Original Article

A Study on English Grammar Micro-lesson Teaching Design based on Cognitive Load Theory

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Abstract - With the development of information technology, the micro-lesson has become a new teaching resource. As the fusion product of information technology and teaching, micro-lesson has injected fresh vitality into teaching with strong pertinence in a short time. Grammar is abstract, with many items to remember, so English grammar teaching seems dreary. Compared with traditional English grammar classes, micro-lessons can arouse students' attention and stimulate their interest in learning English grammar through short videos. Furthermore, using micro-lessons in the classroom is conducive to enriching the classroom content and activating the classroom atmosphere. Micro-lessons are widely used in teaching, but there are some problems in the design and production, such as insufficient teaching design, inadequate knowledge segmentation, and insufficient analysis of students' cognitive characteristics and learning needs. According to the cognitive load effect, this study puts forward the design principles of reducing intrinsic cognitive load, decreasing extraneous cognitive load and increasing germane cognitive load. An example is given to illustrate how to improve the quality and application effect of English grammar micro-lessons.

Keywords - Micro-lesson, English grammar teaching, Cognitive load.

1. Introduction

All kinds of "micro" things gradually come in front of people as information technology is booming. In daily life, Microblog and WeChat have become indispensable communication tools in people's lives. Additionally, micro-lessons and other new teaching resources cater to the development of contemporary education.

Micro-lessons refer to mini-video courses with clear teaching goals, focused content and concentrated problem explanations within 10 minutes (Wu, 2016). Micro-lessons were first seen in the 60-second lecture proposed by Professor Le Roy A. McGrew at Northern Iowa University in the US and the one-minute speech proposed by T. P. Kee at Napier University in the UK (Hu T. S. et al., 2013). As a kind of new teaching resource with many advantages, such as being short, precise and accurate, micro-lessons are of great significance to English teaching. They not only increase students' motivation and interest in English learning but also strengthen memory and consolidate knowledge. Grammar rules are abstract, which leads to a large amount of information and less detailed explanation of key knowledge in the traditional grammar classroom; naturally, students are reluctant to listen (Chen, Q., 2015). Therefore, micro-lessons are very suitable for English grammar teaching.

Wu (2016) pointed out that Hu Tiesheng pioneered the "micro-lesson" model in 2011, and the Ministry of Education began to hold the micro-lesson competition for primary and middle school teachers in 2012 and then began the reformation of micro-lesson teaching and the application of micro-lesson research. This practice achieved some results, but there are still some problems, such as a lack of understanding of the advantages of micro-lesson resources and the application effect of micro-lesson resources in teaching (Wu, 2016). The phenomena have improved after the outbreak of COVID-19, and teachers have realized the advantages of micro-lesson resources and begun to study how to make high-quality micro-lessons. In this regard, Chen S. et al. (2020) put forward some suggestions for making micro-lessons. First, choose the topic carefully to ensure it is practical and effective. Second, grasp the core to strengthen the teaching design. Third, enhance the learning experience with excellent sounds and images. In short, the form should serve the content; therefore, the design of micro-lesson teaching is crucial.

Zhou, L. P. et al. (2017), Wang, W. Z. (2009), Yang, J. Z. (2012) and others pointed out the theoretical guiding significance of Cognitive Load Theory (CLT) for micro-lesson teaching design. Feng, X. Y. et al. (2017) designed micro-lessons based on CLT and further carried out comparison experiments. The results showed that the micro-lesson designed based on CLT could effectively improve learners' learning effect. Therefore, based on the CLT, this paper will focus on designing micro-lessons to reduce students' cognitive load, make students more relaxed

when learning English grammar, and make English grammar micro-lessons valuable.

2. Cognitive Load Theory

Cognitive Load Theory (CLT) was first proposed by Australian cognitive psychologist John Sweller in 1988. According to Sweller (1988), cognitive load is the level of "mental energy" required to process information. Based on the Resource Limited Theory and Schema Theory, he studied cognitive load from the perspective of resource allocation and divided cognitive load into three categories, namely intrinsic cognitive load, extraneous cognitive load and germane cognitive load. The sum of the three kinds of cognitive load is the total cognitive load (Sweller, 1988; Paas et al., 2003). Intrinsic cognitive load refers to the load formed by the interaction between elements, which depends on the interaction between the material and the learners' professional knowledge. Extraneous cognitive load is the extra load of processing irrelevant information caused by improper teaching design and teaching process. Germane cognitive load results from learners' cognitive effort, which benefits their learning.

