EFFECTS OF MODALITY AND REDUNDANCY PRINCIPLES ON THE LEARNING OF MUSIC THEORY AND ATTITUDE AMONG PRIMARY PUPILS OF DIFFERENT APTITUDES IN JORDAN

By

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KESAN PRINSIP MODALITY DAN REDUNDANCY TERHADAP PEMBELAJARAN TEORI MUZIK DAN SIKAP DALAM KALANGAN MURID SEKOLAH RENDAH BERBEZA APTITUD DI JORDAN

ABSTRAK

Penyelidikan ini bertujuan mengkaji kesan prinsip *modality* dan *redundancy* terhadap pembelajaran dan sikap 'Teori Muzik' di kalangan murid tahun tiga yang mempunyai pelbagai *aptitude* di Jordan. Pelajaran 'Teori Muzik' telah dibangunkan dalam tiga mod yang berbeza iaitu audio dengan imej (AI), teks dengan imej (TI) serta audio dengan imej dan teks (AIT). Suatu reka bentuk eksperimen kuasi dengan faktorial 3×3×2 telah digunakan dalam penyelidikan ini. Pembolehubah bebas terdiri daripada tiga mod koswer. Pembolehubah moderator adalah tahap kepintaran muzik, lokus kawalan, tahap kebimbangan dan trait murid. Pembolehubah bersandar adalah skor pos ujian dan sikap murid. Sampel penyelidikan ini terdiri daripada 405 murid tahun tiga yang dipilih secara rawak (sample rawak ringkas) daripada enam buah sekolah rendah pendidikan campuran. Statistik deskriptif dan inferens dijalankan untuk menganalisiskan data yang dikumpul. ANOVA digunakan untuk menentukan perbezaan signifikan di antara skor ujian pra ketiga-tiga kumpulan. Analisis Kovarians (ANCOVA) dan Post hoc dijalankan untuk mengkaji kesan utama serta kesan interaksi yang disebabkan oleh pembolehubah bebas terhadap pembolehubah bersandar. Regresi ringkas dan berganda digunakan untuk menentukan penyumbangan relatif setiap faktor terhadap pembolehubah bersandar. Tujuh hipotesis utama dan enam subhipotesis dipostulat dan diuji.

Dapatan kajian ini menunjukkan murid yang menerima mod AI menunjukkan pencapaian yang lebih baik secara signifikan dibandingkan dengan mod TI. Murid yang menerima mod TI tidak menunjukkan pencapaian yang lebih baik secara signifikan dibandingkan dengan mod AIT. Murid bertahap kebimbangan sederhana

menunjukkan pencapaian yang lebih baik secara sgnifikan dibandingkan dengan murid bertahap kebimbangan tinggi dan rendah dalam ketiga-tiga mod olahan. Murid berlokus kawalan dalaman menunjukkan pencapaian yang lebih baik secara sgnifikan dibandingkan dengan murid berlokus kawalan luaran dalam ketiga-tiga mod olahan. Murid bertahap kepintaran muzik tinggi menunjukkan pencapaian yang lebih baik secara signifikan berbanding dengan murid bertahap kepintaran muzik rendah dalam ketiga-tiga mod olahan. Mod AI didapati membantu murid bertahap kebimbangan tinggi, berlokus kawalan luaran dan tahap kepintaan muzik rendah secara signifikan berbanding dengan mod TI dan AIT. Secara relatif, mod olahan mempunyai sumbangan tertinggi diikuti oleh tahap kepintaran muzik, tahap kebimbangan dan lokus kawalan. Tidak terdapat perbezaan signifikan terhadap kesukaan dan tidak kesukaan dalam ketiga-tiga koswer. Pada keseluruhannya, prinsip *modality* dan *redundancy* patut dipertimbangkan dalam reka bentuk dan pembangunan bahan pembelajaran ‘Teori Muzik’ supaya mutu pembelajaran dapat dipertingkatkan.

Effects of Modality and Redundancy Principles on the Learning of Music Theory and Attitude among Primary Pupils of Different Aptitudes in Jordan

ABSTRACT

The purpose of this study was to investigate the effects of modality and redundancy principles on the attitude and learning of music theory among primary pupils of different aptitudes in Jordan. The lesson of music theory was developed in three different modes, audio and image (AI), text with image (TI) and audio with image and text (AIT). A 3×3×2 quasi experimental factorial design was adopted in this research. The independent variables were the three modes of courseware. The moderator variables were music intelligence, locus of control and trait anxiety. The dependent variables were the post test score and attitude. The study sample consisted of 405 third-grade pupils and were randomly (simple random sample) selected from six different primary co-education schools. Descriptive and inferential statistics were conducted to analyze the collected data. ANOVA was used to determine the significant differences of the pretest scores among the three groups. Analyses of covariance (ANCOVA) and Post hoc were carried out to examine the main effects as well as the interaction effects of the independent variables on the dependent variables. Simple and Multiple Regression Analysis were used to determine the relative contribution of each factor to the changes in the dependent variable. Seven main hypotheses with six sub- hypotheses were postulated and tested.

