# SHARED KNOWLEDGE AMONG GRAPHIC DESIGNERS, INSTRUCTIONAL DESIGNERS AND SUBJECT MATTER EXPERTS IN DESIGNING MULTIMEDIA-BASED INSTRUCTIONAL MEDIA

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## ABSTRACT

The research identified and explored the shared knowledge among the instructional multimedia design and development experts comprising of subject matter expert, graphic designer and instructional designer. The knowledge shared by the team was categorized into three groups of multimedia design principles encompasses of basic principles, authoring principles and design principles. The research focused on soliciting knowledge of agreement on the principles. The research design sequentially began with the modified Delphi technique which involved twelve experts in selecting the list of principles in multimedia design. Next phase, the interview session involved three selected experts to verify the list of principles and obtain detailed information. Outcome of the research is essential in providing description of the cognitive skills needed to perform tasks in multimedia design and development proficiently.

## 1.0 INTRODUCTION

A team Cognitive Task Analysis is helpful as it can describe the way the team is thinking as opposed to the steps it is following. Cognitive processes for teams consist of control of attention, shared situation awareness, shared mental models, application of strategies and heuristics to make decisions, solve problems and plan and metacognition (Cook et. al., 2001). Shared mental models imply that team members have the same understanding for the roles and functions of each team members in accomplishing the task, the nature of the task, the use of equipment and so forth. In most settings a critical factor is the degree to which the team members have a shared mental model of their own roles and functions (Schraagen, Chipman & Shalin, 2000).

One common source of difficulty for teams is when the members are confused about who is supposed to do what. Confusion about roles and functions leads to wasted effort or a failure to carry out essential subtasks. Effective teams understand the functions, including the common routines. Hence shared mental models refer to the configuration of the team and the way it is supposed to perform routines (Hoffman & Militello, 2008).

Another issue that must be addressed is how the elicited information is represented which have not received much attention in the literature, but are crucial if a true picture of team-level knowledge stemming from a team CTA are to be useful. This includes an understanding of what each team members needs to know to function effectively, as well as an understanding of what information must be dynamically shared among members (Schraagen, Chipman & Shalin, 2000)

Research aims at addressing this issue is clearly needed. Despite the gaps in research, a number of knowledge elicitation methods are available from research since such data are required so that team selection, training, task design and management systems can be optimized. Thus, the research is focusing on soliciting knowledge of agreement on strategies (Schraagen, Chipman & Shalin., 2000). The research questions thus highlight the following issues:
   i)   What are the tasks shared among graphic designers, instructional designers and subject matter experts in multimedia design and development for instructional purposes?
   ii)  What are the tasks which are based according to their expertise in design and development for instructional purposes?

## 2.0 REVIEW OF RELATED LITERATURE
### 2.1 Multimedia Design and Development Experts

Bergman and Moore (1991) describe development experts as comprising several specialists who perform the design, development, production and authoring work. They are divided into primary roles and supporting roles. The former consist of Application Designer, Managing Producer, Art Director and Video Director. Meanwhile the latter consist of Writers, Graphic Artists, Developers, Audio and Video Production Personnel, Authors, Programmers, Subject Matter Experts and Administrators. Bergman and Moore (1991) add that some individuals may have multiple skills, thus the team does not necessarily comprise of every specialization.

Careful selection of members with the right skills is essential as it is not realistic to expect any one member to possess all the sophisticated skills required.

Lee and Owens (2000) argue that organizations that assume a couple of people with the right skill sets can design and produce multimedia are misinformed about the number and complexity of skill sets needed for even a minimal multimedia design and development project. Assigning roles to the project group depends on the size of the project, timeline, skills and resources needed. They describe the roles into eighteen, which is more than advocated by Bergman and Moore (1991), encompassing Audio Producer or Technician, Author (Publisher, Materials Developer), Creative Director, Editor, Evaluation Specialist, Graphic Artist, Graphic Designer, Implementation Representative, Instructional Designer (Interactive Designer), Performance Analyst, Project Manager (Project Leader), Quality Review (Evaluator), Sponsor, Subject-Matter Expert (SME), Systems Designer, Systems Engineer (Application Developer), Video Editor (Technician) and Video Producer.

Despite emphasizing on the number of roles, Allessi and Trollip (2001) highlight the importance of brainstorming and collaboration among the experts as an excellent way of bringing together the different people and skills that can contribute productively to project design. Compared to the earlier researchers, Alessi and Trollip (2001) divide the team into a group that creates a design of the program for the most effective learning by the target audience and another group that produces or oversees the production of a set of documents for effective communication with the rest of the team. The former include the Instructional Designer, Clients, Project Manager, Content Experts, Trainers or Teachers and learners. Alessi and Trollip (2001) describe the latter as the production staff comprising technical writers, programmers, graphic artists, photographers, videographers, audiographers, special effects artists and actors.

On the other hand, another group of researchers in multimedia have their own perspective with regard to the role of the multimedia development team. Jamalludin et al. (2003) categorized the team according to three major groups, namely: management, design and technical. The management group comprises of project manager, creative director, art director, technical director and test director. The design group includes subject matter expert, instructional designer and script writer. The technical group encompasses the editor, graphic computer artist, audio specialist, video specialist, 2D animator, 3D animator and programmer. Collaboration between the three groups determines the flow of the project and thus ensures multimedia product quality.

