Music Intelligence and Music Theory Learning:

A Cognitive Load Theory Viewpoint

Osamah (Mohammad Ameen) Ahmad Aldalalah

School of Educational Studies, Universiti Sains Malaysia

Minden 11800, Penang, Malaysia

Tel: 60-1-7413-2557   E-mail: usm.osamah@gmail.com

Soon Fook Fong (Corresponding author)

School of Educational Studies, Universiti Sains Malaysia

Minden 11800, Penang, Malaysia

Tel: 60-4-653-2968   E-mail: sffong05@gmail.com

Abstract

The purpose of this study was to investigate the effects of cognitive load theory and the role of music intelligence on the learning of music theory among Jordanian primary pupils. The independent variable was music intelligence levels (high, low). The dependent variables were the post test score. An analysis of covariance (ANCOVA) was carried out to examine the main effects of the independent variables on the dependent variables. The findings of this study showed that pupils with high music intelligence pupils performed significantly better than low music intelligence pupils.

Keywords: Music theory, Cognitive load theory, Music Intelligence

1. Introduction

Over the recent decades of the 20th century, international educational systems along with the important role of the teachers in community development have emphasized the need for quality education systems with specific focus on the preparation of the teacher in terms of mental aptitudes and abilities (Qtami, 2005). The great potentials of the human mind and how it may be developed demonstrates the importance of having open minded learners who meet the expectations of their communities and perform effectively for the post-industrial community. This necessitates a higher level of cognitive adaptability in the third millennium (Otoum, 2003). To achieve such a goal, planning of curricula was sought in order to develop textbooks that are writtem based on the findings of academic research in psychology and the related cognitive psychology fields. Psychology research indicates that students differ in their intelligence and how they learn. The adoption of one traditional teaching style that depends on reiteration or lecturing would make students feel bored. Psychologists, however, have long been interested in developing many teaching strategies to meet different learning styles (Gnam, 2005). Among the newly established teaching methods is the one which is based on the multiple intelligence approach by Howard Gardner. Intelligence plays a significant role in human life since there is a strong relationship between intelligence and achievement implying that the higher the level of intelligence, the greater the achievement and hence, greater distinction and academic success.

2. Music theory

Many scholars such as Nosir (1980) define music theory as the area in which music works are studied. It mainly deals with the language and notion of music where it is composed and interpreted. It assists to categorize the various music patterns and structures experienced in the process of composition throughout genres, styles or during historical periods. According to Chew (2005) music is a language that possesses both universal context and notations. On the other hand, Aldalalah (2003) argues that music provides a unique structure for musicians to reveal their musical concepts. This is because it focuses on music notation is composed in terms of the components of the notation. Also, it involves basic musical concepts that may be observed in forms of the structure, the organization and the history (Smith, 2009). These musical concepts have an important role in establishing the necessary knowledge for interpreting the development stages in music and the mode in which the notation is utilized in various situations.

3. Musical Intelligence and Learning

Musical intelligence is described as the feeling of musical pitches, sound rhythm and tempo as well as being emotionally affected by such musical components (Gardner, 1983). Intelligence, however, is easily seen in the learners who can automatically remember melodies, identify pitches and rhythms. Learners are thus described as more inclined to hear music and are highly sensitive to sounds around them (Gardner, 2000). Gardner (2004) argued that musical intelligence varies according to people as everyone has his own musical ability, while some others have nothing to do with music. Musical intelligence is related to the identification of tones, melodies, sounds, rhythm, and tempos, particularly, the sense of tone types, melody composition, and sensitivity to sounds as well as using charts for music hearing and understanding musical structure. Musical intelligence is the most emerging type of intelligence in the early stages of a person's life (Al-Ahdal, 2009). It can be identified by the followings characteristics: a disposition to music hearing and attraction to songs, a tendency to read music related topics, playing musical instruments, making musical compositions, writing songs, recognizing consistent and inconsistent sounds, memorizing more songs and melodies, self-singing while doing tasks, easily memorizing melodies, listening to bird sounds, imitating sounds, and a desire to let others listen to the person's voice (Gardner, 2003; Afanan &Alkzindar, 2004).

