Framing Learner's Verbal Report Data in Reading Comprehension; Uncovering the Cognitive Processes

Siti I. Savira[1,*] Anas Ahmadi[2]

[1] *Department of Psychology, Universitas Negeri Surabaya, Surabaya, Indonesia*
[2] *Department of Indonesian Language and Literature,Universitas Negeri Surabaya, Surabaya, Indonesia*
[*]*Corresponding author. Email: sitisavira@unesa.ac.id*

ABSTRACT

This study is aimed to analyze a particular learner's cognitive processes as the learner engages in a reading task. The data was collected primarily by think-aloud, while the interview was used as a complementary source. The think-aloud was conducted while the learner is engaged in a reading task. Therefore, in this essay, the cognitive process will be analysed by comparing the Cognitive Load Theory (CLT) framework to a theoretical framework of reading comprehension as suggested in the cognitive approaches to understanding reading. The data collected from the interview and the think-aloud were transcribed, coded, and categorized, resulting in three major categories, that are the point of difficulties in learning, cognitive processes, and motivation. Each of the categories conveys sub-categories. The present study finds that reading is a complex process that is more likely to impose a high load on a learner's cognitive load. The key strategy in dealing with a complex task according to the CLT framework is to manage the intrinsic load that is, reducing the workload of working memory by creating or automating schema held in long-term memory. The paper is also elaborating on a further discussion around the cognitive process, motivation, and metacognition with the reading comprehension.

Keywords: Cognitive Load Theory, Reading Comprehension, Think-Aloud, Metacognition

1. INTRODUCTION

Reading is an important skill in learning; in education, it is imperative [1]. However, many students, from young to adult, have reported difficulties in reading comprehension [2, 3]). It is also evident that reading related to other learning skills and may as well improve overall learning skills [4, 5] because comprehending written texts involves a complex process, which requires higher-order thinking [6]. Therefore, understanding learner's cognitive processes in reading tasks may provide valuable and useful information to improve student's academic skills. However, collecting information and analyzing one cognitive state is far from simple.

Research would argue that meaning is not relied on the text, but rather on the interaction between the reader, including the individual's prior knowledge, and the text itself [7]. Therefore, understanding written text is not simply recalling content or information, but rather involves combining the content with prior knowledge, analyzing sentences and context, to determine final interpretation [8]. The generative model also suggesting that text comprehension is facilitated when learners utilize retrieval cues to enhance semantic processing stored in memory and construct the meaning of the text [9].

Cognitive load theory (CLT) offers a framework to understand learner's cognitive process by explaining the interaction between the working memory, the task representation, and another extraneous factor that may help or hinder one's cognitive resources [10, 11].

In CLT, for learning to occur, the condition must be in line with 'human cognitive architecture'; either high load or low load will not be sufficient for learning to happen [10, 12]. CLT consists of three categories, which are intrinsic, extraneous, and germane. Working memory is the core element in the intrinsic category [12], which provides the basic source for the cognitive load. The load

in the intrinsic category cannot be reduced except by adding new schema or automating existing schema (Paas, Renkl, & Sweller, 2003). For dealing with complex tasks such as reading, the schema is an important concept.

According to CLT, schema can function as an organizing device in reading tasks [13], because it holds interacting elements that can be retrieved from long-term memory [14]. Furthermore, schema can be defined as an organized framework contains slots to be filled by information from text or default values based on previous experience [15, 16]. It means, schema compressed information that relevance and reduce the amount of information need to be handled, and therefore, reduce the load of the working memory [14]. Most cognitive theories would agree that working memory plays a significant role in processing incoming information [3, 10]; it is where we 'think'. With its limited capacity, it is interesting to investigate the strategies a learner use when facing a complex task, such as reading. Reading is a complex task because it involves word recognition, interpreting, making connections, and so on.