Norazlin et al. (2007) agree to the notion of grouping the team into three different groups according to their area specialization. They add that the role depends on the needs of the particular project, since such needs differs between one project and another. Thus, some of the roles may not be applicable to another multimedia project. Apart from defining the roles, they also emphasize the working culture and leadership quality in the multimedia development team in determining the flow of the project for producing quality multimedia products.

For the purpose of the research, the team of multimedia development is categorized generally into three main groups which are instructional designer, graphic designer and subject matter experts. Thus, this research focuses on the shared knowledge among the three groups in the team.

### 3.0 RESEARCH DESIGN
A cognitive task analysis was conducted using twelve multimedia design and development experts to construct the list of principles in designing multimedia-based instructional media. For the purpose of establishing content validity of the multimedia design principles, the number of experts is more than 10 due to its consistency with Dalkey's finding (as cited in Martino, 1972). The sample involved experts from various fields who are experienced and qualified in multimedia design process.

The research was designed in three phases as illustrated in figure 1. The first phase, was preparing the list of principles based on literature reviews and selection of experts. The second phase, a modified Delphi technique was used to facilitate experts' opinion to reach consensus on the principles in designing and developing multimedia-based instructional media. The list of principles divided into three categories which are Basic principles, Authoring principles and Design principles. Basic principles comprise learning theories, instructional design theories and instructional design process. Authoring principles on the other hand, include authoring and software support tools. Design principles involve interactivity, screen design, audio and visual design and content design. The phase was the interview which was done twice with the three experts from the respective fields. Cognitive task analysis (CTA) uses a variety of interview and observation strategies to capture a description of the knowledge that experts use to perform complex tasks (Clark et. al, 2007). The first interview was done simultaneously with gaining experts' consensus during the second round of the modified

Delphi technique. The second interview was carried out after analyzing the final consensus among the experts, hence the questions asked during the interview were based on the final consensus.
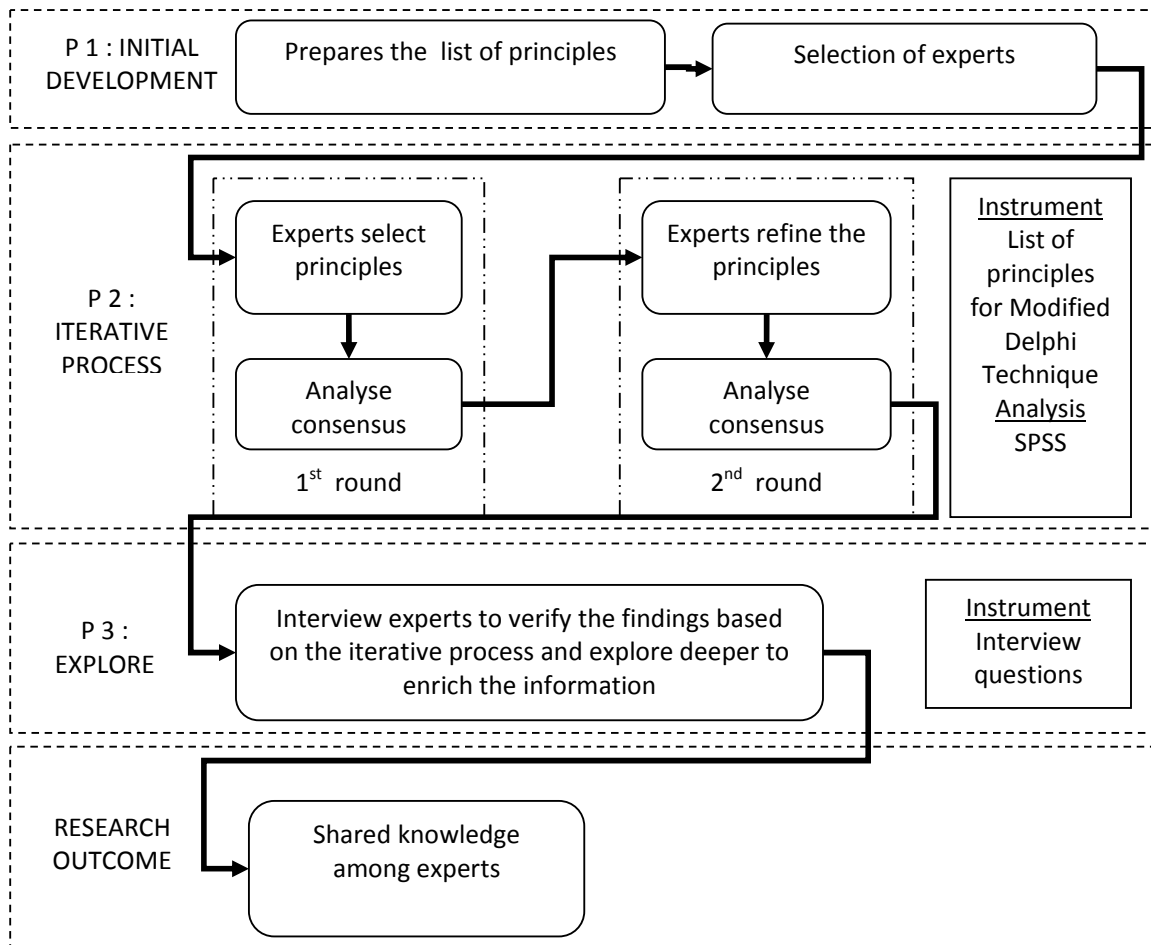


Figure 1: Research Design

## 4.0 RESEARCH FINDINGS
### 4.1 Modified Delphi Technique

For the cognitive principles as described in table 1, graphic designers obtain no consensus with high median score between 4 to 5 and interquartile range between 2.50 to 3.50. On the contrary, subject matter experts and instructional designers reach consensus with high median score 4 to 5 and interquartile range between 0.75 to 1.50 except for elaboration theory.