The educational practice and the day-to-day interaction between the teachers and students at different school levels are helpful in identifying the students' intelligence types. Other entities such as family members can also assist in identifying their interests and preferences. In the following section, a discussion of some behavioral indications that can be used to identify intelligence types in the learners is presented. Such indications may be helpful for the students to accomplish a fruitful and affective learning experience (Dobbs, 2001). A number of researchers have been interested in the degree to which music aptitude or music experiences are related to academic achievement. Using data from first and fourth graders, Lamar (1989) found a significant and positive relationship between music aptitude and reading and one that approached significance for mathematics. Music aptitude was also high related with academic achievement in eight to 12-year-old students. A positive relationship was found for those high schools whose bands participated in festival concerts and SAT scores (Johnson, 2000). According to Luiz (2007) music improves the development of our brains and helps to improve our abilities in other subjects such as reading and mathematics. From simple sums to complex functions, mathematical concepts form part of the world of music. Because in this connection, it is possible to establish a positive correlation between participation performance in music and cognitive development in mathematics. Gardner's theory of multiple intelligences incited several researchers to re-examine the relationships between musical experiences, music learning, and academic achievement. The majority of studies have found that the most significant relationships are between music and mathematics, or to be more specific, between music and spatial-temporal reasoning (important in mathematical concepts), and music and performance in reading. With regard to the former relationship, the assumption is based on a group of studies which explore the effects of learning to play the keyboard on spatial-temporal reasoning, suggesting that mastering a musical instrument helps one to develop an understanding of Mathematics. According to Gouzouasis, Guhn & Kishor (2007), who examined the relationship between participation and achievement in music and achievement in academic courses, based on data from three consecutive British Columbia student cohorts, it was consistently found that music participation was associated with generally higher academic achievement across the three cohorts.

Many studies confirmed the effect of music on achievement. Khalil (2005), for example, showed that Mathematics scores improved for 6th, 7th, and 8th grades students learning to play musical instruments in Saudi Arabia. However, students with musical intelligence and who have inclination for music, possess thinking skills that differ from normal students (Hussein, 2008). Christopher and Memmott (2006) demonstrated that involvement of students with musical intelligence in various musical instructional courses, playing music or even listening to music would improve their achievement compared with their peers who have similar characteristics but lack such musical intelligence (Babo, 2004). Further, musical intelligence not only improves musical achievement but would also have perceived effect on achievement in many subjects (Gouzouasis, Guhn & Kishor, 2007). Gouzouasis, Guhm & Kishor (2007) further indicated that time allotted for musical activities helps academic superiority. On the other hand, listening to music while learning is a contributing factor to academic superiority basically in artistic fields that improves thinking to higher and deepened levels (Gur, 2009). Music improves brain functionality and intrinsic skills of learners primarily in literacy and Mathematics (Luiz, 2007). This result would be accounted for by the outstanding features of music that develop many developmental aspects of children including cognitive development as proven by the multi-intelligence theory. Reportedly, music improves literacy among children, provides a repertoire of lyrics and songs that imply meaningful educational content (Omari, Alhirsh, Aldalalah, & Al-Ababneh, 2010). Finally, there is a strong relationship between multi-intelligences and musical aptitude. This

result received support from Chan (2007) who conducted a study with talented students in Hong Kong. It is therefore essential to pay greater attention to musical intelligence of students in classrooms when studying different subjects including a music class.

4. Cognitive Load Theory and Learning

Cognitive Load Theory (CLT) suggests that the instructional methods should be dynamic based on the cognitive load that is imposed on the working memory (Jeroen, Enboer & Sweller, 2005). Therefore, CLT employs the connections between the information structures and the human cognitive knowledge to establish an instructional design to reduce the redundant or irrelevant cognitive load. The reduction of the irrelevant cognitive load considers the relations between working memory and long-term memory (Sweller, Paas & Renkl, 2003). CLT also has its methods of adapting and responding to the needs of individual learners (Van & Ayres, 2005). Moreover, to effectively utilize the limited capacity of an individual's working memory, the CLT offers principles and methods to design and deliver efficient instructional environments (Paas, Renkl & Sweller, 2003).

