

A PROCESS-ORIENTED E-LEARNING SYSTEM: FROM MASTERY LEARNING PERSPECTIVE

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ABSTRACT

Instructional strategy plays a prominent role in traditional classrooms, but it is not widely noticed in e-learning environment. If a teacher uses a specific instructional strategy in e-learning environment, an e-learning system which supports this instructional strategy could benefit the instructor and the learners. However, which pedagogical method does suit e-learning environment? What kind of system architectures can appropriately support this pedagogical method? This essay focuses on the pedagogical method of mastery learning and proposes an e-learning system architecture which considers the concept of process management and the applications of mobile device for supporting this pedagogical method. This essay also offers a scenario to explain how to use this e-learning system to fulfill mastery learning strategy in e-learning environment.

Keywords: e-learning, online learning, virtual classroom, e-learning environment, process management, workflow, mastery learning, instruction, pedagogical method, system architecture

INTRODUCTION

E-learning has received much attention from universities, corporation, and industry recently. As information technologies (IT) develop, novel ways of teaching and learning environment have emerged, it creates opportunities and turmoil in university and corporative training. Many universities and corporations have used e-learning as a new way for teaching and training (1, 8).

Though using IT to improve teaching and learning has become more and more popular, applying instructional strategies or pedagogical methods to enhance e-learning systems, while not new, has received strikingly little attention (1, 5). But one way to create more appealing and effective online learning environments is to integrate appropriate instructional strategies (15). In addition, because integrating technologies with relevant instructional strategies will enhance learning outcomes through learning processes (1), the learning process is crucial for e-learning systems.

The objective of this research is to integrate instructional strategy with mastery learning to enhance process-oriented e-learning systems. In brief, mastery learning offers a teaching and learning process model in which each student has to pass an assessment before s/he moves on next instruction unit. The concept of process management can facilitate to streamline teaching and learning processes that contains various tasks and resources. We consider mastery learning to be an appropriate instructional strategy for integration because mastery learning methodologies has been much more successful in the behavioral sciences of education (6, 12). In addition, mastery learning offers several types of activities and assessments for learning process (6, 13). Furthermore, the current trend in education and training emphasizes on personalization, and mastery learning is a kind of personalized method. The focus of this essay is on proposing

e-learning system architecture from mastery learning standpoint and process management perspective. In addition, we offer a scenario that describes how a teacher would apply mastery learning method through this e-learning architecture.

LITERATURE REVIEW

The state of E-learning systems

There are many research and commercial web-based e-learning systems in the market. The most popular e-learning systems are Lotus LearningSpace, WebCT, BlackBoard, etc. Generally, most e-learning systems provide two kinds of tools (9):

- (1) Learner tools: include web browsing, asynchronous/synchronous sharing, and student tools.
- (2) Support tools: include course, course contents, data, resource, administration, and help desk.

Although these leading packages provide powerful support tools for various aspects of course management, most of them have not fulfilled instructional strategy. From current information architecture perspective, these popular products seem to lack “explicit definition of principles and background theory” (e.g., instruction theory) (4). From recent perspective in MIS fields, adopting appropriate instructional strategy is a way to create effective e-learning systems (1, 15). That is why an instructional strategy is necessary to be considered in e-learning systems development.

Consequently, this essay proposes to integrate instructional strategy of mastery learning with the concept of process management to create a more innovative e-learning architecture.

Instructional strategy of mastery learning

The spirit of mastery learning requests that almost all students have passed formative assessment before moving on to the next stage in instruction process (6, 12, 13). Many researches have indicated that mastery learning strategy shortens the gap between top and bottom students in traditional classroom over several countries around the world (6). The process of mastery learning can be described as Figure 1.

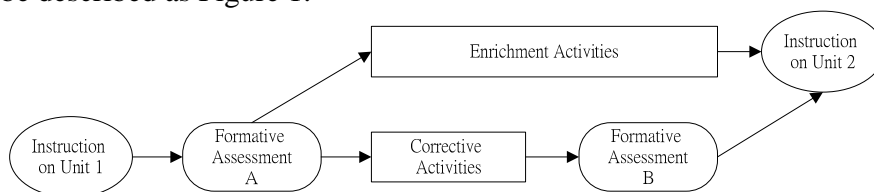


Figure 1: The process of instruction under mastery learning (6)

Mastery learning is an effective instruction method in traditional classroom or in old fashion of computer-based instruction systems such as hypermedia-based systems (10) or using text only systems through Novell server (11). Recently, some researchers claim that the Web is ideal for implementing mastery learning strategy (3). Hence, mastery learning strategy in e-learning environment is possible to be an effective instructional strategy.