2. METHOD

2.1. Participant

The participant in this study was a master degree student. Most of the data collection was conducted not in English. It did not affect much of the study, however, because the instructor and the participant shared a similar cultural background. The participant was chosen based on her report of learning difficulties, particularly in reading comprehension in reading English resources materials. The study was aimed to focus on the learner's point of difficulty.

2.2. Data Collection

The data collected in this study was participant's verbal data and the written note that she generated as a response to a reading. The verbal data were collected by interview and think-aloud protocol.

2.2.1 Interview

The questions used in the interview were replicated from the examples provided in [17] study report, which involves conversational interviews with an open-ended question, semi-structured interview with more narrowed questions, and structured interview. Although the complete set of questions of the study was not freely available, the sample set questions had served as a useful tool to retrieve important information from the participant, such as her self-report about her point of difficulty.

On conducting the interview, however, the structure of the question could not be strictly held, in terms of the wordiness and the order of the question. The participant often needed more explanation on the questions. Some

translation, modification, and aided questions had to be done to avoid misunderstanding from the participant.

Below are the list of questions asked as derived from [17] and the modification made. Some questions were not given because it was predicted that the question would lead to saturation due to the dynamic of the interview. Saturation happens when the same answers emerged repeatedly. There were also occasions when participants coincidently answering other question that was not yet asked, therefore the question was not given and listed as 'answered elsewhere' in the table below.

Table 1. List of questions derived from the sample set from dowson and mcinerney (2003) and the modification made.

The original set of question	Modification
Conversational interview Do you want to do well at school? Why?	None
Why do, or don't, you try hard at school?	Not given. Saturation.
What reasons do you have for wanting to do well in school?	None
What sort of things motivate you to do well at school?	None
Are there things that make it hard for you to be motivated at school?	None
How do you know when you're motivated to do well at school?	Can you describe what kind of situation or task learning task whatever that gets you motivated? Can you describe in detail what sort of behavior when you were motivated when you said that you read something interesting?
Semi-structured interview Some students say that they want to achieve in school to please their parents and because they like their school work. Is this true of you? Why?	Not given. Saturation.
Are you motivated to do well at school because you want to get good marks? Why/why not?	Not given. Answered elsewhere.
Structured interview Do you agree that students who are motivated to do well often feel emotional pressure from their parents or teachers to do well?	More directed question: Do you think that students who motivated to do well feeling some sort of emotional pressure? Probably because of their parents' demand, or their teachers' demand.
Some students say that they have to want to beat other students before they can do good work at school, but they also like to be friends with people who do it even when they want to beat them. Do you think this is true of you? What does it feel like when you beat one of your friends?	Simplified questions: Do you agree when some students say that they have to want to beat other students before they can do good at school? Some students would probably say that 'I want to beat other students' and that kind of thinking, that kind of saying, will make you want to do good work at school and that kind of thinking will motivate you. Do you agree with that?

Other focused questions were also used to retrieve more detailed information about participant's motivational aspects, for example, self-belief, self-efficacy, belief on attribution, etc.

2.2.2. Think-Aloud Protocol

Think-aloud was used to retrieve information about the participant's cognitive process. This technique requires the participant to give a verbal report of their thinking either concurrently, produced when faced with the task, or retrospectively, produced immediately after finishing a task [18-20]. The protocol was treated as a

data collecting method based on the assumption that 'people can only report what they are aware of' therefore, think-aloud is argued to have minimum impact on the learner's cognitive process [21].

There were some problems, however, in applying think-aloud protocols. Although an example of how to perform think-aloud was given to the participant, some instructions were unavoidable to alert the participant to report her 'thinking'. For example, reminding her with questions 'what are you thinking now?' when she suddenly paused in silence while reading, or 'what are you doing?' when she wrote something but not reporting what she was doing. Since some data was missing from the think-aloud, a focused interview was then conducted. The participant could then, explain retrospectively about what she was doing and why she was doing it. For the same reason, think-aloud protocol during the intervention sessions was not transcribed, because what she was doing was more like read-aloud than think-aloud.

