A Study of Self-Regulated Learning in High School Students' English Learning with System Support

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Abstract: The paper studies the self-regulated learning (SRL) of high school students who utilize a scaffolding-based SRL system in English study. The goal of designing the SRL system is to help learners develop self-regulated skills and a set of constructive behavior that affects one's learning. The SRL system provides instructors a Content Accessibility Subsystem to facilitate their teaching and offers students many subsystems for a conducive mobile learning environment. Moreover, the system easily establishes the learners' SRL patterns. In the experiment results, most of students deem that the system can help them possess the SRL attributes, especially for the SRL attribute of Self-aware of performance outcomes.

Keywords: Self-regulated learning, Scaffolding, E-Learning, M-learning, Evaluation of CAL systems.

I. Introduction

People both in academia and the government have keenly promoted the concept of SRL in recent years. The aim of SRL is to help learners to take charge of their own learning. Basically, learning schedules, materials, scenarios, and quality are four factors affecting the performance of SRL. However, executing SRL is obviously difficult through these factors, for the following reasons.

- Learning schedules and materials: A suitable learning schedule can make a person's own learning methodical. However, if a person does not have sufficient experience in designing his learning schedule, he may end up having a poor SRL performance. In addition, because the study materials are limited and varied, a learner may find it difficult to organize the materials he needs.
- Learning scenarios and quality: The rapid development of modern technologies, such as the broadband and wireless communication engineering, makes learning materials easily available. As a result, the learning environment can be extended to the outdoors. However, because there is no tailor-made learning environment outdoors, learners may just give up learning. Moreover, because of many distractions, learners may be unable to focus well. These factors affect their SRL performance.

The motivation of the proposed scaffolding based self-regulated learning (SRL) system adopting the concept of self-regulatory learning cycle [9] is to help learners learn efficiently and in a self-regulated way. During the learning process, the interest of learners is essential for achieving a successful SRL. Having too high a request may disappoint learners, even cause frustration. Thus, the system helps learners to set a reasonable goal such that learners' interest can be increased. The system adopts scaffolding theory [2] to gradually build their learning patterns throughout the SRL cycle. Through the scaffolding theory, the system can dynamically provide information and materials for learners to be familiar with the SRL skills. The accomplishment of scaffolding SRL totally depends on the precise evaluation of the learning outcome, so an elegant evaluation system is provided for learners to determine the learning quality. As a result, learners can set reasonable goals in learning in the system. In addition, learners will be well-acquainted with the time management when experience is repeatedly obtained from each self-regulated cycle.

Supporting a mobile learning environment for learners by means of modern wireless communication technologies is another purpose of the system. Learners can easily get the learning materials anywhere without complicated operations. On the other hand, the mobile learning environment also enables learners to share learning schedules and learning records. Referring to the data from companions, learners can finely adjust learning strategies. Moreover, applying wireless communication technologies to the system enable learners to get instant help or suggestions accordingly.

The rest of the paper is organized as follows. Section II surveys the previous researches on SRL. Section III introduces the SRL system. Section IV describes the experimental results of the system. Finally, Section V concludes the paper.

II. Literature Review

In recent years, educational researchers propose lots of instructional approaches that encourage the development of self-regulation for learners. In this section, some previous researches are mentioned.

There are greatly varied explanations and studies focusing on the definition of SRL. Basically, the definition of SRL can be revealed as a learning process with the following attributes [6].

- Intrinsically or self-motivated: Basically, self-regulated learners tend to maintain learning behavior with a very strong motivation. Learners can raise this motivation through some practices, such as setting learning goals.
- Planned or automatized: Self-regulated learners are apt to use some strategies along with their learning processes, which include both cognitive strategies and self-regulated strategies. Generally, learners improve their learning performance when using self-regulated strategies rather than cognitive strategies. Self-regulated strategies contain goal-setting, goal-planning, organization, transition, exercise, memorization, track record, and self-monitoring. A self-regulated learner should be able to effectively use self-regulated strategies for his learning.
- Self-aware of performance outcomes: Throughout the learning process, self-regulated learners can sharpen their self-awareness toward their learning behavior. In order to approach an ideal outcome, self-regulated learners should be aware of their own learning qualities, and change the behavior or strategies correspondingly.
- Environmentally/socially sensitive and resourceful: The learning environment and resources can affect one's learning pattern. Self-regulated learners have better skills in seeking learning resources or support. With such ability, they should arrange the environmental conditions and search for other resources effectively.

