

# Application of Cognitive Load Theory in Mobile Micro-learning

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**Abstract.** With the rapid development of mobile terminals and the Internet technology, new forms of learning such as mobile learning and micro-learning appear in the field of digital education. Mobile micro-learning, combining the features of both mobile learning and micro-learning, is conducted with mobile devices and with small learning units. It has the characteristics of flexibility and convenience and is welcomed by more and more teachers and learners. However, problems exist in the design of the mobile micro-courses and many teachers consider this new form of learning as extension of classroom teaching and fail to make good use of this new teaching form. To design effective mobile micro-courses, designers should make sure the total cognitive load does not exceed what learners can accept and try to reduce extraneous cognitive load and increase germane cognitive load. This thesis introduces the cognitive load theory into mobile micro-learning, analyzes common problems in the design of mobile micro-learning courses and suggests ways to apply the cognitive load theory to the design of the micro-learning courses.

**Keywords:** cognitive load theory; mobile learning; micro-learning; course design.

## 1. Introduction

In recent years, as the network technology and mobile communication technology advance, smart phones, tablet PCs and other mobile devices are becoming increasingly popular among people. In the field of digital learning, new forms of learning such as mobile learning and micro-learning appear and these new learning forms are welcomed by a large number of learners. In the beginning of 2000, an international expert in distance education Desmond Keegan first introduces the concept of mobile learning into China, which has drawn great attention from scholars both at home and abroad. Many in-depth researches on this theory have been conducted since then. In 2004, an Austrian study expert, Martin Lindner, puts forward the concept of micro-learning which deals with relatively small learning units and short-term learning activities and usually conduct in mediated environments [1]. Mobile micro-learning combines the features of both mobile learning and micro-learning, that is, it is conducted with mobile devices and with small learning units.

As a new form of learning, mobile micro-learning has characteristics of flexibility. However, many people consider mobile micro-learning as extension of the classroom teaching, and ignore its features when designing the course content and teaching. As a consequence, such course designs and teachings fail to make good use of its advantages and generate extra cognitive burden to learners. This thesis firstly introduces the cognitive load theory and its development; secondly it analyzes the problems and common mistakes in designing the mobile micro-learning course; finally, it puts forward methods to design effective learning content and avoid bringing extra cognitive load to students in the process of mobile micro-learning.

## 2. Cognitive Load Theory and its Connotation

It is acknowledged that the early researches of Ulric Neisser, Miller and others on cognitive load theory have a significant impact on the development of cognitive load theory. On the basis of previous researches, in 1988 John Sweller proposes the cognitive load theory. The theory assumes that the human cognitive architecture consists of limited working memory and unlimited long-term memory.

The working memory is also called short-term memory, and its function is to store and receive information quickly in the learning process, but its capacity and storage time are limited [2].

Cognitive load, as the information to be processed in the working memory, can be divided into three categories: internal cognitive load, extraneous cognitive load and germane cognitive load. Intrinsic cognitive load is the effort associated with a specific topic. Extraneous cognitive load refers to the way information or tasks are presented to a learner. And, germane cognitive load refers to the work put into creating a permanent store of knowledge, or a schema [3].

Intrinsic cognitive load is decided by the interaction level of learning elements inside the material. If the amount of information in the learning material exceeds the total of a learner's knowledge, it will bring heavy cognitive load to the learner and has negative influence on the learning effect. Usually, the intrinsic cognitive load is considered to be inherent and cannot be altered. Extraneous cognitive load is generated by the manner in which information is presented to learners and is under the control of instructional designers [4]. This load can be attributed to the design of the instructional materials. Germane cognitive load is that load devoted to the processing, construction and automation of schemas. While intrinsic cognitive load is generally thought to be immutable, instructional designers can manipulate extraneous and germane load.

### **3. Problems in the Design of Mobile Micro-learning Courses**

Mobile micro-learning also known as fragmented learning, is different from the traditional classroom teaching. The learners are not limited by time and place and can learn relatively small units in a short term. It has the characteristics of short time, small fragments, individuation and multimedia [4]. However, as a new form of learning under the support of information technology, the designers often repeat the design of traditional classroom teaching when designing the course, which doesn't bring the advantages of the new learning form into full play. Here are the common problems.

#### **3.1 Lack of Optimized Learning Resources**

Learning resources refers to electronic resources provided to learners according to the learning objectives and curriculum design. Rich learning resources can stimulate learners' desire for knowledge, however, if the resources is merely an electrical presentation of students' textbooks, it would fail to draw learners' attention and hold their interest. Mobile micro-learning is different from the classroom teaching or the ordinary online learning. Because the display content is subjected to the screen size and the learning time is relatively fragmented, it is not suitable for a large amount of reading; it requires concise display of the knowledge and the convenient switch of the content. Besides, it is also necessary to set the extended knowledge pointing in a standardized way; otherwise there would be congestion of learning resources.

