The Architecture of Interactive Multimedia Courseware: A Conceptual and an Empirical-Based Design Process: *Phase One*

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Abstract

This research was aimed at designing an effective interactive multimedia courseware to be utilized in Malaysian classrooms. A courseware for interactive instructional design for learning Arabic (Bahasa Arab Interaktif Kurikulum (BAIK) was developed, incorporating Mayer's Cognitive Load in Multimedia Learning (Mayer, 2001), Gagne's Nine Steps of Instructional Events (Gagne, 1985), Keller's ARCS Model of Motivational Design (Keller, 1988), and ASSURE Model of instructional Design intervention (ASSURE, 1999). The process of developing the software was divided into two phases, namely the conceptual phase and the engineering phase. This paper discusses the first phase namely; the conceptual and theoretical approaches. These approaches are divided further into four parts, such as, the conceptual approach, the model approach, and the design and development process. Furthermore, as this research utilized real life applications of these models and theories of instructional design, the instructional design thus created could act as a prototype for future instructional design developers. Phase two of this research will discuss the empirical aspects of the finished product in an actual institution setting.

Keywords: Courseware, instruction, Arabic, software engineering, methodology

INTRODUCTION

Developing an interactive multimedia instruction is a very challenging task. Xun et al., (2005) describe the development of an instructional design as invoking "*higher-order thinking skills*". Effective instruction entails careful blending of planning, task analysis, experience, needs of intended learners and technical considerations. Dijkstra (2004) defines instruction as a medium of communication between students and the teacher. Hence a good instructional design can revolutionize conventional classroom instruction, making learning more effective. This is achieved by providing learners with a set of procedures to make the learning process more meaningful, flexible and imaginative. As the primary purpose of an instructional design is to facilitate the learning process, it has to offer explicit directions for learners to achieve excellence in their studies. It should enhance the acquisition of new knowledge and allow learners to apply such new knowledge (Rogers, 2002).

PROBLEM STATEMENT

Most multimedia instructions are based on the traditional method of one nail hits all approach. Teacher-centered instruction still prevails in many Malaysian classrooms, for example, where Arabic is taught as a foreign language. The challenge faced in many classrooms is how to make the learning of a language more enjoyable and effective. Hence, the main objective of this multimedia instructional design is to meet this daunting challenge. It should provide a set of procedures for an effective learning environment. It should also offer explicit directions for learners to achieve excellence in their studies. Accordingly, there is a need to design a good multimedia courseware to enhance students' new knowledge and assist them in the application of the new knowledge acquired (Rogers, 2002).

OBJECTIVES

1. To design an effective interactive multimedia courseware based on theoretical and empirical instructional design approaches.
2. To design an effective interactive multimedia courseware that can be prototyped as an alternative to the traditional learning paradigm in Malaysian classrooms.

RATIONALE OF THE RESEARCH

1. The results of this research could offer guidelines for future researchers on the methodology of designing an effective interactive multimedia Arabic courseware. The findings of this research would also contribute to the expansion of a paradigm such as Constructivism.
2. The findings of this empirical research could be prototyped for learning other languages in Malaysian classrooms.
3. This study might be able to offer guidelines for a more viable alternative to the traditional methods of teaching the Arabic Language in the Malaysian environment.
4. This research would assist Malaysian educators overcome the shortage of well-trained Arabic Language teachers in Malaysian classrooms by providing an effective interactive multimedia Arabic Language courseware which is student-centered, theoretically sound and field-tested.
5. Interviews, observations, questionnaires and checklists from this study would yield valuable information for future researchers in language learning.

PART ONE

THE CONCEPTUAL APPROCH

The conceptual approach for this research is derived from models used by eminent psychologists; such models include Mayer's Cognitive Load in Multimedia Learning (Mayer, 2001), Gagne's Nine Steps of Instructional Events, (Gagne, 1985), Keller's ARCS Model of Motivational Design (Keller, 1988), ASSURE Model of instructional Design intervention (ASSURE, 1999).

