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INVESTIGATING KNOWLEDGE TASK DIFFICULTIES IN AN E-TRAINING SYSTEM FOR PROFESSIONAL DEVELOPMENT DESIGN

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Abstract

E-training system has been a practical method in higher learning institutions to enable a virtual training environment. It is a vigorous effort to corroborate educators to prepare and facilitate themselves with professional knowledge, skill, values, and practices through training programs. These training programs are structured with an essence of competency development, lifelong learning, and career path. The effect of e-training design and process difficulties faced by end-

users were less prominent. Therefore, this research's objective is to validate the design of the E-Training System for Professional Development (TaSPoD), using an Applied Cognitive Task Analysis (ACTA) that was performed by a group of experts, to elicit the most difficult cognitive elements. Interview sessions were conducted to answer the research question of the electronic training design recommendation implemented in TaSPoD. The result shows that the experts faced difficulties in two system design elements which are system design and functionality and course content design. Thus, to increase user engagement in the e-training system, experts proposed three recommendations: (i) graphical user interface with simple and appropriate objects, tabs and icons, and video upload tools, (ii) communication tools such as chat programs and video conferencing, (iii) customized application for external documents.

Keywords

E-Training, TaSPoD, System Design, ACTA, Knowledge Audit

1. Introduction

Professional development is an effective way of continuously improving, updating, and enhancing educators' knowledge and skills (Ageel & Woollard, 2012). Training under the umbrella of professional development is perceived as a mechanism for ongoing learning lives for all components involved in the institution systems, as to empower educators' knowledge (Day & Leitch, 2007). With the advancement of technology and the fact that most adults entwined their daily activities with computerized innovation (Tawafak, Malik, & Alfarsi, 2021), educators have begun to adopt and embed some of the latest technologies into their training activities. Moreover, amid the COVID-19 pandemic, which caused unprecedented disruption to the most education process, electronic learning and electronic training system provides opportunities for continuous learning for educators (Shahzad, Hassan, Aremu, Hussain, & Lodhi, 2021).

1.1 Problem Statement

An electronic training system, named TaSPoD is designed to fulfil the needs of continuing professional development by focusing on deliverables of training modules, assessment modules, and management modules. The design of an electronic training system as in this research will therefore be used to prevail the hindrance to successful professional development. To validate the TaSPoD system design, this research explored and probed the task difficulties in e-training system design using an applied cognitive task analysis (ACTA) approach.

1.2 Research Objective and Question

The objective of this research is to identify cognitive tasks that are required while navigating the e-training system. With the investigation of experts' knowledge and end-users recommendation, ACTA identified the most essential types of cognitive tasks for the e-training system, and further proposed system design recommendations to be contemplated during the system development.

The questions posed in this research are:

i. What is the design of the TaSPoD system according to the design refinement?
ii. What is the most suitable electronic training design recommended by the experts and end-users to be implemented in the TaSPoD system?

The structure of this paper started with a description of the e-training system and applied cognitive task analysis approach in the literature review section. The following section discussed the methodology that was used in this research where the cognitive task analysis technique's design and procedures are detailed. The paper concluded with data findings, results, and recommendations.

2. Literature Review

Educational organizations including higher learning institutions play a vital role in shaping the future of social and economic growth of a country. Educators are facing an extensive challenge in this modern world, with the new learning environment, advancement of technology, and developing students' strengths, abilities, and skills. The advances of information and communication technology, and widespread internet access, coupled with the continued changes in the educational structure, have created new paradigms for higher learning institutions to adopt a flexible comprehensive E-training for professional development.

2.1. Electronic Training (E-training)

E-training also referred to as web-based training or online training, requires the use of an electronic medium, consists of modular courses, available over the web, at any time and anywhere the users have access to the Internet. Thus, many organizations hoping to reap the benefit of electronic training to meet their immediate and strategic needs for a flexible and well-trained workforce. The development of human resources is also more effective when implementing e-

training, especially when it involves the millennial generation (Wolor, Solikhah, Fidhyallah, & Lestari, 2020).

