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Effective Flexible e-learning Resource Based Cognitive Flexibility Hypertext Theory from learners viewpoint

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Abstract: The study aims to explore the impact of the e-learning process based cognitive flexibility hypertext theory on the achievement and attitudes of learners in Taibah University. Results show an effective online learning process based cognitive flexibility hypertext theory from learners viewpoints. Indeed, the average time to answer one achievement test is 7.21 minutes/10 minutes and the average of score of learners in the achievement test is 87%/100%.

The attitudes of learners toward flexible e-learning process achieved through a questionnaire distributed to a sample of 143 learners show that the first rank is for the item "*Solving learning difficulties of the e-learning resource*" with an arithmetic mean equal to 1.51.The second rank is for the item Sufficiency of time of the achievement test" with an arithmetic mean equal to 1.45.

Keywords: E-learning, online Teaching, Flexible instruction, Cognitive flexibility hypertext theory.

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Introduction

e-learning is a concept covering a variety of applications, processes and learning methods. It is also referred to the use of information and communication technology to facilitate access to online learning resources and to provide learners with collaborative learning environments. Online learning is based on Open Educational Resources (OER) to share and reuse digital materials, created within a community of practice of teachers and learners in accordance with the aims of the open access movement (Banzato, 2012).

In the e-learning environment, the design of the e-learning process is very pertinent to present for learners learning resources and activities promoting the effectiveness of online learning and teaching.

The design of the instruction adopted in the e-learning process has a direct impact on the effectiveness of learning and teaching (Spiro et al., 1996).

In the learning and teaching contexts, there is a variety of knowledge which are ill-structured. Spiro, Feltovich, Jacobson, & Coulson (1995) define an ill-structured domain of knowledge as follows: "*An ill-structured knowledge domain is one in which the following two properties hold: (1) each case or example of knowledge application typically involves the simultaneous interactive involvement of multiple, wide-application conceptual structures (multiple schemas, perspectives, organizational principles, and so on) . . . and (2) the pattern of conceptual incidence and interaction varies substantially across cases nominally of the same type (i.e., the domain involves across-case irregularity)*".

In the context of e-learning and online teaching, there is also a cognitive negligence of problems linked to structure of presentation of the e-learning resources presented to learners. For these two reasons, Spiro and his research group (1996) established the model of cognitive flexibility hypertext theory of designing learning resource.

Cognitive flexibility hypertext theory is a theory of instructional design adopted to conceive learning environments based cognitive flexibility theory (Spiro et al., 1996).

The aim of the present study is to develop an online course based cognitive flexibility hypertext theory (Spiro et al., 1996) and to test its effectiveness for teaching and learning the educational media course from learners viewpoints.

Cognitive flexibility hypertext

Hypertext is a system used to connect screens of information using associative links. Hypertext products mimic the brain's ability to store and retrieve information by referential links for quick and intuitive access. Hypertext systems are defined as follows: "*a way to link and access information of various kinds. Potentially, hyperText provides a single user-interface to many large classes of stored information such as reports, notes, data-bases, computer documentation and on-line systems help. The internet browser provides access to the hypertext informations* (Berners-Lee, 1990).

Cognitive flexibility hypertext theory is based on presentation of flexible knowledge to learners. Knowledge is based on understanding of the abstract concepts in the e-learning resources. The CFH allows multiple juxtapositions of instructional content through a large and complex conceptual structure based hierarchical navigation by learners in the learning process (Spiro et al. 1996). CFH is a conceptual structure search which allows the learner to 'criss-cross' the conceptual landscape by viewing different example cases that show the many uses of the concept under exploration. Cases contain several themes and knowledge is interrelated through the themes that cut across the cases enabling the learner to focus on the interconnectedness of the knowledge domain in a situated context. This method of representing instructional content through intersecting themes and cases spawns the constructivist principle of knowledge construction requiring learners to assemble a flexible schema that is situation specific. Learners are exposed to multiple perspectives of the content and must analyze issues by understanding the processes that link cases to each other. Some hypertexts programs have been used primarily as knowledge storage and access systems, other applications of this technology have attempted to structure learning environments with explicit instructional goals. Many of these instructional-oriented hypertext systems have been developed in complex domains and are intended for learners at an advanced stage of learning (Beeman et al., 1987, 1988; Crane & Mylonas, 1988).

