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Design of a Self-Reflection Model in GOAL to Support Students' Reflection

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Abstract: GOAL (Goal Oriented Active Learner) system is a platform to support the development of students' self-direction skills using a data-driven feedback loop. It integrates students' learning activity data from the learning management system (LMS) and physical activities data from the mobile health applications or wearable devices. These activity data provide a data-rich context for students to train their self-direction skills, such as planning, monitoring and reflection. The reflection skill plays an important role in the self-directed cycle, and therefore students should be given more opportunities to practically execute the skill and further improve it. This paper proposes a self-reflection model to support the acquisition of reflection skills in students' self-directed learning and physical activities. The model is built on reflective process and strategies in self-direction and self-regulation. It allows students to reflect on their plans and achievements in the planning-monitoring-reflection process and enables them to consider their reflective strategies. The conceptual contribution of this paper is applying reflection theory to the practice in self-directed activities through computer based scaffolds.

Keywords: Self-reflection, student reflection, learning analytics, self-direction, GOAL

1. Introduction

Self-direction Skills (SDS) are acquired through experience, training, and effort. The gain of experience and training depends on the degree to which learners engage in volitionally initiated processes. Since it is a cognitively and behaviorally complex task to execute self-direction, more opportunities that learners engage in self-direction may benefits the acquisition of SDS.

Although there are multiple approaches to capture data on learners' self-direction or self-regulation, self-report measures have still stayed dominant so far. The recent availability of large and fine-grained datasets has led to investigate self-regulation by applying learning analytics (LA). The assessment of frequencies and sequences of regulatory activities in learning environments provides a novel perspective on self-regulation that complements and potentially supersedes traditional self-report measures (Bannert & Sonnenberg, 2014; Li et al., 2018). On the other hand, the increased availability of 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).

This leads us to build the GOAL system to support the development of students' SDS using a data-driven feedback loop (Majumdar et al., 2018). The GOAL system not only leverages the rapidly increasing activity data but also provides computer based scaffolding to foster students' SDS in the self-direction cycle. The reflection is a key phase in the self-direction cycle. In this paper, we introduce how to build a self-reflection model and support the acquisition of reflection skills.

2. Related Work

2.1 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, and tasks while understanding and adhering to organizational or technological constraints of time, resources, and systems. The framework gives a general criterion for a self-directed learner.

Self-directed learning (SDL) and self-regulated learning (SRL) are two terms most frequently used in today's educational discourse on 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.

Technological innovation in the field of data logging and rapidly increasing digital world have expanded the intersection of SDL and SRL, so that, the processes of executing and developing SDL and SRL can be captured. We have proposed DAPER (Data collection - Analysis - Planning - Execution monitoring - Reflection) model which synthesizes the SDL and SRL models to conceptualize data-driven self-direction skill execution and acquisition (Majumdar et al., 2018). It is a process model with five phases, the initial phase of data collection which gives learners the initiative in their contexts, followed by the other four phases: data analysis, planning, execution monitoring and reflection. Figure 1 shows the DAPER phases with example from the context of learning and physical activities.

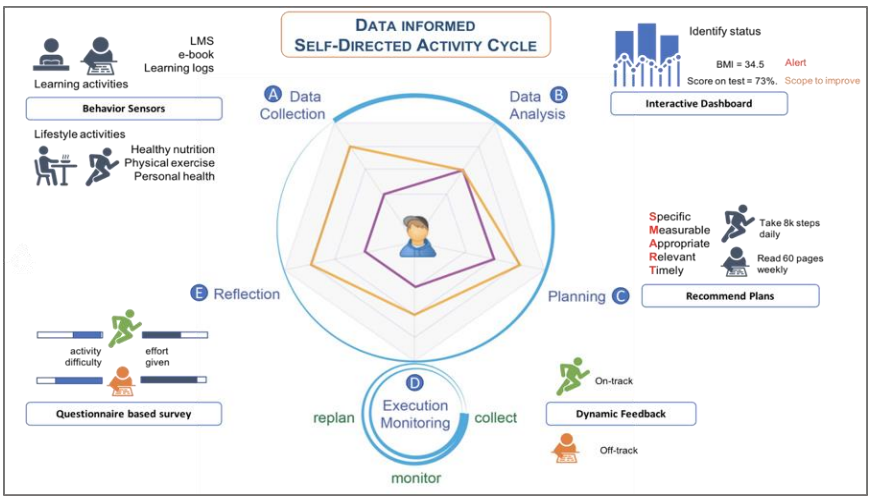

Figure 1. DAPER Model of Self-Direction Skills Execution and Acquisition (Majumdar et al., 2018)