MAYER AND INSTRUCTION

In order to construct a feasible instructional design, Mayer (2001) highlights eight essential principles:

Multimedia Principle: Students learn better from words illustrated by pictures rather than words alone.
Contiguity Principle: Students learn better if the words and pictures are presented concurrently rather than presented individually.
Coherence Principle: Students learn better if all redundant words, sounds and pictures are excluded from the instruction.
Modality Principle: Students learn better if words are supplemented with narration rather than just appearing as text on the screen.
Redundancy Principle: Students learn better with animation and narration, rather than animation, narration and text on the screen.
Interactivity Principle: Students learn better if they are engaged personally.
Signaling Principles: Students learn better if narrated information is divided into small segments for easy comprehension.
Personalization Principle: Students learn better if information is presented to them as a conversation.

GAGNE AND INSTRUCTION

According to Gagne's learning principles, learning takes place when learner's attention is fully engaged in the classroom. The nine principles of Gagne's conditions of learning are recommended.

Gagne's Nine Steps of Instructional Design	
1. Gain Attention	6. Get Learners' Response
2. Set Objectives	7. Provide Feedback
3. Review Lesson	8. Make Assessment
4. Presentation	9. Enhance Retention
5. Provide Guidance	

Table 1: Gagne's Nine Principles of Effective Learning

ARCS MODEL AND INSTRUCTION (Content)

The ARCS model of instructional design is a sequential process. Keeping the learner interested all the time is a prerequisite for successful teaching. If the learner is distracted, he will not be able to focus and pay full attention to the task at hand. Hence, learning will not be effective.

Instructional Design according to ARCS			
Attention	Relevance	Confidence	Satisfaction
Gain learners' attention Arouse curiosity, Provide surprises, Pose a problem Provide Brainstorming	Make the content relevant Explain your objectives Let students provide their own examples	Show positive expectations Provide opportunities Provide feedback Acknowledge students	Provide satisfaction Provide reinforcements Provide certificates

Table 2: Instructional Design According to ARCS

ASSURE MODEL AND INSTRUCTION

ASSURE principles of instructional design stipulate that in order to provide effective instruction, the following guidelines must be present in the design, *viz.* attention, relevancy, user confidence and satisfaction (See Table 3).

ASSURE MODEL	
Analyze Learners	In this model learners are analyzed.
State Objectives	Objectives of the model are set.
Selection of Media	Sounds, graphics and relevant media are placed.
Utilization of Material	Contents are utilized accordingly.
Performance of Learners	Activities to test learners' performance are provided.
Evaluation	Every step of the model evaluates the learners.

Table 3: Instructional Design model according to ASSURE

Models	Applications
ASSURE	Learners are analyzed before design
Mayer	Information is divided into segments
ARCS	Motivating activities are introduced
Gagne	Courseware is evaluated at each step

Table 4: Application of Models of Instructional Design to BAIK

Table 4 indicates the mapping between BAIK and the most workable models of instructional design intervention.

PART TWO

THE MODEL APPROACH (*Content*)

This research utilizes the best and field tested models for its conceptual design, and in the process the following steps are taken into consideration. After the users are identified according to their age and grade, their emotional states are observed (using observation checklist), along with their skills, prior knowledge, attitude and expectations. Activities for BAIK are designed. The main objectives of BAIK are established. Students' learning outcomes are identified. Learners' accomplishments, application of new skills, motivation and performance are outlined. The contents of BAIK are then identified based on the users' needs. The contents are divided into the following sections: vocabulary, comprehension, critical thinking, counting, motivation, matching, reviews, exercises, quizzes, games, songs, conversation and drag and drop activities. A field-tested paradigm of teaching, namely Constructivism is identified as the preferred method of teaching. The principles used in ASSURE, ARCS, Gagne Models are incorporated in BAIK so that its contents would be ideal for the classroom-based learning environment. The contents are delivered using media, text, images and animations. Formative evaluation of the performance of BAIK is carried out in every step. Its performance is closely monitored to ensure the smooth implementation of the instructional design.

SYSTEM DEVELOPMENT BASED ON MODELS AND INSTRUCTIONAL DESIGN THEORIES

BAIK is developed based on the Constructivist methodology of learning and teaching introduced by Brunner, Piaget and Vygotsky.

In order to develop a comprehensive Arabic courseware, this study also uses combined theories of instructional design such as Mayer's Nine Ways to Reduce Cognitive Load in Multimedia Learning, (2003), Gagne's Nine Steps of Instructional Events (1985), Reigeluth's Seven Steps of Elaborative Theory of Instructional Design (1999), and Merrill's Eight Propositions of Component Display Theory (1983). See application of theories of instructional design to BAIK in Table 5.

