Shih, J. L. et al. (Eds.) (2019). Proceedings of the 27th International Conference on Computers in Education.
Taiwan: Asia-Pacific Society for Computers in Education

Promoting Students' Self-Direction Skills through Scaffolding with Learning and Physical Activity Data

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1. Introduction

With the growing trend of preparing students for lifelong learning, the theories of self-directed learning have been increasingly applied in the context of K12 and higher education. Being self-directed would help students to prepare them for success in their future careers, and enables them to engage in lifelong learning. Since it is a cognitively and behaviorally complex task to execute self-direction, it's crucial to create a data-rich environment where students are given more opportunities to engage in self-direction.

Self-direction Skills (SDS) are acquired through experience, training, and effort. The benefits of experience and training will depend on the degree to which people engage through volitionally initiated thought processes. It is becoming a trend to utilize technologies in education, and students' learning behaviors in an online learning environment can be automatically recorded by learning systems. Such learning records provide new opportunities to model students' learning process. On the other hand, the increased availability of the activity tracking data gives individuals more opportunities for establishing benchmarks in objective metrics and improving achievements through the experience of reality (Swan, 2013). The research and design of data quantification have grown as an interest area in information and learning sciences (Lee, 2019).

Therefore, this research focuses on developing a seamless technology platform that supports SDS in students' day to day context, especially building an adaptive scaffolding in the execution and acquisition of SDS. Students' learning and physical activities are chosen as context and the interactions between students and the platform are also recorded as indicators of the development of SDS.

2. Research Goals

This research aims to build an adaptive scaffolding in the execution and acquisition of SDS themselves under the context of learning and physical activities. Three major areas must be investigated for the research.

- What is SDS and its sub-skills acquisition in a data-rich environment?
- How to leverage learning and physical activity data to develop SDS?
- How to design an adaptive scaffolding for the acquisition of SDS in a data-rich environment?

To achieve the research goal, the Goal Oriented Active Learner (GOAL) system is designed and implemented to integrate learning and physical activity data, concretize the process of self-direction and embed the adaptive scaffolding. Students are expected to gradually enhance their SDS in the GOAL system during the daily cycle of data collection, self-analysis, self-planning, monitoring, and self-reflection.

3. Related Work

3.1 Self-Direction Skills

According to P21 (Partnership for 21st Century Skills, 2016) framework, Initiative and Self-Direction requires monitoring one's understanding and learning needs, demonstrating initiative to advance professional skill levels, defining, prioritizing and completing tasks without direct oversight and

demonstrating commitment to lifelong learning. It requires learners to handle multiple environments, goals, tasks, and inputs while understanding and adhering to organizational or technological constraints of time, resources, and systems. The conceptual framework gives a general criterion for a self-directed learner.

Self-directed learning (SDL) and self-regulated learning (SRL) are two most frequently used terms in today's educational discourse on the learning process (Brockett & Hiemstra, 2018; Candy, 1991; Winne et al., 2006; Zimmerman, 2008). Literature highlights their commonality and differences (Saks & Leijen, 2014). Both SDL and SRL have 4 key phases: Task definition – Setting goals and Planning – Enacting strategies – Monitoring and Reflecting. SDL due to its adult education roots is mostly used for describing the learning activities outside the traditional school environment. SRL, on the other hand, is mostly studied in the school environment.

Technological innovation in the field of data logging and rapidly increasing digital world have expanded the intersection of SDL and SRL. The processes of executing and developing SDL and SRL can be captured. For this research, I adopted a five-phase process model, DAPER which synthesizes the SDL and SRL models to conceptualize data-driven SDS execution and acquisition (Majumdar et al., 2018). It has five phases, the initial phase of data collection which gives learners the initiative, followed by the other four phases: data analysis, planning, execution monitoring, and reflection. Figure 1 provides an overview of the DAPER phases with example from the context of learning and physical activities.