The findings of this study showed that pupils using the AI mode performed significantly better than those in the TI mode. Pupils using the TI mode did not perform significantly better than those in the AIT mode. Medium anxiety pupils

performed significantly better than low and high anxiety pupils in all the three treatment modes. Internal locus of control pupils performed significantly better than external locus of control pupils in all the three treatment modes. High music intelligence pupils performed significantly better than low music intelligence pupils in all the three treatment modes. The AI mode was found to help pupils with high anxiety, external locus of control and low music intelligence significantly more than the TI and AIT modes. The treatment modes provided the highest relative contribution to the post-test scores. The second highest relative contribution to the post test score is music intelligence followed by anxiety and locus of control. There were no significant differences in the preference or dislikes towards the three modes of courseware. Overall, the modality and redundancy principles need to be considered in the design and development of music theory learning so as to promote better learning.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Music theory is the field of study that deals with how music works. It basically addresses the language and notation of music in which music can be read and written. It helps to identify the different patterns and structures revealed in the techniques of composers, across or within genres, styles, or historical periods (Nosir, 1980). Music theory can be considered as a universal language as it has a universal context and notations (Chew, 2005).

Since music theory concentrates on how music notation is written (i.e. the elements of the notation) it provides a form of communication for musicians to express their musical concepts (Aldalala, 2003). However, music theory also includes underlying concepts of music such as the structure, the organization and the history (Smith, 2009). These underlying concepts contribute towards building the basic knowledge in music notation and understanding the evolving stages in music as well as the way the notation is used in different circumstances. Accordingly, the theory of music includes the following basics:

1. The elements of standard music notation such as Staves, Clefs, note lengths, note pitches, key signatures, time signatures, beats and bars (i.e. measures).
2. Underlying concepts such as scales, keys, intervals and rhythm.
3. Advanced elements such as dynamics and phrasing (notated with slurs).

4. Advanced concepts such as the history of notation and the form of music theory.

The studies conducted by Wilson (2005) Mcvay (2004) and Guderian (2008) have found that many students encounter difficulty in reading music theory and, hence, have difficulty in learning music. Many Arab countries are reviewing their music curriculum to enhance music theory in music education. Jordan is one of the countries that is currently undergoing a review of the music education curriculum (Yaghmour, 2007).

Degamat (1997) and Haddad (2002) summarized the current curriculum and pedagogy of music theory in Jordan as follows:

- No comprehensive music curriculum exists in Jordan.
- Inability of the teachers to realize the needs and abilities of pupils in music learning.
- No modern music teaching methods are available.
- Lack of research and development efforts by the Ministry of Education to develop new music teaching methods.
- Conventional methods of using sounds, pictures and texts were not effective in learning music theory.
- The characteristics of music theory such as regular construction of complex music theory contents make music theory a difficult topic to master.
- Teachers use audio, image and text as the main methods for teaching music theory and the textbooks and blackboards are the major tools used in music theory learning.

Alwan (2008) reported that music theory is being taught in Jordanian schools using only traditional methods and not supported by computer-based tools. Ramzy & Alabdaly (2005a) found that most pupils indicated that these conventional teaching

methods were not helpful in the learning process and they could not remember or understand music theory in depth. In addition, the students could not apply music theory correctly. From a preliminary survey conducted by the researcher (*as a member of the national team to develop music curriculum at the Ministry of Education in Jordan*) among 53 primary school music teachers in Irbid Governorate (Jordan), it was found that 81% of the teachers indicated that they faced problems in the teaching and learning of music theory effectively.

Obeidat (2008) reported that even though highly competent music teachers in the classroom use audio, image and text in teaching and learning of music theory, the students performance was still very low.

To deal with the problem of weaknesses in understanding music theory, Aldalalah (2003) suggested approaching the problem through designing a computer based learning program. The results showed a marked improvement in the students' level of understanding. In this regard, Obeidat (2003) and Dyabat (2007) conducted a study to investigate the effects of using computerized instructional programs in learning music theory. The results showed that computer-based learning significantly assisted the students in learning music theory.

