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APPLYING COGNITIVE LOAD THEORY IN TEACHING *TENSES* FOR SECOND LANGUAGE LEARNERS

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ABSTRACT

Cognitive load theory is a very useful concept that can be used by instructional designers, teachers, and educators to create effective instruction. It has been applied and developed in many areas including teaching English as a second or foreign language. In designing the instruction for teaching *Tenses*, worked example, split-attention effect, goal-free effect, modality effect, and redundancy effect are effective techniques that are used to reduce extraneous load, increase germane load, construct and automate schema. Designing and developing new instructions using cognitive load theory is also very useful. Teachers should understand this concept thoroughly because each instructional technique is connected to one another. In addition, it is very important to consider learners' level of expertise, elements of interactivity and forms or sources of information before designing the instruction. Those elements of information and instructional techniques that are covered in the concept of cognitive load theory, should be well understood and applied by teachers particularly language teachers. Teaching foreign or second language is a big challenge for non-native English teachers; hence, effective instructional design can assist and enhance teaching learning process. This theory will contribute to positive outcomes where students understand the concept of *Tenses* thoroughly and teachers develop their teaching skill.

Keywords: *cognitive load theory; second language teaching; teaching tenses; second language learners; non-native English teachers*

INTRODUCTION

Effective teaching learning process is determined and influenced by various factors including instructional design. Effective instructional design has significant impacts on students understanding of knowledge. Hence, it is highly recommended for teachers and educators to understand and apply concepts related to instructional design particularly cognitive load theory. Cognitive load theory originated in 1980s and has been developed by researchers around the world in many disciplines since 1990s (Paas, Renkl, & Sweller, 2003; Schnotz & Kurschner, 2007). Because of its expansion and huge impacts on educational field, this paper is going to discuss the application of cognitive load theory in teaching *Tenses* for second language learners. Five important effects that can be used effectively to avoid cognitive overload will be elaborated in details. The examples of instruction in teaching *Tenses* that incorporate worked examples, split-attention effect, goal-free effect, modality effect, and redundancy effect will be discussed thoroughly.

It has been argued that it is important to have knowledge about human cognitive architecture in order to design effective instructional design (Schnotz & Kurschner, 2007). This is because by understanding human cognitive architecture, teachers or educators are able to design effective instruction. Human cognitive architecture contains two main elements, working memory and long term memory (Paas et al., 2003). One of the characteristics of human cognitive architecture is limitation of working memory in duration and capacity particularly when dealing with novel or totally new information (Kirschner, 2002; Paas, Renkl, & Sweller, 2004; Schnotz & Kurschner, 2007; Tindall-Ford & Sweller, 2006). Working memory is a limited place where two to three items of information are processed, contrasted and compared simultaneously (Kirschner, 2002; Paas et al., 2003; Sweller, Merrienboer, & Paas, 1998). On the other hand, long term memory is an unlimited space to storage unlimited amount of information permanently in a form of schema that later can be used or activated to understand knowledge (Kalyuga, 2007; Kalyuga, Chandler, Tuovinen, & Sweller, 2001; Kirschner, 2002; Sweller et al., 1998). Working memory and long term memory are components of brain that play huge

and significant roles in learning process. These characteristics of human cognition influence instructional design.

Effective instruction should be applied in teaching learning process in order to achieve positive outcomes. Effective instructional design should be based on cognitive load theory that derives from a series effects or techniques (Kirschner, 2002; Paas et al., 2003, 2004; Tindall-Ford & Sweller, 2006). Cognitive load theory is a concept that deals with a process of meaningful learning where schema is constructed and automated (Kalyuga et al., 2001; Kirschner, 2002; Paas et al., 2003, 2004). Schema is a unit of knowledge about particular concepts or information. This theory is basically about managing intrinsic, germane, and extraneous load in order to construct schema (Kirschner, 2002; Merrienboer & Sluijsmans, 2009; Paas et al., 2003, 2004; Renkl, Atkinson, & Grome, 2004; Schnotz & Kurschner, 2007). In addition, good instruction may assist individuals to activate schema when dealing with other information. Those three loads should be well-managed in order to achieve understanding. Intrinsic load is a necessary load caused by number of elements and elements of interactivity, germane load is a relevant load caused by activities that catalyse information processing, and extraneous load is unnecessary load caused by poor instructional design (Gog, Paas, & Merrienboer, 2004; Kirschner, 2002; Paas et al., 2003, 2004; Schnotz & Kurschner, 2007). Since intrinsic and germane load are important for learning, and high element of interactivity of information should not be reduced (Paas et al., 2003); in designing instruction, it is crucial to keep the extraneous load to the lowest level (Gog et al., 2004). Hence, total cognitive load will stay within its limit (Paas et al., 2003). This means that when intrinsic and germane load are high, extraneous load should be low in order to avoid cognitive overload. This is because when cognitive load is beyond its limit total, learning is impaired. However, when intrinsic load or elements of interactivity is low, ineffective instructional design may not impair learning because total cognitive load stays in its limit. It has been asserted that cognitive overload can be reduced by applying several instructional procedures such as; worked examples, split-attention effect, goal-free effect, modality effect, and redundancy effect in designing instruction (Kalyuga, 2007; Kirschner, 2002; Paas et