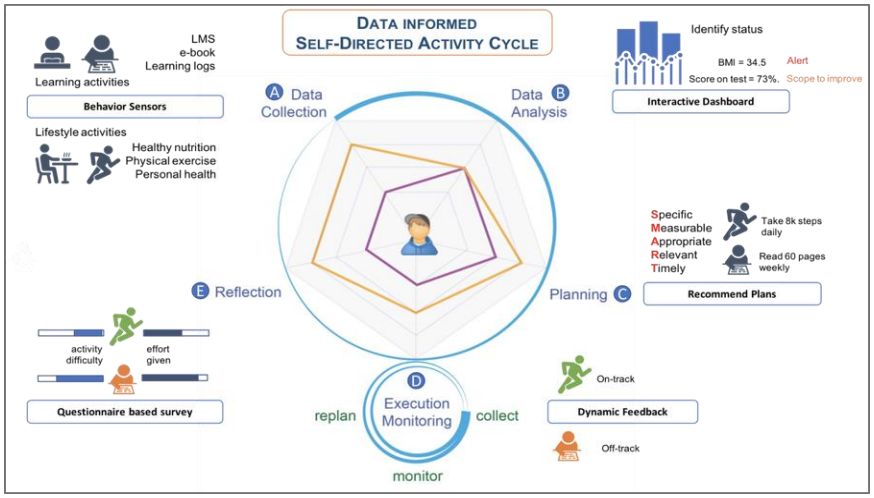

Figure 1. DAPER Model of Self-Direction Skills Execution (Majumdar et al., 2018)

3.2 Quantified-Self

Quantified-Self movement emphasizes the importance of the regular collection, processing, and presentation of data on behavioral indicators, environmental indicators or biological indicators as measures to evaluate personal performance so that individuals can better achieve progress in their areas of interest (Choe et al., 2014). Individuals with focus on the setting process-oriented goals are often interested in the stream of data regarding their own activities during that process to monitor goal accomplishment and if necessary re-plan. The research and design of quantified-self have grown as an interest area in information and learning sciences (Lee, 2019). The quantified resources and technology begin to be used for educational purposes. But keeping track of variables of interest is often time-consuming as data collection is not unified in one application.

3.3 Adaptive Scaffolding

Scaffolds are tools, strategies, and guides that can be designed to support students in directing their learning. Scaffolds can be provided by human and computer tutors, teachers, peers, and animated pedagogical agents during learning to enable students to develop understandings beyond their immediate grasp (Chi et al., 2001). Adaptive scaffolding requires a teacher or tutor to continuously diagnose the student's emerging understanding and provide timely support during learning (Azevedo et

al., 2004). Adaptive scaffolding may be more beneficial for supporting students' self-directed learning because it adjusts to meet students' learning needs. However, there is a lack of empirical evidence regarding the effectiveness of adaptive scaffolding to support the acquisition of SDS.

4. Methods

The Design and implementation of GOAL system is shown in Figure 2. The GOAL system integrates data during learners' learning and physical activities, tracks the interactions between learners and system, and implements the DAPER model with the functionalities required in each phase. Learners can link automatically their learning activity data from the LMS and other linked e-learning tools. For physical activity data, students authenticate to synchronize that data directly from mobile health apps or platforms for wearable devices. This system grounds the theory of SDS and enables learners to develop the skills in the context of learning and physical activities, like e-book reading, walking, running.