Thus it is apparent from the review of these studies that the traditional way of learning music theory audio, image and text may not enhance or facilitate the learning process. According to Mayer and Moreno (2008), redundant onscreen text in a multimedia presentation may overload the visual channel. This is because the image comes into the pupils' cognitive system through the eyes in order to be processed in the visual channel. The printed text too enters through the eyes and must

be processed in the visual channel. Due to the limited cognitive resources in the visual channel that have to be utilized to process both the image and the text, an overload in the visual channel may occur.

The researcher contends that the appropriate application of modality and redundancy of instructional design principles in computer-based learning could effectively enhance the learning of music theory.

In this respect, the modality and redundancy principles offer a feasible approach if they are integrated into computer-based learning as the instructional design. According to Sweller, (1999) and Mayer's theory of multimedia learning (Mayer, 2001), replacing visual text with spoken text (the modality effect) may increase the effectiveness of instructional multimedia. Images are transported along the visual channel while the narration text is transported along the auditory channel resulting in an increase in the working capacity of the memory resulting in greater ease of learning (Seufert, Schu & Nken, 2009). Furthermore, onscreen text accompanied with images in a multimedia presentation may overload the visual channel. In addition, using image, onscreen text and audio narration in which the audio repeats the text will also cause an overload due to the redundancy in the presented material. This extra effort or attention needed by the students to handle such information streams is considered as a disadvantage for the acquisition of both the words and pictures (Clark & Mayer, 2008).

Cronbach (1957) suggested that optimal learning among a wide range of students requires a wide range of instructional modes or environments that suit the individual students' aptitude and learning styles. Such a phenomenon is explained by the aptitude-treatment-interactions (ATI) strategy proposed by Cronbach & Snow

(1997). Aptitude is defined as any individual characteristic that could increase or decrease the student's probability of success in a given treatment. The treatment is defined as variations in the mode or pace of instructions. Studies conducted by Cronbach (1957), Swanson (1990), Shute (1994) and Fong (2000) showed that the learning outcomes of students were indeed better when the modes of instruction were adapted to the student's aptitude and psychological profiles. This research therefore investigates the aptitude-treatment-interactions (ATI) proposed by Cronbach (1957). This research also investigates the aptitude-treatment-interactions (ATI) among students of differing anxiety levels, internals-externals and music intelligence levels with the three modes of presentations (AI, TI and ATI) on the learning of and attitudes of the pupils toward music theory.

1.2 PROBLEM STATEMENT

The problem to be investigated in this study stems from the researcher's previous experience in teaching music to primary school pupils as well as being a member of the National Team for the Development of the Music Curriculum in Jordan. The researcher found that primary grade pupils cannot understand music theory in depth because they were taught using the traditional methods which did not take the different aptitudes and attitudes of the students into consideration. Accordingly, the music theory did not have any significant impact on the pupils' music education and, as a consequence, the desired goals of teaching music were not achieved using the conventional teaching methods. Many researchers such as (Degamat (1997), Haddad (2002), Yaghmour (2007) & Alwan, 2008) have cited several reasons pertaining to this problem. These reasons are listed as follows:

- Teaching music theory is held by some teachers perfunctorily in order to fulfill their job requirement.
- Teaching music theory faces some restrictions arising from the examination system. Usually, there is not enough time to teach music theory in details.
- Many teachers still use conventional teaching methods which can be tedious and boring with no motivation for pupils to learn.

From the questionnaire conducted by the researcher it was found that 66% of the pupils indicated that they faced problems in the remembering and understand music theory effectively.

Dyabat (2007) noticed the ineffectiveness of the instructional design in the conventional teaching methods using the book and blackboard in teaching music theory. The conventional teaching methods were not effective in helping the third graders in Jordan to understand music theory. This resulted in a weakness in understanding and experiencing the entire music theory and the inability to achieve the desired goals (Obeidat, 2008; Yaghmour, 2007; Yaghmour and Aldalalah, 2007; Obeidat, 2003; Haddad, 2002; Abu Zeyad, 2002; Degamat, 1997).

Aldalalah (2003) reported that in spite of teachers using sound, picture and text in their teaching, students were still not performing as expected. According to Mayer (2001), he showed that adding redundant text to the working memory capacity resulted in poorer student learning. The study showed that establishing relationships between different sources of information may be difficult for the learners because they have to deal with multiple representations. Various forms of redundancy can

interfere with the learning and, hence, the variety should be eliminated (Mayer, 2001; Sweller, 1999). According to the cognitive load theory, it assumes that the working memory includes different channels for visual and auditory information processing (Baddeley, 1996). The cognitive load theory also assumes that human memory processing consists of multiple memory registers (stores) which include a very limited working memory and an extensive long-term memory. The working memory is limited in the capacity and in the duration when dealing with novel information (Mayer & Moreno, 2003, Moreno, 2006).