2.3. Data Analysis

The data analysis method used in this study were coding and categorizing. Coding allows data labeling or categorizing without harming the connection between the data [22]. The data collected for this study was recorded, transcribed. The transcription was then coded and categorized. However, some of the data collection processes were conducted in a language other than English, the transcription, therefore, may be affected by the instructor's perception.

2.4. Ethics

The ethics in this study is considered by keeping the subject anonymous. The subject also signed a consent form to participate in this study, which also guarantees confidentiality, and informed with the rights and consequences that may result from this study. For example, the learner is fully aware that she may withdraw anytime from participating in the study. The study is based on the learners' own experience and condition; therefore, the study was expected to benefit her in dealing with the problem. The result of the study was shown to the learner for consenting. The participant was fully aware and consent that all of the data collection processes were recorded.

3. RESULTS AND DISCUSSION

The data collected from the interview and the think-aloud protocol were transcribed, coded, and categorized. The categorization covers a wide range of mental processes. For this present paper, 3 main categories will be further discussed, which are (1) point of difficulties in learning; (2) cognitive processes; (3) motivation

The point of difficulties was stated as follows.

"…usually the discussion the group discussion will talk about the reading, and actually I read about the reading requirement, but sometimes or most of the time, actually (laughing) I didn't get it, maybe I just get a little, but not like.. not critically..?

"I couldn't talk about it much like other students"

"criticizing the reading as they can.. they could get the point better and like yeah sometimes they just.. they can.. they asked something that I didn't think about it before."

From the excerpt, it can be inferred that the participant's point of difficulty is mainly on reading comprehension. The participant concluded that by comparing herself with other students on how they reflect the reading and construct the question. She was aware that she was not as 'critical' as the other students. She also claimed that the "lack of [English] vocabulary" to be the main problem.

The second category is the cognitive process. The cognitive processes include learning strategy; extraneous load; and metacognitive awareness. Learning strategy includes "read as much as I can", "I will keep reading", "I am taking notes so I can get the points as well…". Another strategy she often used is to ask her friends or consult another reading resources or dictionary to do the immediate translation.

Another retrospective interview was conducted after the think-aloud protocol focusing on clarifying the cognitive process while the participant was reading. The interview was necessary since the participant was not very convenient with the think-aloud procedure where she often forgot to say or having difficulties in describing her cognitive process while she was reading. In the focused interview she continues describing her learning strategy in reading comprehension, such as "I highlight the readings, underlining it, make notes…", "…re-read it several times,…, or underlined the text so that I can come back to it later on", "I would underlie a sentence when somehow I know it's important but I don't know what it means".

Furthermore, she explained about using notes, summary, and paraphrasing, "I don't make a summary, what I do is take note of main points of important ideas in the reading,…well, maybe it can be considered as a summary", "…[when do you make notes?]…while I'm reading, when I find something important", "…re-write it with my own words", "re-order the sentence…, or find the synonym".

The extraneous load was described as "…words [that are] usually higher …and more difficult". By higher she meant the level of difficulty and uncommon or specific words usually found in academic journals. She repeatedly mentioned the level of difficulties of her readings in a different part of the interview.

Metacognitive awareness includes "…I think my weakness in English is…I'm lack of vocabulary…[it is

difficult because] I don't know the words". The participant was showing some degrees of awareness that she was worry that she only learned half of what she should or could have learned. However, this awareness was collected using a social comparison that is, comparing her performance with other students. She also claimed that a good student should focus more on what is more important in learning, that is to get more knowledge rather than to score better than other students.