Process management is important because the practices of mastery learning need a sequence of activities. We will discuss process management technology in the next section.

Process management technology

The current trend in Information systems emphasizes on process management. In the business field, packaged systems, e.g. ERP systems, are shifting from task-oriented to process-oriented across departments in corporations. Thus, workflow technology has been widely used in corporations. Workflow technology allows building information systems that offer the right tasks at the right time to the right person along with resources needed to perform these tasks (9). Therefore, process management technology or workflow technology can be a foundation in e-learning system architecture and used to shift the paradigm from task-oriented e-learning systems to process-oriented e-learning systems.

THE ARCHITECTURE OF PROCESS-ORIENTED E-LEARNING SYSTEMS

In our study, the objectives of e-learning systems is to provide e-learning services through various computing device, such as PDA, mobile phone, personal computer and laptop, for supporting mastery learning. Mobile devices can relieve time pressure and offer location convenience, but, in contrast, it has device limitations, e.g. screen size, input (14). For this reason, mobile device cannot totally replace personal computer or laptop. Mobile device might only be used as a complement to offer e-learning services.

In the presentation logic layer, as shown in Figure 3, adapted presentation is necessary for various mobile devices and personal computers. In addition, the module of packaging and synchronization supports offline usage, such as download learning contents from a PDA.

Besides the fundamental service of process management and house keeping, there are four main modules in the business logic layer: learner management, content management, communications, and agent. These modules in business logic layer are described as follows.

Process management

The process management provides the foundational service for every module and sub module in the business logic layer. Instructor can use the process management service to break down the teaching process into several stages and put the instructional content, learning goal, learning resource etc. in each stage before a course begins (as Figure 2). An instructor can also control every check-point in the process. In other words, the pace of instruction can be teacher-determined or student-determined by check-points.

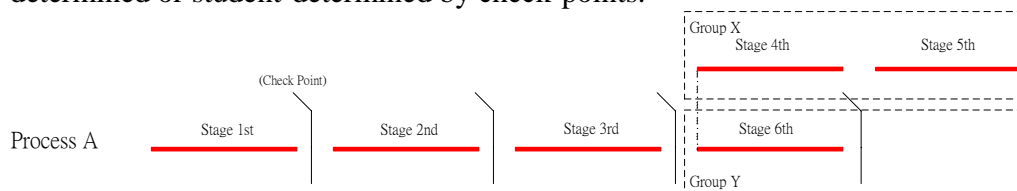


Figure 2: The teaching process and its stages

Learner management

The function of managing learners is not only crucial to traditional classroom, but also it is important to e-learning environment. Five facets of learner management are detailed as follows.