The researcher contends that the learning of music theory can be improved if the modality and redundancy principles are taken into account. Therefore, the study necessitates carrying out a research on three different educational software that deal with various aspects, in particular,

- Audio and Image compared to Text and Image to test the modality principle.
- Audio, Image and Text and Text, Image compared to (Audio, Image and Text) to test the redundancy principle.

Such tests are based on the cognitive theory of multimedia learning while measuring the impact on pupils' remembering and understanding capabilities. In the proposed instructional software applications, the pupils should be able to identify the theories of music and their concepts in an enjoyable and artistic style presented in the form of computerized music lessons. These lessons will take advantage of the text, images and sounds offered by the multimedia application in this area.

Hence, the focus of this study is the music instructional multimedia program. It aims to study the relationship between the computer and music while considering the cognitive theory principles (i.e., modality and redundancy principles). The above instructional computerized programs are so designed to obtain better results in teaching music theories while taking into consideration the individual differences among the pupils in the primary third grade. The study variables under focus will be with respect to anxiety level, internal as well as external locus of control and the level of musical intelligence.

The main purpose of this study is to find out to what extent the computer-based courseware may improve the learning of music theory among third grade Jordanian pupils. Specifically, the study investigates if there are any significant differences in music theory learning between pupils taught via the Audio, Image (AI) mode, Text, Image (TI) mode and the Audio, Image & Text(AIT) mode.

1.3 RESEARCH FRAMEWORK

The research framework in Figure 1.1 shows the relationships between the different variables under investigation.

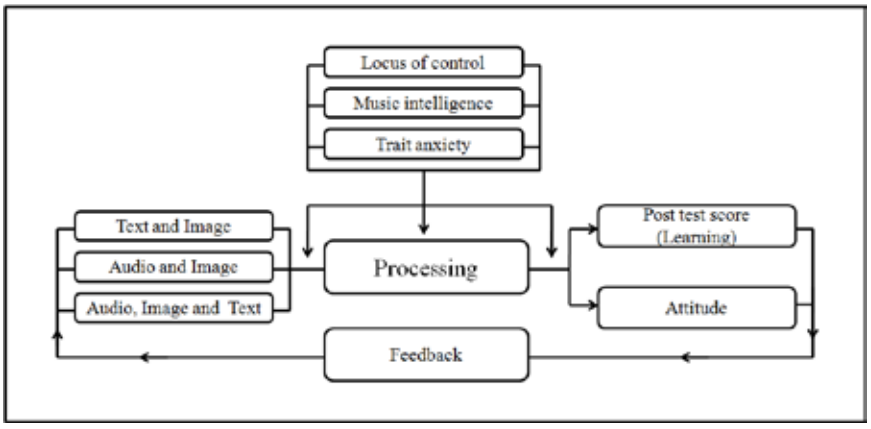

Figure 1.1 Research Framework

The research framework depicts three variables. The independent variables are the three treatments of Audio with Image, Text with Image and Audio, Image with Text. The dependent variables are learning and attitude. The moderating variables are locus of control, music intelligence and trait anxiety. The three moderating variables present in this study and they give a strong contingent effect on the relationships between the independent and dependent variables. The effect of using the three treatments, “The three software applications” on learning and attitude, will be identified by measuring the overall learning of and attitude towards music theory in the third grade class.

1.4 RESEARCH OBJECTIVES

There are four main purposes of this study:

1. The design and development of three modes of courseware, particularly: Text and Images (TI), Audio and Images (AI) and Audio, Images and Text (AIT).
2. Evaluating the impact of modality and redundancy principles on the learning of music through computer based learning.
3. Identifying the attitude of the third primary graders with regards to learning from computer based learning.
4. Conducting an aptitude treatment (Locus of control, Anxiety, Music intelligence) to investigate the possible interaction effects of the aptitude of the pupils in the three treatments.

1.5 RESEARCH QUESTIONS

The research questions that drive this study are as follows:-

1. Will pupils using the Audio, Images (AI) mode attain significantly higher post test score (PTS) than pupils using the Text, Images (TI) mode, while pupils

using the Text, Images (TI) mode will not attain significantly higher post test score (PTS) than pupils using the Audio, Images, Text (AIT) mode?

2. Will pupils with medium anxiety (MA) attain significantly higher post-test scores (PTS) than low anxiety (LA) pupils while pupils with low anxiety (LA) attain significantly higher post-test scores (PTS) than high anxiety (HA) pupils?