The basic viewpoints of CLT are as follows. On the one hand, only when the total amount of cognitive resources required by individuals for learning is not overloaded can their learning be effective. On the other hand, the construction of schema and its automation can effectively reduce the workload and improve learning efficiency (Ruan, 2016).

According to CLT, many teaching effects can guide the teaching design. For instance, goal-free effect, worked example effect, problem completion effect, split-attention effect, redundancy effect, expertise reversal effect, guidance fading effect, isolated interacting elements effect, dual-channel effect, variability effect, element interactivity effect, modality effect, imagination effect, self-explanation effect. The meanings of the main teaching effects are shown in the table below.

The below teaching effects do not exist independently but are related—for example, the worked example effect and problem completion effect. Although providing samples has the benefits of deepening understanding and saving time, the high frequency of using this way and students' low self-awareness would reduce the learning efficiency. The problem completion effect will solve this problem well. It will provide only a part of the example, conducting students' active thinking to solve the rest.

Table 1. Main teaching effects

Teaching Effect	Meaning
Worked example effect	Provided with examples of problems that have been solved, learners can effectively improve their problem-solving level.
Problem completion effect	In order to avoid learners from being lazy in thinking when providing learners with ready-made samples, the best way is to provide only a part of the sample and ask students to complete the rest.
Split-attention effect	When the information contained in one mode of presentation is insufficient, and the remaining information is presented in another way, learners need to pay extra cognitive load to integrate them, resulting in scattered attention.
Redundancy effect	Suppose the same information is presented in multiple ways at the same time, and learners can understand the information in a single way. In that case, other ways of presentation will become redundant, resulting in an increase in extraneous cognitive load.
Isolated interacting Elements effect	When the learning content is relatively complex, it is indispensable to separate, present them individually, and integrate related elements.
Dual-channel effect	It refers to the phenomenon where instructional effectiveness is enhanced when teaching materials are presented simultaneously through visual and auditory channels, compared to using a single channel.
Variability effect	Changing the problem situation, structure, etc., facilitates learners to better cope with new situations and problems. Although it may increase the difficulty and cognitive load of learning, it can help learners improve their problem-solving skills and the effect of knowledge transfer.

3. Micro-Lesson Design Rules Based on Cognitive Load Theory

Based on the general teaching design principles, micro-lesson design should also follow micro-lesson ones according to CLT and try to make the total cognitive load required for learning the micro-lesson lower than the total cognitive load that learners are able to bear to promote effective learning. According to CLT, some scholars put forward some principles of micro-lesson teaching design. Yang (2012) proposed the principle of (1) clear positioning, (2) simple interface, (3) small module presentation, (4) random access learning, (5) two-channel, (6) redundancy removal, (7) proper ordering, and (8) situational cognition. Wang (2009) put forward the principles of (1) skillfully using graphical representation, (2) skillfully using voice presentation, (3) skillfully using prompt and graphic integration, (4) removing irrelevant information, and (5) controlling redundant information. In addition, Chen S. et al. (2020) also put forward some referential suggestions. This paper integrates, improves and summarizes them into the following principles according to three kinds of cognitive load.

3.1. The Principles of Reducing Extraneous Cognitive Load

3.1.1. The Principle of Focusing

This principle refers to selecting key points, difficulties, test points, and error-prone points as micro-lessons topics before designing micro-lessons. The time of micro-lessons is controlled within ten minutes; accordingly, not all knowledge points are suitable for micro-lessons. The topic should be focused rather than generalized to ensure that, in a short time, they can be explained thoroughly and deeply to help students understand and master the knowledge. Apart from refining, the connection between content is also crucial. A micro-lesson is not a simple explanation of the teaching content; that is to say, one micro-lesson only talks about a certain knowledge point, and the other micro-lesson talks about other knowledge points. Such micro-lessons simply achieve refinement, but they ignore the connection between content. When knowledge is broken up and explained to students in a meaningless way, the systematicness and logic of knowledge will be destroyed. It is arduous for learners with low knowledge levels to integrate these independent knowledge points and internalize them into their own knowledge structure since it occupies more of learners' cognitive load in this process, increasing their burden.

