

# An Individualized and Self-Regulated e-Learning System

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**Abstract** – Because a self-regulated learning is a self-leading and a positive learning, it is referred to an ideal learning. The interest on an individualized and self-regulated e-learning system is more increasing. After making a contract process with the proposed system, learners can organize the individualized course based on the learner's demand and level. In this research, the self-regulated learning system which can lead to a learning goal effectively by establishing a learning strategy, is designed and implemented. It provides the learner-centered learning environment which can process the differentiated and flexible individualized-learning service regarding an individual characteristic.

**Keywords:** Web-based Learning, Self-Regulated Learning, Self-Directed Learning, Learning Contract, e-learning, Courseware Individualization

## 1 Introduction

The teaching-learning system based on the web's educational effectiveness and utility value has been developed toward the self-directed learning approach in the learner-oriented educational environment[1]. The study aims to design and implement a self-regulated learning system, which is an ideal method for the learner-oriented educational approach. The system incorporates the learner's requirements to allow the configuration of unique courseware for the learner. It also can be adapted to the learner to provide personalized learning services.

## 2 Background

### 2.1 Self-regulated learning

Self-regulated learning encourages the learner to define his learning requirements to cope with the responsibility of controlling the learning environment and applies appropriate learning strategies to reach the study's goals[2,3]. In order to implement self-regulated learning, the sequential learning approach developed by the instructor should be removed, and a new learning environment must be created in which a learner can study courseware and learning strategies tailored to his individual requirements.

### 2.2 Individualization of web courseware

Web courseware refers to educational courseware that uses the Internet's distributed hypermedia information system as the delivery medium[4]. Misanchuk and Schwier[5] claimed that the learning path depends on the learner's characteristics. As part of the effort to implement self-directed learning, recent studies have involved the provision of courseware customized for the learner. As a result, the web's courseware is individualized by using the web's hypermedia characteristics.

### 2.3 Web-based instructor-learner system

An agent is a software program that automatically performs tasks on behalf of the user[6]. The teaching-learning system agent constantly monitors and evaluates the learner's progress to calculate and analyze his levels of understanding and achievement in the individual course. Moreover, the agent provides an adaptive system environment by guiding and advising the learner based on the results of its analyses.

## 3 Configuration and Design

### 3.1 Structure of Self-regulated learning system

As shown in Fig. 1, the learning system that provides the study materials for the learner is a multi-agent system that consists of three agents.

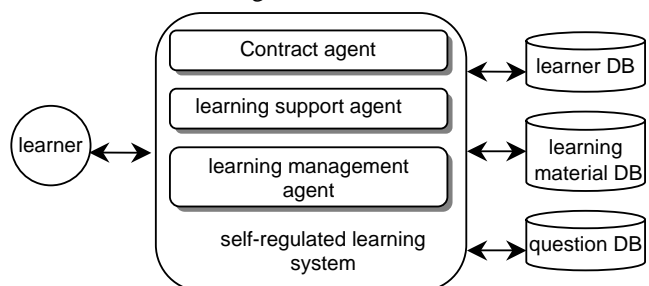


Fig. 1, Configuration of Self-regulated learning system

#### 3.1.1 Contract agent

The learning contract, which is one of the elements required for the learner to direct his learning process, involves a learner and an instructor forming an equivalent

relationship which develops the learning process while the learner receives support from the instructor[7]. The system's contract agent internally proposes courseware based on the learner's information input, and acts as a task agent that develops the contract process through interaction between the established system strategy and the learner's selections. Having completed the contract process with the contract agent, the learner defines his own learning requirements and applies learning strategies adequate for achieving the study's objectives. These procedures yield a unique and significant learning process and result for the learner.

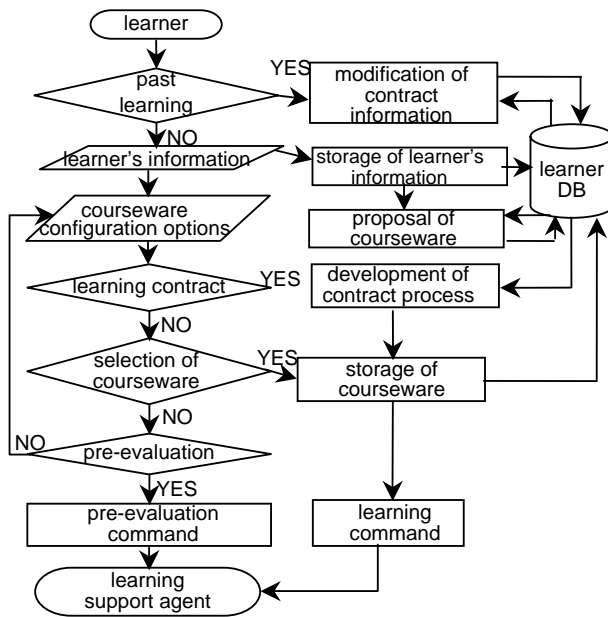


Fig. 2 , process of contract agent

### 3.1.2 Learning support agent

The learning support agent consists of the learning/guide module and the test module. It is an interface agent that supports diverse interactions among the system, the learner and the study's objects, and the agent can be regarded as a system that acts as the instructor in a conventional classroom environment. The learning/guide module provides the learner with the individualized courseware created from the contract information received from the contract agent to enable the learning process. Furthermore, this module is equipped with a guideline structure that guides the learner and proposes effective learning by monitoring the study's status and progress.