#### **3.2 Lack of Personalized Design of Learning Content**

At present, the focus of educational research is changing from "teaching-centered" to "learning-centered". The teaching idea and the learning environment are advocated to be learner-centered in order to meet students' different needs, learning styles, motivations and characteristics. However, the present mobile micro-learning is still in the exploratory stage, with little experience to refer. Designers may overlook learners' different needs, and the design of the content and learning process is often fixed. During the learning process, a large amount of learning resources may be provided, but there is often a lack of personalized learning space. Taking college English teaching as an example, the students with different foundations and interest may require different learning content and time. Therefore, designers have to consider these differences and design the course in a personalized and flexible way.

#### **3.3 Lack of Effective Communication and Interaction.**

Alexander Dye mentioned in the definition of mobile education that mobile devices used in mobile learning have to effectively present the learning content and provide two-way communication between teachers and learners [5]. For educators, through interactive communication, they can learn about the learners' learning progress, solve difficult problems and arouse their initiatives. However,

mobile micro-learning is still in the experimental stage, in which effective supervision is still in need. In some courses, effective interaction between students and their teacher and the interaction among students are often missing. Without the interaction with teachers and their peers, students often find the online course ineffective and they may feel reluctant to keep up with the course flow. In a sense, the two-way online communication becomes one-way and emphasis is laid on how to teach just like in traditional classroom teaching.

#### 4. Application of Cognitive Load Theory in Mobile Micro-learning

The course design has to conform to the characteristics of mobile devices and reduce the extraneous cognitive load. Mobile micro-learning mainly relies on the mobile phone, which is the most popular information technology terminal equipment. At present, the smart phone generally has high-speed processing chips, standardized display screen, strong memory chips, as well as a user-friendly interaction interface. Besides, it has small volume and is easy to carry. All these features conform to the demand for mobile micro-learning. But because the mobile phone terminal is different from traditional teaching equipment, it is necessary to organize the teaching materials in order to adapt to the display characteristics of the mobile phone screen. To control the extraneous cognitive load, it is necessary to use the multimedia technology to combine the text, pictures, video and audios to show the teaching content. In the meanwhile, multiple representation of the same knowledge has to be avoided redundant information and to ensure effective learning.

The course design has to take the internal cognitive load into account. Kalyua and other scholars have studied the cognitive load effects of different levels of learners, and pointed out that the learner's actual cognitive load level is often ignored when designing the course. For example, the aim of college English teaching is to improve students' English language skills, including listening, speaking, reading and writing abilities, and to cultivate students' learning interest and good learning habits through mobile micro-learning courses. Considering students' different levels of English, it is necessary to design the course in different levels, from low to high, from simple to complex. As is shown in Fig.1, the course can establish primary learning module to cover basic knowledge such as phonetics, grammar and vocabulary, intermediate module to include skills such as listening and reading and advanced module to cover skills like translating, speaking, etc. Because students can accept different levels of cognitive load, it is important to allow students to choose their own starting point in the course. They can choose to start the course from the primary module or they can skip it and to begin from the intermediate and advanced modules.

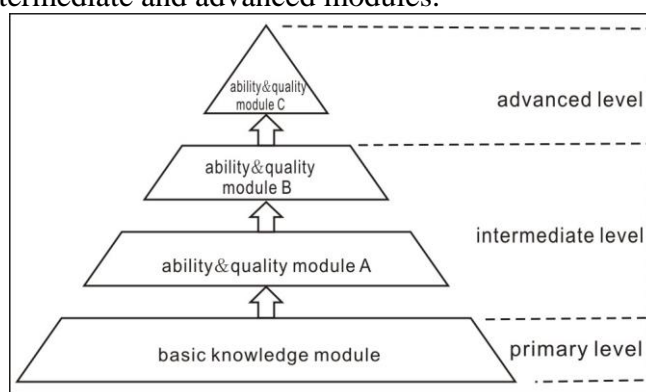


Fig.1 Structure of the mobile micro-learning courses

The course design has to stimulate learners' cognitive efforts to improve the germane cognitive load so that learners can invest more cognitive resources to construct schema and achieve better learning outcomes. To carry out mobile micro-learning, teachers play a more active role. They should first learn about learners' learning progress and give necessary online tutoring, according to the learners' different abilities to promote their the process of cognitive resources. Secondly, they should actively guide the learners to conduct self-assessments regularly to stimulate higher germane cognitive load [6]. Through assessment, learners can reflect upon their own weakness in the learning

process and adjust the strategy to improve the efficiency in time. Therefore, the interaction between teachers and students should be an essential part in the mobile micro-learning courses. If there are difficulties in the software development, teachers can interact with students with the help of other network platforms. The teachers' timely guidance to students is the most effective way to improve the germane cognitive load of learners.

## 5. Summary

It is of great significance to apply the cognitive load theory to the mobile micro-learning. For teachers, they not only have to learn about students' level of cognitive load and choose proper ways to present the learning content, but they also need to provide timely guidance through interaction and facilitate students to achieve better learning effect. For students, they have to achieve appropriate cognitive resources to ensure a smooth information process through mobile devices. The cognitive load theory has provided effective guidance for the design of mobile micro-learning courses.

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