Table 1 : Consensus among subject matter experts, graphic designers and instructional designers for principles under cognitive theory.

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| prior knowledge | 4.5 | 3.25 | 4.5 | 1.50 | 5 | 1.50 |
| hierarchical cognitive | 4.5 | 2.50 | 4 | 0.75 | 4 | 0.75 |
| meaningful learning | 4.5 | 3.25 | 4.5 | 1.00 | 5 | 0.75 |
| elaboration theory | 4.5 | 3.25 | 4.5 | 3.25 | 5 | 2.25 |
| depth of processing | 4.5 | 3.25 | 5 | 0.75 | 4 | 0.75 |
| conceptual model | 4.5 | 3.25 | 5 | 0.75 | 5 | 0.75 |
| dual coding, symbol system | 4.5 | 3.25 | 5 | 0.75 | 4.5 | 1.00 |
| invested mental effort | 4.5 | 3.25 | 4.5 | 1.50 | 4.5 | 1.00 |
| cognitive-spatial maps | 4.5 | 3.25 | 4.5 | 1.50 | 5 | 1.50 |
| situated and generative learning | 4 | 3.00 | 5 | 0.75 | 5 | 0.75 |
| cognitive flexibility | 4 | 3.00 | 5 | 0.75 | 5 | 1.50 |

For principles under behaviorism theory in table 2, graphic designers obtain no consensus with median score between 4 to 5 and interquartile range between 2.25 and 3.25. In contrast, subject matter experts and instructional designers obtain consensus with median score between 4 to 5 and interquartile range between 0.00 to 1.50.

Table 2 : Consensus among subject matter experts, graphic designers and instructional designers for principles under behaviorism theory

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| categorized material | 5 | 3.00 | 4 | 0.00 | 4 | 0.75 |
| positive and negative examples | 5 | 3.00 | 5 | 1.50 | 4 | 1.50 |
| write sequences | 4.5 | 3.00 | 5 | 1.00 | 5 | 1.00 |
| sequence by difficulty | 4 | 3.50 | 4 | 1.50 | 4 | 1.00 |
| sequence without learner control | 4 | 3.25 | 5 | 2.00 | 4.5 | 2.00 |
| go through based on performance | 5 | 3.00 | 5 | 1.00 | 5 | 1.00 |
| practice based on performance | 4 | 3.25 | 5 | 1.50 | 4 | 1.50 |
| categorized skill with explanation | 5 | 3.00 | 5 | 0.00 | 5 | 0.75 |
| performance standards are explicit | 5 | 3.25 | 4 | 1.00 | 4 | 1.50 |
| practice build proficiency | 4.5 | 3.25 | 4 | 0.75 | 4 | 0.00 |
| use of remedial loop | 4.5 | 3.00 | 5 | 1.00 | 5 | 1.00 |
| reinforcement for motivation | 5 | 3.00 | 4 | 0.75 | 5 | 0.75 |

Table 3 : Consensus among multimedia designers, graphic designers and instructional designers for principles under constructivism theory

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| discovery learning | 5 | 3.00 | 5 | 1.00 | 5 | 1.00 |
| scaffolding | 5 | 2.75 | 4 | 0.75 | 5 | 0.75 |
| authentic task | 5 | 2.75 | 5 | 0.75 | 5 | 0.75 |
| multiple intelligence | 5 | 3.00 | 4.5 | 1.00 | 5 | 1.00 |
| stages of development | 4 | 3.00 | 4 | 3.00 | 5 | 3.00 |
| multiple reality representation | 4 | 2.75 | 5 | 2.25 | 5 | 2.25 |
| reflection | 5 | 3.00 | 5 | 3.50 | 5 | 3.50 |
| collaborative learning | 5 | 3.00 | 4.5 | 0.75 | 5 | 0.75 |
| learner centered design | 5 | 3.00 | 5 | 0.75 | 5 | 1.00 |
| intrinsic motivation | 5 | 3.00 | 4.5 | 0.75 | 5 | 1.00 |
| active learning | 5 | 3.00 | 5 | 1.00 | 5 | 1.00 |

As described in table 3, the three groups of experts obtain no consensus for the principles such as multiple reality representation and reflection with median score from 4 to 5 and interquartle range from 2.25 to 3.50. Subject matter experts and instructional designers reach consensus with high median score between 4 to 5 and interquartile range between 0.75 to 1.00. However, graphic designers obtain no consensus for all the principles with median score from 4 to 5 and interquartle range from 2.75 to 3.00.