In general, when looking to enable learners, the above attributes should be taken into consideration in designing an adequate system for self-regulated learners. Once such attributes are possessed, learners can skillfully self-regulate their learning. Hence, the paper proposes the system for learners to present the attributes of SRL.

To help learners become self-regulative, Zimmerman, Bonner and Kovach proposed a self-regulatory learning cycle for learners to gain SR skills, as shown in Fig. 1[9]. The model efficiently assists learners in self-examining and self-evaluating their

learning performance. The details of the processes are as follows:

- Self-evaluation and monitoring: learners must tend to understand their learning characters and styles according to their prior learning behavior and results.
- Goal setting and strategic planning: before learning, learners should firstly catch on to what they shall or can learn, and set appropriate achievable goals. Then, the learners have to determine practicable learning strategies.
- Strategy implementation and monitoring: during learning, learners should try to use the strategies that they plan to use, and to execute the strategies exactly.
- Strategic outcome monitoring: in order to substantially revise strategies, learners need to comprehend their performance, and then focus on the relation between the result and the strategies used during the learning process.

Generally, learners draw up and carry out their learning plans by themselves in these processes. Thus, such cyclic model enables learners to not only arrange their own learning, but also fulfill their learning voluntarily.
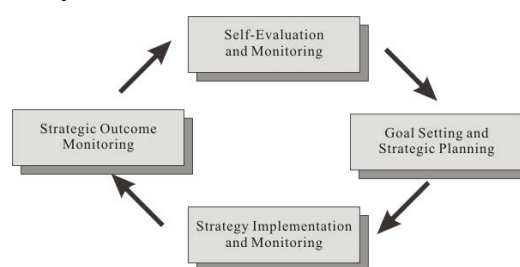

Fig. 1. A cyclic model of self-regulatory learning [9].

III. The Scaffolding Based Self-Regulated Learning System

The SRL learning system is mainly based on the cyclic model of SRL [9]. Learners can sequentially and repeatedly experience the four processes in the self-regulatory learning cycle by means of the SRL system and establish their patterns of SRL gradually. This section introduces the mapping of the proposed system and the cyclic model.

Shih, Chang, et al. proposed the prototype of the system [5]. According to the learner feedbacks and the opinions from educational theorists, we continually enhance the proposed system to efficiently improve the SRL performance of learners. Previous research conducted that an intervention that increasing cognition or motivation can have benefited to the

development of self-regulated capability [4]. In our design, instructors are also involved in learners' SRL to help learners become skillful in SRL.

Basically, a state transition diagram is proposed and used to indicate the behavior of a learner who employs the cyclic model of SRL to become self-regulatory. Fig. 2 indicates the state transition diagram. The diagram is composed of seven states indicating what actions a learner takes in SRL. The states include the Activity Scheduling, the Schedule Reviewing, the Learning and Monitoring, the Learning Evaluation, the Analysis, the Synchronization, and the Help Seeking states. Among them, the Activity Scheduling, the Learning and Monitoring, the Learning Evaluation, and the Analysis states are major states mapping to the four processes in the cyclic model.

With the aid of the proposed system, learners in the Activity Scheduling state can obtain the information about what to learn and, thus, can arrange suitable learning schedules. As the result, the state maps to the Goal Setting and Strategic Planning process. After setting learning schedules, learners enter the Learning and Monitoring state. In the state, because learners can undertake the scheduled activities by using varied learning strategies and their learning behavior will be completely observed, the state maps to the Strategic Implementation and Monitoring process. Our system utilizes two pieces of equipment, Hyperbook and Hyperpen, to enrich learning experience when learners engage in the learning activities. Hyperbook is a hardcopy book with some reference tags. In principle, reading a hardcopy book benefits learners to enjoy comfortable reading anywhere. However, the content of a book is limited and fixed. On the contrary, staring at the monitor of learning devices for a long time make learners tired easily. Furthermore, learners may persecute with the complicated operation of learning devices because they may need to alternately use varied input devices such as the mouse or the keyboard to obtain supplemental materials. Thus, to enrich learning experience with easy operation, learners can use a scanning device, termed as Hyperpen, to scan reference tags for more supplemental learning materials, such as Flash, recording and video. Supplementary learning materials will be shown in learner's mobile devices after a learner scans tags.