In using cognitive flexibility hypertext theory, Spiro and his research group (1996) suggest to allow learners to develop through the e-learning process based cognitive flexibility theory flexible cognitive treatment of the e-learning resources, and to acquire knowledge having a structure which can be as a flexible support in cognitive treatment of the information.

Hypertext system is used to link abstract concepts to projects, examples, case study, etc., to explain all unclear concepts for learners. According to Spiro and Jehng (1990), links between concepts and case studies, examples or projects are more easily realized by using the capacity of hypertext systems, which allows connecting explicitly the information. (Spiro et al., 1996).

A recent experimental comparative study of Barhoumi and Rossi (2013) shows that the use of cognitive flexibility hypertext theory (Spiro et al, 1996) is effective in designing online learning resource compared to linear instruction designed without cognitive flexibility hypertext theory. The main results of the study of Barhoumi and Rossi (2013) show the effectiveness of the hypertext system course design based hierarchical navigation in the e-learning process and its superiority compared to direct online course design. The study shows the positive attitudes of learners of the experimental group toward using hierarchical instructional design compared to the attitudes of learners of the control group using a linear course design. The study validate through an experimental device the effectiveness of the cognitive flexibility hypertext theory in designing Adobe Flash course compared to linear texts used for Adobe Illustrator course (Barhoumi & Rossi, 2013).

Cognitive flexibility hypertext theory is based on some learning principles (Jacobson & Spiro 1993):

- Cognitive flexibility hypertext theory used for designing online courses provides multiple representation of the same knowledge to be acquired by learners and allows the necessary

mental developments for treatment of the information.
- Connecting abstract concepts to case studies with the aim of showing knowledge as "knowledge-in-use";
- Demonstrate conceptual interconnection of knowledge with a nature similar to a network of complex knowledge;
- Interconnection between knowledge can be through hypertexts or hypermedia systems. Hypertext systems allow reaching information in a non-sequential and extremely flexible manner by incorporating notions of navigation adapted to online learners;
- Advancing gathering of knowledge rather than reproductive memory. Introduce at once the abstract complexity as well as the complexity of the domain;
- Promote active learning for learners which is based on the role of learners in the construction of their knowledge with the active pedagogy;
- Structure of knowledge in the present study is based on cognitive flexibility hypertext theory. Spiro and his research group indicate that the best strategies for teaching and learning ill-structured domains of knowledge are based flexible instruction (Spiro et al., 1996).

In reference to conception suggested by cognitive flexibility hypertext theory (Jacobson & Spiro, 1993), the structure of the e-learning resources adopted in present study is based experimental device of Jacobson and Spiro in the following points:
- The e-learning process begins with a PDF file presenting generalities of Educational Media course;
- The abstract concepts (titles, subtitles, etc.,) of Educational media course are presented by means of a map allowing better visibility of the unclear concepts of the course. The map shows clearly the hierarchical navigation in the e-learning resource with random access instruction;
- The abstract concepts presented in the map allow reaching through hypertext links treated simultaneous cases, projects, other points of view, examples, Web links, etc.;
- The interconnection between various concepts to be studied and case studies or examples is similar to a network of complex knowledge. It is realized through hypertext links from the information stored in a network of the interconnected node. A node allows reaching texts, graphs, sounds, videos, programs and other varieties of the useful information for explaining the unclear concepts. Hypertext systems give the possibility of reaching information in an extremely flexible manner by incorporating notions of hierarchical navigation in the Educational Media course;
- In the present study, the active pedagogy, based active role of learners in the construction of their knowledge was adopted by referring to cognitive flexibility theory.