al., 2003, 2004; Schnotz & Kurschner, 2007; Tabbers, Martens, & Merrienboer, 2004). Those instructional procedures are very useful and related to one another.

Cognitive load theory can be applied in many areas of teaching including in teaching foreign or second language (Diao & Sweller, 2007). Hence, in order to structure this essay, I take a unit of lesson from my school. Since I am an English teacher particularly teaching English for specific purposes for environmental health practitioners at one of the higher education institutions in Indonesia, that unit of lesson is taken from the curriculum of the first semester of this school. Specifically, course outline of week one to four with the aim to make students understand *Tenses* and are able to formulate sentences using appropriate *Tenses* that cover the material of *Present Tense*, *Past Tense* and *Future Tense* will be used to design and redesign instructions. Since *Tenses* is the basic concept that second or foreign language learners of English should acquire before they are able to speak and write appropriately, it is important to discuss and design effective instruction for teaching *Tenses*. Most of the students in this school are novices particularly on the knowledge about *Tenses*. Hence, most of the instructions that are going to be discussed will consider learner's level of expertise in *Tenses*. Each of the five effects followed by the examples of instruction will be discussed thoroughly in the following section.

DISCUSSION

Worked example effect

In teaching learning process, in order to assist learners to understand particular concepts, examples are considered to be one of the effective ways. Worked example is considered to be an effective method because it provides procedures to solve particular problems that may reduce cognitive load (Atkinson, Derry, Renkl, & Wortham, 2000; Chandler & Sweller, 1991; Gog et al., 2004; Kirschner, 2002; Paas et al., 2003, 2004; Sweller et al., 1998). In addition, it consists of problems states and their solution steps (Atkinson et al., 2000; Kalyuga et al., 2001; Schnotz & Kurschner, 2007; Sweller et al., 1998). In order to create effective worked example, it is important to consider learners' prior knowledge or level of expertise because what is effective for novice may be redundant for experts

or what is good for experts may be bad for novice learners (Kalyuga, 2007; Schnotz & Kurschner, 2007). Consequently, under particular conditions, problem solving is better for experts than worked examples (Kalyuga et al., 2001). However, means-ends analysis which is a strategy used to solve problems may impose high cognitive load to novice learners (Gog et al., 2004; Kalyuga et al., 2001). In order to facilitate schema construction and automation, novices need to be exposed to worked examples as the guidelines to solve particular problems (Gog et al., 2004). This is because learners will direct their attention to the problems and the solution steps. It is recommended that worked example should focus more on process oriented than product oriented. This is because process oriented assists the students to not only understand the steps but also know the rationale behind those steps (Gog et al., 2004). It is important for learners to not only know the solution but also why particular steps of solution are taken and the reasons for performing those steps under particular orders. Learning and reasoning facilitate and enhance the understanding of concepts or knowledge. In designing instruction, in this case worked examples, teachers should not only consider learners' prior knowledge but also the sources of information and how to integrate and manage those different modes of information (Chandler & Sweller, 1991). This is because those factors contribute to information processes.