Table 4. : Consensus among multimedia designers, graphic designers and instructional designers for principles under andragogy theory

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| Provide learning outcomes | 5 | 2.00 | 5 | 0.00 | 4 | 1.00 |
| Self-directed learning | 5 | 3.00 | 5 | 0.75 | 4 | 1.00 |
| Experiential learning | 4.5 | 2.00 | 5 | 0.75 | 4 | 1.00 |
| Cope effectively with real-life situation | 5 | 2.00 | 5 | 0.75 | 4 | 1.00 |
| Applicable | 4.5 | 3.00 | 5 | 0.00 | 4 | 1.00 |
| Internal pressures | 5 | 2.00 | 5 | 0.75 | 4 | 1.00 |

Table 4 described that, graphic designers obtain no consensus with median score from 4.5 to 5 and interquartile range between 2.00 to 3.00. Instructional designers and subject mater experts obtained high consensus with median score 4 to 5 and interquartile range from 0.00 to 1.00.

Table 5 : Consensus among subject matter experts, graphic designers and instructional designers for principles under instructional design theory

| PRINCIPLES | GD | | SME | | ID | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| advance organizes & learning hierarchies feedback and emerging technologies | 4.5 | 3.25 | 5 | 2.25 | 5 | 0.75 |
| generic prompts | 4.5 | 3.25 | 4.5 | 3.25 | 5 | 0.75 |
| instructional control | 4.5 | 3.25 | 5 | 3.25 | 5 | 0.75 |
| structural cueing | 4.5 | 3.25 | 4.5 | 3.50 | 5 | 0.75 |
| navigational aids | 4.5 | 3.25 | 5 | 2.25 | 5 | 0.75 |
| feedback | 4 | 3.25 | 4 | 3.25 | 5 | 0.75 |
| mastery learning | 4.5 | 3.25 | 4.5 | 3.25 | 5 | 0.00 |
| problem-based learning | 4 | 2.00 | 4 | 2.00 | 5 | 0.00 |
| cooperative learning | 4 | 2.25 | 4 | 2.25 | 5 | 0.75 |
| Needham model | 4 | 3.00 | 4 | 3.00 | 5 | 0.75 |
| Laurillard conversational framework | 4 | 3.00 | 5 | 3.00 | 5 | 0.75 |
| drill and practice | 4 | 2.25 | 4 | 2.25 | 5 | 2.00 |
| tutorial | 4 | 2.25 | 4 | 0.75 | 5 | 0.00 |
| simulation | 4 | 2.25 | 5 | 0.75 | 5 | 0.00 |
| instructional game | 4 | 3.00 | 4 | 0.75 | 5 | 0.00 |
| problem solving | 4 | 3.00 | 4 | 0.75 | 5 | 0.00 |
| ARCS | 4 | 3.00 | 4 | 0.75 | 5 | 0.00 |
| ABCD | 5 | 3.00 | 5 | 1.00 | 5 | 0.75 |
| | 5 | 3.00 | 5 | 1.00 | 5 | 0.75 |

Table 5 explains that the experts obtain no consensus with regard to laurillard conversational framework with median score between 4 to 5 and interquartile range from 2.00 to 2.25. Subject matter experts obtain no consensus for majority of the principles with median score between 4 to 5 and interquartile range from 2.00 to 3.50. Graphic designers obtain no consensus for all the principles with high median score between 4 to 5 and high interquartile range between 2.00 to 3.25. On the other hand, Instructional designers obtain high consensus with median score 5 and interquartile range between 0.00 to 0.75 with the rest of the principles.

Table 6: Consensus of Subject Matter Expert, Graphic Designer and Instructional designer in software support tools

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| graphic tools | 5 | 0.00 | 5 | 3.50 | 4 | 3.00 |
| planning and organization content-area tools | 5 | 0.75 | 5 | 3.50 | 4 | 3.25 |
| | 5 | 0.00 | 5 | 3.50 | 4 | 3.25 |

Instructional designers and subject matter obtain no consensus for all the principles in software support tools as illustrated in table 6. The median score obtain is between 4 to 5 and interquartile range between 3.00 to 3.50. In contrast, graphic designers obtain high consensus for software support tools with median score 5 and interquartile range between 0.00 to 0.75.

Table 7 : Consensus of subject matter expert, graphic designer and instructional designer in interactivity

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| provide opportunities | 4 | 3.00 | 4 | 0.75 | 5 | 0.00 |
| chunk content | 4 | 3.25 | 5 | 0.75 | 4 | 0.75 |
| question by content | 4 | 2.00 | 4 | 0.75 | 5 | 0.75 |
| question prior knowledge | 4 | 3.00 | 5 | 0.75 | 5 | 0.00 |
| apply what is learned | 5 | 2.25 | 4 | 0.00 | 4 | 0.00 |
| rhetorical questions | 5 | 3.25 | 4 | 0.75 | 4 | 0.75 |
| active exploration | 5 | 2.00 | 5 | 0.75 | 5 | 0.00 |

As described in table 7, instructional design and subject matter expert similarly obtained consensus for principles under interactivity with high median score between 4 to and low interquartile range between 0.00 to 0.75. However, graphic designers obtain no consensus for all the principles with median score between 4 to and interquartile range is between 2.00 to 3.25.