The implementation of cognitive flexibility hypertext theory is not a simple issue to exploit, but the power of hypertext systems used to realize links between intra and inter pages is very important to design the e-learning resource based hierarchical navigation and flexible instruction (Spiro et al., 1996). According to the cognitive flexibility hypertext theory, the e-learning resources are conceived hypertext links between abstracted concepts and sufficient number of examples, case studies, projects, multiple points of view, etc.

Figure 1 demonstrates the abstracted concepts connected to projects, case studies, examples directed to learning such as learning by cases and the illustration of concepts to facilitate learning favored by cognitive flexibility hypertext theory (Jacobson & Spiro, 1993).
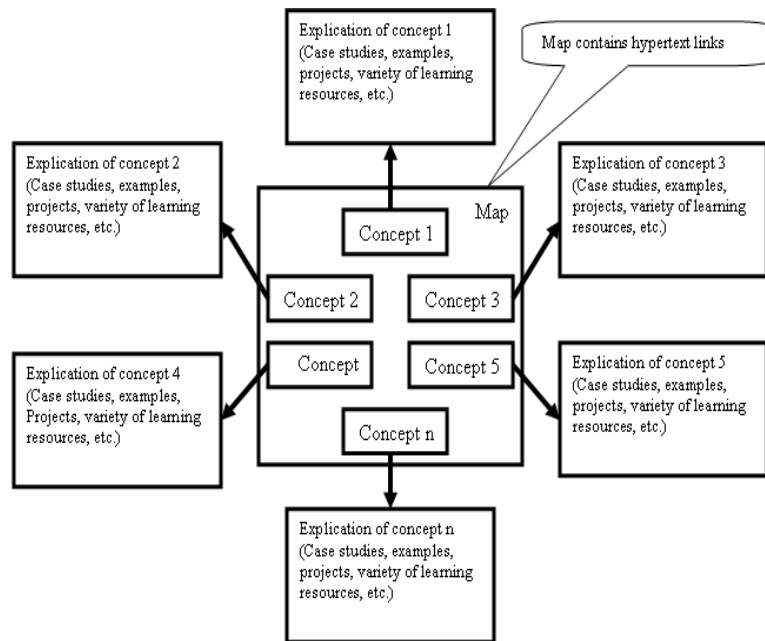

Figure 1. Conceptual structure based cognitive flexibility hypertext theory (Source Barhoumi & Rossi, 2013).

Based on the conceptual structure described in Fig.1, the e-learning process based cognitive flexibility hypertext theory begins with a map presenting hierarchical navigation in the online course.

The interconnection between various concepts to be explained thought case studies, projects, other points of view, examples, Web links, etc., is similar to a network of the complex knowledge. Indeed, knowledge acquired by learners in the e-learning process is organized in a semantic network; concepts (node) are connected by associations (Lindsay & Norman, 1980; Baddley, 1993). Jonassen and his research group give an importance for the use of hypertext systems, for designing the structure of navigation in an online course, and indicate that learning based hypertext systems is superior to linear texts from effectiveness of learning point of view (Jonassen, 1991, 1993).

The e-learning process based cognitive flexibility hypertext theory used also interactive video prepared by the online instructor and inserted at the beginning of the e-learning process to provide learners with generalities of the Educational media course.

