure 4. Problem prompts for some of the sub-tasks in the micro-learning task

Learners can attempt these sub-tasks in any order. Using these reflection scaffolds, they then write code for the given problem statement. We believe that providing learners with such reflection scaffolds in a programming problem can help them solve the problem better.

3.2 Pilot Study

We conducted a study with 78 participants, who were enrolled for the online Algorithms course. Participants first filled a consent form and attempted a questionnaire which measured their planning and learning motivation skills. The questionnaire was adapted from the self-directed learning instrument (SDLI) (Shen, 2014). They then proceeded to do 2 tasks in LA-Reflect. Each task had a problem statement, along with reflection scaffolds as mentioned in Section 3.1. Participants read the problem statement in LA-Reflect and could use the reflection scaffolds (see Figure 3 and 4) to write a working Python program for the given problem. They could test the correctness of their program by running the code in the programming portal, and the portal showed how many test cases passed.

3.3 Proposed Data Analysis

Various learner interactions such as their mouse clicks, which sub-task they are attempting, time spent in each element and answers to prompts are logged in the LA-Reflect platform. We are in the process of analyzing this data. There are two useful ways to analyse the interaction data. First, we can examine transition patterns of students across time, and see if common patterns emerge. For example, some students may follow a linear process i.e., follow all the sub-tasks sequentially. Others may go back and forth between sub-tasks. Others might spend a lot of time understanding the problem, while others might directly jump into writing the code.

Second, we can correlate transition pattern categories with the correctness of their final program (how many test cases passed). Some patterns can emerge, for example - students who spent a lot of time understanding the problem may have performed better.

The key idea is that the availability of such interaction data provides opportunities to investigate the effectiveness of reflections in the micro-learning task. Extending this idea, as part of future studies, we also intend to provide students with their own interaction data after they have attempted a microlearning task. We are interested in understanding how interpreting their own data affects their programming problem solving process and whether this has any bearings on their performance as well.

4. Discussion

This work stems from the initial attempt to design the ENaCT platform (Majumdar et. al., 2021) which just had the activity attempt interface and was logging interactions during a critical thinking task. The technical development discussed in this paper the second round in the design based research cycle where the authoring tool was presented. By allowing the authoring process (done by the teacher) to focus on development of the tasks and sub-tasks, the platform facilitates reflection-in-action for the teachers and knowing-in-action for the learners. The data based insights will further improve the reflection-on-action (for both teachers and learners) and the knowing-on-action (for the learners) thereby allowing the learners (and teachers) to go through different stages of a competency spiral (Baumgartner, 2013). The pilot implementation of the platform in the online Algorithms course, and its use by the learners has provided us with an initial understanding about the usefulness of the design from an authoring perspective. One major implication that we see with the use of microlearning framework is the need for the platform to have better integrations with traditional learning management systems so that the activity can be more seamless. The focus on one domain also limits our understanding of the types of reflection prompts that need to be supported for a larger adoption of the platform. However, we believe that the capability of allowing a broad spectrum of learning content to be integrated in the learning task would address this limitation. While the focus of this DBR iteration was primarily on the authoring, we intend to have a lesson design including the dashboard activity in our future work.

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