The third category derived from the data is motivation. The data that fall under this category are external motives, expectancies and values, and internal motives. The participant describes her external motive(s) is to make her father proud of her. Interestingly, she described more about her internal motive(s) relative to external motive. Her internal motive(s) includes personal interest, where she repeatedly saying that she liked her major in her master's degree, and that drives her and maintain her enthusiasm to come to lectures. She also said that watching another student's success may not affect her as much as her drives to success. She made another remark that supports the claim; she said that she really "want to learn about this, and I want to know about this deeply", and on another part, "I would feel satisfied when [I] know or [able to] understand about something…".

According to [3], [23] the 'text signals' is a useful strategy in reading comprehension. Therefore, the way the task was presented is very important in constructing a learner's understanding [24], or creating text signals when it is not available. Research on reading comprehension have focused on investigating the effective strategies to improve this skill, such as the effect of text-highlighting [e.g. 25], summary on reading comprehension [e.g. 8], and note-taking [26]. Some of the strategies the participant was using in reading are highlighting, underlining, repeating a sentence or word or phrase, note-taking (immediately while reading English reading sources), translating (into her native language which is not English), simplifying sentence (by eliminating or skipping 'complex sentence' or long sentence), making the connection between information, for example, causal relationship ('this happens because of that'). She also uses help-seeking, such as looking at a dictionary or 'asks friends'. Most of each of the strategies has its different purpose according to the participant, but she elaborated the main purpose of using the strategies was to make it easier to come back to those points after reading, because he cannot remember or, sometimes, understand all the information at once.

The participant's idea of not being able to remember or understand all the information at once reflects her understanding of the limited capacity of her working memory. Her strategy was a way to reduce the load of her working memory by taking notes or making a summary, which in line with [27] suggestion. However, she

appeared to treat the information or 'points' in the reading as independent information rather than a comprehensive impression toward the reading. For example, she would repeat a word or sentence to understand the sentence before going through to another sentence. By highlighting and underlining points or main ideas in the text, she made lists of information instead of trying to relate the information. Not only that this strategy is time-consuming, but it also will eventually leave the working memory with loads of information to handle. Regarding [28] argument about the summary as being a 'product' instead of a 'cause' of comprehension, the finding of this study also seems to support that. A summary is only a reflection of the reader's meaning of construction regarding the text. Therefore, examining the participant's notes may give valuable information about her learning processes.
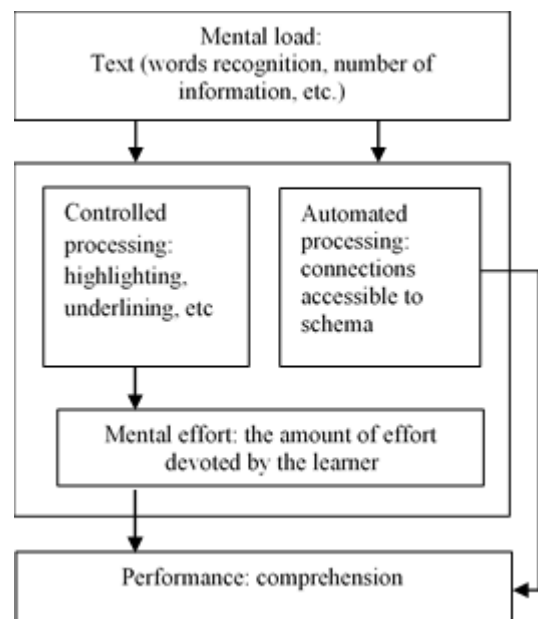

Figure 1 the construct of CLT in reading as adapted from Paas and Merrienboer, 1994 [11].

CLT would suggest that a learner has an opportunity to an unlimited extension of working memory, should he/she can automate the schema as provided by the long-term memory [14]. Automatic processing of schema will create a short cut from mental load to performance, while the cognitive strategy a learner used will require 'mental effort' before it can be translated into performance [11]. Similarly, [7] suggest that skillful readers use prior knowledge to organize, interpret, and integrate information in the text that helps them to create a context and somewhat predict incoming words or sentences. Therefore, the more automatic the schema is the lesser the mental effort needed in dealing with a task. The process can be illustrated in the following figure, as adapted from [11].