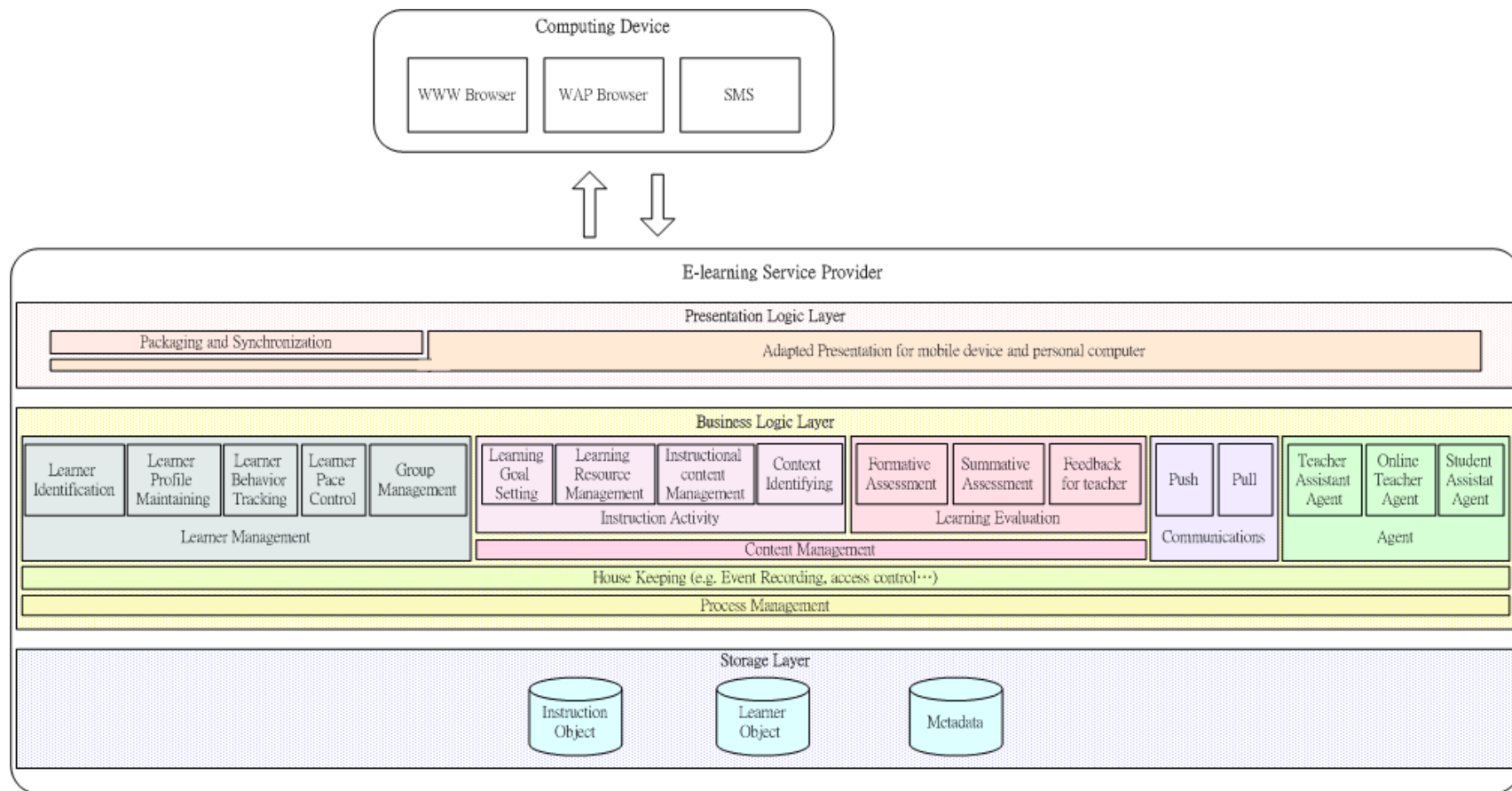


Figure 3: The e-learning system architecture

- (1) Learner identification – Because offering mastery learning strategy can be regarded as a kind of personalized service, identifying individual learner is necessary. This module offers the mechanism of learning account maintenance, such as creating, updating, freezing, or deleting accounts.
- (2) Learner profile maintaining – This module not only records basic personal data, such as name, gender, address etc., but records learner’s personality characteristics. Because there is a relationship between personality characteristics and learning outcomes in e-learning environment (8), the function of personality testing is useful for instructors and it should be included in this module.
- (3) Learner behavior tracking – Online learning behavior, e.g. login frequency, spending time on reading instructional content, and discussing with other classmates, could be predictor variables of learning outcome in e-learning environment (2, 7). Hence, this module can offer valuable information for instructors.
- (4) Learner pace control – Controlling learner’s pace in instructional process has not received much attention in traditional task-oriented e-learning systems. But it is important to mastery learning (6) and the process-oriented e-learning system (9). Using this module, a teacher can determine whether a student can pass a check-point or not.
- (5) Group management – As Figure 2 has shown above, students might be separated into several groups to offer more personalized learning stages. The module of group management helps teachers to do this task more easily.