Figure 2 shows the design of flexible e-learning process based cognitive flexibility hypertext theory.
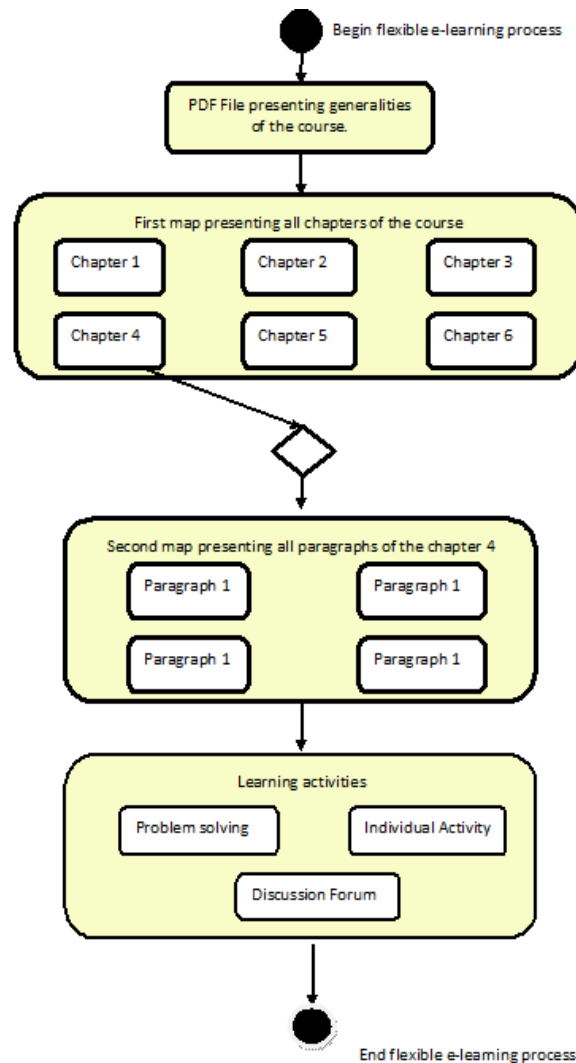
Figure 2. Design of flexible e-learning process

Research questions and aim of the study

Two research questions guided the present study:

- Is the structure of presentation of the educational media course based on cognitive flexibility hypertext theory improving the cognitive performance of learners?
- Generally, are learners satisfied by the e-learning process based on cognitive flexibility hypertext theory?

Research method

In the present paper, the descriptive research method is used for the experimentation of the cognitive flexibility hypertext used for designing educational media online course. The experimental process is based on two criteria. The first criterion is cognitive performance of online learners (measurement of time of achievement tests and scores on different tests). The achievement tests allow in the present study a maximum evaluation of knowledge acquired

during the e-learning process. The second criterion is a questionnaire based method designed with Likert scale of a typical three-level, it could be: (Agree (1), Neutral (2), and Disagree(3)) (Likert, 1932) to evaluate the degree of satisfaction of the student by the e-learning process based cognitive flexibility hypertext theory used for online learning and teaching Educational Media course. A survey was conducted with a group of 143 learners from Taibah University during the academic year 2013. The participants in this study consisted of undergraduate learners pursuing an educational Media course in Moodle e-learning platform. Learners received the username and password from the online instructor to enter into the e-learning system.

The questionnaire was distributed face-to-face and contains questions which can explore the attitudes of learners toward using e-learning process based cognitive flexibility hypertext theory.

Description of online courses
The Educational Media course (EDCT 346) is a general course taught for a variety of specialties at Taibah university. The course is mandatory for learners of the faculty of education.

The course is composed of 6 units.
Unit1: Introduction to instructional technology and its relation to educational. media, information technology.
Unit2: Teaching and learning through the 5 senses.
Unit3: Components of Educational Media**.**
Unit4: Instructional technology: theories and applications.
Unit5: Examples of educational media**.**
Unit6: Classification of educational media by senses and experiences. (cone of experience attributed to Edgar dale, etc.)

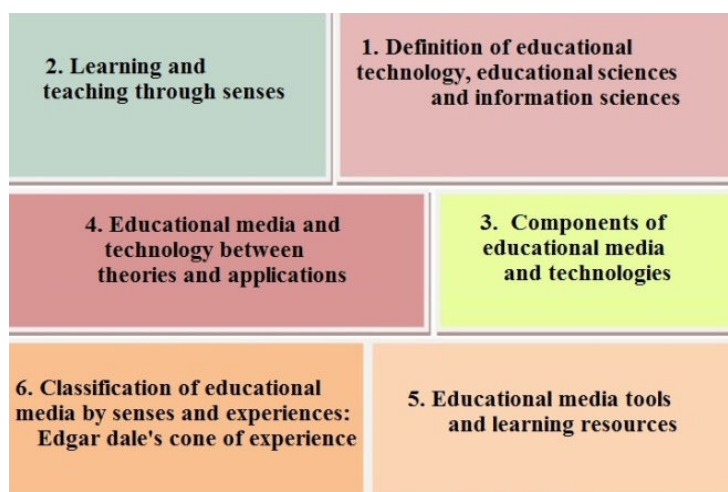Figure 3 shows the map presenting chapters of the course Educational Media.

