The Design and Implementation of Case-based Learning in Adaptive Learning

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Abstract

The development of information technology brought a new prospect for the network study, the adaptive learning has been possible to meet learner's individual requirements. The case-based learning may provide the simulation situation for the learner, but the adaptive learning takes on the both superiority of the Case-based Learning and simulation situation. It take the case as the study object, shields the relations between various concepts in the case, and simplified concept map. And also, it presents the learner’s cognition abilities with belief vector, contacts learner's learning capability with the case. It can make students learn cases orderly with different levels, and it can make it possible of efficient study.

1. Introduction

The rapid development of information technology has brought great changes to study, especially to learning modes and channels. We gain more convenience in distance learning, lifelong learning and education popularization, because of the appearance of network learning. It further improved the development of the network that beacause of the development of Internet technology based on the Internet, and the characteristics of distributed resources environment for learning. Adaptive learning become an important research direction of network teaching, it refers to the one in the learning process, according to the learners to collect information and the learning process for learners to regulate itself, its ability to adapt to the content, and can adjust. Also can provide for learners to each parameter for the evaluation of appropriate, to provide reference for further study.

Case-based learning is drawn into the network learning, because it can meet the further requirements for the learning efficiency and practicability of the learner's requirements. In the other word, “Let learners gain initiative of general knowledge, ability and attitude from the limited cases, in other words, they can get the essence of principle, structural, and typical things and regularity, interdisciplinary relation, etc. They can understand and solve some of the structure of the same or similar phenomena and problems of single, by the general knowledge, ability, attitude.” [6] Overall, the case-based learning is developing knowledges in one or more of the hypothesis about the situation, it shoud virtual the process of learning to handle the problem of assumption.

Zhang Zhenhua, Jiang Kan put forward into the intelligent Agent and feedback system as a whole through the exchange of case teaching, strengthening the supervision of real-time online and grasps students learning. [7] MiaoYuHui, ZhaoYuQing think building case-based learning in network can greatly shorten the teaching situation with the actual situations. [8] Jia YiMin and Lin CaiHong put forwards a new ideas about case-based learning on network [9]. Zhong Ying(Taiwan) put forward a method that use intelligence technology for teachers' teaching management such as case reasoning and artificial neural network [10]. They did not consider this question that the relation of Case-based Learning and Adaptive Learning, or representation of case, or the relation of the case and the learning adaptability.

Therefore, this paper puts forward to the Adaptive learning system centering on the Case-based learning, namely CLAL system. It take the case as study object, and put the case into different stages. Then the study content of each stage was designed as case, and made into a multi-level cases. CLAL will collect the information of the learners in their learning process, analyzing these information and then offer for learner with adaptive case. The purpose of this paper is to provide a more efficient network learning method, research on how to cultivate the ability of solving the
problem and dealing problems for the learner when they faced the actual situation, but also for the reform of education career.

2 The expressions of the case

The knowledge was usually expressed by concept map in the intelligent tutoring system. McAleese defined the concept map as "a directed acyclic n-dimensional graph consisting of a set of m Concept Labels \{C1 \ldots Cn\} and a non-empty set of r Relationships or Arcs \{R1… Rn\}".\(^{(1)}\) or "A tool used to organize and express the knowledge".\(^{(2)}\)

Because the complexity of the relationship between the concept leads to the difficulties in the adaptability of navigation system, so we need a more simple method, which can meet the adaptability of learners, and reduce the teacher design work. This paper puts forward knowledge into the case, not only be good for students' learning, but also reduce the difficulty of design procedure.

2.1 The partition of knowledge

The CLAL system can make navigation relation between the knowledge simplify, to package different knowledge in the same level case, to shield the complicate relation of knowledge, so it can be put in more energy studying the efficiency how to improve study in the system. Knowledge is divided into different category, then divided it into different part according to needing. Then, we carry out partition as show in Fig. 1, leave only one route between every part. The route unitariness can carry out simplification on adaptability navigation.

![Fig. 1 The partition of knowledge](image)

In figure 1, we can see different levels of the case, the lower case in the left hand and the higher level case in the right. In order to ensure a more comprehensive, the same level of cases should have all sorts of different cases, these cases can contain the level of all or part of the knowledge.