In our design, Hyperpen is embedded with a Bluetooth solution which is a kind of WPAN technology so that learners do not refuse to use Hyperpen due to no annoying cable between the mobile device and Hyperpen. Besides, learners can directly scan the words and sentences in the book for more learning supplements. Scanned keywords will be submitted to the Internet dictionary or the database. Note that, Hyperbook is made by an authoring tool, HardSCROM Editor [8], which conforms to SCORM 2.0 [1]. That is, any learning course under the SCORM standard can be edited and output as a hardcopy document. It helps instructors easily provide directions and arrange learning materials for learners.
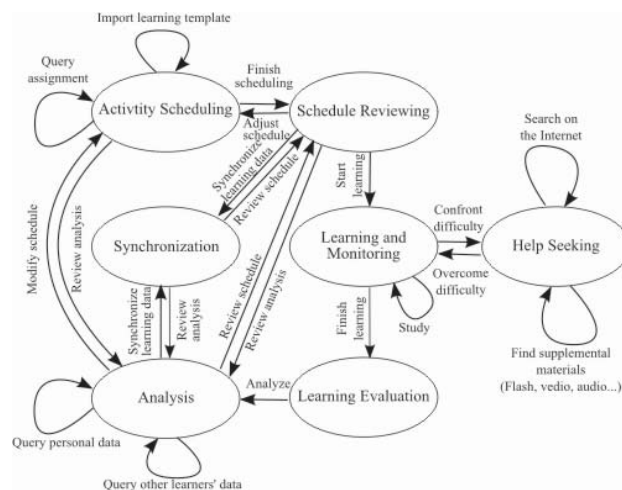

Fig. 2.   State transition diagram of the learners using our system.

In the Learning Evaluation state, learners evaluate their learning achievements by self-checking and examination. The state maps to the process of Strategic Outcome Monitoring, accordingly. In addition, learners evaluate their learning results by means of varied statistical charts, and discern their SRL patterns in the Analysis state, so the state maps to the Self-Evaluation and Monitoring process. When obtaining detailed understanding of their learning characters, learners can go into the Activity Scheduling state again, and arrange more rigid schedules for future learning.

In addition to the aforementioned states, the Synchronization, the Help Seeking, and the Schedule Reviewing states are also involved in the system for learners to develop the skills of the SRL. When entering the Synchronization state, learners can get others learning experience by exchanging learning schedules and records. Such experience can assist learners in adjusting learning strategies, and motivate their learning. In the Help Seeking state, learners can use functions provide by the system to seek supplemental learning materials. In doing so, learners can get into the habit of the help seeking when having learning difficulties. The Schedule Reviewing state is for learners to observe whether they can engage in the scheduled activities on time. In this way, learners can

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know their opportune learning movements, for example, in the afternoon or in the morning.

Based on the state transition diagram mentioned above, Fig. 3 illustrates the architecture of the proposed SRL System. The system is composed of several subsystems categorized as the instructor side and learner side. The instructor side is for instructors to assist learners in developing the self-regulated approaches. In general, beginners or unskillful learners are unable to arrange their learning well due to the inexperience in self-regulation, so providing directions and scope by instructors are helpful to learners to be proficient at SRL skills. Alternatively, the learner side aims at forming a pleasant SRL environment where learners are able to practice the skills of SRL. In such an environment, learners can schedule, perform, and self-evaluate their learning. With the aid of scaffolding theory, the system provides much more help to learners who are unskillful in SRL, whereas give less help to skillful self-regulated learners. Please refer to the research of Shih, Chang et al. for the details of the system.
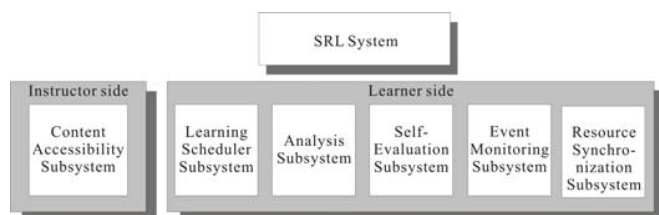

Fig. 3.   Architecture of the Self-Regulated Learning System.