3.1.2. The Principle of Removing Redundancy

Redundancy differs from "irrelevant information", which is irrelevant to the learning content. However, redundancy is information relevant to the learning content but superfluous and hardly necessary. According to the redundancy effect in CLT, removing redundant information will not affect the understanding of learning content but can promote learning. Leahy et al. (2003) showed that presenting learning content in the form of text and auditory information at the same time can promote learning. However, when the same learning content is presented in the form of a graph, the auditory information will hinder learning. In other words, if the visual picture and text and the auditory explanation express the same meaning, then one of them becomes redundant. When the information is presented graphically enough to be fully understood by the learner, the relevant textual statements are redundant and should be removed. Of course, with the increase in learners' knowledge level, unnecessary examples and knowledge points are redundant information.

Therefore, in the design of micro-lesson teaching, the principle of removing redundancy should also be considered to avoid presenting repetitive information to reduce learners' extraneous cognitive load and better promote learners' cognition and understanding.

3.2. The Principles of Reducing Intrinsic Cognitive Load

3.2.1. The Principle of Small Module Presentation

Small module presentation means the whole is disassembled into parts, presented module by module, and combined. This is because when the teaching content is relatively complex, if presented to students completely at one time, the information that students need to process simultaneously will be very large, resulting in cognitive overload.

When designing micro-lessons, even just a few minutes of video, it is indispensable to break the teaching content into meaningful smaller modules according to the correlation between teaching contents and then explain it to students step by step to reduce the intrinsic cognitive load of tasks.

3.2.2. The Principle of Proper Sorting

It is possible to reduce learners' intrinsic cognitive load by ordering appropriately. Learning tasks are typically ordered from easy to difficult to facilitate the learning process and optimize learning outcomes (Corbalan et al., 2008). There are several reasons for this approach. Firstly, build a foundation. Starting with easier tasks allows learners to establish a solid foundation of knowledge and skills. By mastering simpler concepts and tasks, learners can gradually build their understanding and confidence, which prepares them for more complex challenges. Secondly, minimize frustration. Beginning with easier tasks helps learners experience early success, which can boost motivation and engagement. This positive reinforcement encourages learners to continue their efforts and persevere through more challenging tasks. Overall, ordering learning tasks from easy to difficult supports learners' progression, motivation, and engagement while ensuring the gradual and effective acquisition of knowledge and skills.

In the design of micro-class teaching, proper sorting of learning materials can make them conform to the learning

rules from simple to complex and from low to advanced, which can reduce the intrinsic cognitive load of learning materials and improve the learning efficiency of learners.

3.3. The Principles of Increasing Germane Cognitive Load

3.3.1. Principle of Stimulating Interest

Appropriate, interesting topics or pictures are adopted in combination with the student's situation. Only interesting content can attract students' attention and enable students to devote more energy; that is, it can increase relevant cognitive load and promote learning. In addition, interesting content can enhance students' memory of knowledge points. It should be noted that interesting content can only wake up the students, is suitable for use as an introduction, and can not take too long; otherwise, the student's attention will focus on this rather than the knowledge itself.

3.3.2. The Principle of Situational Cognition

The principle is that teachers purposefully create vivid scenes relevant to students' lives to help them understand. In view of the abstractness of English grammar, for middle school students, it is difficult to understand, and the learning process is boring. Therefore, creating situations is particularly important for English grammar teaching. A situation close to reality is a bridge between the teaching content and the real world outside the classroom, and interesting and creative situations can quickly attract students' attention. Learning in situations, students can enjoy the learning process and achieve the learning goals more easily.

A situation can be in many ways, that is, using things, pictures, videos, collaborative learning and other means so that students can perceive grammar rules in the situation and stimulate students' interest in learning grammar.

3.3.3. The Principle of Pleasant Auditory and Visual

According to the dual-channel effect, a single form of information leads to the waste of sensory channel resources, and visual information and auditory information should be presented simultaneously to promote learning. Therefore, when making micro-lessons, first, in the picture design, the material is required to be a clear, reasonable layout, color coordination, and unified style. Second, in the sound design, the sound is required to be natural and smooth, with moderate volume and a combination of sound and picture. The sound of the video should be as far as possible to use the teacher's original voice rather than the machine's because the teacher's original voice will make students feel close and trustworthy. Teachers do not have to worry about their own voice; using the original voice is convenient for the teacher and close for students, encouraging students to be more engaged.