The CLT also assumes that the human processing memory consists of multiple memory stores including a very limited working memory and an extensive long-term memory. The working memory is limited in capacity and in time when dealing with novel information (Mayer & Moreno, 2003). However, the limitations of the working memory make it difficult for the learner to understand multiple information elements simultaneously (Artino, 2008). There are three types of cognitive load: intrinsic, extraneous, and germane (Deleeuw & Mayer, 2008). Since, the cognitive load interactivity is intrinsic, then altering the interactivity by instructional interventions is not possible. Extraneous cognitive load suggests that an inappropriate instructional design that requires a considerable amount of working memory resources may impose a heavy cognitive load and thus interferes with the learning process (Sweller, 2004). However, the extraneous cognitive load is detrimental and can be controlled by the instructor. The third type of cognitive load is the germane cognitive load, which occurs when working memory resources are engaged with learning. However, the germane cognitive load is also detrimental and can be controlled by the instructor (Toh, 2005).

Therefore, Paas & Gog (2006) suggests that allowing the available working memory resources to be dedicated to the germane cognitive load as well as, reducing the extraneous cognitive load will significantly help in achieving effective learning. As a result, recently, the CLT has been employed as a framework for designing instructional procedures and materials for complex learning by reducing extraneous cognitive load and increasing germane cognitive load (Mayer & Moreno, 2003). Long-term memory is unlimited and holds a permanent record of everything the learner has acquired. The long-term memory can hold all the knowledge which in turn can be processed as a single element by the working memory because all learning activities require the working-memory capacity. However, if the required working-memory capacity goes beyond the learner's limit, his learning or problem-solving performance will be affected, which is known as a cognitive overload (Jun-xia, 2007). On the other hand, a high cognitive load may occur when the learner's attention is split (*i.e. when a learner is required to process unnecessary information*) which is known as the split-attention effect (Mayer & Moreno, 1998). Therefore, reducing the cognitive load of the materials is the only way to maximize the students' learning because the cognitive load is subcategorized into intrinsic cognitive load and extrinsic cognitive load (Jun-xia, 2007).

5. Methods & Procedures

5.1 Sample

The population of this study comprised all third grade primary pupils (2263) enrolled in the ALKORAH educational directorate in Irbid Governorate in the second semester for the 2008/2009 academic year. There are 37 primary schools in the ALKORAH educational directorate in Irbid Governorate. In order to implement this study in a naturalistic school setting, existing intact classes were used (O'deh and Malkawi, 1992). Pupils are from different towns within the ALKORAH Education Directorate. The population of this study is representative of almost all the existing social classes in Jordan in terms of gender, age, nationality and native language. They are in the age group ranging from 8 to 9 years and of both gender. They are also homogenous in terms of their nationality, mother tongue (Arabic), exposure to English as a foreign language, and educational system and cultural background. Pupils in the selected schools – as well as all ALKORAH Government schools - were from approximately equivalent socioeconomic status as defined by the Ministry of Education of Jordan. They are from the low income group Figure 1. The sample consisted of 405 pupils who studied in third-grade classes and were randomly selected from six different primary co-educational schools. According to Gay and Airasian (2003) ''all the individuals in the defined population have equal and independent chance of being selected''. The six schools

were also randomly selected from the primary schools where music was taught in heterogeneous classes with no grouping or ability tracking.