E-training will facilitate trainees to access the system anywhere and at any time, using appropriate electronic tools. Thus, supported and stimulated trainees to execute independent study in an interactive, flexible and non-linear manner, authorizing each trainee to be in control and be in charge of their own pace of the training, as discussed by many researchers all over the globe for years (Arsovski, Stefanovic, & Arsovski, 2007; Batalla-Busquets & Maria-Jesus Martinez-Arguelles, 2014; Ismail, Zaharudin, Hashim, & Ariffin, 2020; Park, Son, & Kim, 2012; Wijakkanalan, Wijakkanalan, Suwannoi, & Boonrawd, 2013).

2.2. ACTA technique

ACTA technique is an analysis tool to be used by professionals without a cognitive psychology background, such as instructional designers and system designers, to elicit critical cognitive elements of a particular task and in turn provide recommendations for a system design (Militello & Hutton, 1998).

ACTA approach consists of four techniques, which are task diagram, knowledge audit, simulation, and cognitive demand table. All these techniques are complementary to get different aspects of cognitive skill technique. The procedure for using this method is further explained in Section 3.2.

To design interfaces that assist the decision-making strategies and aid operators' needs of information, using ACTA technique is notable and remarkable to expose the skills and exhibit knowledge necessary to perform the cognitively challenging work of the system, as ACTA technique has been widely used in studies of different fields (Nor'ain Mohd Yusoff & Siti Salwah Salim, 2012).

3. Methodology

TaSPoD will be used as a tool for continuing professional development programs among higher learning institutions educators. The research utilized qualitative design methodology, which involved interview protocol with the experts to gain comprehensive data. The interview procedures were conducted using the technique in ACTA.

3.1. Participants

The ACTA analysis was conducted using four experienced experts who are instructional designers and trainers, to get their recommendation on the system screens' designs. For the purposes to increase the interviewer's knowledge and verifying information among experts, the number of experts conducting the method is between three to five, which is consistent with the ACTA toolkit suggestion (Militello et al., 1997). The selected experts are with a background in electronic learning or training environments, as well as experience with using technology in education or training. They are identified as the person directly involved with the execution, implementation, or presenting the training activities for professional development. Interview sessions were conducted with all the experts according to the phases in ACTA.

3.2 Research procedure

The research uses four techniques of ACTA, where it consists of a series of structured interviews that were used at three different phases, as shown in Figure 1. In this research, a series of structured interviews were conducted with experts.

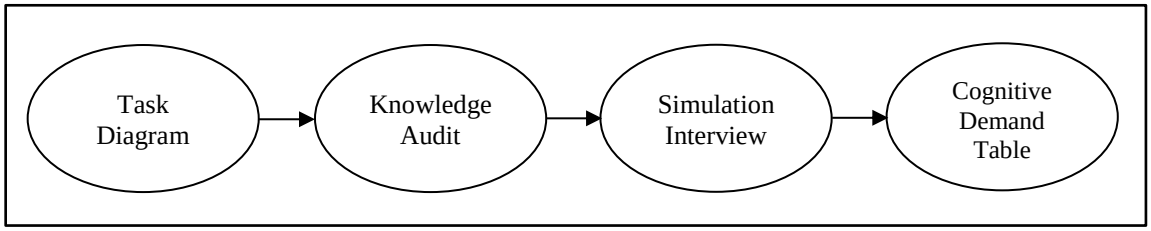

Figure 1: *Phases of Applied Cognitive Task Analysis Method*

(Source: Nor'ain Mohd Yusoff & Siti Salwah Salim, 2012)

The analysis process started by presenting the experts with several TaSPoD screen designs. The screen designs are used to single out the cognitive skills of the end-users during the task diagram and knowledge audit techniques. Figures 2 and 3 below show samples of TaSPoD screen designs that were constructed with various multimedia elements.

