Study on Design and Development E-Learning System Based on Learning Flow

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***Abstract*—*an approach to design and analyze the learning support system based on "learning flow" has been presented from a new perspective according to the chronological processed characteristics with which the learning activities carry out. "Learning flow", inspired by the concept of the "workflow" technology, will be able to provide a new support structure for designing the learning system of e-Learning. This paper, comparing the similarities and differences between work flow and learning flow, has focused on visual modeling elements and related models of learning flow and introduced the functional demand for visual modeling tools as well.*

Keywords- Learning Flow , e-Learning System , Learning Activity

I. INTRODUCTION

All activities, including the business affairs of human society, are completed by means of information tools, the evolution of which every time has inevitably promoted that of human activity. With regard to the trend of E-learning platform, some scholars have pointed out that electronic activity management is the great tide for both the enterprise and E-learning as a higher education. [1]. Some deficiencies revealed when LMS or LCMS was used, especially for supporting the learning activities, since they took learning objects (or "Content") as an intermediary basically, and we can not directly make plans from the level of system. Aiming at the flexible and effective activity management, people tried to build a learning support system from the perspective of learning activities, and some efforts have been made in the relevant standards and the system prototypes resulting in the birth of a learning design concept as well as specifications.

From CMS to LMS and to LCMS, revolutionary changes haven't took place for E-learning platform in itself, but still functional changes and expansions; What is more creative change is the ramification of the concept and applications of learning objects, providing the basis for data exchange and the construction of standardization between learning support systems. However, there is no denying that content management is still the central function of the mainstream of the current E-learning platform, which is essentially demand-driven that the industry is attaching importance to course training and management. Under the impetus of Design learning concept, cases based on learning activities to structure learning support system have appeared recent years, and IMS has developed the first standard (IMS Learning Design Specification) [2]. Learning Activity Management System appeared to stem from the reflection of the system architecture having content and learning objects as the core, and meanwhile it shows the return of technology in education, to some extent. But with a closer analysis of the function of the learning management system, learning content management system and learning activity the management system, we found that the main innovation is in the conceptual level of the system design changes during the developing context of learning support system .From the sporadic course content that can not be shared to reusable learning objects and then to be able to share the idea of learning design is innovative explicit form; However, we believe that, in spite of great differences between the explicit form and structure, there are not a substitute for each other, but are to solve problems at different levels and areas. Learning activities in particular management system, from the aspect of concept architecture , it is new relative to content management system, and much closer to the actual teaching process; In terms of the technical architecture, the reusable learning design depends on the sharing of learning objects, and the learning activities also depend on the specific functions of various tools , so it will be inextricably linked with LMS, LCMS, which is also fully reflected in the IMS-LD specification.

II. FROM THE "WORKFLOW" TO "LEARNING FLOW"

Research on the process apperanced early in the industrial and commercial fields. In order to support the implementation of business processes, mutual collaboration and easy to manage, a new computer technology known as the Workflow Management (Workflow Management, WFM) has been formed. workflow technology ,a key technology for the implementation of modern enterprise management and process control, has now been widely used in enterprise management, business process reengineering (business process reengineering, simply as BPR) and other areas of workflow that need to plan and manage [3].

The concept of workflow, with fixed procedures of conventional activities ,is rooted in production organization and office automation, which can be disassembled well into the assignment, role, rule and process to monitor so that enhance the systematical efficiency and the level of organization. The advantage of the Workflow is the integrated management of the system, which will be able to

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organize the people, information and application tools effectively and reasonably to make the flow of information more reasonable so that bring the greatest potency of the system into play, and this will be more conducive to the efficient operation of distributed systems [4].

This study believes that the process of learning activities also takes activities as the basic unit, and is carried out with time sequence, which has a commonality with the workflow, so the idea and methods of workflow technology can be learned from for the study of the learning activities of the system. In order to facilitate research and follow-up modeling, we decide to introduce the definition of "learning flow" (Learning Flow) first:

Learning flow (Learning Flow) refers to formal description of a set of rules and the process that learning activities has developed .Specifically, Learning flow provides learning activities and their time sequence and the logical relationship, and connected various activities in accordance with the sequential logic to the formation of a process, which is learning flow. Learning activities is one logical step or segment of learning flow, and each learning activity should include such information: the conditions of the beginning and the end, the role to play, required resources and support to complete the activities, etc.

For teachers, instructional design is mainly reflected in planning learning flow, that is, relevant teaching activities in the teaching process will be stated formally in flow by certain rules (usually the teaching model or strategy); for a specific learner, the learning process is to execute the learning flow once again in accordance with rules defined by the teachers, in the learning process, learning objects changes along with learning activities.

