# EXPLORING THE COGNITIVE LOAD OF DIGITAL LIBRARY INFORMATION ARCHITECTURE IN SUPPORTING E-LEARNING AT TERTIARY LEVEL OF EDUCATION

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**Abstract**: *The digital revolution has brought vivid deviations to information access, retrieving and storage. The formation of digital libraries has made an essential influence on teaching and learning process. Moreover, an educational digital library may supply a fortune of educational resources which focusing at different target audience from primary school children to graduate student. Furthermore, the growth of the digital information has led to significant development in search engines. In line with that, information architecture (IA) is a current paradigm that has been progressively familiarized in most web development tasks today. IA is a process of organizing and*

*managing information, where the usability plays an important role in the solutions created. On the other hand, cognitive load theory is concerned with the manner in which cognitive resources are focused and used during learning and problem solving. It is important to maintain the average cognitive load for each working memory task. This research is mainly to access the cognitive load for the current information architecture for digital library in supporting the e-learning process.*

**Keywords**: *Information architecture, Digital library, e-learning*

## INTRODUCTION

One of the elements in e-learning is information architecture. IA is a system design which includes the organization, labeling, navigation and searching process. It translates the user requirements into functional definitions. It is an essential element because in this era of information overload there is a great need to create order from chaos so that information can be used effectively (Hamid, A.A). In this ultramodern era, the existence of digital library is mainly to cater the group of digital objects that can include text, visual, audio, video that were organized as a library collection. On the other part, IA in digital libraries were now growing beyond the traditional library organization (cataloging, preserving and archiving), but still valuable from the approaches to collection and management. (Dillon, A & Turnbull, D. 2005). A study conducted by Sheeja, NK (2010) found that, most students were satisfied with the design of information architecture of educational digital library and it was frequently being accessed by the students for educational related information. Furthermore, IA is very important for the beginner learners who need to understand the overall structure of a digital library. According to cognitive theory, (Sweller, 1988) as for novice learner, who lack of proper mental schemas to integrate the new information with the prior knowledge, freely explore a highly complex environment may generate a heavy working memory load that is harmful to the learning process.

## LITERATURE REVIEW

### Information Architecture for Digital Library

In this modern era, the primary function for the information architecture of an education digital library is to ease the task of retrieving learning material for education purposes. that can be reused for learning. Furthermore, IA also supports in accessing the digital contents and it helps to reduce the browsing and understanding time for information retrieval process. (Dong, A. & Agogino, A. M., 2001).

### Information Organization System

The main principles of developing information organization structure for the architecture is to allow organization information to provide opportunities for students and educators to create, synthesize, manipulate or debate content rather than merely to passively receive instruction.(Dong, A. &Agogino, A. M., 2001). Firstly, the collection created in the digital library can be shared to engage discussion between the user and the author or contributors of the resources as well as with others interested in learning about the same subject matter using the same learning object. Secondly, it allows the user to

navigate through the space of digital library resources in a concept space that is defined by the user.(Dong, A. &Agogino, A. M., 2001). Organization systems give students and educators opportunities to create, synthesize, manipulate and debate digital collections rather than passively receiving information from the digital collections.

**Information Labeling System**

Labeling system precedes information classification with different educational purposes, such information designs for different ages, instructional methods and academic levels, in order to achieve the educational utilization.

The key goal of information labeling is to supporting the discovery of education resources rather than merely supporting the discovery of resources in general.(Dong, A. &Agogino, A. M., 2001). By labeling learning resources with information about how they might be used, the labeling supports better learning through better instructional design.(Dong, A. &Agogino, A. M., 2001).

**Information Navigation System**

Since a learning object normally has several elements and requires instruction about the online learning, navigation is required to guide user towards the adaptation and collection of learning objects associated with different learning goals. (Dong, A. &Agogino, A. M., 2001).

Navigation system proceeds collection navigation and assists the users in adapting to learning resources and performing individual learning objectives.

**Information Search System**

Educational objectives should be searchable and listed in the search results. The extent to which a learning element is relevant correlates. The extent to which a learning element is relevant correlates with how the learning element achieves a learning goal. (Dong, A. &Agogino, A. M., 2001). An effective search system is needed to enable searches based on personal interests, knowledge, comprehension, capabilities and experiences of educators or students. A popular approach to implement digital library search service is to utilize an existing full-text information retrieval system such as Google. (Dong, A. &Agogino, A. M., 2001).