In learning *Tenses*, worked examples can be used as a technique to design instruction. This can be done by giving students examples of how *Tenses* pattern is formulated into sentences. For example, when teaching *Simple Past Tense*, teachers can use worked examples by providing steps of creating sentences using *Simple Past Tense*. There are several steps that the students can apply. First, they should know the pattern of *Simple Past Tense*. Then, they are provided with the explanation of each element in the pattern such as What kind of *Verb* and also what typical of *Time Signal* that should be used. In addition, it is very crucial for students to understand the function of this type of *Tense*. By exposing students to those steps and giving examples of each step, learning and schema construction are facilitated.

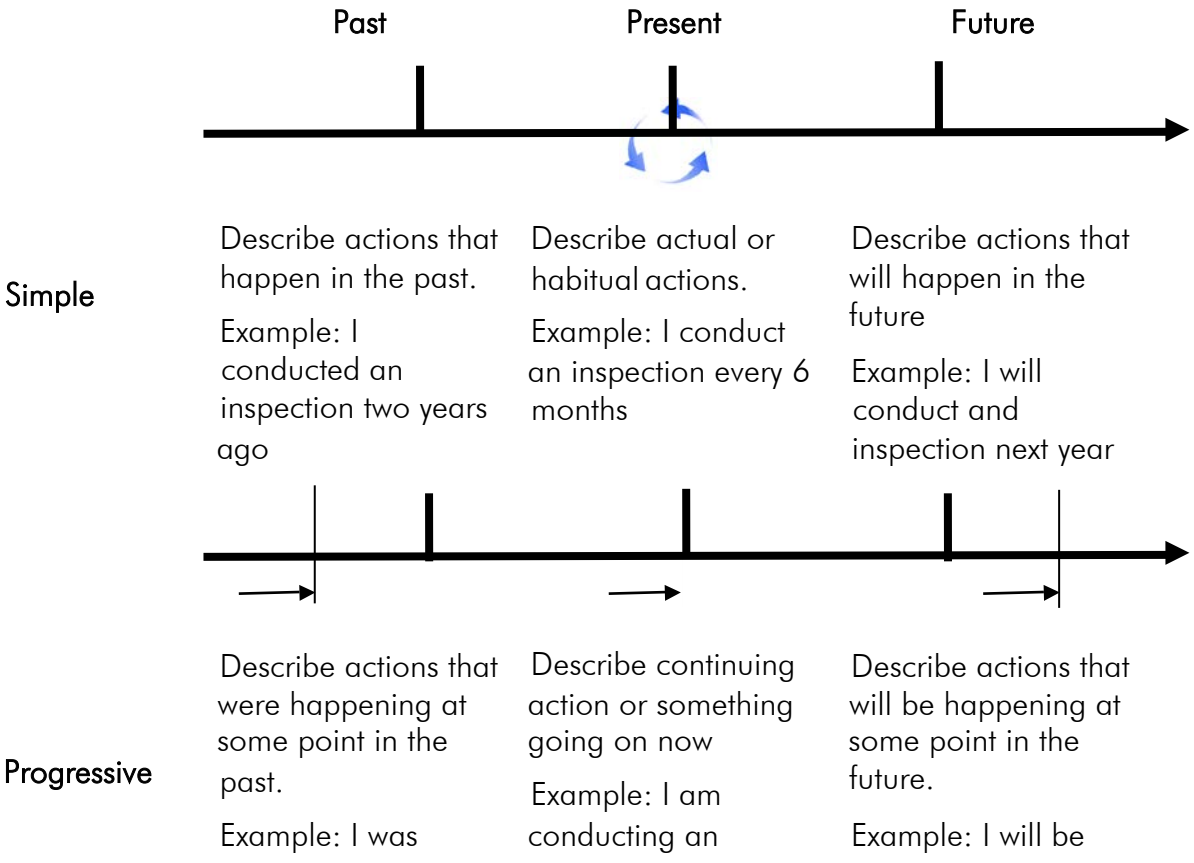
One of the main objectives in learning *Tenses* is that the students are able to formulate sentences using appropriate *Tenses* in writing paragraph. In order to