Table 8 explains that graphic and instructional designers obtain no consensus for all the principles under analysis phase. The median score obtain between 4 to 5 and interquartile range between 2.00 to 3.25.       In contrast, subject matter experts obtain high consensus for the principles under analysis phase. The median score is between 4 to 5 with low interquartile range between 0.00 to 0.75. Graphic and subject matter experts obtain no consensus for all the principles under the design phase. The median score obtain between 4 to 5 and interquartile range between 2.00 to 3.50. In contrast, instructional designers obtain high consensus for all the principles under the design phase. The median score is 4.5 with low interquartile range between 0.00 to 0.75. Instructional designers and subject matter experts obtain no consensus for all the principles under develop phase. The median score obtain between 4 to 5 and interquartile range between 2.25 to 3.00. However, graphic designers obtain high consensus for all the principles under develop phase. The median score is 4 with low interquartile range 0.75. Instructional designers and subject matter experts obtain no consensus for all the principles under produce phase. The median score was between 4 to 5 and interquartile range between 3.00 to 3.50. Nevertheless, graphic designers obtained high consensus for all the principles under the produce phase of the instructional design process. The median score is 5 with low interquartile range between 0.00 to 0.75. All the experts obtain no consensus with regard to all the principles involve in the authoring phase.  The median score was between 4 to 5 and interquartile range between 2.00 to 3.50. They also obtain no consensus with regard to all the principles involve in validation phase. The median score was between 4 to 5 and interquartile range between 2.25 to 3.25. All the three groups of experts obtain high consensus for enhancement phase with high median score between 4 to 5 and low interquartile range between 0.00 to 0.75. Similarly, they obtain high consensus for maintenance phase with high median score between 4 to 5 and low interquartile range between 0.00 to 0.75.

Table 8 :  Consensus among subject matter experts, graphic designers and instructional designers for principles instructional design process

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| *Analysis Phase* | | | | | | |
| define problem | 4 | 3.00 | 4 | 2.00 | 4 | 0.75 |
| describe facilities & schedule | 5 | 3.25 | 5 | 2.00 | 5 | 0.75 |
| audience detail description | 5 | 3.00 | 5 | 2.00 | 5 | 0.75 |
| needs analysis | 5 | 3.00 | 5 | 2.00 | 5 | 0.75 |
| general objectives | 5 | 2.25 | 5 | 2.00 | 5 | 0.00 |
| *Design Phase* | | | | | | |
| evaluate team capability | 4 | 3.50 | 4.5 | 0.75 | 5 | 2.00 |
| review objectives | 5 | 3.00 | 4.5 | 0.00 | 5 | 2.00 |
| plan high level design process | 4 | 3.25 | 4.5 | 0.75 | 5 | 2.00 |
| prepare design strategies | 5 | 3.00 | 4.5 | 0.00 | 5 | 2.00 |
| *Develop Phase* | | | | | | |
| develop storyboard | 4 | 0.75 | 5 | 3.00 | 4 | 3.00 |
| develop scripts | 4 | 0.75 | 5 | 3.00 | 4 | 3.00 |
| write for narrators | 4 | 0.75 | 5 | 3.00 | 4 | 2.25 |
| computer     screens     and     video | 4 | 0.75 | 5 | 3.00 | 4 | 3.00 |
| graphics plan budget | 4 | 0.75 | 5 | 3.00 | 4 | 3.00 |
| *Produce Phase* | | | | | | |
| organize materials | 5 | 0.00 | 4 | 3.25 | 5 | 3.00 |
| check content accuracy | 5 | 0.75 | 4 | 3.50 | 4.5 | 3.25 |
| edit     and     evaluate     media components | 5 | 0.75 | 4 | 3.50 | 5 | 3.50 |
| *Author Phase* | | | | | | |
| integrate media elements | 4 | 2.00 | 5 | 3.00 | 4 | 3.50 |
| end users' perspectives | 5 | 2.00 | 5 | 3.25 | 4 | 3.50 |
| refine the presentations | 5 | 2.00 | 5 | 3.25 | 4 | 3.50 |
| *Validate Phase* | | | | | | |
| measurement instrument | 5 | 3.00 | 4 | 2.25 | 4 | 2.25 |
| interview audience and record | 5 | 3.25 | 5 | 3.25 | 5 | 3.25 |
| analyze validation findings | 5 | 3.25 | 5 | 3.00 | 5 | 3.00 |
| *Enhancement Phase* | | | | | | |
| beautify | 4 | 0.00 | 5 | 0.75 | 5 | 0.75 |
| *Maintenance Phase* | | | | | | |
| maintain | 4 | 0.00 | 4 | 0.75 | 5 | 0.75 |

Table 9 : Consensus of subject matter expert, graphic designer and instructional designer in screen design

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| prepare for learning | 4 | 0.75 | 5 | 0.00 | 4.5 | 0.00 |
| develop and maintain interest | 5 | 0.00 | 5 | 0.75 | 4 | 0.75 |
| deep processing | 5 | 2.00 | 5 | 1.00 | 4 | 1.00 |
| learner engagement | 5 | 1.00 | 5 | 0.75 | 4 | 0.75 |
| organize information | 4 | 1.75 | 5 | 0.75 | 5 | 0.75 |
| facillitate lesson navigation | 4 | 1.75 | 5 | 1.00 | 5 | 1.00 |
| learning environment | 4.5 | 2.00 | 4 | 0.75 | 5 | 0.75 |
| understood | 5 | 1.00 | 4 | 0.00 | 4.5 | 0.00 |
| familiar | 5 | 1.00 | 4 | 0.00 | 4.5 | 0.00 |
| minimal cognitive resources | 5 | 2.00 | 4.5 | 0.75 | 5 | 0.75 |

Instructional designers and subject matter experts gain consensus for all the principles in screen design with high median score between 4 to 5 and  low interquartile range between 0.00 to 1.00 as explained in table 9. However, graphic designers obtain no consensus for principles such as deep processing, learning environment and minimal cognitive resources with high median score between 4.5 to 5 and interquartile range 2.00.