The intrinsic category is the one that provides a 'baseload' in cognitive load, while other categories are additive. If the intrinsic category deals with internal processes, such as organizing information to be processed by the working memory, the extraneous and germane category are affected particularly by external factors. Extraneous load increases when external factors available are not relevant to the information processed, while germane load increases when external factors are relevant. Extraneous load is only important when an intrinsic load is high because it will affect the amount of additive load in an intrinsic load that the working memory needs to handle [29].

In the participant's case reading is considered a complex process, which tends to impose a high load on cognitive load, the extraneous load would be too much to handle by the working memory. Her strategy was to reduce the extraneous load was to eliminate or skip some of the less important information in long sentences. She would also try to translate the text into her native language in which she feels more relevant to her schema, and would be more likely to trigger more connections. Having the background knowledge activated during reading allows readers to make confirmation or adjustment of their existing knowledge; it gives them a point to start meaning construction. Accordingly, [30] suggested that readers would tend to adjust their understanding according to their purpose or reading; the more the purpose is personally meaningful to them, the more likely comprehension to occur.

The participant also explained that when she could not understand a text, it is due to the wordiness used in the text. She argued that some of the articles would use difficult and uncommon vocabulary. She also spends more time trying to figure out a long sentence with a lot of comas or complements. For example, figuring out which one was the first sentence, which part complements which, and so on. Therefore, language differences could also be an extraneous load. The illustration is described in figure 2.

When the intrinsic load is low, understanding English might not be as difficult as when the working memory trying to hold some important information. Accordingly, [31] defined cognitive architecture as 'language of thought' where it involves a combination of semantic and syntactic structure. In alignment with that notion was [7] argued that to be skillful reader word recognition must happen automatically and accurately. Therefore, learning something in a second language may well increase the mental effort needed due to its difficulty to practice schema automaticity when retrieval cue and the storage code is different.

Concerning the extraneous category is the germane category. In the participant's case, she was trying to improve the germane load when the intrinsic and extraneous load was high. Her strategy was to help-

seeking by asking friends. If the information provided is relevant, it will reduce extraneous load and provide more cognitive resources to the working memory [29]. For example, the participant described understandable materials are those that are simple, explained with examples, and relevant to daily lives. She would also intuitively determine important information from the text, without knowing exactly what it means. For instance, she would say that one of the reasons for underlining a text is because she knew it was important, although she did not know what it meant. Such awareness is an indicator of metacognitive functioning. One important part of metacognition is monitoring and evaluating one's comprehension [32], whose ultimate goal is to determine whether learning can be terminated or not. The participant was showing a certain degree of metacognitive awareness, that she is yet getting there and so decided that she needs to work more on her reading.
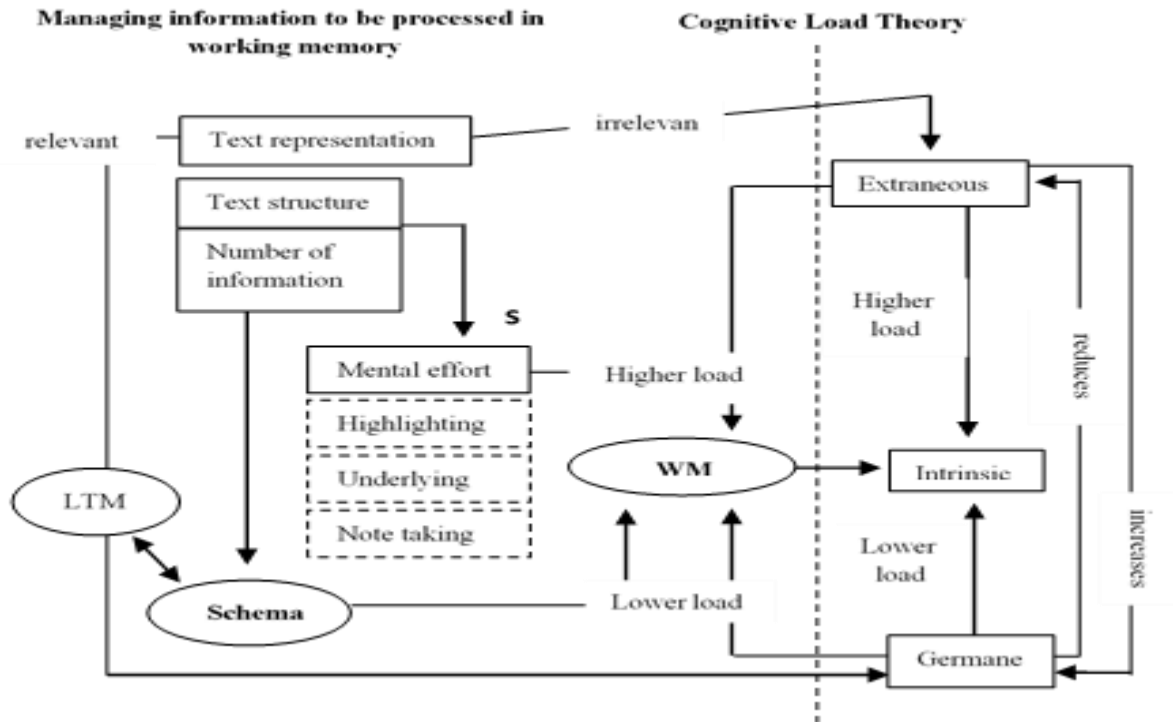
Figure 2 Conceptual framework of CLT and learner's cognitive process in reading