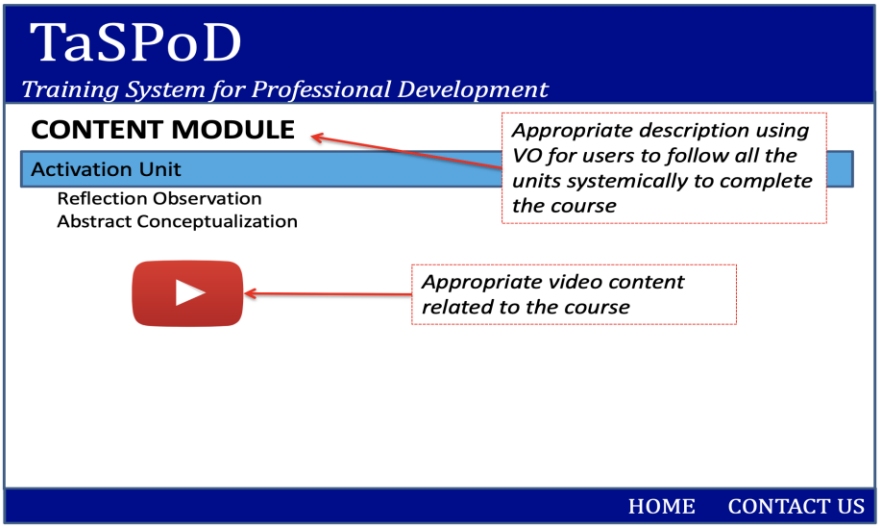

Figure 2: *Content Module with Media Design*

(Source: Self)

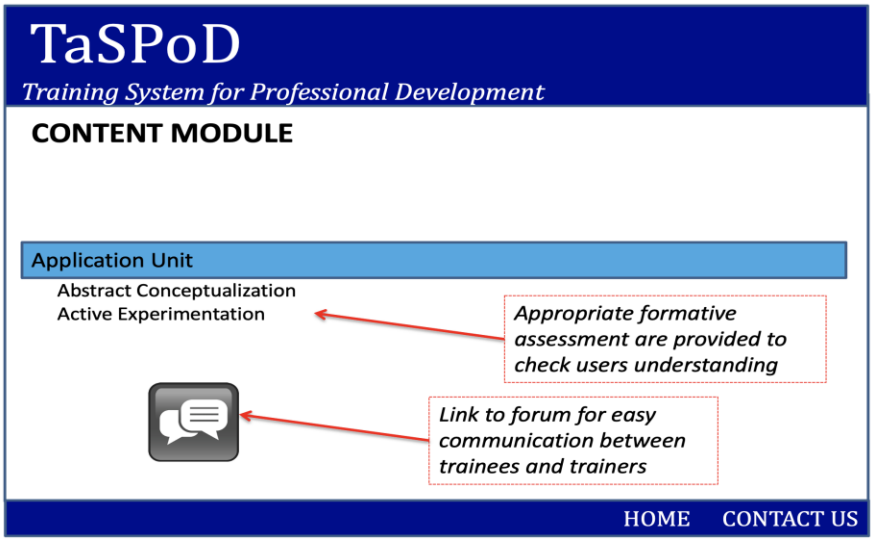

Figure 3: *Content Module with Assessment And Forum Design*

(Source: Self)

3.2.1. Task Diagram Technique

In the task diagram phase, this technique involved eliciting a broad overview of the task under analysis. This technique identified the cognitive skills required in the e-training system. Experts were asked to decompose the tasks into four main components of the TaSPoD design to be analyzed, as followings:

1. System Design And Functionality
2. Course Content Design

3. Voice Over
4. Downloadable And Pop-Up Documents

Upon completing the task diagram interview, the task components in the e-training design were classified into two categories; tasks that required most cognitive skill and tasks that required less cognitive skill. The two distinct tasks; most cognitive skill and less cognitive skill are represented with a task diagram.

3.2.2. Knowledge Audit Technique

Following the cognitive task difficulties identified in the task diagram technique, the knowledge audit technique is used to further inquire into the tasks. A list of the questions is utilized for the second stage of interview sessions. The sample of questions is as shown in Table 1. The goal is to determine and be aware of skills, specific events, and strategies that have been used. Experts were questioned about cues and strategies they rely on when they encountered difficulties in the e-training design. A knowledge audit table is used to present the findings from this phase.

Table 1: *Questions Asked in Knowledge Audit Technique*

Column title	**Questions**
Examples	Examples of a situation where you experience cognitive task difficulties
Cues/strategies	In this situation, what cues and strategies would you rely on?
Why difficult	In what way would this be difficult for an end-user? What makes it difficult to do?