Table 10 : Consensus among subject matter expert, graphic designer and instructional designer in authoring tools

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| Hypercard and Linkway | 5 | 2.75 | 4 | 2.25 | 4 | 2.25 |
| Powerpoint | 5 | 3.00 | 4 | 2.25 | 4 | 2.25 |
| video as real-time communication | 4 | 2.00 | 5 | 3.50 | 4 | 2.00 |
| video to depict problem | 4 | 2.00 | 4 | 2.25 | 4 | 2.25 |
| weblog | 4 | 2.00 | 4.5 | 3.00 | 5 | 3.50 |
| Wikis | 5 | 3.00 | 4 | 2.50 | 4 | 2.50 |
| podcast | 4 | 2.25 | 5 | 3.00 | 5 | 3.25 |
| e-portfolios | 4 | 3.00 | 5 | 2.00 | 5 | 2.00 |
| video sharing communities | 4 | 2.25 | 5 | 2.25 | 4 | 2.75 |
| social networking sites | 4 | 2.25 | 5 | 3.00 | 5 | 3.00 |
| Quicktime Virtual Reality | 4 | 3.50 | 5 | 3.25 | 5 | 2.00 |
| Geographic Information Systems | 5 | 2.25 | 4 | 2.00 | 4 | 2.00 |
| 3-D models | 5 | 3.00 | 4 | 2.00 | 4 | 2.00 |
| virtual reality environment | 5 | 2.50 | 5 | 3.25 | 5 | 3.00 |
| full immersion system | 4 | 3.00 | 4 | 3.00 | 5 | 2.25 |
| Facebook | 4 | 3.00 | 4 | 3.50 | 5 | 3.00 |

Table 10 shows that the experts similarly obtain no consensus for principles under authoring tools.  They obtain high median score between 4 to 5 and interquartile range between 2.00 to 3.50.

Table 11 :Consensus among subject matter expert, graphic designer and instructional designer for principles under content design

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| multimedia principle | 5 | 3.00 | 5 | 3.00 | 4 | 3.00 |
| split attention principle | 5 | 2.75 | 5 | 0.00 | 4 | 0.75 |
| modality principle | 5 | 3.00 | 5 | 0.75 | 4 | 0.75 |
| redundancy principle | 5 | 2.00 | 5 | 0.75 | 4 | 0.75 |
| segmenting principle | 5 | 2.75 | 5 | 0.75 | 4 | 0.00 |
| pretraining principle | 5 | 3.00 | 5 | 0.00 | 5 | 0.00 |
| coherence principle | 5 | 3.00 | 5 | 0.00 | 5 | 0.00 |
| signaling principle | 4 | 0.75 | 5 | 0.00 | 5 | 0.00 |
| spatial contiguity principle | 5 | 2.00 | 5 | 0.75 | 5 | 0.75 |
| temporal contiguity principle | 5 | 2.75 | 5 | 0.00 | 5 | 0.00 |
| voice principle | 5 | 3.75 | 5 | 0.00 | 5 | 0.00 |
| personalization principle | 5 | 2.75 | 5 | 0.00 | 5 | 0.00 |
| cognitive aging principle | 5 | 3.00 | 5 | 0.00 | 5 | 0.00 |
| prior knowledge principle | 5 | 3.00 | 5 | 0.00 | 5 | 0.00 |
| site map principle | 5 | 0.75 | 5 | 1.75 | 5 | 1.75 |
| navigation principle | 5 | 0.75 | 5 | 1.00 | 4 | 1.00 |
| guided-discovery principle | 5 | 2.00 | 5 | 0.75 | 4 | 0.75 |
| worked-out example principle | 5 | 2.00 | 5 | 0.75 | 5 | 0.75 |
| collaboration principle | 5 | 2.00 | 5 | 0.75 | 4 | 0.75 |
| self-explanation principle | 5 | 2.00 | 5 | 0.75 | 4 | 0.75 |
| animation principle | 5 | 1.00 | 5 | 3.25 | 4 | 3.50 |
| interactivity principle | 5 | 1.00 | 5 | 0.75 | 4 | 0.75 |
| Self-critique principles | 5 | 0.75 | 5 | 0.00 | 5 | 0.00 |
| Conceptual principles | 5 | 0.75 | 5 | 0.00 | 4 | 0.00 |
| Marketability principles | 5 | 0.75 | 5 | 0.00 | 4 | 0.00 |
| Consistency principles | 5 | 0.75 | 5 | 0.00 | 5 | 0.00 |

The experts obtain consensus for the principles such as self-critique principles, conceptual principles, marketability principles, consistency principles, site map principle, navigation principle, interactivity principle and signaling principle with high median score between 4 to 5 and interquartile range between 0.00 to 1.00.