2.1. Will pupils with high anxiety (HA)using the Audio, Images (AI) mode attain significantly higher post-test scores (PTS) than high anxiety (HA) pupils using the Text, Images (TI) mode, while pupils with high anxiety (HA) using the Text, Images (TI) mode will not attain significantly higher post-test scores (PTS) than high anxiety (HA) pupils using the Audio, Images, Text (AIT) mode?

2.2. Are there interaction effects between treatment modes and anxiety on the post-test scores (PTS)?

3. Will pupils with internal locus of control attain significantly higher post-test scores than external locus of control pupils?

3.1. Will pupils with external locus of control using the Audio, Images (AI) mode attain significantly higher post-test scores (PTS) than external locus of control pupils using the Text, Images (TI) mode, while pupils with external locus of control using the Text, Images (TI) mode will not attain significantly

higher post-test scores (PTS) than external locus of control pupils using the Audio, Images, Text (AIT) mode?

3.2. Are there interaction effects between treatment modes and locus of control on the post-test scores?

4. Will pupils with high music intelligence (HMI) pupils attain significantly higher post-test scores than low music intelligence (LMI) pupils?

4.1. Will pupils with low music intelligence (LMI) using the Audio, Images (AI) mode attain significantly higher post-test scores (PTS) than low music intelligence (LMI) pupils using the Text, Images (TI) mode, while pupils with low music intelligence (LMI) using the Text, Images (TI) mode will not attain significantly higher post-test scores (PTS) than low music intelligence (LMI) pupils using the Audio, Images, Text (AIT) mode?

4.2. Are there interaction effects between treatment modes and music intelligence on the post-test scores (PTS)?

5. Will the treatment modes of presentation have the highest contribution to the post-test scores (PTS). Will Music intelligence have a higher contribution to the post-test scores (PTS) as compared to locus of control while locus of control will have a higher contribution to the post-test scores as compared to Anxiety Levels?

6. Will pupils using the Audio, Images (AI) mode attain significantly higher attitude scores (AS) than pupils using the Text, Images (TI) mode?

7. Will pupils using the Text, Images (TI) mode attain significantly higher attitude scores (AS) than pupils using the Audio, Images, Text (AIT) mode?

1.6 RESEARCH HYPOTHESES

Based upon the literature reviews alternate directional hypotheses were designed for this study:

H_1. Pupils using the Audio, Images (AI) mode will attain significantly higher post test score (PTS) than pupils using the Text, Images (TI) mode, while pupils using the Text, Images (TI) mode will not attain significantly higher post test score (PTS) than pupils using the Audio, Images, Text (AIT) mode.

H_2. Medium anxiety (MA) pupils will attain significantly higher post test score (PTS) than Low anxiety pupils, while Low anxiety (LA) pupils will attain significantly higher post test score (PTS) than high anxiety (HA) pupils.

$H_{2.1}$ High anxiety (HA) pupils using the Audio, Images (AI) mode will attain significantly higher post test scores (PTS) than high anxiety (HA) pupils using the Text, Images (TI) while high anxiety (HA) pupils using the Text, Images (TI) mode, will not attain significantly higher post test scores (PTS) than high anxiety (HA) pupils using the Audio, Images, Text (AIT) mode.

$H_{2.2}$There are interaction effects between treatment modes and anxiety on the post test score (PTS).

H_3. Internal locus of control pupils will attain significantly higher post test score (PTS) than external locus of control pupils.

$H_{3.1}$.External locus of control pupils using the Audio, Images (AI) mode will attain significantly higher post test score (PTS) than external locus of control pupils using the Text, Images (TI) mode, while external locus of control pupils using the Text, Images (TI) mode will not attain significantly higher post test score (PTS) than external locus of control pupils using the Audio, Images, Text (AIT) mode.

$H_{3.2}$ There are interaction effects between treatment modes and locus of control on the post-test score (PTS).

H_4. High music intelligence pupils (HMI) will attain significantly higher post test score (PTS) than Low music intelligence (LMI) pupils.

$H_{4.1}$.Low music intelligence (LMI) pupils using the Audio, Images (AI) mode will attain significantly higher post test scores (PTS) than Low music intelligence (LMI) pupils using the Text, Images (TI) mode, while Low music intelligence (LMI) pupils using the Text, Images (TI) mode will not attain significantly higher post test scores (PTS) than Low music intelligence (LMI) pupils using the Audio, Images, Text (AIT) mode.

$H_{4.2}$There are interaction effects between treatment modes and music intelligence on the post-test score (PTS).