In short, the production of micro-lessons should be as good as possible in both sound and image, pleasing to the eye and bringing a good viewing experience and enjoyment of beauty to learners so that students may be more willing to make efforts, thus promoting the improvement of germane cognitive load. It should be noted that in any case, the content is core, the form should serve the content, and the cool micro-lesson is not suitable for normal production and application.

4. Teaching Design of Micro-Lesson based on Cognitive Load Theory

This paper takes junior high school English grammar as an example, three "used" easily confused phrases in junior high school micro-lesson teaching. Using micro-lessons to explain junior high school English grammar can deepen students' understanding of grammar knowledge and strengthen their ability to use grammar knowledge flexibly.

4.1. Selecting a Topic

The contents of micro-lessons should be small rather than large; consequently, when selecting the topic of the micro-lesson, the author deliberately avoided the unit grammar and consciously chose small content, as far as possible, to explain thoroughly. Combined with practical experience, the author found in teaching and checking homework, "used to do", "be used to do" and "be used to doing". These three phrases about "used" are hard for students to distinguish. Accordingly, distinguishing three easily confused phrases, "used to do", "be used to do", and "be used to doing", is determined as the topic of the micro-lesson. Moreover, the materials are selected from the Grade 9 English textbook by People's Education Press.

4.2. Making the Teaching Design of the Micro-Lesson

4.2.1. Teaching Objectives

- Language ability: distinguish and correctly use the phrases "used to do", "be used to do", and "be used to doing".
- Cultural awareness: Know the general development process of chopsticks; cultivate good eating habits of using chopsticks to ensure food hygiene; through the understanding of the process of making chopsticks and the meaning of the shape, to establish cultural confidence.
- Thinking quality: It will be able to practice what has been learned in this lesson in combination with the given situation, use three phrases creatively, and develop creative thinking.
- Learning ability: It will be able to memorize corresponding phrases through the three stages of chopsticks' development. By observing video development, Make memorization more efficient by using graphics.

4.2.2. Analysis of Students

After two years of English learning in junior high school, Grade 9 students have a considerable English foundation. Before this lesson, students have a certain understanding of "used to do" and "be used to doing" and can master its various sentence patterns and positive and

negative answers.

At the same time, they have certain self-learning abilities and self-control abilities and can basically complete the learning before class. Grade 9 students are usually from 11 to 12 years old and have a certain degree of consciousness, good thinking, curiosity and a strong sense of inquiry in this period. A micro-lesson before class integrates graphs, texts and sounds to improve student's learning interest. It can not only cultivate students' ability of independent thinking but also cultivate students' ability of cooperative exploration.

4.2.3. Teaching Difficult and Important Points

Students have learned the sentence patterns "used to do", "be used to do," and "be used to doing" before, but these three similar sentence patterns make students feel confused and cannot be used correctly in the learning and practice. The teaching important point is to make students learn to distinguish them. Moreover, the teaching difficult point is to use them correctly in writing and speaking.

4.2.4. Teaching Procedure

Table 2. Teaching steps

Steps	Teaching Contents	Purposes
Lead-in	Showing the learning objectives Telling a story: Amy and Bella visited the museum Unfolding a historical scroll telling the development of chopsticks	Make students clear learning objectives Catch students' attention
Presentation	Watching the video of the development of chopsticks, in which three phrases correspond with "used to do", "be used to do", and "be used to doing". Explain the differences among them according to the order in which the phrases appear in the video.	For the convenience of remembering easily, the development process of chopsticks corresponds to the order of three phrases, explained in turn.
Practice	Describe a situation and ask students to use their imagination to write three sentences using these three structures.	To check whether students have mastered them.
Summary	Integrating the content explained in the previous sections into one page for review.	To review this lesson.

4.3. Writing the Scripts of the Micro-Lesson

The most important thing is to write the script according to the student's needs and level. The object of this lesson is junior high school students, so in language, concise and clear, avoid using complex vocabulary and sentence structure so that students can easily understand. Aural, the pace of speech is moderate, and the tone is natural so that students can follow and understand. Visually, images and animations are used to explain abstract concepts and provide enough examples and exercises to help students understand and apply what they have learned. The following is the script of this micro-lesson.