facilitate learning, worked examples about how to formulate the sentences are needed. After students already understand and are able to formulate sentences using appropriate *Tenses* pattern, teachers can increase the level by asking them to write a paragraph. In designing the instruction, teachers can provide some examples of writing paragraph using each *Tense* clearly. The steps to write the paragraph should be elaborated by giving the pattern and familiarize the students with *Verbs*, *Subject Pronoun*, and *Time Signal* of each *Tense*. To avoid worked-example that is product oriented, teachers should be able to provide information about how paragraph should be organized using particular *Tenses* patterns. Before the students are able to formulate the sentences, firstly, they should understand the *Tenses* pattern and paragraph. Then, they have to analyze the context where the actions are performed in order to construct sentences using appropriate *Tenses*. There should be minimal one worked-example of how to formulate sentences for each *Tense* that includes *Simple Present Tense*, *Present Progressive Tense*, *Simple Past Tense*, *Past Progressive Tense*, *Simple Future Tense,* and *Future Progressive Tense*. By following those steps, they should be able to create sentences with appropriate *Tenses* in writing a paragraph.

Split-attention effect

Providing students with worked examples of how each *Tenses* pattern used in sentences should consider several factors such as the sources of information whether it is text, diagram, or audio. This is important to avoid split-attention. Split attention happens when learners have to split their attention between multiple source of information such as written text and diagram which are presented in isolation (Atkinson et al., 2000; Chandler & Sweller, 1991; Merrienboer, Kirschner, & Kester, 2003; Schnotz & Kurschner, 2007; Tindall-Ford & Sweller, 2006). Worked examples will be more effective if separate sources of information such as text and diagram are physically integrated (Florax & Ploetzner, 2010; Kalyuga et al., 2001; Schnotz & Kurschner, 2007; Sweller et al., 1998). Instead of separating diagram and the text that contain the explanation of the diagram, it is highly recommended to physically integrate them.

In teaching *Tenses*, before going into details about how teach *Tense* works, it is important to provide general overview of *Tenses* timeline. This is because some of learners' native languages do not morphologically display such pattern like *Tenses*. Therefore, the *Tenses* timeline will help them to understand what *Tenses* is and how each *Tense* is different from one another. The *Tenses* timeline can be explained using a diagram accompanied by text that describes the *Tenses* timeline. In order to avoid split attention, enhance learning and reduce cognitive load; physically integrating text that contains the explanation of *Tenses* and the diagram that consists of the timeline is considered to be effective instructional design. The diagram shows the changes of *Verb* pattern and also *Time Signal* of each *Tense* across the time. Moreover, the timeline which is integrated with the text clearly shows the difference between *Simple Tense* and *Progressive Tense*. The most important point is that students do not have to split their attention between the text and the diagram of timeline. Figure 1 illustrates how the instruction benefits the students to comprehend the concept of *Tenses*.



conducting an inspection at 2 p.m. yesterday	inspection at the moment	conducting an inspection at 7 p.m. tonight

Figure 1. Example of instruction to avoid split attention

From the instruction above, it is obvious that the students do not have to split their attention because the text and the diagram are integrated. They can easily see how the changes on *Verbs* and *Time Signal* in both *Simple and Progressive forms*. In addition, the different pattern of each *Tense* is also identified. Hence, hopefully, this instruction can reduce learners' cognitive load and assist their working memory in processing the information.

Another example of applying split attention effect in teaching Tenses is when teaching the difference between *Simple Tense* and *Progressive Tense*. It is a difficult concept because it has high intrinsic load particularly for novices. Providing the diagram of timeline pointing on the differences between *Simple* and *Progressive Tense* may assist students to understand the concept. The diagram with the text that explains how those two types of *Tenses* are different is considered to be good instruction. This instruction is even better when the diagram and text is integrated. This is because students do not have to split their attention. The differences of *Simple* and *Progressive Tense* includes the difference of *Verb*, *Auxiliary Verb* and *Time Signal*. Each aspect of differences can be explained in the diagram by integrating the text. Moreover, cuing and highlighting may also be useful to direct learners' attention on particular state of problem.

Goal free effect

Setting goals in learning is one of strategies to achieve good results. However, in designing instruction, setting specific sub goals and goals may not be effective for learning. Goal free problems assist learners to solve problems by considering any problems encountered and find any operators to solve the problems state (Schnotz & Kurschner, 2007). Goal free effect is effective because it reduces cognitive load by eliminating effort to do means ends analysis (Schnotz & Kurschner, 2007; Sweller et al., 1998). This instruction procedure is also called no goal effect because it is aimed to reduce goal-specificity effect (Sweller et al., 1998).