H_5. The treatment modes of presentation will have the highest contribution to the post test score (PTS). Music intelligence will have a higher contribution to the post test scores (PTS) as compared to locus of control. While Locus of control will have a higher contribution to the post test scores as compared to Anxiety Levels.

H_6. Pupils using the Audio, Images (AI) mode will attain significantly higher attitude scores (AS) than pupils using the Text, Images (TI) mode.

H_7. Pupils using the Text, Images (TI) mode will attain significantly higher attitude scores (AS) than pupils using the Audio, Images, Text (AIT) mode.

1 .7 SIGNIFICANCE OF THE STUDY

This research study is useful for curriculum designers. It would help them understand the importance and effect of varied implementation of the modality and redundancy principles through instructional programs on music learners. It contributes to developing new musical teaching strategies, musical skills and learning methods taking into consideration the perceived role of music in our life as well as our education. It would provide them the design and help develop an instructional program with three musical learning treatments (i.e., software applications) in the learning of music theory on the third grade primary pupils. This is by employing multimedia in the three instructional programs (the first program

was an audio/image, the second was text/ image, the third was audio/ image/ text). The significance and relevance of such studies such as the present study is validated by scholar Obeidat (2008, p 125) who states that,

> *This study aimed at knowing the most important musical computer programs and areas of using these programs in music education, and knowing the important benefits that these programs accomplish in developing the musical skills of the learners, and the study community consisted of the users of these programs.*

In this regard, the findings and results of this study will be useful in encouraging music teachers and teaching materials designers to consider the significance and effects of varied implementation of the modality and redundancy principles through instructional programs and incorporate them in the present music teaching and learning materials. Furthermore, this study will have great contributions to research in music theory in a Jordanian context. The Jordanian Ministry of Education along with the Ministry of Culture are putting in great efforts to activate the role of music in education and using computer-based programs as instructional aids in the teaching and learning process.

Consequently, the current research hopes to shed light on the significance of varied implementation of the modality and redundancy principles through instructional programs and their contributions to the learning of music theory. This study is important as it goes beyond the traditional approaches by making comparisons within a single method in an attempt to present information in a way that can enable the learners to handle such music theory knowledge. In contrast, the

traditional methods which have no theoretical basis would only yield confusing results and contribute to ineffective learning by pupils. Its importance is related to its emphasis on the aptitude-treatment which looks into one's improved characteristics acquisition by presenting treatments or applications that meet the abilities and readiness of the individual.

Finally, this study focuses on pupils' attitudes toward computer-based learning and the relationship between different treatments and student attitudes toward the learning of music theory using the computer.

1.8 THEORETICAL FRAMEWORK

The theories underlying this study are as follows:

A. Cognitive Theory of Multimedia Learning
B. Cognitive Load Theory

1.8.1 Cognitive Theory of Multimedia Learning:

According to Mayer (2001) when watching a multimedia presentation, the information processing system in human beings uses both words (printed text, spoken text) and pictures (drawing, charts, graphics, maps, photos, animation and video) together rather than words alone. The design of multimedia environments should be compatible with how people learn. Mayer (2001) presented a cognitive model of multimedia learning to present the human information processing system (Figure 1.2).

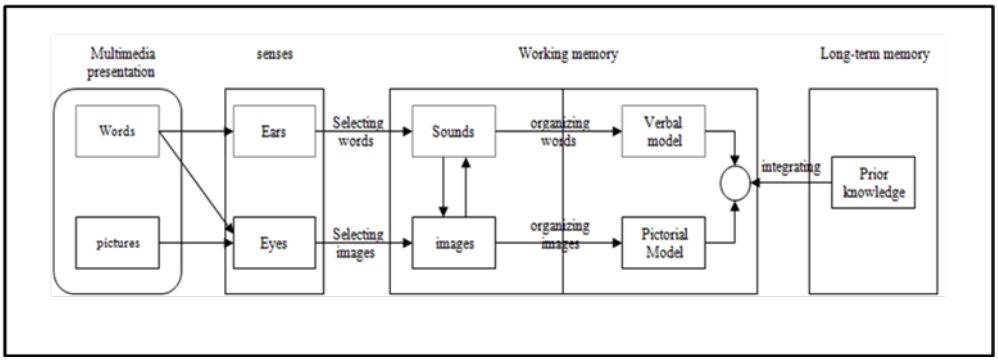

Figure 1.2 Cognitive Theory of Multimedia Learning

(Mayer, 2001)

In Figure 1.2 there are three frames, "second, third, fourth", of human memory that store Sensory, Working and Long-term memory. Pictures and words come in from the outside world through a multimedia presentation and enter sensory memory through the eyes and ears (included in the sensory memory frame). Sensory memory allows for pictures and printed text to be held as exact visual images for a very brief time period in the visual sensory memory and for spoken words and other sounds to be held as exact auditory images for a very brief time period in the auditory memory. The arrow from the pictures to the eyes corresponds to a picture being registered in the eyes; the arrow from the words to the eyes corresponds to the printed text being registered in the eyes.