**Cognitive load**

The main concern of cognitive load is the manner in which cognitive resources are focused and used during learning and problem solving. (Sweller 1988, 1989). According to Shebab & Nussbaum (2015) when information is being process, the working memory holds very limited resources. Due to this constrains, an efficient instruction should be considered in designing the IA. (Sweller & Chandler 1994; Sweller Van Merrienboer & Paas, 1998).

Moreover, the cognitive load imposed on a student learning is due to a combination of the complexity of the material to be learned and the design of the instructional materials. (Sweller Van Merrienboer & Paas, 1998).However problem arises in cognitive

load when the load exceeds the capacity of the person processing it. Basically there are three main types of cognitive load which are intrinsic, intrinsic, extraneous and germane.

**Intrinsic**

Intrinsic cognitive load is the cognitive load integral within the information to be learnt. Intrinsic cognitive load is dependent on the current understanding of an individual and the new information which will be process simultaneously in the working memory to be understandable. (Marcus, Cooper &Sweller, 1996).Additionally, intrinsic load is related to the intellectual complexity of information or call element interactivity. It is the extent to which elements of the task or concept interact with one and therefore must be considered simultaneously in working memory (Pollock, Chandler &Sweller 2002). Other than that, Malamed, C. (2000) state that intrinsic load is enforced by the nature of what is to be learned, including the number of information elements and their activity.

**Extraneous**

Extraneous load is also known as unnecessary load and reducing it should be a main focus when designing instruction.( Sweller Van Merrienboer & Paas, 1998). This type of load normally arises from the instructional design practice and handle by the instructional designer. Malamed, C. (2000) describe that the inappropriate instructional design may cause a bad cognitive load to mental activities that will affect the learning process. Presently, there are a lot of researches focusing on techniques to reduce extraneous cognitive load in instructional materials. (van Merriënboer& Ayers, 2005; Sweller, 2010 and Sweller et. al 2011).

**Germane**

Germane cognitive load is closely related to a dependent on intrinsic cognitive load. Consequently, germane cognitive load refers to working memory resources which necessary to work with intrinsic cognitive load ensuing in learning. Likewise working memory resources are essential to deal with extraneous resources are required to deal with extraneous cognitive load and are sometimes referred to as extraneous resources. Furthermore, the effort in reducing extraneous cognitive load can help to increase germane cognitive load, by releasing working memory capacity for learning.(Sweller, 2010). Malamed, C. (2000) agrees that germane cognitive load may contribute to better learning process by simplifying the schema formation and automation.

**E-Learning Dimension**

The main difference between e-learning situation and the traditional classroom is the medium over which instruction is transmitted. In e-learning situation, the learning provider is separated from the learner by cyberspace. According to Elly and Jansak (2010) there are 8 e-learning dimensions which are describe as follows.

**Constructivists approach**

Dewey (1916) and Piaget (1972) define constructivism learning theory as active construction of new knowledge based on learner's prior experience. Furthermore, Harman & Koong (2005) and Hung (2001) agrees that constructivism learning theory focuses on knowledge construction based on learner's previous experience, is a good for e-learning because it ensures learning among learners.

**Self-directed learning**

According to Ponton (2005) and Bouchard (2009) several researchers in the field of self-directed learning see learner autonomy as an important component of self-directed learning. Additionally, the learning context, connections people and learning environment are the determining factors in the success of self-directed learning journeys. (Bandura, 2002).

**Evoke intrinsic motivation**

Intrinsic motivation refers to being motivated to do something because it is naturally fun. Intrinsic motivation leads people to involve in investigation, play and other behavior driven by curiosity in the nonexistence of explicit return. These activities favor the development of board competence rather than being directed to more externally-directed goals. (R.W.White, 1959)

**Reflective approach**

Dewey (1933) defined reflective approach as energetic, determined, and cautious consideration of any belief or supposed form of knowledge in the light of grounds that supports it and further conclusions to which it tends. Moreover, the connecting ideas was essential to think and that one had to hunt for deeper meanings through reflective thinking to capture and understand the core spirit of something, to transform disbelief into understanding and understanding into further action.(Andrusyszyn & Davie, 1997).

**Individual learning styles**

The online classroom is a flexible environment that accommodates different learning styles. An effective learning occurs when the students expends a minimum of time and effort to acquire a competence he can retain and demonstrate. As well, learning is effective when an activity designed to encourage learning complements the student's dominant dimension of intelligence, preferred pace and preferred degree of orderliness or method. (Hamid, A.A, 2002).