(Source: Adapted from Nor'ain Mohd Yusoff & Siti Salwah Salim (2012))

3.2.3 Simulation Technique

In this third phase of ACTA, experts were demonstrated with a sequence of events in executing the TaSPoD system. The experts have then experienced the TaSPoD system simulation. Questions shown in Table 2 were used to probe the experts' views about TaSPoD system design. The data findings that described the challenging elements were presented in a simulation table, and they are independent of the knowledge audit findings in the preceding phase.

Table 2: *Questions Asked in Simulation Technique*

Column title	Questions
Event	The events that you identified as difficult and challenging
Actions	What actions would you take at this point?
Situation assessments	What is your assessment of the current situation?
Critical cues	What pieces of information led you to this situation assessment and these actions?
Potential errors	What errors would an end-user make?

(Source: Adapted from Nor'ain Mohd Yusoff & Siti Salwah Salim (2012))

3.2.4. Cognitive Demand Table

The data findings of all the three ACTA techniques: task diagram, knowledge audit, and simulation were integrated. The data were presented in a cognitive demand table, which comprised the difficult cognitive elements, and subsequently provided a format required to design a new system.

4. Research Findings

This section discussed the findings of the output constructed from two of the phases in the ACTA analysis, which are the task diagram technique and knowledge audit technique. Thematic analysis was done towards the transcripts of the interviews, from the two phases. Recommendations given by experts were also discussed.

4.1. Task Diagram Technique

The experts stated that the components in TaSPoD that require the most cognitive skills are identified as 'system design and functionality and 'course content design'. The experts also agreed that 'voice over' and 'downloadable and pop-ups documents' require less cognitive skills than the other two. The task diagram of the TaSPoD design is shown in Figure 4.

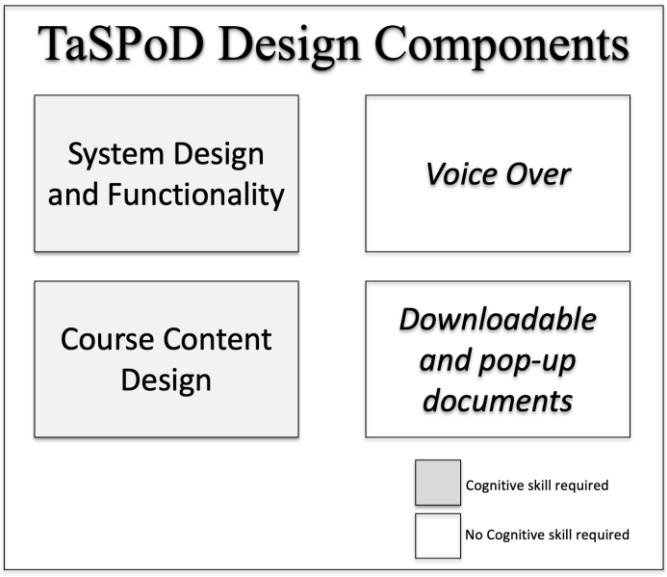

Figure 4: *E-Training System Design Main Components*

(Source: Self)

4.2. Knowledge Audit Technique

The knowledge audit table technique is used to investigate the cognitive task difficulties ascertained from the preceding task diagram technique. It presented detailed aspects of system design and functionality, as well as the screen view design. The knowledge audit table is shown in Table 3.

The knowledge audit table exhibits the detailed characteristics of tasks difficulties in system design and functionality and course content design. The tasks difficulties in system design and functionality include screen view design and system navigation. In screen view, generally, the design of the screen will cause difficulties to acquire users' engagement to the system. While for system navigation, the choice of multimedia used in the navigation design will affect users' capability to complete the e-training session. This will further cause arduous to users' interaction with course content.

Table 3: *The Knowledge Audit Table*

TaSPoD components	Cues & Strategies	Why difficult
System design and Functionality	***Cues:*** Users, who are not familiar with similar online applications or Learning Management	Difficult to use due to lack of experience (especially download/upload external content).