The central work of multimedia learning takes place in the working memory. Mayer (2001) advocated that the working memory is used for temporarily holding and manipulating knowledge in active consciousness. The visual sensory memory and the auditory memory go into the working memory, that is, the visual images of pictures and sound images of words as represented in the left hand side of the box labeled working memory in Figure 1.2. The arrow from sounds to images represents the mental conversion of a sound (such as the spoken word “stave”) into a visual

image (such as an image of a “stave”), that is, when you hear the word “stave”, you might also form a mental image of a “stave”. The arrow from images to sounds represents the mental conversion of a visual image into a sound image, that is, when you see a picture of a “stave” you may mentally hear the word “stave”. These processes may occur by mental association in which the spoken word “stave” primes the image of a “stave” and vice versa. In contrast, the right side of the working memory box represents the knowledge constructed in working memory pictorial and verbal mental models and link between them. The major cognitive processing required for multimedia learning is represented by the arrows labeled selecting images, selecting sound, organizing images, organizing words, and integrating.

The box labeled long-term memory is the learner’s storehouse of knowledge. Unlike the working memory, long-term memory can hold large amounts of knowledge over long periods of time. For a person to actively think about material in the long-term memory, it must be brought into the working memory (as indicated by the arrow from long-term memory to working memory).

The learner represents an active agent in the learning process via multimedia. He attempts to construct a meaning for the information presented through the following three major mental processes: Selection, Organization and Integration. Selection is a mental process where the individual learner pays attention to relevant information presented to him verbally or non-verbally. Mayer (1984) defined selection as choosing the right information and adding it to the working memory.

On the other hand, Paivio (1986) defined selection as a process that involves selecting verbal stimulation "words" to construct verbal base "text base" and selecting non-verbal stimulation to build non-verbal base "pictorial base" information to be sent to "short-term memory".

After the leaner has selected the verbal and non-verbal information, the next step is organization. This process involves ordering and organizing information that have been selected meaningfully and logically. Clark and Mayer (2008) states that organization is a mental process performed on text “selected words" in order to organize them in a verbal model that is capable of interpreting this verbal information.

The organization process is also performed on image base "selected images" to organize them in an image model capable of intercepting them. As the verbal model and visual model are constructed, the integration process follows. Integration means making connection between the verbal and image models. Moreno & Mayer (1999) indicated that such processes involve connecting organized information in the verbal and image models with relevant and similar information stored in long term memory. Paivio (1986) indicated that integration involves making referential connections between both verbal and image models.

As such, we can see that in multimedia, information is presented to the learner in more than a single form such as words, images, motion pictures, sounds and other forms. Therefore, it is necessary to know how the learner processes

information presented to him via Multimedia that fits his mental processing style and which will facilitate his construction of correct and good mental models.

1.8.2 Cognitive Load Theory

According to Toh (2005) cognitive load theory is one of the theories that is related to mental processes and learning, Cognitive load theory (Paas, Renkl & Sweller, 2003) is a set of principles and guidelines to design and deliver instructional environments that promote learning by utilizing the limited capacity of working memory and minimizing working memory overload. Cognitive load theory assumes a limited working memory capacity that includes partially independent subcomponents for auditory/verbal information and visual information and assumes an unlimited long-term memory capacity holding schemas that vary in their degree of automation (Kalyuga, Ayres, Chandler & Sweller, 2003).

Cognitive load theory suggests that many instructional designs are ineffective because they ignore universal and fundamental aspects of cognition (Sweller, 2005). The theory has three components: a cognitive architecture explained by evolutionary principles and specified as a natural information processing system; a division of cognitive load into three additive categories; and instructional effects that flow from human cognitive architecture and the categories of cognitive load.