In teaching *Tenses*, in order to assess students' understanding of particular *Tenses* patterns, drill practice or exercises after each class session is an effective assessment. In conventional instruction, teachers usually ask their students to produce sentences using particular *Tenses* pattern, for example, making sentences using *Simple Present Tense* or *Present Progressive Tense*. Another example of instruction is asking students to construct sentences using particular *Tenses* by giving particular *Subject Pronouns*, *Verbs*, and *Time Signal*. This conventional instruction may cause means-ends analysis because learners should first analyze the *Time Signal* in order to determine which *Tense* pattern they should apply. Then, they have to identify the *Verb* and modify it by referring to *Time Signal* and *Subject Pronoun* before they construct the appropriate sentences. This type of instruction imposes high cognitive load because students have to work backward by analyzing each state of problem before being able to solve the problems. In order to enhance learning and avoid means-ends analysis, the instruction should facilitate the students to work forward. Figure 2 shows the comparison of instruction that does not use goal free effect and the one that use it.

Figure 2. Comparison of conventional instruction and instruction using goal-free effect

Conventional instruction	Goal-free effect
Make sentences using appropriate *Tenses*: 1. (+) She / make / yesterday 2. (-) We / study / next week 3. (+) He / collect / everyday 4. (+) They / take / two years ago 5. (-) It / go / next year	Make positive and negative sentences by using as many *Tenses* as possible!

From the table above, there are several differences between traditional instruction and instruction using goal-free effect. For traditional instruction; students have to follow several steps or achieve some sub-goals before they are able to construct appropriate sentences. They first should identify *Times Signal* to choose appropriate tenses. For question number 1, the *Time Signal* is *yesterday*. It means

that the *Tense* that learners should use is *Simple Past Tense* or *Past Progressive Tense*. Then, *Verb* form should be identified whether it is *Regular* or *Irregular Verbs*. For example, in number 2, the *Verb* is study and it is *Regular Verb*. After changing the *Verb* form by referring to *Subject Pronoun* and *Time signal*, *Auxiliary Verb* and *To-be* should be identified before the learners can make positive or negative sentences using appropriate *Tenses* pattern. For example, in number 3, the *Verb* is *collect* and it should be inflected by adding *"s",* it becomes *collects* because of the *Subject Pronoun "He"*. Finally, the sentences are formulated. This kind of instruction imposes high cognitive load especially for novices because they have to work backward and the element of interactivity is too high for them. Redesigning the traditional instruction by using goal-free effect is more effective. This is because the students can work forward by choosing any *Tenses*, *Vocabularies* and *Subject Pronouns* that they want to use. Then, learners directly apply the *Tenses* Pattern in making positive and negative sentences. For example, if students want to make sentences using *Simple Present Tense*, they simply apply the *Tenses* pattern by choosing any *Regular* or *Irregular Verbs*, *Subject Pronoun* and *Time Signal*.

In designing instruction, teachers can use more than one mode of information, such as, text, audio, and visual. However, teachers should be able to manage those different sources of information in order to enhance learning. Modality effect may assist instructional designers in designing instruction that uses more than mode of information.

Modality Effect

A good instruction is an instruction that can assist learners to construct schema. Schema construction is facilitated when cognitive load is reduced by increasing available working memory resources (Tindall-Ford & Sweller, 2006). Those resources consist of audio and visual channel. It has been argued that presenting material in dual mode, audio/visual is better than visual only because it increases working memory capacity (Kirschner, 2002; Moreno & Mayer, 1999; Tindall-Ford & Sweller, 2006). This is because working memory consists of multiple channels such as visual and audio channels (Moreno & Mayer, 2002; Paas et al., 2003, 2004; Schnotz & Kurschner, 2007; Sweller et al., 1998; Tindall-Ford &

Sweller, 2006). Hence, it is better to activate both channels than only one channel in designing instruction. It has been argued that text is better if it is presented in audio than visual form (Paas et al., 2003; Schnotz & Kurschner, 2007; Sweller et al., 1998; Tabbers et al., 2004; Tindall-Ford & Sweller, 2006). Therefore, visual diagram and auditory text is better than visual diagram and visual text (Tindall-Ford & Sweller, 2006).

