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Supporting Data-Driven Decision Making by Learners and Teachers

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Abstract: My research focuses on interdisciplinary data driven approach to support students and teachers. For students, I aim to design technology interventions to develop their self-directedness skill (SDS). For teachers, I investigate how learning dashboards can facilitate adopting actionable learning analytics in teaching practices. This two-pronged research agenda uses a proposed core process model, we call DAPER model. In DAPER model, users utilize data to plan, monitor and reflect on one's practices. We are developing LET's GOAL system based on the DAPER model to support the students. The model also fits in Learning Evidence Analytics Framework (LEAF), our proposed technology framework for evidence-based education system.

Keywords: Learning Analytics, Evidence Based Education, DAPER model, Goal Oriented Active Learner Learning (GOAL), Learning Evidence Analytics Framework (LEAF)

In this article I shall give an overview of my ongoing postdoctoral research work on data driven approach to support students and teachers.

1. Technology support for acquisition of self-direction skills

Literature on 21st century skills highlights learner's self-direction as a sub-skill. Even in a broader context self-directedness is crucial in the current society across all age groups and across contexts. To study how a data-driven intervention can support a learner in planning, monitoring execution and reflecting I choose academic learning and maintaining one's healthy lifestyle by physical activity as the two scenarios to execute SDS. With that as the research objective, we need to answer the research question ***How to collect, analyze and visualize learning and health logs together to support self-direction skill of students?*** To seek answer, the proposed work takes an interdisciplinary approach and applies methods from Learning Analytics (LA) and Quantified Self to log individual's learning and health data, analyze it and interpret that from the theoretical perspective of Self-Directed Learning (SDL) (Loyens et.al. 2008). Synthesizing the models of SDL, we came up with our DAPER (data-analysis-planning-execution-reflection) model to conceptualize the process of SDS execution and acquisition. To initiate, I adopted our Kyoto University group's LA framework and implemented infrastructure that supports connecting various learning logs across e-learning platforms (Flanagan and Ogata, 2017). The present work (Majumdar et.al. 2018) further extends that framework to include health logs from wearable and mobile devices. Based on our DAPER model, we designed and developed **G**oal **O**riented **A**ctive **L**earner (**GOAL) system** to synchronize-visualize-analyze multisource data regarding student's learning and physical activities (see overview in Figure 1). We called for pilot users who would help in design feedback of both the intervention and the application. Fourteen participants joined in for the program and we had monthly interactions as a part of the pilot need and context analysis.

Synchronous logging of learner's learning and physical activities that the GOAL project affords, shall generate a data poll that potentially opens further research opportunities at the intersection of LA and QS research. There is an increasing need of actionable data in Society 5.0, across domains of business, health care and even in education. While many consider a learner centric analytics model in education, there is still no framework which focus on supporting self-direction skills of students considering their health and learning activities together. I plan to study the interactions with the GOAL system to formulate future research questions to understand the

interplay of data visualization, technology affordances and acquisition of self-directedness. I currently received a JSPS Kaken Grant-in-Aid for Research Activity Start-up for the GOAL project.

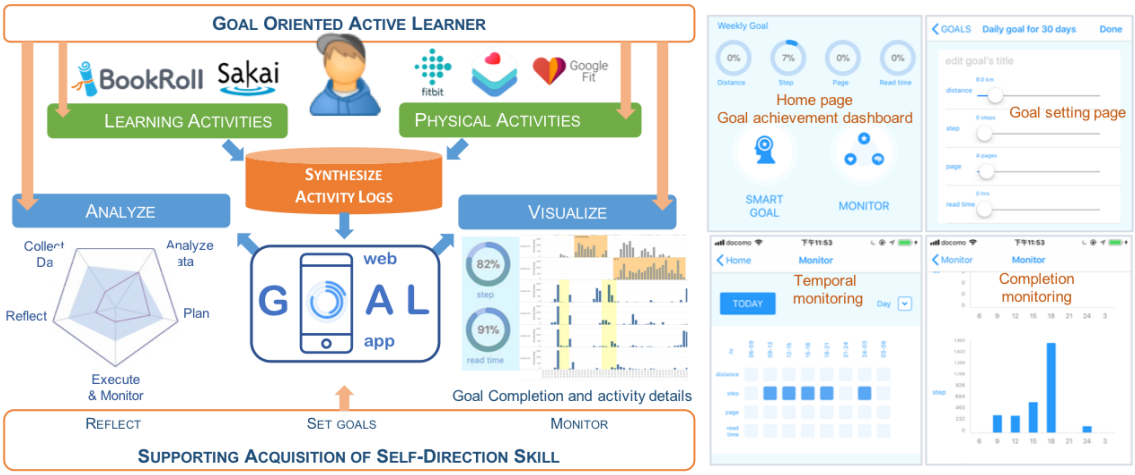

Figure 1. Overview of the GOAL project and the screenshots of its iOS application