Fig. 1 Screenshot 1

Commentary: Hello, boys and girls. Welcome to my class. In this class, we will learn three expressions about the word "used". They are "used to do", "be used to do", and "be used to doing". They look similar, right? But they have totally different meanings. So, after this class, I hope you can know how to use them in different contexts and not confuse them.

Fig. 2 Screenshot 2

Commentary: Yesterday, Amy and Bella visited a museum with the theme of Chinese culture. While walking along the corridor, they found a pair of chopsticks displayed in a glass cabinet.

"Look! Here is a pair of chopsticks. But what is this?"

"Amy, there is a video explaining it on the wall. Let's watch it together!"

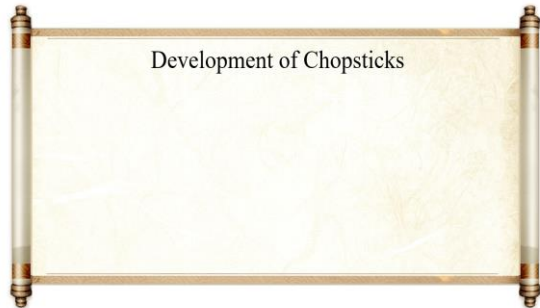"Okay, I also want to know more about it."


Fig. 3 Screenshot 3

Commentary: In ancient times, people did not eat food with chopsticks. What did they eat with? Of course, hands. The reason why our second finger is called the index finger is that people used to use this finger to feel the temperature and the taste of food. This is not surprising because, in ancient times, people used their hands to eat directly. That is why people habitually wash their hands before meals. Later, for the sake of health and safety, bamboo or wood are used to make chopsticks. There are several steps: cutting, washing, boiling and drying. Now people are used to using chopsticks rather than knives or forks! It is given that it is convenient to pick up almost everything. Why are chopsticks so long? Because we can easily share food with those sitting around us. Thus, strengthening the bond among family members it is actually a symbol of togetherness.

Fig. 4 Screenshot 4

Commentary: Okay, boys and girls, did you find these expressions in the video? Let us learn them together. Before chopsticks were invented, people used to use their hands to eat. "Used to" means something that happened frequently in the past. It conveys the underlying meaning: The person does not do it anymore in the present. So this sentence means people usually ate meals with their hands but now not anymore. Okay, in this short video, there are more

sentences. Let us watch. So, the first one, "I used to walk. I used to run." But now, I don't walk or run. Another sentence, "He used to talk to me." But not anymore. "She used to be terrible, but not anymore; she is beautiful now." "They used to work with me", but now they don't. "My dad used to do this", but not anymore. Look, these are the same: used to. So, no matter what the subject is, I or he or she or they or others, it's "used to". No change. Then, how about the word behind "used to"? "do", "work", "be", "talk", "walk", and "run", they are base forms of the verb. What's the base form of the verb? For example, do, did, done. "Do" is the base form. Another example, work, worked, worked. The first one, work, is the base form. Can you guess why it should be the base form of the verb? Because "used to" is a model verb. So, it also follows the rules for model verbs. Okay, this is "used to do".
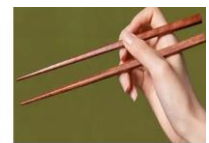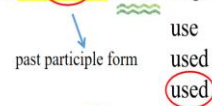
Fig. 5 Screenshot 5

Commentary: Next one. Chopsticks were invented. Bamboo or wood is used to make chopsticks. What does "be used to do" mean? Actually, this sentence shows passive voice. Here, "used" is the past participle form of the verb. What is past participle form? For example, use, used, used. The third one, "used", is the past participle form of the verb "use". So, we can also change this sentence into an active voice. That is, "people use bamboo or wood to make chopsticks". Okay, this is "be used to do".