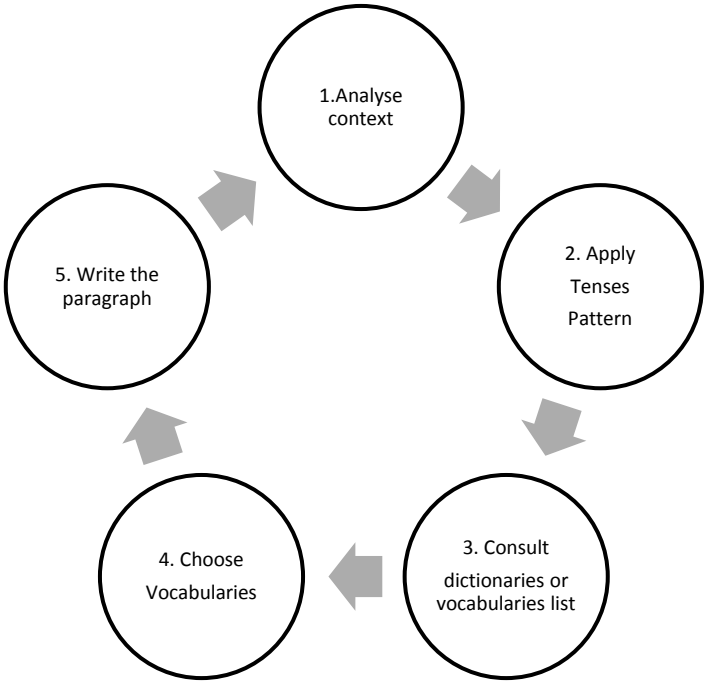
Figure 1 can be explained using modality effect by presenting the text in audio mode. Audio mode here means the explanation of the diagram will be presented in audio form by mixing the native language of the learners and the target language. In teaching second language, in order to assist students in understanding a concept such as *Tenses*, using learners' native language may be useful. This is because their effort will be focused on understanding the concept not understanding the way the concept is explained. This is important because when students have to put more effort in understanding the way the concept is presenting while they have to understand the concepts being taught, it will result in ineffective learning. Ineffective learning in this context means that the students are overloaded with the information about the form and meaning of *Tenses* and also instructions delivered in target language. For example, teachers explain the form and an meaning of *Simple Present Tense* using English not Indonesian This imposes high extraneous load because they have to work hard on understanding teachers' instruction and also the concept of Simple Past Tense at the same time. Learning will be more effective if the instruction of form and meaning of the *Tense* is delivered in students' native language. Beside consider learners first language, in designing instruction for teaching second or foreign language, the designers should also consider learners' level of expertise (Kalyuga, 2007). Rather than integrating text and diagram of timeline as shown in Figure 1, the text can be explained in audio form. This facilitates learning because learners activate their visual and audio channels.

When all *Tenses* have been covered, at the end of the fourth meeting, students are required to write a paragraph based on several questions. Before the students are able to write the paragraphs, there are several steps that they should follow. Those steps are better presented using modality effect. The instruction will be

presented using dual mode channel. There is a diagram of a step, and an explanation of the diagram in a form of text. This instruction should be redesigned to be more effective by changing the form of a text into audio mode. Figure 3 shows the diagram of the steps. The diagram will explain using both native language and second language.

Figure 3. Instructional design using modality effect

Follow the steps below as a guideline to write the paragraph!



The audio content covers the explanation of each step in both native and target language. For the first step, students should analyze the context of the given questions. By analyzing the context, students can identify types of *Tenses* that they should use. After selecting the appropriate *Tenses*, then, students can directly apply the *Tenses* pattern in writing the sentences in the paragraph. After that, they should consult dictionaries and the given vocabulary list in order to choose appropriate vocabulary that is related to the topic they have chosen. After consulting the dictionary and choose the vocabulary, students can write the paragraph by using good grammar.

When students read the diagram while listening to the explanation above in audio form, hopefully they can understand the steps easily. Later, they can write good paragraphs that contain sentences with appropriate *Tenses* pattern. However, sometimes, this type of instruction may be redundant for learners. This is because when students level of proficiency increases, they do not need the explanation either in a form of text or audio. The diagram itself can help them understand the instruction and the audio or text is not relevant for them. Hence, instructional designer should also consider redundancy effect as a technique to assist schema instruction and activation. In terms of instruction, redundant can be both the amount of information and also the sources of information.