IV. Evaluating pedagogy interaction in the SRL system

In this section, an experiment is made in a high school to demonstrate the effectiveness of the proposed SRL system. The experiment focuses on whether learners think that the system can help them possess the four self-regulatory attributes

A. Method

In the experiment, the target learners are the secondary students because the students in teens are thirst for knowledge, but lacks of SRL skills. The learning topic is English learning, which is regarded as one of the major subjects in the high school in Taiwan. Seventeen volunteers from one of the 11th grade classes are involved in 3-week SRL. Each student is given a Hyperbook, a Hyperpen, and a tablet PC. The Hyperbook contains 6 English lessons from the IVY magazines [3], which are also popular English learning materials in Taiwan.

Three weeks later, the students are requested to fill in a questionnaire, named Self-Regulated System Indication Questionnaire (SRSIQ). SRSIQ is used to evaluate the support of the self-regulatory attributes and the friendliness of user interfaces of the proposed system. Generally, a SRL is able to be surveyed in different psychological dimensions of research on academic self-regulation by using some Scientific Questions, including why, how, what, and where. Schunk and Zimmerman indicate the questions and task conditions necessary to self-regulate at each component of the integrated academic self-regulation findings [6]. The question of why addresses the learner's motivation to self-regulate his learning. The question of how indicates the methods which a learner uses to self-regulate his/her learning. The question of what deals with the self-regulated effort of a learner. The question of where address the effort of a learner who self-regulates his physical and social environment in order to learn.

Basically, SRSIQ is to ask the students the Scientific Questions when the proposed system is involved in their SRL. Students should fill in SRSIQ according to the experience on using the system. The questionnaire applies a five-point Likert-type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The results retrieved from this questionnaire are used to determine the assistance of the system during students' SRL. Due to the limited space, please refer to our web cite for the details of the SRSIQ [7].

B. Results

The experiment results focus on analysis of the supporting of the four self-regulatory attributes. The analysis is based on the SRSIQ results of the students. Because the students fulfilled the questionnaire after the experiment, they can express their own deepest feelings in terms of the supporting of the four self-regulatory attributes. Whether students think that the system can help learners to have the four self-regulatory attributes is presented in order. The reliability of whether our system supports the self-regulatory attribute of Intrinsically or self-motivated is 0.81; this implies that the questionnaire items have a high reliability.

The summary of the descriptive statistics is shown in Table 1. This subscale is greatly influenced by how much learning motivation was inspired by our system. The SRL system enables learners to have motivation by the following aspects, the supplementary multimedia materials (Q13, Q14, Q15, and Q16) and the learning analysis (Q27). Most students thought that

supplementary multimedia materials can excite their interest in learning. One of the possible reasons is that the supplementary materials and the methods to access the Internet enrich their learning experience and make them thirst for learning. Therefore, the students take spontaneous pleasure in the English learning. In addition, the proposed system involves the learning device Hyperpen to help the students quickly and conveniently get access to the learning materials without complicated operations. This also supports the reason why the students think that with the providing materials can excite their interest.

In the aspect of learning analysis, most students also agree that they can be motivated by the analysis charts. Because the personal learning analysis charts such as the historical grade chart or the interruption statistic charts reflect students' learning achievements, the students can find the self-fulfillment. On the other hand, the learning analysis char for all students can inspires the competition between classmates in the students. However, the trend is not as strong as that in the first aspect. The reason may be that the analysis charts are not rich and varied enough for the students to identify their learning achievements.

The reliability of whether our system supports self-regulatory attribute of Planned or automatized is 0.758. The result indicates that the 5 questionnaire items also have a high reliability(Cronbach's Alpha=0.76).

For the attribute of Planned or automatized, all functions such as scheduling, help seeking, and learning analyzing enable learners to try to use proper learning strategies (Mean=3.34, SD=0.749, Table 2).

Among questionnaire items about the attribute of Planned or automatized, prior scheduling experience give significant assistance in planning their future schedules (Q9, Mean=3.59, SD=0.870). For a student, different schedules may result in different learning result. Therefore, the learning results shown as different analysis charts and presented in the learning review tool helps students to get a tremendous sense of learning achievements. Therefore, learners can plan appropriate learning schedules.