They similarly obtain no consensus for principles such as multimedia with high median score between 4 to 5 and interquartile range 3.00. Subject matter experts and instructional designers obtain high consensus for majority of the principles with median score between 4 to 5 and interquartile range between 0.00 to 0.75. Moreover, they also similarly obtain no consensus for animation principle with median score between 4 to 5 and interquartile range between 3.25 and 3.50. Graphic designers obtain no consensus for majority of the principles with median score between 4 to 5 and interquartile range between 2.00 to 3.00.

Table 12: Consensus among subject matter expert, graphic designer and instructional designer for principles under audio visual

| PRINCIPLES | GD | | ID | | SME | |
|---|---|---|---|---|---|---|
| | Med | IQR | Med | IQR | Med | IQR |
| color is used sparingly | 4 | 0.75 | 5 | 3.25 | 4.5 | 2.75 |
| color for cue | 5 | 0.00 | 4 | 2.00 | 4 | 3.00 |
| color for highlight | 4 | 0.00 | 5 | 2.75 | 5 | 2.00 |
| color for important points | 5 | 0.00 | 5 | 3.00 | 5 | 2.00 |
| consistent color scheme | 4 | 0.75 | 4 | 2.00 | 5 | 2.00 |
| graphics and difficult topics | 5 | 0.75 | 4 | 2.00 | 5 | 3.00 |
| graphics illustrates concept | 4 | 0.75 | 5 | 2.00 | 5 | 2.25 |
| animation for key animation | 4 | 1.75 | 5 | 3.00 | 4 | 3.00 |
| animation and students' interest | 5 | 1.00 | 5 | 2.25 | 4 | 2.25 |
| animation facilitate recall | 5 | 1.75 | 5 | 3.00 | 4 | 3.00 |
| audio and visual presentation | 5 | 1.00 | 5 | 3.50 | 4 | 2.50 |
| video for advance organizer | 5 | 2.00 | 5 | 2.25 | 5 | 3.00 |
| video for lesson summarization | 5 | 2.75 | 5 | 3.00 | 5 | 2.00 |
| principles of art | 5 | 0.75 | 5 | 2.50 | 5 | 2.25 |
| elements of design | 4 | 0.75 | 5 | 3.00 | 4 | 3.00 |
| principles of organization | 5 | 0.75 | 4 | 3.00 | 4 | 3.00 |
| compositional techniques | 5 | 0.00 | 4 | 2.25 | 5 | 2.50 |

Instructional designers and subject matter experts obtain no consensus for all the principles under audio visual with high median score between 4 to 5 and interquartile range between 2.00 to 3.00. Graphic designers obtain consensus for majority of the principles with median score between 4 to 5 and interquartile range between 0.00 to 1.75. They obtain no consensus pertaining to video for advance organizer and video for lesson summarization with high median score 5 and interquartile range between 2.00 to 2.75.

**4.2 Interview**
Findings from the interview of an expert in the respective field are categorized into shared task and expertise-based task.

4.2.1 Shared Task
The findings highlight the importance of sharing ideas among members of the multimedia design team. Expert 01 emphasizes that discussion is important where graphic designers share ideas with other members of the team through drawing or writing in explaining the storyboard. The visualization or discussion clarifies uncertainties among team members. Due to that, text as well as illustrations are applied in order to ensure the message delivered is clear and precise. Expert 03 further adds that graphic designers should not obstruct or constrain themselves from contributing ideas.

> *graphic designer cannot be stingy in giving ideas ...if committed graphic designer...they will think this way... they know that it is difficult for teachers to teach certain concept so we use mm to explain to students effectively...so do not be stingy throw ideas for other partners to know... in team work manager is important.*

Expert 01 stresses that if graphic designers are unable to explain in words they are welcome to draw their ideas as long as the ideas are shared among members. Thus, sharing ideas in order to ensure the quality of the product is no doubt essential for every member of the team. Expert 01 elaborates:

> *We don't call it meeting....but we call it visualization..meaning we have to visualize first ... like brainstorming or mindmapping ... during the discussion there'll be a white board ... graphic designers start sketch what the discussion about..they use thumbnail ... either he'll draw or write.... thumbnail is small boxes ... and this is the basic for storyboard..*

Instructional designers and subject matter experts share knowledge in the application of screen design principles. They similarly involve in application of majority of the principles under content design. Their specialization in developing and designing content requires them to apply principles under cognitivism, behaviorism, constructivism, andragogy, instructional design theory and interactivity in designing multimedia. This is elaborated by expert 01 that:

> subject matter expert developing content..instructional designer focusing on design aspect..

The two parts a and c, all three of them as, share the same viewpoint for the principles under authoring tools that the tasks requires technical skills which does not involve job specifications of subject matter experts, instructional designers and graphic designers.

4.2.2 Expertise-based Task
From the findings, some of the applications are not shared but applied according to area of specialization.

Instructional designers' and subject matter experts' task in instructional design process are segregated. Subject matter experts focus on the analysis phase where they define problem, describe facilities and schedule, analyze learners' detailed description, needs analysis and general objectives. On the other hand, instructional designer concentrate on designing aspects such as planning high level design process, prepare design strategies, evaluate team capability and review objectives. This is further advocated by expert 01 who explains that:

> the flow of work starts from subject matter expert developing content..instructional designer
> focusing on design aspect. .