Redundancy Effect

In designing instruction, redundant information is irrelevant for learning. This is because when learners' have to digest irrelevant information, it will impose high cognitive load. Under particular circumstances, integrating text and diagram may be redundant (Diao & Sweller, 2007; Kalyuga et al., 2001; Moreno & Mayer, 2002). This is because the diagram and text can be understood in isolation without referring to one another particularly when the learners level of expertise increases (Schnotz & Kurschner, 2007). Learners perform better if redundant information is eliminated because this reduces cognitive load (Mayer, Heiser, & Lonn, 2001; Sweller et al., 1998).

The instruction displayed in Figure 1 is the introduction of the lesson. After the students understand the general concept of *Tenses*, the next sessions will be focused in each *Tense*. All *Tenses*: *Simple Present Tense*, *Present Progressive Tense*, *Simple Past Tense*, *Past Progressive Tense*, *Simple Future Tense*, and *Future Progressive Tense*, will be explained one by one. When teaching each *Tense*, it is unnecessarily to provide the timeline again. It is considered to be redundant because students can learn each *Tense* in isolation without referring to the diagram of timeline.

Another example is when teachers teach students about the concept of *Past Tense*, it is considered irrelevant when teachers have to add information about *Present* or *Future Tense*. Sometimes, referring to those other *Tenses* is useful, but if it

is excessive, this may be redundant. Then, this will result in ineffective learning. This is because students have to put more effort to correlate those *Tenses* while they are struggling to understand a particular *Tense* pattern. This is even worse for novices because they have to understand a tense and relate it to another tense pattern at the same time. For example, novice students will experience cognitive overload when they have to relate *Simple Past Tense and Simple Present Tense while the have not completely comprehend the form of Simple Past Tense*. Therefore, teachers should be careful in selecting the information that they want to incorporate in a lesson.

CONCLUSION

In conclusion, cognitive load theory is a practical concept that can be used by instructional designers, teachers and educators to create effective instruction. Effective instruction does not cause cognitive overload and considers characteristics of human cognitive architecture. Cognitive load theory has been applied and developed in many areas including language teaching particularly teaching English as a second or foreign language. In designing the instruction for teaching *Tenses*, worked example, split-attention effect, goal-free effect, modality effect and redundancy effect are effective techniques that are used to reduce extraneous load, increase germane load, construct and automate schema. When the students are asked to create sentences using appropriate *Tenses*, some examples can be given by explaining the rationale for applying several steps before they are able to create the sentences. Teachers should consider split-attention effect when designing the worked examples. In order to avoid split attention, physically integrated text and diagram is better than separate them in isolation. This reduces extraneous load and enhance learning. In teaching Tenses, the diagram that consists of timeline of *Tenses* can be integrated with the text that contains the explanation of the diagram. Learners are not limited to particular steps or goals before they are able to answer the problems. Learners should be asked to create sentences using as many *Tenses* as possible rather than given them particular *Tenses* to be used to make the sentences. Modality effect is also another technique to design good instruction by addressing the audio and visual components of information. Human brain consists of dual channel, audio

and visual channel. Hence, it is highly recommended for teachers to use dual mode channels to enhance learning. This is because when both channels are activated, cognitive load is reduced. Therefore, instead of explaining the diagram that consists of steps of writing paragraph in visual mode using text, it is better to explain the steps in audio mode. Since teaching *Tenses* is a challenging task for second language teachers and students, hopefully, redesigning traditional instruction is expected to enhance learning. Designing and developing new instructions using cognitive load theory is also very useful. Teachers should understand this concept thoroughly because each instructional technique is connected to one another. In addition, it is very important to consider learners' level of expertise, elements of interactivity and forms or sources of information before designing the instruction. Those elements of information and instructional techniques that are covered in the concept of cognitive load theory, should be well-understood and applied by teachers particularly language teachers. Teaching foreign or second language is a big challenge for non-native English teachers; hence, effective instructional design can assist and enhance teaching learning process. Hopefully, by applying this theory in teaching Tenses will contribute to positive outcomes where students understand the concept of *Tenses* thoroughly and teachers develop their teaching skill.

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