5.2 Instruments

The music achievement test: that was administered on the participants of the groups in this study is adapted from the music theory competency test developed by the researcher. The music theory competency test consisted of 15 recall (remembering) and 15 understanding items. The duration of the achievement music test was 35 minutes. The achievement test comes in the following arrangement: The test is composed of two types of items. The two types of items are based on multiple-choice items for remembering and understanding that are specifically designed to assess learners' music achievement. The stability or what is commonly known as test-retest method is considered the most suitable approach of measuring the reliability that guarantees tests consistency over time (Tuckman, 1999). Nevertheless, this type of reliability has a major problem as to the period of time that should pass between the two testing sessions (Gay & Airasian, 2003). The time that elapses between the two tests was four weeks in order to measure the reliability of the music achievement. The pre-test and post-test given to the sample were the same to maintain consistency. The Music Achievement Test contains 30 items used to evaluate the students' ability to gain what they understood from the lessons and the topics covered in the music theory unit by reporting their learning achievement scores in the test. The reliability of the test questions was calculated using the Cronbach Alpha procedure to calculate the internal consistency. The Cronbach Alpha of the test was 0.80, the internal consistency of the test was 0.93. The Discrimination Index values ranged from 0.45–0.98 and the difficulty values ranged from 0.31–0.66. The total score of the music achievement test is 30. Students received a score of "1" for a correct answer and a score of "0" for an incorrect answer or for the case of no answer on each item.

The Music Intelligence Test: that was administered on the participants of the groups in this study was adapted from the music intelligence competency scale developed by the researcher. The Music Intelligence Competency Test consisted of 10 items. It comes in the following arrangement: The scale is composed of two types of items. The two types are based on multiple-choice items for rhythm and tone that are specifically designed to assess learners' music intelligence. The duration of the music intelligence test is 20 minutes. The total score of the music intelligence test is 10. Pupils received a score of "1" for a correct answer and a score of "0" for an incorrect answer or for the case of no answer on each item. Music Intelligence pupils were divided into two levels based on the music intelligence test scores : Low and High. The levels are identified based on Equation (1) below:

$$Z = \frac{\text{Highest Mark - Lowest Mark}}{\text{Nnumber of Levels}} \quad \text{……. Equation (1)}$$

where   Hmin = Highest Mark

Lmin = Lowest Mark

Z   = The difference between a level and the other.

L   = Low,   H = high

L (range) = [Lmin   - Lmin + Z]

H (range) = (Lmin + Z - Lmin + 2 Z]

Highest Mark = 9,   Lowest Mark = 1,   Number of Levels = 2

$$Z = \frac{9 - 1}{2} = 4$$

L (range) = [1   - 5]

H (range) = (6   - 9]

- The reliability coefficient of this instrument was computed by the implementation of Cronbach Alpha whereby it was 0.85 for the whole scale. The internal consistency in this instrument was 0.88. The Discrimination Index values ranged from 0.57–0.85 and the difficulty values ranged from 0.35–0.56.

- Instruments Validity: Validity of the instruments are important aspects that should be taken into account when conducting a research. Validity consists of two different aspects that is face and content validity. According to Gay and Airasian (200) face validity relates to '' the degree to which a test appears to measure what it claims to measure''. Face validity was judged by a panel of experts in the field of education and music. Content validity refers to the ''degree to which a test measures an intended content

area (Gay & Airasian, 200). Content validity of the instruments in this research was justified by the panel. The feedback and comments received from the panel of experts were employed to establish the necessary clarifications, changes, and modifications before and after piloting the study.

5.3 Research Variables

The present research contains three types of variables (independent, dependent and moderating variables) that are presented as follows:

o   Independent Variable

Music Intelligence Levels (High, Low)

o   Dependent Variable

Post Test Scores (learning)

6. Results

The analyses of the collected data were carried out through various statistical techniques such as the ANCOVA. The data were compiled and analyzed using the Statistical Package for the Social Science (SPSS 16) for Windows computer software.

6.1 Measure of Relationship between Pre-test Scores and Post-test Scores

Table 1 shows the degree of relationship between the pretest score and post-test score. A correlation coefficient of $R= 0.627**$ indicates a high positive relationship between the two variables.

6.2 Testing the two groups' equivalence

The purpose of the pre-experimental study was to test the assumption that the participants across the groups were equivalent in their remembering and understanding of the music theory unit for third grade primary pupils. To achieve this purpose, a pre-test that measures pre-music theory was conducted before the beginning of the study. To examine the equality of treatment mode on the pre-scores, the t-test procedure was used. The values $p = .463$ showed that there is no significant difference in the pre- test scores in the various groups. This means that the two groups have the same level of prior knowledge of the unit on music theory for third grade primary pupils.