### 3.1.3 Learning management agent

The learning management agent is a task agent system that analyzes the learner's level of learning and achievement based on the evaluation results and learning history information generated by the learning support agent. Items evaluated and analyzed by the learning management agent are indicated in Table 1.

Table 1, items for analysis

items for analysis	value		description
	T	True	
	F	False	Learning not completed
result of test	PS	Pass	Problem solved
	RT	Retry	Problem solved after retry
	FL	Failure	Problem not solved
evaluation of level	EC	Excellent	Excellent understanding
	HG	High	High understanding
	BS	Basic	Basic understanding
	PR	Poor	Poor understanding

## 3.2 Study material Design

The study materials for this system consist of collections of individualized learning processes and learning objects that can be restructured. The learning objects are organized into chapters and lessons, and materials in each lesson are designed to implement learning for each unit and level. The system is capable of proposing a study course or guiding the learner and the system to determine the level of understanding and prior knowledge.

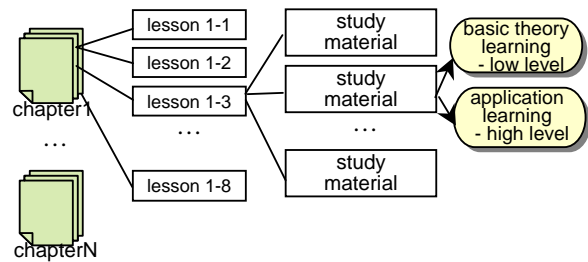


Fig. 3, Design of learning objects

$$\text{Chapter } N = \{ x \mid x = \text{Lesson } M \}$$

- N = General Learning Course or Advanced Learning Course
- $0 < M < \text{selected lesson number}$

$$\text{Lesson } M = \{ x \mid x = \text{Le\_p\_q} \}$$

- M = Basic Learning Lesson or Specialized Learning Lesson
- Le\_p\_q = Basic Theory Learning or Application Learning

## 3.3 Learning Evaluation Design

Accurate evaluation of the learning level is an important element of self-regulated learning that informs the learner of his current level and of areas in which he lacks knowledge and understanding. The system's evaluation test is displayed in Table 2.

Table 2, test for learning evaluation

items of test	description	
CS	Covering the Studying	Evaluate pre-knowledge of learning contents
PV	Preview	Evaluate environment knowledge of learning before each lesson
AC	Activity	Evaluate understanding of contents during learning
EP	Exploration	Evaluate application of learning contents
AM	Applying Mathematics	Evaluate learning contents related a mathematical concept
PR	Practice	Evaluate understanding level of each lesson
EX	Example	Evaluate understanding level of each chapter

## 4 Implementation

The system has implemented the learning material based on the University of Chicago's "School Mathematics Project Second Edition Geometry"[8].

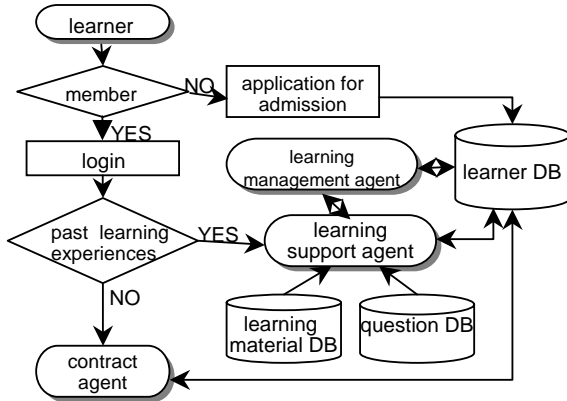


Fig. 4. Self-regulated learning process

After logging in, the learner configures his courseware or receives assistance from the learning support agent based on his interactions with the contract agent depending on past learning experiences, as displayed in Fig. 4.

### 4.1 Selection of courseware configuration options

The system enables the learner to conduct learning activities by configuring his own courseware based on the contract process with the system. In terms of constructing the courseware, interaction with the system is crucial for a learner who lacks the self-regulating learning capabilities to achieve the study's objectives.

Table 3. Courseware configuration options

Item	Characterist	Benefit
Learning according to courseware defined by the system	System-directed approach	Allows systematic learning according to relativity among knowledge fields and reduces the burden on the learner of creating the study's content.
Learning according to courseware proposed by the system after preliminary evaluation	System proposal + Incorporation of learner's requirement	Allows accurate assessment of the learner's study level and restructuring of the proposed courseware.
Learning according to the learner's selection and configuration of courseware	Learner-directed approach	Allows maximum reflection of the learner's requirements and implementation of individualized courseware.