Fig. 6 Screenshot 6

Commentary: Let us see the last expression we will learn. After chopsticks were invented, people were used to using chopsticks in daily life. When this structure "be used to" followed by sth. Or doing something means "be

accustomed to" or "be familiar with" doing something. This expression can describe something in the past, present, or future. Let us see some sentences. About the past, "I was used to it" "They were used to the noise". About the present, "I am used to spicy food." "Jack is used to running." "We are used to wearing masks because of the COVID-19 pandemic." About the future, "You will be used to getting up early."
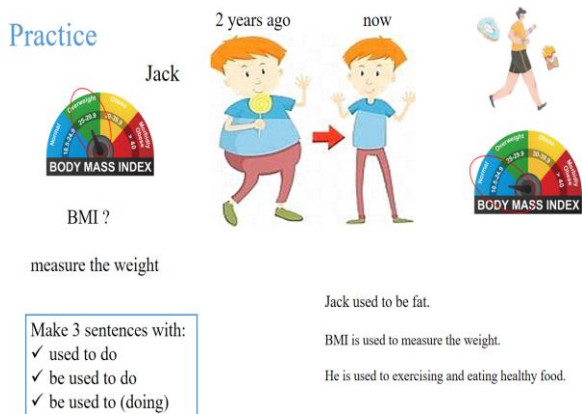
Fig. 7 Screenshot 7
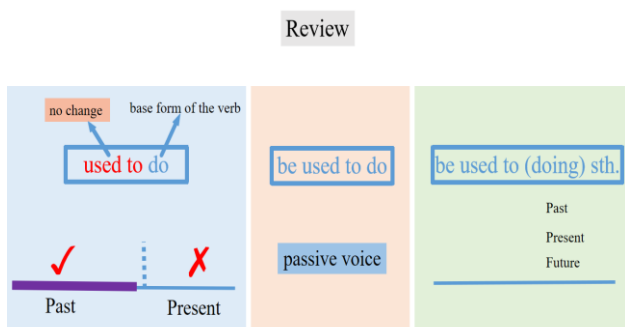
Commentary: Now, practice time! This boy is called Jack. Jack was fat 2 years ago. Later, he realized he was very fat because of "BMI". What's BMI? It's Body Mass Index. It can measure the weight. The person should be overweight if the number is between 25-29.9. After he realizes it, he exercises every day and eats healthy food. So now he is thin. And his BMI decreased to 20. He is normal according to "BMI". Can you use these three expressions to make three sentences? Please pause and think. I will show you my answer. Jack used to be fat. BMI is used to measure the weight. He is used to exercising and eating healthy food. Well done!

Fig. 8 Screenshot 8

Commentary: Let us review what we have learned today. "Used to" means something that happened frequently during a period in the past but not anymore. Used never to change and followed by the verb's base form. "Be used to do" this expression used passive voice. "Be used to doing" means "be accustomed to" or "be familiar with" doing something. Sth or doing sth can be added.

Fig. 9 Screenshot 9

Commentary: Finally, do not forget to use serving chopsticks when we are eating meals with others because of the coronavirus. So much for today, see you!

4.4. Making the Video

When producing images, PowerPoint or specialized animation software can be used, such as "Animiz", which contains more animation effects, but in operation, PowerPoint is more convenient; therefore, in the production of the screen, you can combine the two applications according to the situation. After creating the relevant image, use the screen recording software, such as "Camtasia Studio". By the way, the audio recording software "Audacity" is recommended. The editing function is efficient and easy to operate, and the most noteworthy is its noise removal function.

One trick to creating a video of a micro-lesson is to use "Audacity" to record the audio of the script first. The sound needs to be emotional, with small pauses in place to give students time to think. Then, according to the audio, play the images made in advance so that the audio and the images are consistent.

5. Conclusion

With the development of science and technology, micro-lessons are more widely applied in education, making learning more flexible. Combined with a flipped classroom, micro-lessons can be used before teaching new lessons so students can have a basic understanding of new knowledge, inspire students to think about problems worth thinking about, and spend more class time on important and difficult issues. Of course, it is also possible to put the micro-lesson after class to help review and answer students' error-prone knowledge points.

English grammar is abstract, and the content required to memorize is complicated. Micro-lessons can attract students' attention in the audition, but the design of micro-lessons also needs a good teaching design. Based on the general principles of classroom teaching design, it is necessary to follow some other principles in writing micro-lesson teaching design, such as the principles of focusing, removing redundancy, small module presentation and pleasant auditory and visual, to promote the effectiveness of grammar micro-lesson.

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