2.2 Self-Reflection in Self-Direction and Self-Regulation

There are many indications that reflection plays an important role in learning processes (Boud et al., 1985; Holmberg, 2005; Hammond & Collins, 2013), and that reflection also constitutes an important factor in the acquisition of self-direction and self-regulation (Kuiper & Pesut, 2004; Nesbit, 2012). Reflection can be conceived of as a skill or strategy that operates on other strategies, such as planning, monitoring. Learners should reflect on not only what they had learned (monitoring/reflection) but also how they learned (planning/monitoring). By reflecting on ones' own learners become aware of their learning processes and possible alternative strategies. During self-directed activities, reflection becomes of greater importance for learner success when the process is less externally guided (e.g., by the teacher). Learners must then manage their learning to a greater extent, making reflection more critical. Therefore, learners require more strong support for self-reflection.

2.3 Support Self-Reflection in Self-Direction and Self-Regulation

While there is a broad consensus that reflection is a crucial factor for the improvement of students' self-direction and self-regulation, it is also found that the majority of students do not reflect deeply on their learning processes in educational practice (Zimmerman, 2006). In order to engage students in effective self-reflection, a scaffolding environment for training can be considered. Regarding this support environment, the question is: what should provide to self-reflection for students? Students may

lose their directions if without reliable, revealing and relevant data that support effective reflection. Following the learning analytics process model learners need to translate awareness into action (Bodily et al., 2018). They need a 'representative reference frame' to interpret the data (Wise, 2014). Both the contextual activity data and trace data of self-direction behavior can be valuable ways to create such a reference frame.

Furthermore, reflection journal writing is effective in promoting self-reflection and learning (Lew & Schmidt, 2011). Students can reflect on their process and achievement through a structured reflection journal. Prompting has been identified as a promising method to evoke these reflective actions. Therefore, in this study a computer based scaffold is integrated using a reference frame, a reflection journal, and reflection prompts. It is designed to support and stimulate students to reflect on their learning processes and achievements.

3. Design of the GOAL System

The design and implementation of the 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, such as digitized reading logs, answers of quizzes, and status of course assignments (Flanagan & Ogata, 2018). Learners can also synchronize physical activity data directly from mobile health apps or platforms for wearable devices, such as data from runs, workouts, sleep, steps taken, weight, heart rate, and calories burned. Furthermore, the interactions between learners and the GOAL system are logged as eXperience API (xAPI) statements in the GOAL server. This system grounds the theory of SDS and enables learners to develop the skills in the context of learning and physical activities.