III. THE ANALYSIS OF THE ELEMENTS OF VISUAL MODELING OF LEARNING FLOW

The core of learning flow system model is the connection between activities and the applications you want to call in the implementation process of the activities and also other related information. The ultimate result of detailed design of the process model is the model data structures to be used by the modeling tools and for process modeling, as well as graphical modeling components available to the user's offered by modeling tools.

Lots of experience on the control of the path has been accumulated in Workflow field, which will be able to provide reference for establishing learning flow model. In order to build a learning activity system, it is necessary to understand the internal structure model of learning activities. Our analysis of a constitutive model of learning flow is showed as follows.

A. The starting point model of learning flow

The starting point of learning flow indicates the beginning of the learning activities. For collective learning (that is, learning under the guidance of the teachers), the starting point is one and only, while for online learning, as learners can control their own paces themselves, learning path may have more than one entrances, and the types of starting point are diverse as well.

1) Single Start Node

Single start node is the simplest type of start node, that is, there is only one entrance to learning flow, as is shown below, all learners have to begin with A1.

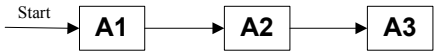

Figure 1. Learning flow of the Single start node

2) Multiple Start Node

The application of the learning flow of multiple Start nodes is uncommon in the traditional learning, but for online learning activities, especially in adaptive learning, it is a very common starting point type. The principal meaning is that there are multiple starting points in the same learning flow, which can be the specific learning activities, or control logic.

There are two main forms for the learning activities of multiple Start nodes: one form is the parallel multi-star node. As is shown in the following figure, learners can participate in the activity A1, and can also participate in activity A2 to begin with.

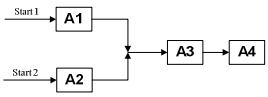

Figure 2. Learning flow of the parallel multi- start node

The other is the serial multi-start node; learners can participate in learning activity A1, and can also jump directly to learning activity A3 to begin with.

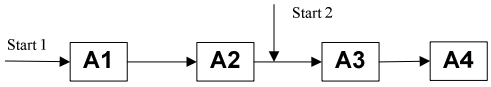

Figure 3. Learning flow of the serial multi-start node

B. The activation model of learning flow

The starting point model of learning flow has defined the entrance to learning flow, when a learning flow is activated, it will go along the route scheduled from the starting point in an orderly or disorderly conduct. The ways of activate the Learning flow are mainly introduced as follows:

1) Manual activation

That is, learning flow is activated by man. For teachers, the activation information has been sent in the phase of use generally after the design of learning flow completed, so that the students begin to enter the process of learning.

2) Timing activation

That is, to activate a particular learning flow within a special time. The primary significance of the activation way in teaching is that the start-up time has been set for learning flow after the teacher finished the instructional design, and when the point time reached, the learning flow is automatically activated, and students will be able to enter the learning process, thereby the automation of teaching process has been achieved.

3) Condition activation

That is, the learning flow will be activated after that the learners met certain conditions which generally include post-test scores, the online time, and the knowledge points and so on. Condition activation is commonly used for achieving adaptive learning. Combined with the judgments of the capacity of former following and follow-up related to the C element of ATC mathematical models, judgments conditions will be able to build based on the ability of the learners.

4) Message activation

That is the learning flow starts up after receiving certain messages. When there are several learning flows in the system of the learning activities, message activation is a common approach to realize Jump between different learning flows, As is indicated in the following figure:

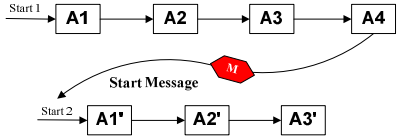

Figure 4. The model of message activation

When the activity A4 in the learning flow1 has finished, messages are sent to learning flow 2, which will start when capturing the message .From the diagram above we can see that the message activation can realize the calling between different learning flows, which will be significant for establishing a flexible management system of learning activities.

C. The basic operational model of the learning flow

The circulation is the core of the learning flow, and the flowing process is also the learning process for learners. Generally, types of the operation of the learning flow are mainly introduced in the following:

1) The basic operational type

The basic operational type is relatively simple, and the running path of the learning flow is almost linear. There are several types detailed as follows:

Serial: Serial is the most simple model to be understood easily, that is in accordance with the linear support. Serial structures are generally single start nodes. As follows:

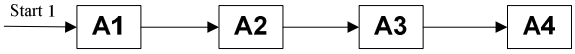

Figure 5. Serial operational model of learning flow

Self-circle: that is, learning activities that repeat the implementation of a node or several nodes. There are two types of self-cycle shown below. Left characterization is unconditional self-cycle, namely when finished learning activities A1, the learners can decide whether or not to re-enter the A1 learning. With the conditions, the latter includes While / Do and Repeat / until two types. When the condition C is real, execute A1 repeatedly, until it becomes false, Jump to A2.