It is important to notice though, that the participant was relying on social comparison to evaluate her accomplishment in a learning task. Using social comparison instead of internal self-assessment may be an indicator of inadequate metacognition [33]. It may inform that the individual is not activating the monitoring phase as suggested in metacognition functioning. The monitoring phase helps a learner to be aware of their position in learning accomplishment and therefore, allows them to choose an effective strategy in learning [34]. Failure to understand one's learning may lead to using less effective strategy or 'trial-and-error' strategy in problem-solving [35].

Another useful approach to understand learner's cognitive processes is examining the learner's motivation. Motivation has been defined as so many definitions, but a simple way to say it as something that moves us to do something [36, 37]. Many researchers then try to explain the differences between 'level of motivation' and the 'orientation of motivation' among learners, and yet students may have their perspective about what is important in learning and how to determine a successful academic experience. Accordingly, [17, 38] suggested that learners are establishing their own learning goal by trying to answer a basic question 'Why am I doing this [academic] task?'

Supposedly, a learner's learning goal will 'guide and direct' the cognitive and behavior toward the learning tasks. Therefore, analyzing learner's goals in learning will help to understand his behavior toward achievement and to be aware of the various dimensions of motivation.

An achievable goal will increase one's self-efficacy and improve skill development more effectively because it will give them a sense of growth capabilities; therefore, asking students to gradually setting goal within their 'proximal attainment' can help them improve their self-efficacy [39] [40].

4. CONCLUSION

Reading is a complex process that is more likely to impose a high load on a learner's cognitive load. The key strategy in dealing with a complex task according to the CLT framework is to manage the intrinsic load that is, reducing the workload of working memory by creating or automating schema held in long-term memory. CLT framework would argue that John's strategy in reading comprehension needs improving on how to manage better the working memory. John needs to practice more on automating schema instead of just making a list of information or important points in the text.

The extraneous and germane load will become more important for learners when they are facing a complex task. Teacher's instruction is one of the important factors that may affect learner's cognitive load [10, 11, 14, 29]. Therefore, effective instruction may help learners to increase the germane load that may reduce extraneous load. The summary of the process elaborated in this essay is illustrated in figure 2.

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