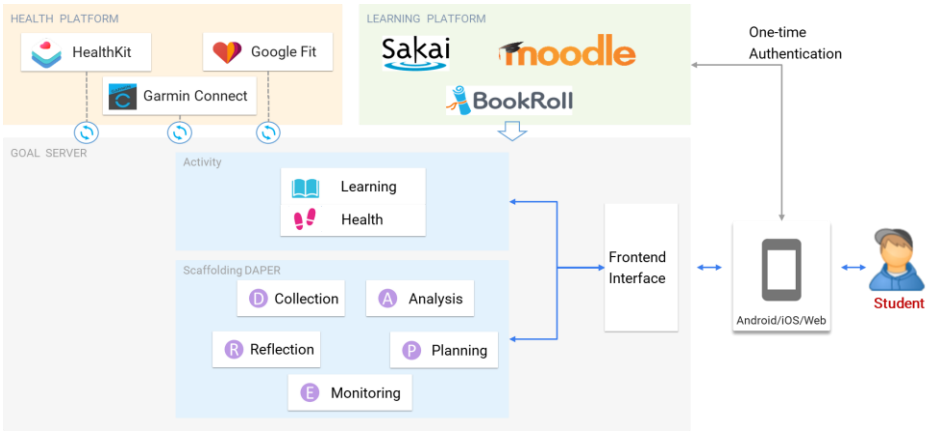

Figure 2. The Design and Implementation of the GOAL System

In the pre-planning phase, students could collect and analyze their own activity data from the learning or health platform. Once they have set a plan for a learning or physical activity, they start to monitor the progress and reflect on the learning processes and outcomes in the post-planning phase (Li et al., 2019). The students have active involvement in these phases since they increase their ownership by interacting with their own activity data and plans. They can create learning or physical activity plans, such as an extensive reading activity in English in weekly scale or a running activity in daily scale.

4. Design of the Self-Reflection Model

Our proposed self-reflection model is shown in Figure 3. First, a reference panel is shown, which consists of the detail of plan, target achievements, and activity achievements. Second, a structured reflection journal is provided to let students rate the degree of plan difficulty, the target achievement rate, and the effort to achieve the plan. An unstructured comment is also added in the reflection journal. Third, a skill diagnosis of self-reflection skills is performed using a 5-point scoring rubric. Finally, an adaptive feedback is generated based on the diagnosed score. The model is executed by students in self-reflection process in an iterative cycle.

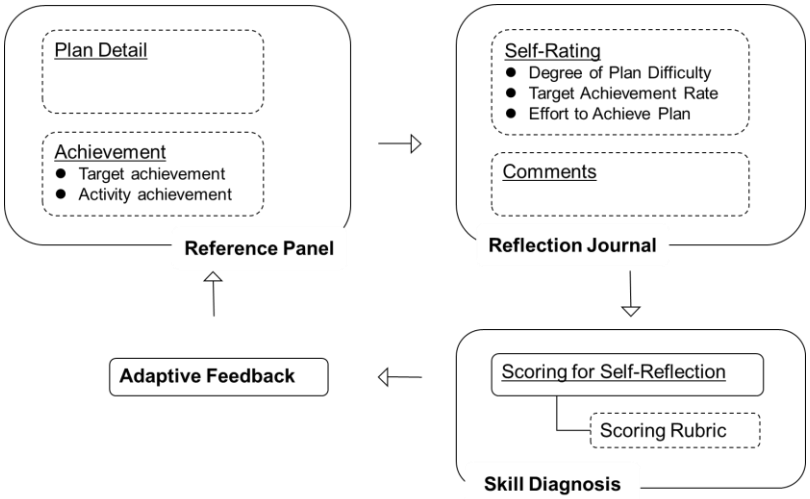

Figure 3. Self-Reflection Model

4.1 Reference Panel

The reference panel contains the detail of plan, target achievements, and activity achievements. The detail of plan has these items: plan name, activity type, start date, end date, frequency, target value, target unit, and notes. The target achievement shows the days when the learner achieved the target value and the completion rate within the planned duration. The activity achievement shows the average and total amount of the planned activity.

4.2 Reflection Journal

The reflection journal contains the degree of plan difficulty, the target achievement rate, and the effort to achieve this plan. These indicators can be rated as a 3-point score. Also, an unstructured thought could be input in an additional comment area by learners, which can be the current problems, specific strategies, or further actions.

4.3 Skill Diagnosis using 5-point Scoring Rubric

The self-reflection skills are measured by a 5-point scoring rubric. Table 1 indicates the scoring rubric for self-reflection skills with the score, criteria and interaction objects. Five levels of self-reflection skills are diagnosed: never reflect, reflect on personal plan only, reflect on personal plan and achievement, reflect by self-rating but no comments, and reflect by self-rating and further comments.

Table 1: *Scoring Rubric for Self-Reflection Skills*

Score	Criteria	Interaction Objects
4	Reflect by self-rating and further comments	Reflection journal
3	Reflect by self-rating but no comments	Reflection journal
2	Reflect on personal plan and achievement	Reference panel
1	Reflect on personal plan only	Reference panel
0	Never reflect	

4.4 Adaptive Feedback based on Skill Scores

Learners are classified into 5 groups based on the diagnosed skill scores. They are given adaptive feedback through feedback prompts (see Table 2). The feedback prompts are actionable suggestions which support learners continuously to improve their reflection skills.