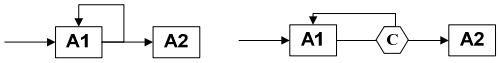

Figure 6. Two self-circle operational models of Learning flow

Condition jump: That is, when facing a certain learning activity to be executed, first entry condition judgments. When meet certain conditions, skipping some learning activities, and re-selecting the starting point for learning. Condition jump is one of the basic operational mode for achieving adaptive learning.

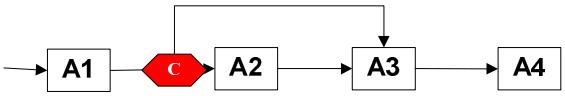

Figure 7. The condition jump model of learning flow

Message jump: Each activity of learning flow in the implementation will intercept the messages of the system, when finding the jump (Message), the learning flow automatically will jump to specified node, as is shown below.

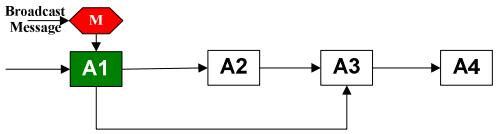

Figure 8. The message jump model of the learning flow

2) Divergent node type

The so-called "divergence" refers to the existence of node branch of learning path. Divergent operational type refers to how the learner enters these branches on the path of learning activities. Mainly types of the divergent node operating are presented as follows: Parallel operation Type: It refers to the learning flow with branches. When a learning activity is over, learners can choose to enter any one branch of the parallel architecture. What needs to be emphasized is, each branch is equipotent, and the learners must complete the two branches of activities in order to enter the next event.

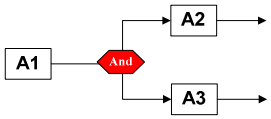

Figure 9. The parallel operation model

Exclusive operation model: When an activity has been finished, the learners will be allowed to select only one branch in the following branch process. This choice is a man decision-making, not pre-set rule.

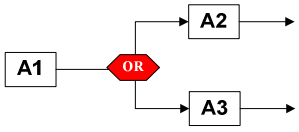

Figure 10. The exclusive operation model

Conditional operating model: that is, when a learning activity has been finished, the learner will have to entry the

condition judgments, and decide to enter which path branch to learn according to the judgments of conditions.

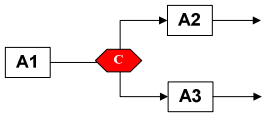

Figure 11. The conditional operating model

For example, when the learners have finished the unit "What is teaching Media?" we may take A1 as testing activities, and the test results will be recorded as Mark. The condition C is when the mark> 60, the learner will be qualified to enter the A2 " The applications of the teaching media ", otherwise enter the A3" Reading expansion of the teaching media " to supplement learning.

3) Aggregate node type

Comparative with the "divergent" operational type, "aggregation "mainly refers to how to gather a number of path branches together to a node. Divergence and aggregation combined together will constitute the flexible structure of learning path. The main types of aggregation operation are presented as follows:

Synchronous aggregation: The finished path branches of learning activities will be converged at a node, which is one of the basic aggregate operations. What needs to be emphasized is that the prerequisite of simultaneous aggregation is a number of branches of learning activities have been completed.

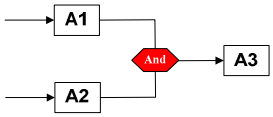

Figure 12. The simultaneous aggregation

Select aggregation: that is, after the completion of any branch before a node, entering the continuous path of learning activities will be the next event.

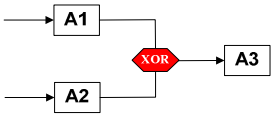

Figure 13. The select- aggregation

Several operating models above are the basic form of operation, and common flows can be constituted by these basic types.

4) The running nested model of the learning flow

In the practice of the design of the learning flow, especially for the complex learning flow, we sometimes need to consider the nested learning flow that when more than one learning flow exists, how to run the portfolio. The nested models of learning flow mainly include using embedded model and inlay model. Nested learning flow is an important guarantee to build flexible learning flow.

The using embedded model of the learning flow includes two categories, one is embedded after the learning flow, and the main flow is no longer running until the completion of the using embedded flow, just as shown below:

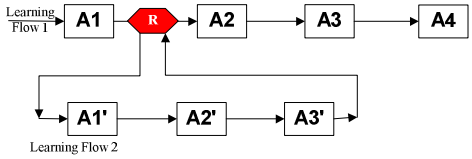

Figure 14. The using embedded model of the learning flow（1）

The other type is that the main flow and embedded flow run at the same time, but they need to converge at a node, just as shown below:

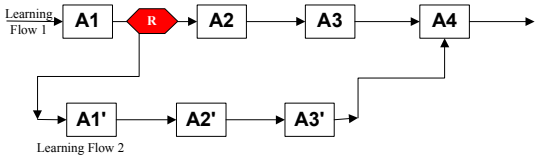

Figure 15. The using embedded model of the learning flow（2）

The inlay model of Learning flow refers to after the completion of an learning activity and the activation of another learning flow, the main learning flow (that is, learning flow1) and embedded learning flow (that is, learning flow2) will run separately, non-interfering, which is different from the using embedded model, since the other learning flow doesn't return to the main flow (that is, learning flow1).