Figure 3. First map presenting chapters of the course Educational media.

Figure 4 shows the map presenting learning activities (Individual activity, Problem solving, Discussion forum) of the Educational Media course.
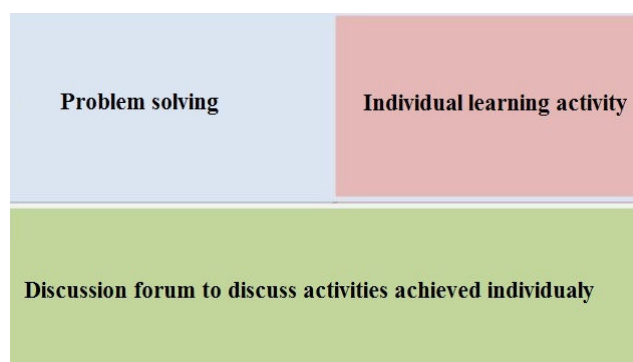

Figure 4. First map presenting chapters of the course Educational media.

Findings
Variables of cognitive performance
Table 1 shows the average time of achievement tests of the e-learning process based cognitive flexibility hypertext theory. The time of achievement of tests is controlled by the e-learning system which shows to online learners' time on the screen of the e-learning platform.

Table 1. THE AVERAGE TIME OF ACHIEVEMENT TESTS

e-learning process	Tests of E-learning process based cognitive flexibility hypertext.			
Test numerous	1	2	3	4
Averages time of achievement of tests	7.21 minutes			
Max Time proposed by the instructor	10 minutes			

Table 2 shows the averages of scores of learners in the achievement tests.

Table 2. THE AVERAGE OF SCORES OF LEARNERS IN TESTS

e-learning process	E-learning process based cognitive flexibility hypertext.			
Test numerous	1	2	3	4
The average of scores of tests	87%			
Max score	100%			

Rresults of the questionnaire of the attitudes of learners toward flexible online course design
Table 3 shows the results of satisfaction of samples in the e-learning process based cognitive flexibility hypertext theory.

Table 3. TABLE OF ARITHMETIC MEANS AND STANDARD DEVIATION

Rank	Variables	Arithmetic mean and Standard deviation	
		A Mean	**SD**
1	Solving e-learning difficulties	1.51	.839
2	Sufficiency of the time of achievement of the e-learning activities	1.45	.654
3	General satisfaction by the e-learning process.	1.37	.654
4	Guiding learners in the e-learning process	1.36	.619
5	Cognitive legibility of e-learning resource	1.35	.628
6	Structuring of the e-learning resource	1.32	.621
7	The ease of learning	1.24	.531

Discussions

Results of the cognitive performance in table 1 show that the average time of achievement tests of the e-learning process based cognitive flexibility hypertext theory is 7.21 minutes taking into account that the time proposed by the instructor to finish one test is 10 minutes. The average time of achievement tests of the e-learning process based flexible instruction is very acceptable compared to the time proposed by the instructor to finish one test (10 minutes).

According to table 2, we notice that the average of scores of learners in achievement tests in the e-learning process based cognitive flexibility hypertext theory is acceptable 87% compared to the max score 100%.

Table 3 shows the results of learners attitudes toward the e-learning process based cognitive flexibility hypertext theory. Arithmetic means are organized in descending order. The first rank is for the item " *Solving e-learning difficulties*" with an arithmetic mean equal to 1.51 and standard deviation equal to .839. The item "*sufficiency of the time of achievement test*" is in the second rank with an arithmetic mean equal to 1.45 and a standard deviation equal to .654. The ease of learning is in rank number 7 with an arithmetic mean equal to 1.24 and a standard deviation equal to .531. etc., (See all the rank of items in table 3).