Table 5: Application of Theories of Instructional Design to BAIK

Application of Theories of Instructional Design to BAIK		
Theorists	**Principles**	**BAIK**
Gagne Keller	Attention and clear objectives. Motivation.	Familiar pictures of student's school attract their attention. Clear objectives are provided in every lesson.
Brunner Piaget	Student-centered and discovery learning. Practice and critical thinking.	Relevant activities allow learners to discover patterns in the language. Students learn with little assistance from their teacher.
Mayer	Multimedia and memory overload. Icons and symbols.	Sound, pictures, icons, symbols and graphics are carefully placed. Memory overload is avoided by eliminating background noise.
Reigeluth	Simple to complex learning.	Start with vocabulary and slowly build simple sentences.
Vygotsky Brunner	Zone of proximal development and scaffolding.	Symbols and icons assist continuous learning. Low-ability students learn through symbols. Interaction with friends and teacher.
Merrill	Symbols and icons	Provide symbols to assist learner connect ideas.
Piaget Keller	Practice, relevancy and critical thinking.	Familiarity and relevance of topics to the learners. Interactive lessons encourage learners to practice and think critically.

Table 5 indicates the mapping between BAIK and the most established theories of instructional design intervention.

BAIK is designed based on the field-tested models of instructional design intervention such as Mayer, ASSURE, Gagne and Keller's ARCS model of learning and teaching. See the summary of models of instructional design application to BAIK in Table 6.

Table 6: Application of Models of Instructional Design to BAIK

Application of Models of Instructional Design to BAIK		
Models	**Principles**	**BAIK**
ASSURE	Analyze learners	Identification of needs and capabilities of users.
Mayer	Segmentation of information and interactivity	Contents of BAIK arranged in a lesson format with sub-divisions for easy comprehension and reinforcement.
ARCS	Motivate learners	Earning points and playing games to motivate learners.
Gagne	Review and evaluate learners	Interactive activities allow learners to review and self-correct.

Table 6 shows the mapping between BAIK and universally recognized models of instructional design intervention.

PART THREE

DESIGN AND DEVELOPMENT PROCESS

The design and development of BAIK comprises the **pre-production phase**, **production phase** and **post production** phase. In every step of the design, formative evaluation is conducted to examine the fidelity of its design and development progress.

Pre-Production Phase: The following section shows the pre-production phases of BAIK, which consists of storyboard and need assessment.

Storyboard Development: BAIK is developed based on a storyboard to determine what important information should be included on the screen. The storyboard is created to assist the study in arranging the contents of BAIK such as text, graphics, media (audio, video, and animation), lesson plan, feedback, navigation, hyperlinks in a meaningful manner. The purpose of the storyboard is to pave the way for the research to program and build the module in an orderly manner.

Figure 1: Storyboard

Needs Assessment: The audiences are analyzed taking into consideration their emotional state, skills, age, grade, prior knowledge, social status, learning environment, attitudes, expectations, learning outcome, accomplishment, new skills and performance. A formative evaluation is conducted to examine the reliability of the needs assessment. One unit from the outline of a language course selected as the main content of the courseware and integrated with sounds, pictures, and animations for better learning outcomes. The contents are divided into the following sub-sections such as vocabulary, understanding, critical thinking, counting, motivation, satisfaction, matching, reviews, exercises, quizzes, games, songs, conversations, drag and drop activities. Formative evaluation is conducted to examine the quality of the graphics.

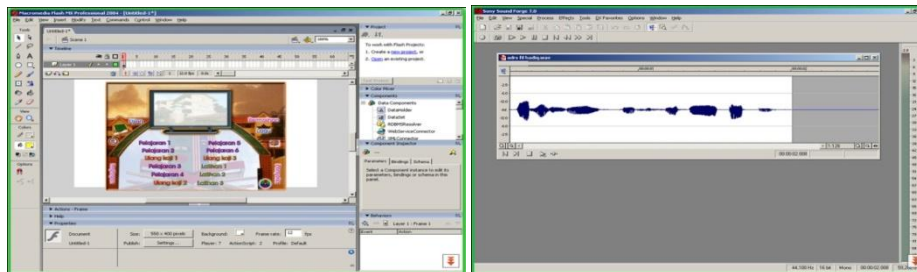**The following are some screen shots of the model**