Content management

According to mastery learning, content management of e-learning can include two parts:

- (1) Instruction activity – In mastery learning strategy, instruction activities include instruction on learning unit, corrective activities, and enrichment activities. And each one has its learning goal, learning resources, and instructional contents.
 - Learner goal setting – A student and his/her teacher set the goal or objective together through this module so that student can engage in later learning activities.
 - Learning resource management – Besides instructional contents edited by instructors, other learning resources (such as textbook, workbook, video tape, and library) can be helpful in learning activities. This module helps instructors to manage the learning resource and reminds learners to use the learning resources in each stage of the process.
 - Instructional content management – Instructional contents can contain various forms of media, such as video, audio, text, or picture. This module offer tools for instructors to manage these contents and deliver these contents to learners.
 - Context Identifying – This module can be aware of context information and can deliver useful information to learner through mobile device immediately.
- (2) Learning evaluation – Learning evaluation plays an important role in mastery learning. There are two kinds of assessment and related feedbacks to teachers.
 - Formative assessment – A formative assessment is used primarily to check students’ learning progress and pinpoint any learning difficulties that they may be experiencing.
 - Summative assessment – It is used primarily to evaluate how well the whole course learning goal has been attained at the end of the course.
 - Feedback to teacher – Teachers can receive two kinds of feedbacks from the above assessments. The first is a description of each student’s learning progress. The second

offers the information about the instructional contents' effectiveness.

Communications

Besides web contents, communication tools, e.g., discussion board, chat room, e-mail, and short message are important to facilitate teaching and learning. If a student's login frequency is high and the time pressure of information is not high, pull technology, such as discussion board and chat room, is enough. If a student's login frequency is low or the time pressure of information is high, push technology, such as e-mail and short messages, is necessary.

Agent

Agent can reduce teachers' workload and it can assist students to learn better. There are three kinds of agent here.

- (1) Teacher assistant agent – It can notify teachers what jobs they have to do and furthermore provide assistances. For example, teachers can receive just-in-time knowledge when they are answering the question or evaluate students' learning outcomes.
- (2) Online teacher agent – Because e-learning mainly is an asynchronous system, it is impossible that teachers are always online 24 hours a day, 7 days a week. Online teacher agent can do something when teachers are offline. For example, if students loss attentions, or idle too long when reading instructional contents, online teacher agent will give them reminders.
- (3) Student assistant agent – For example, when students login, this agent can remind them what they should do and what their learning pace are.

House-keeping

The module of house keeping includes event recording and access control, etc.

- (1) Event recording – If anything happens in the e-learning system, these events will be recorded by this module.
- (2) Access control – Its responsibility is to control every user's visibility and authorities depending on their identification.

A SCENARIO OF USING THE PROCESS-ORIENTED E-LEARNING SYSTEM

Because the description of the process-oriented system architecture above is abstract, we lay out a simplified artificial scenario of using this e-learning system from an instructor's standpoint.

In a morning, a teacher, Crystal, logs in her e-learning system to start her works. Then teacher assisting agent informs her that five students, *A-E*, completed formative assessments and have been waiting to across check-points, the last login time of one student (*F*) was 2 weeks ago, five students, *G-K*, are discussing in the discussion board and maybe need a teacher's help, and 2 students, *M-N*, have asked some questions through e-mails.

First, Crystal reads these *A-E* students' formative assessments, decides that they can pass to next stage by means of learner pace control module. Then the system automatically sends the congratulation e-mails and short messages to them. Second, Crystal checks the student *F*'s profile and behavior tracking record and tries to recognize why he has never been the e-learning

system so long, then writes a letter to express the teacher's cares. Then the system sends this letter through short message and e-mail automatically. Third, Crystal figures out the discussion of these five students *G-K* deviating the learning goal too far, and she gives a comment within their discussion. Forth, Crystal reads the *M-N* students' questions, and discovers their questions reporting that a sentence in her instructional content is not very clear. Hence, she begins to edit this sentence and the system sends this update event to every student in this class automatically.

CONCLUSION

In this essay, we proposes a process-oriented e-learning system integrating with a systematic instructional method – mastery learning. This kind of e-learning system could reduce teacher's workload, streamline teacher's teaching process and student's learning process, and, moreover, offer personalized e-learning services based on the instruction theory. In the future, we will implement it. In addition, process concept does exist in various instruction theories. Different integrated instructional strategy in process-oriented e-learning systems could be studied.

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