6.3 Music Intelligence Distributions

In the final distribution based on their scores in the music intelligence test, the samples were divided into two groups: low music intelligence and high music intelligence of the music intelligence scale based upon a score of 1 mark per music intelligence test on the 10 items. The maximum score of the music intelligence test is 9. The mean score is $M = 5$. The distribution of the group is tabulated in Table 1.

6.4 Frequency Distribution of Music Intelligence

Figure 2 shows the frequency distribution of Music Intelligence of the 405 pupils involved in the study. There were 245 pupils and 160 pupils for the low and high music intelligence groups respectively.

6.4 Testing Homogeneity

The results from Levene's Test for homogeneity of variance by comparing the dependent variables across the two. As $p > 0.05$, the results show that the groups were homogenous.

6.5 Testing of Normality

A skewness range and kurtosis range presented values reveal that the variables are normally distributed and have met the criteria for further analysis.

6.6 Description of the Post-test Scores of Pupils with Different Levels of Music Intelligence (LMI & HMI)

Comparison was made between the two groups – pupils with low music intelligence level and pupils with high music intelligence level (LMI & HMI) - based on the mean of the post-test scores using the descriptive procedure (Table 1).

From Table 2 it can be seen that the post-test score mean ($M = 21.5813$) for high music intelligence group is higher than the post-test score mean ($M = 17.9755$) for the low music intelligence group.

6.7 ANCOVA of the Post-test Scores of Pupils with Different Levels of Music Intelligence (L & H)

In order to reduce the statistical error, the pre-test scores were used as the covariate, and a comparison was made among pupils with different levels of music intelligence (LMI & HMI) using the ANCOVA procedure (Table 3).

The values F (1, 402) = 5.243, Mean Square = 95.349, and p = .023 show a significant difference between the post-test scores of pupils' with different levels of music intelligence (LMI & HMI).

7. Discussion

Results of the study show that high music intelligence pupils (HMI) attained significantly higher post-test scores than Low music intelligence (LMI) pupils. Various studies confirmed a strong relationship between multiple intelligence theory and academic performance across various subjects (Dobbs, 2001; Afana & Khazendar, 2004). Hussein (2008) reported that high musical intelligent pupils seem to have better memory. Seemingly, this could be attributed to the larger mental capacity in the working memory for cognitive processing. Johnson & Memmott (2006) demonstrated that American students who attended training classes on music showed significant improvements in learning Mathematics and English. This result is consistent with Gouzouasis, Guhn, & Kishor's (2007) who found that music trainees in Britain showed improvements in their other academic achievements. Luiz's (2007) study showed that learning music improved the students' achievements in Mathematics. Gur (2009) reported that classical music positively improved the cognitive process of Turkish pupils in performing drawing-tasks. Babo's (2004) study found a positive relationship between middle school students' participation in music activities and academic achievements in language, literacy, and arts. However, Al-Darris (2008) found no effect of musical intelligence on learning among primary students with learning difficulties. Literature reviews on musical intelligence was not able to throw any light on the apparent positive correlation of musical intelligence or even the blending of music in improving learning. Chan's (2007) study reported the positive correlation of musical intelligence to students' attitude in music. The working memory refers to an information processing system that provides temporary storage and manipulation of the information necessary for complex cognitive tasks in music theory learning. The working memory requires simultaneous storage and processing of information and is therefore very important for processing musical theory by the pupils. In other words, pupils with a poor working memory capacity may have delayed learning of music theory. From this study, pupils with high music intelligence seem to have a larger capacity in their working memory and hence could process and realign information better and that helps maintain information retention and storage in the long-term memory.