Unlike instructional designers and subject matter experts, graphic designers do not involve in the application of principles under cognitivism, behaviorism, constructivism, andragogy, instructional design theory and interactivity in designing multimedia. Graphic designers involve totally in application of the principles under audio visual and software support tools which is not applicable among instructional designers and subject matter experts. As for instructional design principles, graphic designers involve in develop phase produce phase.

Expert 01 elaborates that graphic designers perform task based on their observation of characters, images and events around them. Their work is mostly based on experience rather than reading materials. Expert 01 explains:

> the role of graphic designers is not just reading..he obtain information by digesting his
> surrounding …..meaning he needs to observe characters, images..reading or reference as such
> are not applicable and very limited for graphic designers ..

Segregation of tasks will be easier and all members will perform the best according to their potential. This will help to ensure product quality. Expert 02 explains:

> so when we interact with people we know how they perform so we assign task according to
> their nature for example a person who is detail in doing his work so we assign him the difficult
> part for him to complete ...whereas the person who has the skill but cannot achieve the level
> that we want ... so assign him with simpler task ...when dividing task as a leader we have to
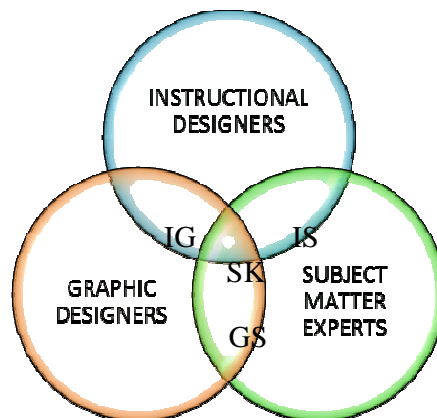> follow according to potential of the person ...

**5.0 DISCUSSION**

Figure 2 : Proposed Shared Mental Model of  Multimedia Design Experts in Designing Instructional Media

Model of shared mental among instructional designers, graphic designers and subject matter experts is suggested based on the research finding.  The model highlights four parts the shared knowledge between graphic designers and instructional designers (IG), instructional designer and subject matter expert (IS), graphic designer and subject matter expert (GS) and shared knowledge among the experts (SK) as shown in figure 2.

Instructional designers and subject matter experts share knowledge and ideas in most of the application of principles in designing multimedia. Jamallludin et al. (2001) categorized the team according to three major groups; management, design and technical.   The design group includes subject matter expert, instructional designer and script writer.  This is also supported by Alessi and Trollip (2001) who divide the team into a group that is to create a design of the program that leads to the most effective learning by the target audience and another group is to produce or oversee the production of a set of documents that communicate effectively with the rest of the team.  The team  inclusive of  instructional designer, content experts or subject matter expert, clients, project manager, trainers or teachers and learners.

Based on the findings, the shared knowledge involves the principles under content design such as self-critique principles, conceptual principles, marketability principles, consistency principles, site map principle, navigation principle, interactivity principle and signaling principle.  Apart from that all three of them do not involve in author and validate phase.  Lee and Owens (2000) explain that validation phase  involves Quality Review (Evaluator).  Even though enhancement and maintenance phases are newly added phases in the instructional design process, all the three groups of experts agree that those two phases are important.  The additional two phases are similar to the Three-Phase Development (3PD) Model.  Sims and Jones (2003) elaborate that the phases elicit learning content through process of enhancing and maintaining materials, rather than the more traditional systems approach of analyze, design, develop, implement, evaluate. Subject matter experts, instructional designers and graphic designers similarly do not apply principles under authoring tools, video for advance organizer and video for lesson summarization. The result is due to the principles under authoring tools requires technical skills which does not involve job specifications of subject matter experts and graphic designers.

A systematic flow of performing tasks from one specialization to another in instructional design process is advocated by experts from the interview.  They start with subject matter experts developing content, then pass their work to instructional designers for designing the instruction.  Graphic designers illustrate concept. Jamalludin et al. (2001) categorized the team according to three major groups; management, design and technical.  The collaboration of the three groups determine the flow of the project and thus ensures the quality of the multimedia product.

The team members have a shared mental model of their own roles and functions. Hence, they have the same understanding for the dynamics of key processes.   These processes can include the roles and functions of each team member in accomplishing the task, the nature of the task, the use of equipment and so forth (Schraagen et al., 2000).  The involvement of each expert varies according to their specialization of tasks.  Norazlin et al. (2007) agree to the notion of grouping the team into three different groups according to their area specialization. Bergman and Moore (1991) add that some individuals may have multiple skills, thus the team does not necessarily comprises of every specialization.  Careful selection of members with the right skills is essential as it is not realistic to expect any one member to possess all the sophisticated skills required.

**6.0 CONCLUSION**
Previous research (Keppell, 2000) addresses the gap in the field of instructional design and outlines a number of key principles to consider in interacting with subject matter experts. Without effective principles for interacting with the subject matter expert, valuable time will be lost understanding and organizing the content.  Norain and Siti Salwah (2012) developed guidelines for developing e-learning storyboard for effective ID-SME interaction. This  research extends the scope of specialization, analyzing cognitive task of graphic designers in designing multimedia.  The shared knowledge among the experts emerges as solid understanding of the factors that influence team decision making and performance in order to identify interventions that can affect the decision making process and improve performance (Hall & Regian, 1996; Klinger et al., 1993; Salas, Bowers, & Cannon-Bowers, 1995).

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