	System Platform would find E-training challenging to follow. The navigation and placement of buttons should be more self-explanatory. Provide an option to go to the previous screen. The downloading and uploading of the documents via PDF and word processing application to be customized within the E-training system ***Strategies***: A simple, straightforward, user-friendly and attractive document should be designed. Identifies types of activities and tasks that will be performed by users.	Difficult for users who don't know how to adjust their browsers. Difficult to be active in the forum, assignment, etc. along with their real work commitment.
Screen View Design	***Cues:*** The fonts should be easy to read on various screen resolutions. The standard text size should be used for visitors. The home page can be made more interesting with animations or pictures which can draw the attention of users, as well as including a short video narration about E-training, what is it and how to use it, before users log in or registers for E-training ***Strategies***: The screen views need to be designed using a graphical user interface that contains simple and appropriate objects, tabs and icons, and video upload tools.	Difficult to focus on the learning process. Difficult to acquire users' engagement to the system.
System Navigation	***Cues:*** E-training did not give a clear guide on how to use the system for training. Users need to navigate non-linear throughout E-training ***Strategies:*** E-training should sequentially automate the learning process to give clear navigation,	Difficult to navigate as it has a mouse rollover option. Difficult to motivate to complete the task

	guidance and engagement in learning to users. Avoid using a complex navigation button and menu. Every page should have help/hint buttons to assists users.	
Course Content Design	***Cues:*** Do not provide the complete content when using mouse rollovers. Improve with adding progress chart/graph in percentage after completion of each activity (after completing videos, Assessments etc.) Users can only communicate via an electronic forum which is considered quite conventional and not fun. ***Strategies:*** In using mouse rollover, brief information is provided and upon clicking, users can see the detailed information. The communication pages such as online forums and email design can be added to give an immediate response. It should also include a feedback form to receive a response from users and use to improve the site.	Difficult to read detailed content. Difficult to create active interactions between E-training and users. Difficult to communicate between E-training and users.

(Source: Self)

4.3. Discussion and Recommendation

The TaSPoD's main function is to equip educators with an electronic training system that is utilized for enhancing their competency, skill, and knowledge. It is essential for system designers and system developers to be able to design and develop an e-training system that satisfies users' cognitive elements needs. Thus, through ACTA analysis, ascertaining the TaSPoD system task difficulties will be valuable for system designers and system developers to produce an effective and successful e-training system.

In this research, experts have identified system functionality design, screen view design, system navigation, and course content design as the difficulties of the major task. These difficulties somewhat affect users' engagement while using the TaSPoD system, and the overall learning process.

To ensure that learners reap maximum benefit from the system, experts recommended simple, straightforward, user-friendly, and attractive document or screen views. The screen views of TaSPoD should be designed using a graphical user interface that contains simple and appropriate objects, tabs and icons, and video upload tools, which will also increase user engagement (Rebelo & Isaías, 2020).

In addition, experts propose having applications to communicate with TaSPoD such as chat programs, video conferencing rather than the usual online forums and emails. This is in line with research findings by Silva, Mendes, & Gomes (2020), that having communication tools in e-learning is one of the important collaboration tools for learners. Moreover, some researchers (Hoq, 2020; Saintika et al., 2021) pointed out that learners and educators are familiar with online communication and utilizing the internet for communication purposes.

Lastly, experts suggested that the downloading and uploading of the documents via PDF and word processing applications be customized within the TaSPoD system. This functionality is crucial to ensure continuous acceptance of online learning. Saintika et al. (2021) recommended in their findings for an institution to make policy to maximize the usage of e-learning.

5. Conclusion

TaSPoD furnished higher learning educators with an electronic training system that helps educators to intensify their skills and knowledge. The research focused on the cognitive analysis that was conducted on the TaSPoD system design, using applied cognitive task analysis. The result of the analysis extracted from the users' cognitive skills is valuable for many beneficiaries such as system developers, who appreciate the representation from the users' perspective (Klein & Militello, 2001). The result of the ACTA is essential to uphold cognitive tasks in an e-training system design and support effective designing tasks. Finally, the research has attained meaningful impact and influence from the study which ensued TaSPoD's design improvement. The novel innovation of this research is TaSPoD will be a platform to bridge the technological gap, that enables educators regardless of gender, to maximize their potential through professional development activities.

5.1. Research Limitations

Nevertheless, it is worth noting that this research involved experts from the same institution, which may not be adequate and necessarily represent the actual view of all higher learning institutions. Therefore, this fact may indicate that the results of this research may not be generalized to a larger population of higher learning institutions. For future research work, the researchers recommend having multiple experts from different universities, to gauge a better result on the analyzed items to further strengthen the validity of research outcomes.

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