Conclusion

Apparently, high music intelligence pupils have larger capacity in their working memory to accommodate and integrate incoming information. Hence the performances of the high music intelligence pupils are better. The researchers were not able justify for such a phenomenon and strongly recommend that more studies be conducted to determine other instructional designs that might help the "disadvantaged" low music intelligence pupils.

References

Afanan, I., & Akzndar, N. (2004). Multi intelligence levels among basic education students stage in Gaza and their relationship to achievement in mathematics and orientation towards. *Humanists Studies Journal, 12* (2), 323-366.

Al-Ahdal, A. (2009). The efficiency of activities and approaches based on the multi-intelligence theory in improving the achievement of Geography and maintaining the learning effect among first year secondary students in Jeddah Province. *Journal of Science Education and Human, 1* (1), 191-242.

Aldalalah, O. M. (2003). *Educational software effects in learning musical concepts for class rooms teachers, students and their attitudes toward them.* Master Thesis (Unpublished), Yarmouk University, Jordan.

Al-Drais, S. (2008). *Multiple intelligences assist primary students who have academic difficulties.* Master Thesis (Unpublished), Kuwait University.

Artino, A. R. (2008). Cognitive load theory and the role of learner experience: An abbreviated review for educational practitioners. *AACE Journal, 16*(4), 425-439.

Babo, D. G. (2004). The relationship between instrumental music participation and standardized assessment achievement of middle school students. *Research Studies in Music Education, 22* (1), 14-27.

Chan, W. D. (2007). Musical aptitude and multiple intelligences among Chinese gifted students in Hong Kong: Do self-perceptions predict abilities?. *Personality and Individual Differences, 43*(6), 1604–1615.

Chew, D. (2005). *Computer-assisted instruction for music theory education: Rhythm in music.* PhD Thesis (Unpublished), California state university.

Christopher, J. M., & Memmott, J. E. (2006). Examination of relationships between participation in school music programs of differing quality and standardized test results. *Journal of Research in Music Education, 54*(4), 293-307.

Deleeuw, K. E., & Mayer, R. E. (2008). A comparison of three measures of cognitive load: Evidence for separable measures of intrinsic, extraneous, and germane load. *Journal of Educational Psychology, 100(1)*, 223-234.

Dobbs, V. R. (2001). *The relationship between implementation of the multiple intelligences theory in the curriculum and student academic achievement at a seventh – grade at-risk alternative school.* Ph.D Thesis (Unpublished), Yarmouk University, Jordan.

Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York:
Basic Books.

Gardner, H. (2000). Project Ero: Nelson Goodman's legacy in arts education. *Journal of Aesthetics and Art Criticism, 58*(3), 245-249.

Gardner, H. (2003). *Multiple intelligences after twenty years*. Paper presented at the American Educational Research Association, Chicago, Illinois.

Gardner, H. (2004). Audiences for the theory of multiple intelligence. *Teacher College Record. 106*(1), 212-220. Columbia University.

Gay, L. R., & Airasian, P. (2000). *Educational research: Competencies for analysis and application (6th ed.).* Upper Saddle River, NJ: Merrill.

Gay, L. R., & Airasian, P. W. (2003). *Educational research: Competencies for analysis and application (7th ed):* Prentice Hall.

Gnam, K. (2005). *The impact of the use of collective guidance skills training courses to improve the level of academic achievement and Locus of control*. Master Thesis (Unpublished, Jordanian University, Jordan.

Gouzouasis, P., Guhn, M., & Kishor, N. (2007). The name assigned to the document by the author. This field may also contain sub-titles, series names, and report numbers. the predictive relationship between achievement and participation in music and achievement in core grade 12 academic subjects. *Music Education Research*, *9* (1), 81-92.

Gur, C. (2009). Is there any positive effect of classical music on cognitive content of drawings of six year-old children in Turkey?. *European Journal of Scientific Research, 36*(2), 251-259.

Hussein, Z. M. (2008). *Pattern of Thinking Music Students.* PhD Thesis (Unpublished), Gulf University.

Jeroen. J., Enboer, V., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*(2), 147-177.