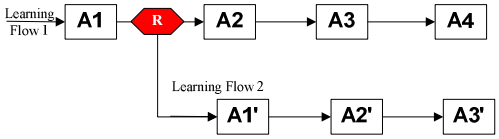

Figure 16. The inlay model of Learning flow

5) Terminal model of learning flow

The termination of the learning flow includes the normal termination, abnormal exit, master stop, master suspended, overtime and other types of termination. Normal termination: the learners have completed all the learning activities of the learning flow, and the learning process has ended, then terminate the learning flow normally.

Abnormal exit: the learners, due to physical reasons (such as computer failures, etc.) or personal reasons (such as do not want to continue learning), exit from the learning process, and the learning instance is forced to be suspended.

Master stop: The teachers take the initiative to stop the learning flow, and all the running instances stopped. Master stop, is very important in the teacher-led learning process, by which the teachers can control the learning process of students.

Master suspended: The teachers suspend the operation of flow, all running instances of learning flow have been

stopped, but, the learning flow can still be re-activated under this mode.

Overtime Termination: The teachers has set up the running time of the learning flow, and the learning flow will be suspended when the learners exceed the running time,

IV. THE FUNCTIONAL REQUIREMENTS FOR MODELING TOOLS OF LEARNING FLOW

We have analyzed the modeling elements of learning flow above and the formation of the actual running flow needs the support of modeling tools and the basic requirements for modeling tools are shown as follows. We will introduce the process of modeling of the learning flow in detail and the structure and functions of the LAMP system will be linked.

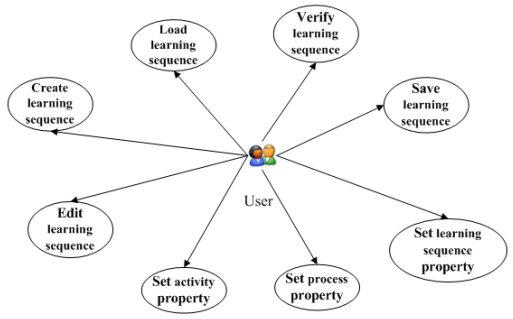

Figure 17. *the* function *that the modeling tools need to achieve*

a) new model: the user can select the "New" menu or click the corresponding button on the toolbar to create a new empty document model.

b) mapping model: using a variety of modeling component provided by modeling tools to render models.

c) set model attributes: by setting the dialog box of model Properties

d) set process attributes: by setting the dialog box of process Properties to set the model attributes.

e) set node attributes: by setting the dialog box of Node Properties to set the attributes of the various nodes

f) validate model: after modeling, the feature can be verified to validate whether the model has logical errors or not.

g) save model: the model shoule be saved to facilitate reading documents, and there are two forms of model preservation, one is saved as XML document format; the other is sent to the relational database according to certain structures

h) edit model: that is, load the learning flow, and open it to re-edit.

i) other available features include: the deletion of modeling components, copy, paste and other basic editing functions; the entire zoom function of graphical model, the preview function of learning flow diagram.

V. SUMMARY

According to the activity theory, the best unit of analysis of the learning environment design is activities, and the task of learning environment design is to analyze the elements of the activity system and the dynamics between the elements. Colin Tatters all and Rockier in their articles also pointed out that the current E-learning industry has reached a consensus that client-centered learning should be developed to having activities as the core [5]. The traditional management framework had function or learning object as the core, which now change to focusing on learning activities in the design and management, representing a new design philosophy of the Learning Support System. It believes that only learning object can not constitute effective teaching, despite the learning object in the learning management system is still very important, and the learning objects should be a certain degree of structure, and a specific learning and behavior and service integration, and the best integration carrier is the learning activities. In the Learning activities management system, a series of Learning Activity Sequence detailed planned has replaced the original learning object, whose outer form is learning flow. And learning flow is the object for teachers to carry out the instructional design and for students to learn. The course of instructional design for teachers, mainly reflected in the analysis of the specific issue of education, and convert it to a specific plot of the process in order to describe the learning goals, learning tasks and learning activities, and thus the establishment of these basic sequence, and can be recorded in the descriptive form and form a descriptive document of learning flow and conducted it into the learning flow management system. Learners participating in the instructional process are mainly reflected in the choice of learning flow, and study in accordance with the process definition of learning flow.

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