Table 2: *Adaptive Feedback for Learners based on Skill Scores*

Score	Self-Reflection Skill Level	Feedback
4	Reflect by self-rating and further comments	Well done! You got a great reflection skill
3	Reflect by self-rating but no comments	Great! Then try to reflect on your strategies and record it into comments
2	Reflect on personal plan and achievement	Please try to rate by yourself about your plan and achievement
1	Reflect on personal plan only	Please check your achievement
0	Never reflect	Please check your plan

5. Self-Reflection Model-Based Interface in GOAL System

The self-reflection model-based interface in GOAL system is shown in Figure 4. Three components of self-reflection model are provided: reference panel (plan detail and achievement), reflection journal, and adaptive feedback. The contextual activity in this interface is extensive reading in English. The learner has created a daily reading plan for extensive reading, and could review the achievements since the plan was finished.

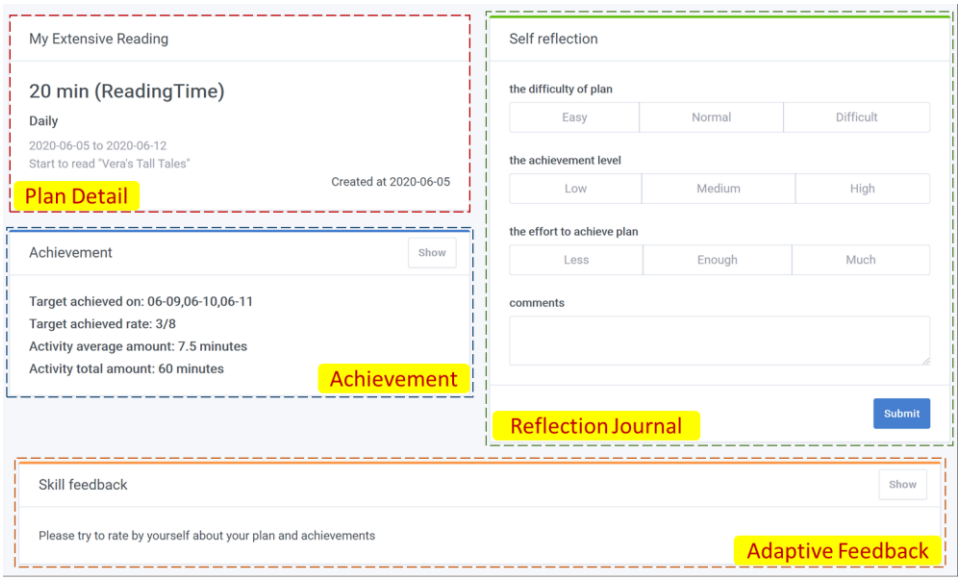

Figure 4. Self-Reflection Model-Based Interface in GOAL System

6. Conclusion and Discussion

In this paper we proposed a novel model for self-refection and support the acquisition of reflection skills in the context of self-directed activities, like e-book reading, walking, or running. The reference panel of this model triggers learners to reflect what they had learned (monitoring/reflection) and how they learned (planning/monitoring). The structured reflection journal of this model guides learners to rate key indicators in the planning-monitoring-reflection process and lets them reflect deeply and critically. The skill diagnosis and adaptive feedback help learners to further understand their learning processes and outcomes to improve their self-reflection skills. The benefits of using the model are to facilitate the transfer of skills between the system and learners. The conceptual contribution of this paper is applying reflection theory to the practice in self-directed activities through computer based scaffolds.

The proposed model is executed as an iterative cycle to facilitate a continuous improvement in self-reflection. Furthermore, it involves other phases of self-direction process, such as planning and monitoring. For instance, it can enhance subsequent planning and monitoring phases and then further reflection. Therefore, the model can influence the whole cycle of self-direction process and foster learners' SDS. The effect of the proposed model will be examined in the future.

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