Johnson, D. A. (2000). The development of music aptitude and effects on scholastic   achievement of 8 to 12 year olds. Ph.D Thesis (Unpublished), Kentucky: University of Louisville.

Jun-Xia, G. (2007). Action research: The application of cognitive load theory to reading teaching. *Sino-US English Teaching, 4*(4), 19-23.

Khalil, A. (2005). *Science of creativity* [Online] Available: http://www.adabfalasteeni.org/artical.php. (Accessed 3 April 2009).

Lamar, H. B. (1989). *An examination of congruency of musical aptitude scores and mathematics and reading achievement scores of elementary children*. Ph.D Thesis (Unpublished), University of Southern Mississippi.

Luiz, C. S. (2007). *The learning of music as a means to improve mathematical skills.* International Symposium on Performance Science Published by the AECAll rights reserved.

Mayer, R. E., & Moreno, R. (1998a). A split-attention effect in multimedia learning: evidence for dual processing system in working memory. *Journal of educational psychology, 90*(2) 312- 320.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist, 38*(1), 43–52.

Nosir, S. (1980). *Music theory*. Egypt: Dar Alsabeel.

Omari, M., Alhersh, A., Aldalalah, O., & Ababneh, Z. (2010). Effect drill and practice pattern in mathematics among first-grade students, compared with music anthems, and traditional way. *Journal of Science Education and Human (Umm al-Qura University). 21* (1). (in pres)

Otoum, A. (2004). *Cognitive psychology*. Amman: Dar Almaserh.

Paas, F. & Gog, T. (2006). Optimising worked example instruction: Different ways to increase germane cognitive load. *Learning and Instruction, 16*(2), 87-91.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: recent developments. *Educational Psychologist, 38*(1), 1-4.

Qtami, U. (2005). *Educational psychology and thinking*. Jordan: Dar Hanen.

Smith, K. H. (2009). The effect of computer-assisted instruction and field independence on the development of rhythm sight-reading skills of middle school instrumental students. *International Journal of Music Education, 27* (1), 59-68.

Sweller, J. (2004). Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. *Instructional Science, 32*(1), 9–31.

Sweller, J., Paas, F., & Renkl, A. (2003). Cognitive load theory and instructional design: recent developments. *Educational Psychologist, 38* (1), 1-4

Toh, C. S. (2005). Recent advances in cognitive load theory research: implication for instructional designers. *Malaysian Online of Journal of Instructional Technology (mojtt), 2*(3), 106-117.

Van, J., & Ayres, P. (2005). Research on cognitive load theory and its design implications for E-learning. *Educational Technology, Research and Development, 53*(3), 5-13.

Table 1. Distribution of Music Intelligence Group

Levels of Musical IQ	Frequency	Percent
Low	245	60.5
High	160	39.5
Total	405	100.0

Table 2. Post-test Scores of Pupils with Different Levels of Music Intelligence (LMI & HMI)

Music Intelligence	Mean	Std. Deviation	N
Low	17.9755	5.18899	245
High	21.5813	5.24191	160
Total	19.4000	5.49464	405

Table 3. ANCOVA of the Post-test Scores of Pupils with Different Levels of Music Intelligence (LMI & HMI)

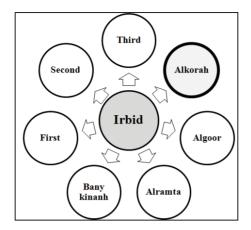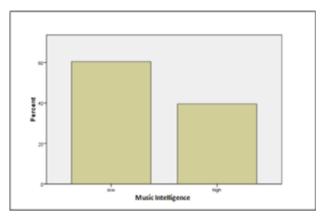| Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4886.354[a]	2	2443.177	134.342	.000
Intercept	689.686	1	689.686	37.924	.000
pre-test	3627.951	1	3627.951	199.489	.000
Music Intelligence	95.349	1	95.349	5.243	.023
Error	7310.846	402	18.186		
Total	164623.000	405			
Corrected Total	12197.200	404			

Figure 1. Educational Directorates in Irbid Governorate

Figure 2. Frequency Distribution of Music Intelligence