**Experiential learning**

Experiential learning a unique quality if personal involves the person in both feeling and cognitive aspects of the learning event. (Hoover,1974). Besides, experiential learning exists when there is a personal responsible participant cognitively, affectively and behaviorally process knowledge, skills and or attitudes in a learning situation characterized by high level of active involvement. (Hoover & Whitehead, 1975)

**Learning both a private and social activity**

E-learning has the capacity to encourage both modes of learning. Features such as search out, sort and evaluate information accommodate the private side of learning. Features such as discussion board or presentation space prompt social learning that is more collaborative.(Hamid, A.A, 2002)

**Learning is not linear**

Research has shown that the learning brain naturally assimilates concepts in a spiraling, progressive manner. The openness of the Internet has allowed the designing of spiral learning. Good instructional design takes the student on spiral path through course

material such that the learner cycles through the topics at an increasingly deep and detailed level. (Hamid, A.A, 2002).

**Conceptual Framework**

Figure 1 depicts the proposed framework for determining the use cognitive load that was affected by the current digital library information architecture base on the e-learning dimension. Three main variables had been figure out based on the research objectives in the framework. The first variable is the set of cognitive load which adopted by the previous study by (Sweller, 1988). The next variable is the list of e-learning dimension. (Elly and Jansak, 2010). Finally is the component of information architecture (Dong, A. & Agogino, A. M., 2001).

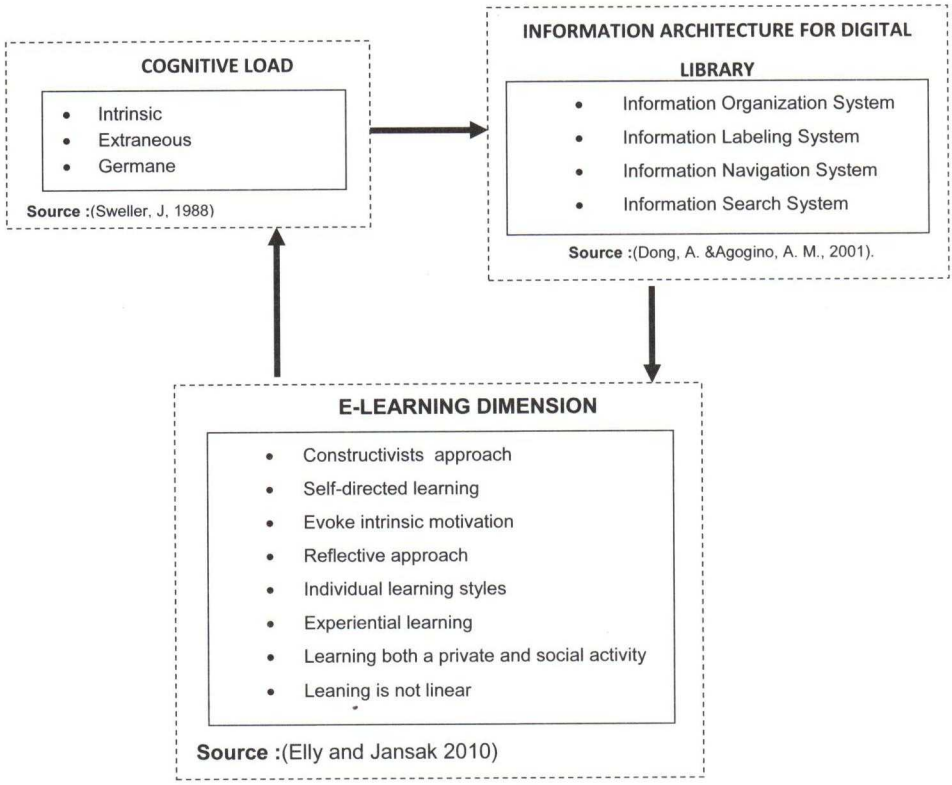


*Figure 1.0 : Conceptual model on cognitive load of digital library information architecture in supporting e-learning*

## CONCLUSION

This paper has discussed the elements of cognitive load which are intrinsic, germane and extraneous. Furthermore it also discussed on the four main components of digital libraries information architecture and the e-learning dimension. The discussion leads to the development of the conceptual framework of a study on the establishment of conceptual model on cognitive load of digital library information architecture in supporting e-learning. The conceptual framework will be a guide to the researcher to conduct the study further.

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