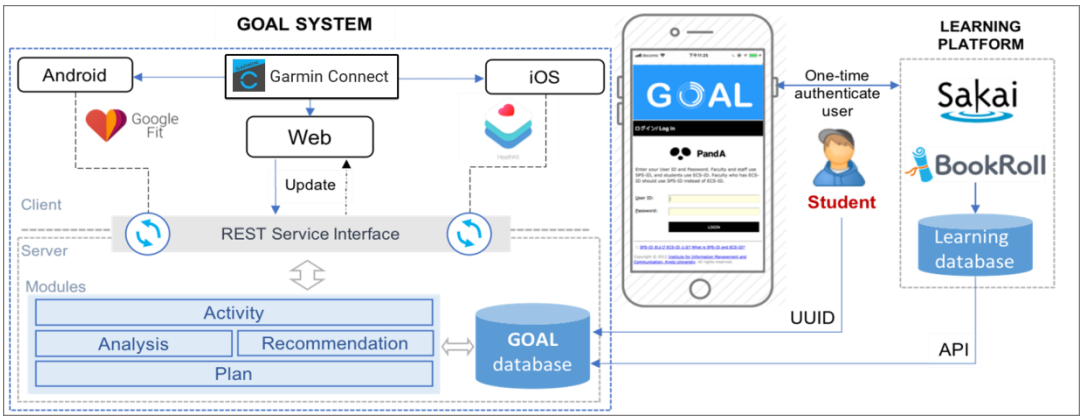

Figure 2. The Design and Implementation of GOAL System

The framework of scaffolding for self-direction skills acquisition in a data-rich environment is given in Figure 3. It contains activities, scaffolding in GOAL, and self-direction skills. The learners' activity data is the records of learning systems and physical activity platforms. During the learners execute their own learning or physical activity, the scaffolding will be provided to execute and acquire SDS. Two components of scaffolding are required: tasks and interface features. The tasks would be given to demonstrate the SDS sub-skills and the interface features are used to execute these tasks. Finally, five SDS sub-skills are measured and promoted based on the interactions between the learners and GOAL system: data sufficiency in data collection phase, status identification in data analysis phase, SMART (Specific, Measurable, Appropriate, Relevant, Timely) planning in planning phase, regular tracking in execution monitoring phase, and self-evaluation in reflection phase.

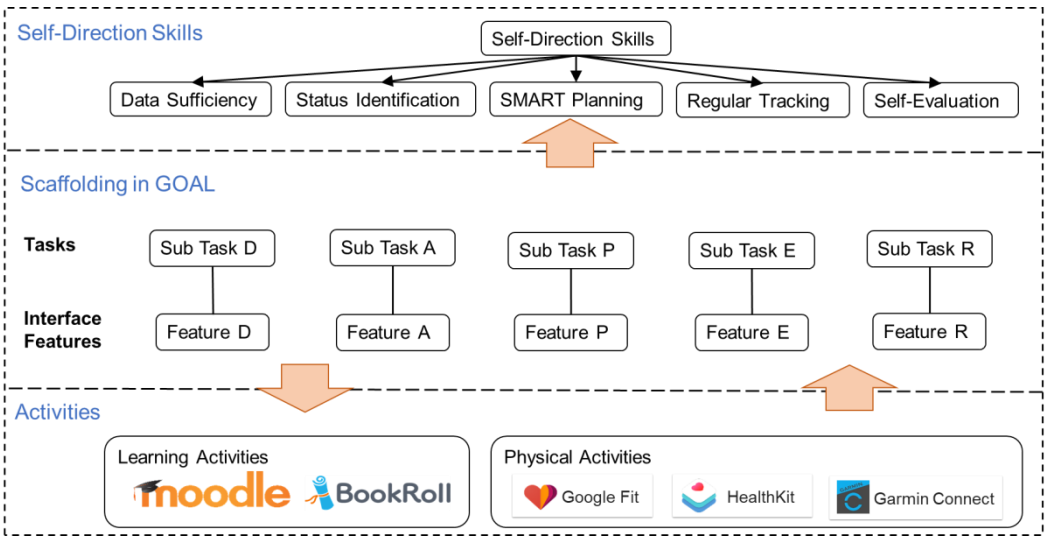

Figure 3. Scaffolding for Self-Direction Skills Acquisition in a Data-Rich Environment

5. Expected Academic Contributions

SDS are considered as a necessary 21st century skills (Partnership for 21st Century Skills, 2016). For learners, SDS is crucial to maintain academic performance as well as a healthy lifestyle while they have multiple activities to carry out. There is limited work which connects both the learning and physical data of learners and provides a holistic perspective to develop their SDS. Hence, this research explores to leverage learning and physical activity data to develop SDS in learners' day to day context.

Furthermore, there is a lack of empirical evidence of scaffolding for the acquisition of SDS. This research attempts to support learners being self-directed through adaptive scaffolding in a data-rich environment. The scaffolding is triggered in a data-driven manner and decomposed into actionable sub-tasks, which contributes to exploring a data-driven paradigm to develop such meta-cognitive skills in the current data-informed world.

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