When processing integrated information, students are able to avoid the extraneous cognitive load imposed when one source of information is held in working memory while searching for its associated referent (Paas, Tuovinen, Tabbers & Van, 2003). In this way, adjacent and mutually referring instructional

elements permitted scarce working memory resources to be directed towards constructing schemas rather than searching for the necessary relations between elements. Similarly, in the dual-modal condition, restructuring the same information across two modes facilitated students' schema construction by making available for learning the expanded processing capacity of combined visual and auditory working memories. In contrast, it is assumed that the extraneous cognitive load generated by the split-attention format interfered with learning by imposing an additional, and excessive, load on limited working memory capacity (Paas, Renkl & Sweller, 2004). The total amount of mental activity imposed on working memory in an instance of time is known as cognitive load, which has been found to have three distinct parts (Sweller, 1994):

1. Intrinsic load includes the inherent complexity of the subject matter and reflects the level of difficulty of the material to be learned.
2. Extraneous cognitive load is generated by the manner in which information is presented to learners and is under the control of instructional designers. This load can be attributed to the design of the instructional materials.
3. Germane load relates to the effort involved in processing and automating new information. Automation helps overcome working memory limitations and decreases cognitive load.

According to Sweller (2006) ccognitive load theory highlights several practices that can be applied to training and performance improvement. The most fundamental of these include methodologies for reducing the effects of the extraneous cognitive load of instructional materials to ensure optimal leaning.

1. 9 LIMITATIONS OF THE STUDY

This study investigates the effects of varied implementation of modality, and redundancy principles through an instructional program that handles the learning of music theory on third grade primary pupils at ALKORAH Directorate of Education in Jordan.

The limitations of this study are as listed below:-

- This study is limited to music theory and thus may restrict generalizing the findings of the study to other units in the music curriculum.
- This study is limited to two principles of cognitive theory of multimedia learning.
- The results of this study only apply to primary third (lower level of education) graders within ALKORAH provincial School District in Jordan and therefore cannot be generalized to other music learners. (The researcher is aware that there are other important features that contribute to learning music).
- This study was conducted not in the natural setting of the class as it was conducted in the computer laboratory.
- Curriculum for music in Jordan Government schools is different from the curriculum of music in Jordan private schools. So the population in this study is limited to students in government schools. The results from this study may not be generalized to the private schools in Jordan.
- This study is moderated by three aptitudes (Anxiety, Locus of control and music intelligence).
- This study is limited to three modes of courseware.

- This study is limited to the effects of modality and redundancy principles for lower order thinking applications of music theory learning among third grade pupils.
- The final limitation is associated with measuring pupils' learning, attitude and moderator variables which were assessed via achievement tests, questionnaires and scales; such assessment procedures may be insufficient as there were no verbal reports that measure the direct observation of the pupils' interaction and strategy used and its development.

1.10 OPERATIONAL DEFINITIONS

- **Anxiety**: is a psychological and physiological state characterized by cognitive, somatic, emotional, and behavioral components. These components combine to create the painful feelings that we typically recognize as anger, fear, apprehension, or worry. Anxiety is often accompanied by physical sensations such as heart palpitations, nausea, chest pain, shortness of breath, stomach aches, or headache (Sawalha & Asafa, 2008). In this study, it means individual differences in the disposition to experience feelings of apprehension and being worried in an academic environment especially music learning.

  High Anxiety: In this study pupils with high levels of anxiety have low performance levels in the learning of music theory. The value of high anxiety is 62 and above in the anxiety scale**.**

  Medium Anxiety: In this study pupils who report medium levels of anxiety perform better in the learning of music theory. The value of medium anxiety from 44 to 61 in the anxiety scale**.**

Low Anxiety: In this study pupils with low levels of anxiety have medium performance levels in the learning of music theory. The value of low anxiety is 43 and below in the anxiety scale**.**

- Attitude: Attitude is a hypothetical construct that represents an individual's like or dislike for an item. Attitudes are positive, negative or neutral views of an "attitude object": i.e. a person, behavior or event. People can also be "ambivalent" towards a target, meaning that they simultaneously possess a positive and a negative bias towards the attitude in question. And the A concept of attitudes as an evaluation, identifying topics and issues as, “good, bad, harmful-beneficial, pleasant-unpleasant, and likable-dislikable” (Ajzen, 2001). The attitude an affective position toward a fact, entity, or condition based upon strongly held beliefs. Pohan and Aguilar (2001) relate that attitudes are comprised of multiple beliefs that are employed to predict a person’s behavior. In this study, it means positive, negative or neutral feeling and perception of the pupils toward computer based courseware. Their attitude was measured through the questionnaires and music software in the treatments.
- **Attitude questionnaire:** a questionnaire adopted and adapted to measure learning tendencies through music theory program.

Attitude Score (AS): scores of the pupils in the attitude questionnaire.

Positive Attitude: positive tendencies of the pupils about learning through the music theory program. The value of positive attitude is 47 and above in the anxiety scale**.**

Neutral Attitude: neutral tendencies about learning through music theory program. The value for neutral attitude is from 34 to 46 in the attitude questionnaire**.**