2. Towards Evidence-based Education and Learning

Focusing on the teachers, the overall objective is to develop an evidence-based education system (EBE). We have proposed Learning Evidence Analytics Framework (LEAF), a technology design framework to support extraction and utilization of evidence from learning logs (Ogata et.al. 2018). Figure 2 elaborates with an example of the workflow of an evidence extraction system. The students use a learning tool (in our case BookRoll, an e-book reader) and their learning logs are stored in a Learning Record Store (LRS). Our framework (Flanagan & Ogata, 2017) supports learning tool which has LTI based authentication to collect UUID linked anonymous learning logs. This anonymity facilitates researchers to do data analytics and build robust LA engines. Using the LTI also helps to convert the UUID to user name and present it in our dashboard, *LAview*. Based on the role of the user (student or teacher) LAView presents appropriate views of the information. The visualized indicators in LAview along with the support of the recommendation engine in LA tool can assist the teacher to identify possible problems in students learning, provide feedback to the students and monitor if there is a change. This workflow generates the basic unit of analysis for log-data driven EBE, the Teaching-Learning Case (TLC). Currently I am working to define the structure of TLCs which can then be stored in an Evidence Record Store (ERS) for further analysis. This led us to further conceptualize an evidence analytics tool. It would comprise of an evidence engine to aggregate and segregate the TLCs and rate them as evidence of improved learning practices. An associated evidence portal can help to access details of such analyzed TLCs and recommend for future use by other teachers. The researchers can possibly use the evidence portal to come up with a data-based narrative of teaching-learning practices as new theory.

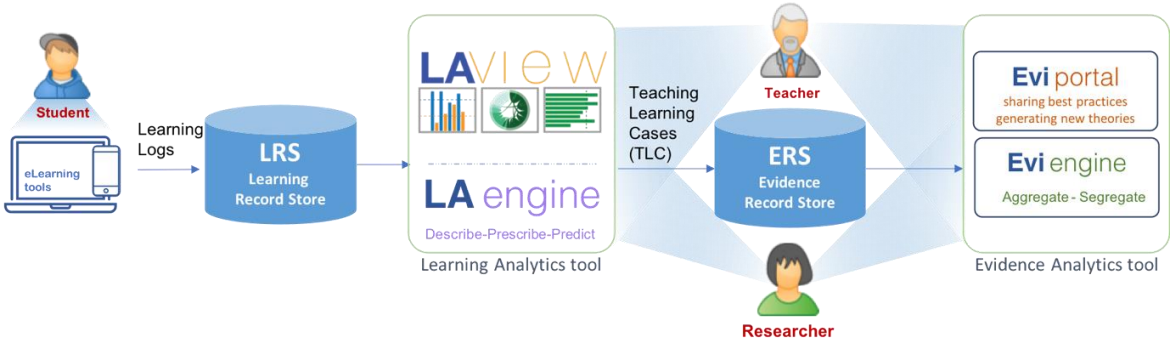

Figure 2. Components of Evidence-based Education and Learning system

While EBE is studied under different names (see Davies, P. 1999) such as research-based education, literature-based education or context-sensitive practices, none of them use the power of big data of learning logs to build evidence. We conceptualized the notion of evidence similar to the evidence based healthcare and clinical pathways literature (Kinsman, 2010). It would involve collecting data of learners, conducting cohort analysis and generating specific feedback and intervention strategies for such cohorts. Based on the results of the intervention certain intervention plan might be more effective to mitigate a specific learning issue seen in the class and emerge as an evidence of better learning outcome or better teaching practices.

To summarize, I present the core process model (DAPER) in Figure 3. It highlights the different activities that the students and teachers need to conduct in their respective context.

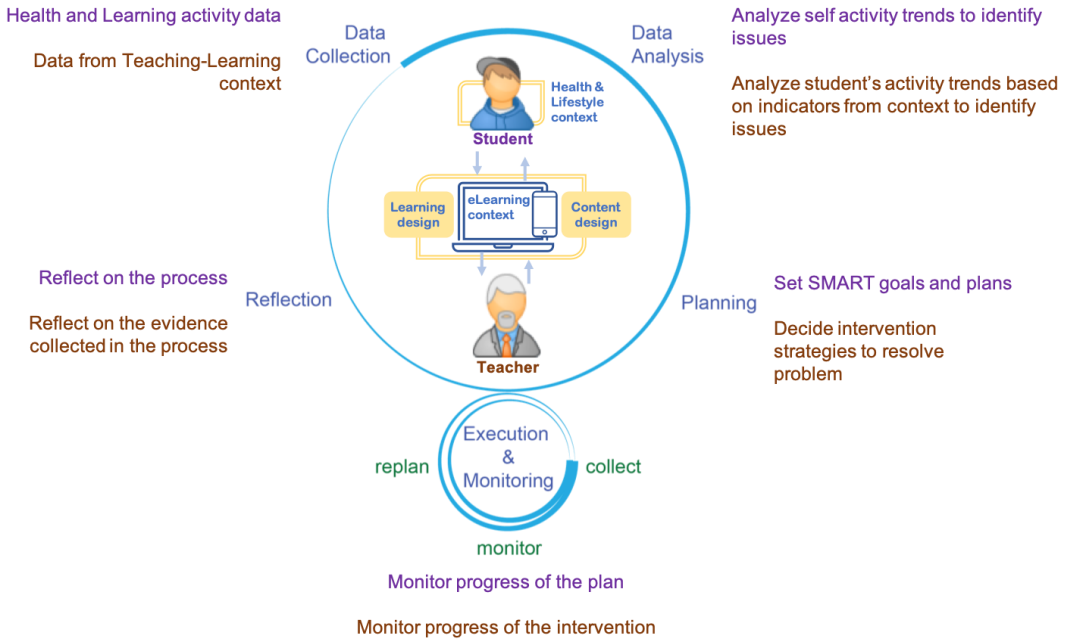

Figure 3. Core DAPER model and sample activities of students and teachers in each phase

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