Item Q10 indicates that the interface of learning review tool should be more friendly (Mean=3.06, SD=0.966). Because the interface of the tool is divided into two parts, students have to frequently switch over the two parts to view the scheduled activities and learned activities. Besides, because other functions (e.g., learning synchronization and the starting of learning activities) should be executed through the tool as well, students may think that the operation of these functions through the interface is complicated.

Therefore, students deemed that the interface is not friendly enough. The operation of the tool should be simplified and intuitional.

For the attribute of Self-aware of performance outcomes, we also obtain a good reliability (Cronbach's Alpha=0.91). Thirteen items tap on the subjective learning performance. The item statistics are shown in Table 3. Statistics show that the information brought to learners can let them get the sense of their learning achievements (Mean=3.357, SD=0.766).

Through the learning analysis, students thought that our system can precisely monitor the learning behavior and easily record interruptions. Most students also agreed that the Self-Evaluation Subsystem helps to conveniently record the cognition to a learning activity, which is used to determine the gap between subjective and objective learning achievements (Q18, Mean=3.47, SD=0.702). Students also agreed that the providing of learning analysis is helpful (Q25, Mean=3.47, SD=0.717).

Although learning monitoring is regarded as a useful function to understand one's own learning status (Q19, Mean=3.29, SD=0.920; Q20, Mean=3.35, SD=0.702), students felt that the function is a little bit hard to use (Q21, Mean=3.00, SD=0.866). That is because behavior is observed when students use the functions of the proposed system. In the experiment, the proposed system is installed in the Tablet PC which has no ordinarily input devices such as the keyboard and the mouse. Unlike the desktop PC, the operation in Tablet PC is more difficult and unfamiliar for the students. Additionally, the recognition ratio of Hyperpen is about 89%. Students are not satisfied with the ratio. "It is hard to scan the tags," one student said. Therefore, to increase the ratio is our important future work because higher recognition rates can encourage the use of our system, and can more completely observe students' learning behavior.

On average, students are positive about the support of the attribute of Environmentally/socially sensitive and resourceful (Cronbach's Alpha=0.85). The item statistics are shown in Table 4. The result indicates that the function of the learning record synchronization (Q31, Mean=3.29, SD=0.772), the providing of learning materials, such as videos (Q13, Mean=3.24, SD=0.970), pronunciations (Q14, Mean=3.47, SD=0.943), translations (Q15, Mean=3.47, SD= 1.007), and phrases (Q16, Mean=3.47, SD=1.068), as well as the Internet searching (Q17, Mean=3.18, SD=1.131) can inspire students to positively obtain and seek useful learning resources. Among them, Searching on the Internet is the least useful function. Because the

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learning topic is English learning, the students thought that the resources provided by the system are enough and have less will to supplement other resources from the Internet. In the future, the system should be modified to support different types of help seeking for different kinds of learners. For example, the system should enable skillful learners to positively search extra learning materials, whereas allow unskillful learners to become accustomed to using extra learning resource.

V. Conclusions

In this paper, high school students' English learning with system support is studied. A scaffolding-based SRL system involving the self-regulatory cyclic model and scaffolding theory is used to cultivate self-motivated, self-directed, and self-regulated learners.

In general, the results of the experiment show that the SRL skills of the students can be improved by utilizing the proposed system. Most of the students deem that the system enables learners to possess the four Self-regulatory attributes: intrinsically or self-motivated, planned or automatized, self-awareness of performance outcomes, and environmentally/socially sensitive and resourcefulness.

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Acknowledgments

Table 1. Summary item statistics of the self-regulatory attribute: Intrinsically or self-motivated.

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	3.329	3.000	3.471	.471	1.157	.044	5
Item Variances	.897	.500	1.140	.640	2.279	.058	5

Table 2. Summary item statistics of the self-regulatory attribute: Planned or automatized

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	3.339	3.059	3.588	.529	1.173	.28	13
Item Variances	.749	.471	1.360	.890	2.891	.069	13

Table 3. Summary item statistics of the self-regulatory attribute: Self-aware of performance outcomes

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	3.357	3.000	3.471	.471	1.157	0.16	13
Item Variances	.766	.493	1.441	.949	2.925	0.67	13

Table 4. Summary item statistics of the self-regulatory attribute: Environmentally/ socially sensitive and resourceful

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	3.353	3.176	3.471	.294	1.093	.018	6
Item Variances	.977	.596	1.279	.684	2.148	.055	6