Generally, these results demonstrate that learners agree that the experimented e-learning process based cognitive flexibility hypertext theory is effective for learning and teaching Educational Media course from point of view (ease of learning, solving learning difficulties of the e-learning environment, guiding learners in the e-learning process, structuring of the learning resources, the sufficiency of the time of achievement of the e-learning resources, cognitive legibility of the e-learning process based cognitive flexibility hypertext and General satisfaction with the e-learning process based cognitive flexibility hypertext). The criteria of cognitive performance (time of the achievement tests, scores of learners in the achievement test) show clearly the effectiveness of the cognitive flexibility hypertext online course design: See table 1, table 2.

Cognitive flexibility hypertext theory is largely concerned with transfer of knowledge and skills beyond their initial e-learning situation. For this reason, emphasis is placed upon presentation of the information from multiple perspectives and use of many case studies that present diverse examples. Cognitive flexibility hypertext online course design also asserts that effective learning is context-dependent, so instruction needs to be very specific. In addition, the theory stresses the importance of constructing knowledge; learners must be given an opportunity to develop their own representations of information in order to properly learn.

This research paper discusses transfer of ill-structured knowledge resulting from the application of an innovative theory-based hypertext learning environment for teaching and learning Educational Media course. The results of this research are complementary, coherent and validated all research questions for the evaluation of the e-learning process based cognitive flexibility hypertext theory for learning and teaching Educational Media Course. The results of the experimentation of the learning process based flexible instruction suggest

that the application of the instructional hypertext system in the design of the e-learning process demonstrates conceptual interrelationships and the assembly of different case studies and abstract knowledge components would prepare learners to use their knowledge in new ways and in new situations and provide the educational effectiveness of a given type of technology-based learning environment (Spiro et al., 1996). According to the results of the study, we observe that the cognitive flexibility hypertext theory adopted to design the Educational Media course has a remarkable positive effect on the effectiveness of learning through the best scores in achievement test and time spent for the achievement answers of the test and also thought the satisfaction of learners with the e-learning process based on cognitive flexibility hypertext theory.

Based on previous study, results of the present study supports the superiority of flexible instruction based cognitive flexibility theory compared to direct instruction (Barhoumi & Rossi, 2013). Also, results support researches of Jonassen giving importance to the use of hypertext systems in designing hierarchical structure of navigation in the learning resource. He indicates that learning resource based hierarchical hypertext systems is superior to linear texts from effectiveness of learning point of view (Jonassen, 1991, 1993).

Results of the study are in accordance with results of the experimental devices of Jacobson and Spiro (1993).

Conclusion

Results of this paper show that Cognitive flexibility hypertext theory suggested by Jacobson and Spiro (1993) provides multiple representations of the same knowledge to be acquired by learners and allows for them the necessary mental developments for treatment of information and knowledge acquisition.

The cognitive flexibility theory suggests that the learners can face the complexity of the learning situation more easily by multiple representations of the same information in various contexts to acquire the necessary mental developments (Spiro et al., 1996). The cognitive flexibility hypertext theory is used to assist learners in developing rich, interconnected, and usable knowledge in teaching and learning Educational media course. The effectiveness of learning is provided by the power of hypertext structure of presentation of the e-learning resources for online learners. The explication of abstracted concepts by case studies, example, project, a variety of e-learning resources, guiding learners during the e-learning process. Cognitive flexibility hypertext theory promotes an active learning for learners and motivates learners' access to the e-learning resources and improve their knowledge acquisition.

Cognitive flexibility theory facilitates the cognitive development useful for learning and the knowledge acquired by learners during the learning process. Indeed, the learner can acquire a capacity to pass of a type of data processing to the other one in a faster and more flexible manner.

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