Figure 2: BAIK Menu Screen Shot and Sound Screen Shot

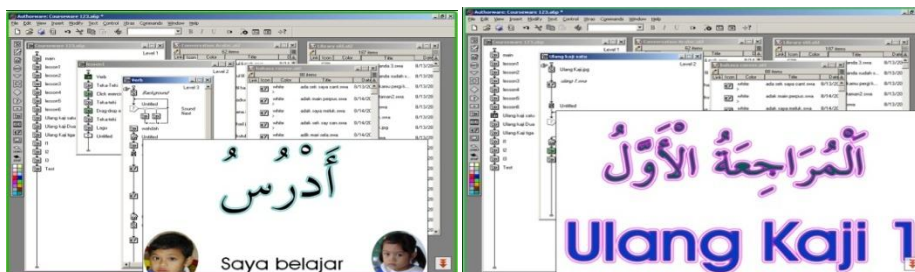The sounds for BAIK courseware is being edited to make learning more enjoyable.

Figure 3: Lesson One Flow Chart

PART FOUR

POST-PRODUCTION AND SUMMATIVE EVALUATION

BAIK is evaluated step by step using the formative method of evaluation by subject matter experts. Summative evaluation is performed when the courseware is in post-production, ready for the final packaging. In addition, BAIK is tested using *Lindsley's* Dead-Man Test (Ogden Lindsley, 1965) to evaluate its effectiveness. The following are investigated:

1. Accuracy of content.
2. Logic of organization.
3. Clarity of objectives.
4. Freedom from bias.
5. Accuracy of presentation.
6. Ease of navigation.
7. Clarity of the Arabic text.
8. Attractiveness of design.
9. Functionality of buttons, graphics, and sound.
10. Suitability of animations.
11. Suitability of text and fonts.
12. Suitability of screen resolution.

Further, all the components of BAIK such as main menu, review, drills, motivation, exercises and conversation used are based on Mayer's Nine Ways to Reduce Cognitive Load in Multimedia Learning, (Mayer, 2001) Gagne's Nine Steps of Instructional Events, (Gagne, 1985) Keller's ARCS Model of Motivational Design (Keller, 1988) and Heinrich & Molenda ASSURE Model of instructional Design intervention (ASSURE, 1999).

Main Menu

When the main menu loads, it has an element of surprise. The graphics and the backgrounds are taken from the students' school. Studies indicate that relevancy increases motivation (Keller, 2004). In the main menu, students know the goals and the objectives of the courseware just by a click of the mouse. Moreover, in BAIK, learners know what skills and expertise they will gain at the end of the courseware. Lessons are deliberately categorized into various sections such as critical thinking, drag and drop, conversations, songs, games, evaluation, revision and exercises. The puzzles in BAIK start with the easier ones, and become increasingly more challenging in the later exercises. Studies show that children need to go through stages of development gradually, building up their skills and confidence (Wood, et al., 2001). See the main menu of BAIK in Figure 4.


Figure 4: BAIK Main Menu

This courseware is designed based on the low entry behavior of young learners. As such, it is very easy and appropriate for young children to operate. Furthermore, BAIK is specially designed to nurture young children's cognitive ability and language skill performance. The lessons are designed meaningfully and follow certain patterns of logical learning succession. The logical sequence of the lessons assists young children to build the required skills as they progress with the lessons. New skills are acquired in this courseware as children progress to the next lesson. When the students complete the courseware, they certainly have the potential to learn concepts, expertise, problem solving skills, critical thinking and knowledge which can be internalized and can be used in the later stages of their lives.

BAIK facilitates the learning process by allowing the learner to be in control (Howell & Lake, 2006). BAIK plays the instructor's role in teaching the students. Learners using this courseware need minimum assistance from the teacher. It is student-centered learning (Wu, et al., 2007). In BAIK, children are not passive; instead they are very actively involved in all learning activities. Research has shown that active involvement in the learning process improves students' academic performance (Tandogan, et al., 2007).