### 4.2 Selection of courseware configuration options

The learner must complete the following four steps when constructing courseware based on the contract with the system.

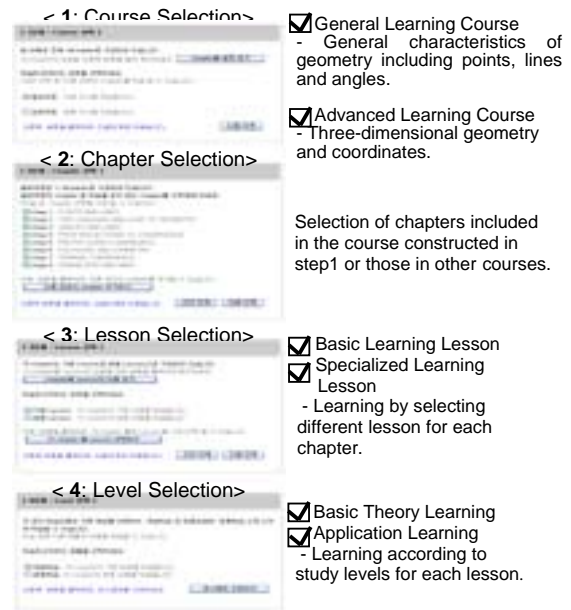


Fig. 5. Four steps of courseware configuration

### 4.3 Learning according to courseware

The learner generally conducts learning activities according to the procedures displayed in Fig. 6.

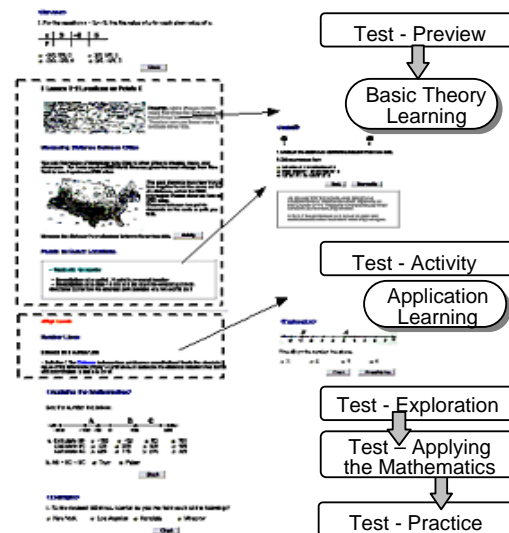


Fig. 6. General Learning Process

Prior to taking each lesson, an evaluation (PV test) is performed to assess the background knowledge and level of understanding. The PV test result allows the learner to be aware of his own level prior to taking the lessons, and assesses the areas that the learner must focus on during the learning process.

[ Lesson Learning Report ]	
proposal for learning strategies	
Learning path:	1-4 / 1-5 / 1-6 / 1-6+ / 1-1 / 1-6
Previous level:	BS Target level: DC
Learning level:	HS
Completion rate:	75%
Repeated learning:	[Lesson 1-6]
Related pre-Lesson:	[Lesson 1-3]
restructuring of courseware:	need not
<input type="button" value="OK"/> <input type="button" value="Lesson Select"/> <input type="button" value="Courseware Modify"/>	

Fig. 7. Result report of Learning

After completing the PV test, the learner participates in basic theory and application learning levels, during which AC and EP tests will be given before completing a study unit. The learning management agent informs the learner of his level of learning and achievement as according to the test results, and advises him of the necessity of prerequisite knowledge and related prerequisite knowledge areas, units which require repeated learning and restructuring of the courseware.

## 5 Implementation

Table 4 exhibits a comparison between the learner-oriented teaching-learning system and the system proposed in this study.

Table 4, Comparison to other system

	Baek's system [9]	Choi's System [10]	M.Kim's system [11]	H.Kim's system [12]	Proposed system
Individualization of courseware			X		
Dynamic construction of courseware			X	X	
Incorporating the learner's requirement		X	X	X	
Suggestion according to inference			X	X	
Level learning	X				

The compared learning system offers individualized learning, adaptive learning, level learning and self-directed learning. Although all of these systems share the objective of providing a learner-oriented study environment, they have restrictive and selective features in terms of incorporating the learner's requirements. The proposed system provides an environment in which the learner is engaged in self-regulated learning and adjusts his own learning process. In a self-regulated learning system, the learner must be able to construct individualized courseware. The system proposed in this study provides means of structuring individualized courseware that incorporates the learner's level of understanding, and encourages the learner to implement his own courseware based on the learning contract. Furthermore, the learner is able to establish his own study strategies to successfully achieve the study's objectives by interacting with the system, which plays the role of advisor or guide to effective learning activities. As a multi-agent system, it also monitors and evaluates the learning process, and the results provide an adaptive system environment for interactions with the learner. There is a plan to expand the system to manage the learning schedule in addition to the courseware structuring. It is also necessary to apply a more systematic solution that incorporates the relational factors among knowledge fields when designing the individualized courseware and research efforts are needed to find more diverse and adequate evaluative and analytical methods.

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