2.2 The description of concept and case

The concept describes serial number, knowledge unit name, the level of cases, text description, etc. Describing XML concept with the following form:

```xml
<kknowledge 1>
    <knowledge no>kknowledge no</knowledge no>
    <knowledge name>kknowledge name</knowledge name>
    <knowledge level>kknowledge level</knowledge level>
    <knowledge description>kknowledge description</knowledge description>
    ...
</knowledge 1>
```

Concepts constitute the cases. There is one or more concept in the case. It mainly consists of case Numbers, name, level, concept number, descriptions, author, upload datetime, etc. Describing XML concept with the following form:

```xml
<case 1>
    <case no>case no</case no>
    <case name>case name</case name>
    <case level>case level</case level>
    <case num_kn>case num_kn</case num_kn>
    <knowledge>knowledge</knowledge>
    ...
</case 1>
```

2.3 The construction of the case in the system

The paper is based on the design of the Word which is the foundation courses of "computer applications" in secondary vocational school. Design system and tested in students. The main contents of this course include: text editing, document formatting, documents pertaining to the use of form, add graphics or formula to document, etc. we design the first three parts in this system only.

The course will be divided into 3 levels cases in the system, the first level is editor, the second is the text document formatting, the third is the senior formatting.

The first level case "edit" contains the main points: the method of select text, copy the text, move the text, delete text, divide or merge the paragraph, etc. Main case: case11, adjust the order of poetry sentence; case12, modify notification; case13, modify essay a; case14, modify essay b.

The second case "format" contains the main points: settings of font, font size, word set, alignment, the effect of paragraph indents, spacing, etc. Main case: case21, poetry's format setting; case22, notify's format setting; case23 essay's format setting a; case24, essay's format setting b.
The third case “senior format” contains the main points: header, footer, border, background, and graphics etc. Main case: case31, poetry’s format beautification. case32, notice’s format changes. case33, essay’s format changes a. case34, essay’s format changes b.

3 The eastablishing of Student model and the description and evaluation of the learning ability

3.1 The eastablishing of Student

Model is the real thing of abstraction. It extracts the factors concerned from the real thing, discard the secondary, which is helpful for people to pay attention to the nature of things. Student model is a special kind of user model which designed for the students. Sison and Shimura defined student model as “A student model is an approximate, possibly partial, primarily qualitative representation of student knowledge about a particular domain, or a particular topic or skill in that domain, that can fully or partially account for specific aspects of student behavior.”[3]

Therefore, student model is not true expression of all the characteristics of students, but only to describe elements and part what the system needs to. The essence of student model depends on its use. Students need to say something and say what in the model depend on system by the target, not because of the students themselves.

When building model we should consider the learners’ knowledge state, the core questions is how to express the learners’ state. At present, there are many user modeling method, but far more practical modeling method is Overlay Model, Stereotype Model, Model Portfolios which brought by Brusilovsky.[3] This paper used the Model Portfolios to build students model.

3.2 the system analysis of students’ learning ability

The CLAL system use system evaluation, student evaluation and teacher evaluation and can evaluate students’ learning achievements for the further study. The system can be reflected from the numerical evaluation on student learning, and the evaluation form students and teachers can have larger initiative, can evaluate the various of advantages and disadvantages of students' more comprehensive. The system of evaluation considered the cognitive abilities of students. The ability to change in the learners are expressed discontinuous, but not so in reality. We use the rules to calculate learners Belief Cognition, [4] in order to try to describe the learners’ cognitive ability accurately.

$$\text{BC} = \sum_{i=0}^{3} p_i$$

The BC is the value of Belief Cognition abilities for learner, i is the index of cognitive ability belief vector, pi is the i component values of the learners’ cognitive ability belief vector. Use the following formula calculation, if the vector i scoring average is p after the test, then the value of the vector i will be:

$$\frac{p}{\sum_{i} p_i}$$

The worst cognitive ability vector is (1,0,0,0), and the BC is 0; the best cognitive ability vector is (0,0,0,1),and the BC is 3. Therefore, the range of BC is $0 \leq \text{BC} \leq 3$. For example: vector (0.05, 0.55, 0.35, 0.05), learner’s BC is:

$$\text{BC} = 0.05*0+0.55*1+0.35*2+0.05*3 = 1.3$$

3.3 The connection between cases and cognitive ability

In order to make students learn to carry on, there need to supply the case which adapt to themselves. So, it needs to evaluate the students’ cognitive ability. The system calculated cognitive ability by the system test after the completion of the studies on stage, them provide different cases for the students according to cognitive ability. For example, learners take a test after learning case 11, and the master degree of knowledge such as: there are 80% in the stage of cognitive, 60% in the stage of memory, 75% in the stage of application and analysis, and 65% in the stage of the comprehensive application. The system will generate learners' learning cognitive belief vector is:

$$\left(0.29, 0.21, 0.27, 0.23\right)$$

According to calculate by the formula 2, the learner's BC after study case11 is:

$$\text{BC} = 0.29*0+0.21*1+0.27*2+0.23*3 = 1.44 > 1$$

We know the learner’s cognitive ability in the level of the application and analysis from the table 1. So he doesn't allow learn higher case. He can choose case or select the case by the system. If BC> 2, he can upgrade.

Table 1. The table from the value of cognitive ability to the level of cognitive ability

<table>
<thead>
<tr>
<th>No.</th>
<th>the value of cognitive ability</th>
<th>the level of cognitive ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.29</td>
<td>0.21</td>
<td>0.27</td>
</tr>
</tbody>
</table>
3.4 Navigation among cases

The system uses the technology of navigation in cases to supply content which adapted the student’s learning process. As shown in figure 2, in the system, the learners can be free to choose case, or learn the case be showed by the system. The learner is independent, so they feel much more freedom.

Fig. 2. Navigation in cases

4. The design and implementation of CLAL

4.1 System’s requirements analysis

Here, we take it for the target that to establish a case-based learning in the adaptive learning system which guided by constructivism learning theory. System provides a method to study in simulated situations for learners, can adjustment learning object according to the circumstance of oneself, so the system can make learning more practical significance. The system is more suitable for vocational training and basic skill training, etc.

According to the design goal, this system has the following functions:

1. The basic functions: provide system management, login, communication for information, etc.
2. Content management functions: provide course selection, case design, parameter setting, etc.
3. Automatic analysis function: to record and analysis of the learner’s personalized, to analysis the results and process of learning, to provide the corresponding evaluation, and to supply adaptive navigation and, adaptive presentation.
4. System feedback function: to collect the learners’ suggestion, and feedback to the manager.

4.2 Use case diagram of the system

The system be described using UML, which can express the design intent direct viewing. Because it can not only make designers use easy-to-understand method to express design ideas, but also provide a mechanism which can Shared and communication design results between different people. In Fig.2, We use UML to describe the relations between users in this system, and make them more clearly. In addition, we want to describe system needs more exact, so describe system use case by UML in Fig. 4.
4.3 system structure

The main module of the system are achieved by network programming, so we established the system on the three layer architecture which commonly used in network platform. As follow: Data service layer, Functional layer, The user interface layer. Fig. 5.

4.4 system function

To sum up, in order to satisfy various demands, the CLAL system must have general function as shown in Fig. 6:

4.5 environment of system

Now, the CLAL system are in the experimental stage, so there use this technique to design it, such as: SQL, ADO database access technology, HTML/XML, ASP, and VBSCRIPT, etc. System adopt the kind of system structure popularly, three layer architecture, i.e: B/S/D (Browser/Server/Database). It took three functions with three layers, namely, besides Client and Database Server, added Application Server to deal with the work.

4.6 The testing results of system

We created the same environment as far as possible (i.e., selecting students randomly, using the same content and the same hardware, etc.), then compared this system with traditional teaching methods. Students were investigated after learning. This system is compared with traditional teaching methods: more than 10% in the number of the students in the medium level; the same in master degree of theory; more than 20% in the number of students who operate ability is better; less than 10% in satisfaction of system or teacher; more than 10% in satisfaction of themselves.

Therefore, this system is compared with the traditional teaching method can be more efficient in the completion of the teaching task even without the full freedom to learners. So CLAL have have much effect on network learning.

5. Conclusion

The paper raises a new idea: CLAL, which based on the study of the case-based learning and adaptive learning. The CLAL combines Case-based learning with adaptive learning. This system can simplify the representation of knowledge and the realization of
navigation, can supply simulative situation for learner, can make learning close to reality, so the learners will feel greater sense of achievement, and the learning will be more efficient.

10. References


Chinese references