SCAFFOLDING (EXERCISES AND HELP)

Scaffolding is a technique used by an instructor to assist a weak student to accomplish a task, gradually shifting the responsibility to the student to continue learning without further assistance. The instructor assists students who are actually unable to go further without such assistance. In any educational environment, errors are expected from the students and the teacher tries to help by giving them appropriate feedback until they master the given task by themselves. Once the teacher is convinced that the students can do the task individually, the teacher gradually withdraws from the discussion of the task or problem; hence the scaffolding is gradually removed. See examples of scaffolding in Figure 5.
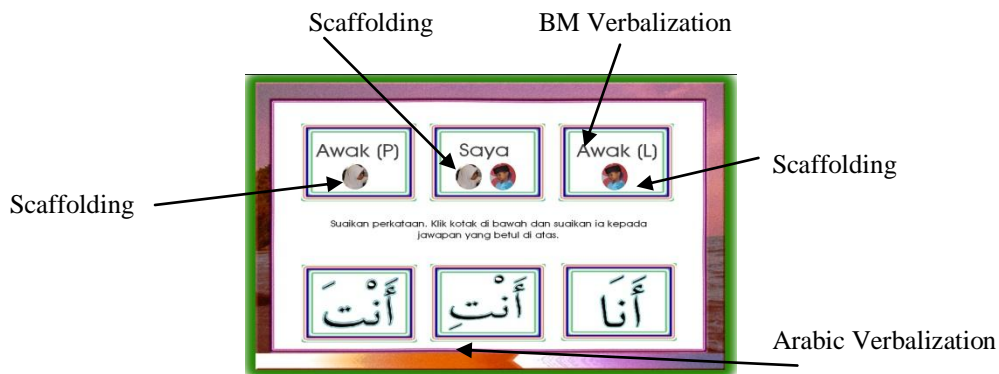
The concept of Scaffolding is well explained in the above example. In the above figure, there are two concepts involved: High-ability student and low-ability student. In case of high-ability students, the teacher has no problem as he/she can do the given task without the instructor's help. BAIK is concerned with the issue of low-ability students who do not know what to do. In the above Figure there are three little icons indicating one male person (male), two persons (male and female) and one person (female) indicating the Arabic grammatical role and scaffolding. If a low-ability student still does not know how to solve the problem, then the teacher has to intervene to scaffold until the student can do the work without the help of the instructor.

LEARNING THROUGH CONVERSATION

In BAIK, the Arabic text is presented as a conversation. Furthermore, BAIK supports the concept of cooperative learning. In cooperative learning, students share their knowledge with one another. Studies indicate that conversation improves learning (Randi, 2007). In BAIK, grammar is not taught explicitly; instead students learn grammar subconsciously as they engage in a conversation. In Figure 3.22 for instance, there is a conversation between a boy and a girl. In the conversation the boy and the girl are greeting each other. It is interesting to note that the role of grammar is discussed between them but they do not realize that, in fact, gender (male and female) is being studied.

Figure 7: BAIK Conversation Section
Figure 3.22 shows BAIK conversation section is created to facilitate learning.

ASSESSMENT AND EVALUATION

BAIK constantly evaluates learners to make sure that they are learning effectively. Assessments actually increase learning effectiveness (Eleanore, 2007). In fact evaluation improves students' knowledge, besides a good courseware (Age, 2007). In Figure 3.23 for example, students practice the previous lesson before starting a new lesson. In this page there is no exit button and the students must finish the exercise.

LEARNING THROUGH GAMES AND SONGS

In this section children learn the Arabic language through songs and games. The songs and games are related to the students' school. The songs are composed in such a way as to motivate them to continue learning. Studies show that computer games, songs and stories are excellent methods of knowledge transfer (Cameron, 2006).

CONCLUSION

This conceptual and theoretical study demonstrates that an instructional design such as BAIK, when embedded with the state of the art technology and blended with the latest theories and paradigms of teaching and learning, could help students to master language skills more easily. Furthermore, for an instructional design to be effective, it is crucial to understand how a foreign language, especially the Arabic language, is acquired. To understand how a person learns, the instructor must identify the nature of teaching and learning first before even attempting to design the instruction. Because technology is redefining our classrooms, educators need to understand and adapt to different pedagogies in order to improve classroom environment. BAIK offers language learners a more effective approach to language learning.

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