

Effects of Computer–Based Instructional Designs among Pupils of Different Music Intelligence Levels

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Abstract—The purpose of this study was to investigate the effects of computer–based instructional designs, namely modality and redundancy principles on the attitude and learning of music theory among primary pupils of different Music Intelligence levels. 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). The independent variables were the three modes of courseware. The moderator variable was music intelligence. The dependent variables were the post test score. 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. 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 low music intelligence significantly more than the TI and AIT modes.

Keywords—Modality, Redundancy, Music theory, Cognitive theory of multimedia learning, Cognitive load theory, Music intelligence.

I. INTRODUCTION

MANY scholars such as Nosir [1] 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 [2] music is a language that possesses both universal context and notations.

On the other hand, Aldalalah [3] 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 [4].

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

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in various situations. Wilson [5], Mcvay [6] and Guderian [7] conducted a study to investigate the difficulties that students face when reading a music theory. The findings of their work revealed that many students face problems when it comes to interpreting and reading a music theory. This results in learning music. Also, the findings of their research led many Arab countries to revise and review their music curriculum to improve music theory learning in an educational context [8]. Similarly, Jordan took the same step of making a drastic review and revision of its music education curriculum [9]. Thus, music theory in Jordan is still taught at music schools implementing conventional teaching methods that are not aided by computer-based teaching techniques [10].

Likewise, Ramzy and Alabdly [11] argued that using traditional methods to teaching music to school pupils and students was not supportive in the process of learning music theory. Also, they found out that implementing these conventional methods did not assist students understand or consider music theory in depth in which they use the music theory incorrectly. That is, students are still weak, low-performance and incompetent in using music theory even though they are taught by professional and skilled music teachers implementing audio-visual methods in teaching music [12]. In order to solve the problem of weakness and students' low performance in understanding music theory, this difficulty should be dealt with by developing a computer-based music learning programs [3]. He adds, using these programs assisted students improve markedly in learning and understanding music theory.

Similarly, Obeidat [13] and Dyabat [14] investigated the effects of using computerized instructional programs in teaching and learning music. The findings of their study revealed that computer-based programs were very useful for students in learning and understanding music theory. In connection with past literature and previous research work, it is realized that using conventional methods to teaching and learning of music as well as using music theory audio, image and text may not be appropriate to advance and improve the music learning process. Clark and Mayer [15] state that the redundancy of visual text in a multimedia show may exceed the visual channel because the image is processed in the visual channel by the students' cognitive system through their eyes. This similar to the printed text in which they are entered through the eyes as well. Owing the limitedness of the cognitive resources in the visual channel that should be used

to process both the text and image, an excess in the visual channel may take place.

In this regards, the researchers argues that the appropriate application of modality and redundancy of instructional design principles in computer-based learning can successfully improve the learning of music theory. In other words, if the modality and redundancy principles provides a realistic approach if they are incorporated into computer-based learning as an educational design. Sweller [16] and Mayer [17] state that reinstating visual text within the modality effect may enhance the efficiency of educational (instructional) multimedia. Images are transferred throughout the visual channel whilst the narration text is transferred throughout the auditory channel leading to an enhancement in the function capacity of the memory causing a better access and flexibility of learning [18]. Additionally, implementing image, onscreen text and audio narration where the audio reiterates the text results in an excess because of the redundancy in the exhibited material. This additional attempt required by music students to deal with available data streams is taken into account as demerit for acquiring both words and picture [15].

According to Cronbach [19] the most favorable learning amongst an extensive range of music students needs a similar range of instructional situations that are appropriate for individual students' abilities and learning approaches. This occurrence is discussed by Aptitude Treatment Interactions approach recommended by Cronbach and Snow [20]. In this regards, researchers and scholars define aptitude as any individual traits that may enhance or reduce the students' potentiality of accomplishment within a specific treatment. Treatment refers to the disparity in the style of instructions. Research work done by scholars such as Cronbach [19], Swanson [21], Shute [22] and Fong [23] revealed that the learning output of students certainly improved when methods of teaching were used to the students' aptitude and psychological profiles.

However, the present research work intends to examine the Aptitude Treatment interactions (ATI) suggested by Cronbach [19]. Also, it aims at investigating the Aptitude Treatment Interactions (ATI) amongst students with varied internals-externals that contain three forms of presentations are AI, TI and ATI on the learning of and attitudes of the students in relation to the music theory.

II. MODALITY PRINCIPLE

Moreno & Mayer [24] suggested that pictures should go together with a synchronized auditory explanatory recitation rather than a synchronized explanatory text, (see Figure 1).

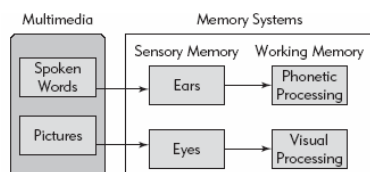


Fig. 1 Modality Principle [24]

Mayer & Mereno [25] and Alherish, Alababneh & Aldalalah [26] found that the learner's understanding when

watching animated images on a certain phenomenon (the lightning phenomenon) accompanied with an auditory explanation is much better than the learner's understanding when watching animated images on the same phenomenon while verbally reading an onscreen-text explanation. At the same time, this principle is in tandem with the cognitive learning theory using multimedia techniques. The cognitive learning theory suggests that reading an onscreen-text along with animated pictures will result in interference in the rendered information especially when this information is to be processed verbally [27]. However, this will add more load on the visual working memory because both are addressed in the form of verbal memory and in visual approach while the auditory text is processed in the verbal model and audio working memory [28]; [29]. Furthermore, animated images are processed in the visual model, thus, providing an auditory text along with watching an explanatory film that does not overlap [30]. Therefore, this also fits the modality principle by combining the visual channel for graphical material and the verbal channel for the explanation of this material to increase the working memory capacity effectiveness and facilitate learning [31].

III. REDUNDANCY PRINCIPLE

There is now much evidence to suggest that redundant material imposes a significant extraneous cognitive load that has negative outcomes for learning and understanding [16]. Redundant material interferes with learning rather than proving to be advantageous or even neutral when acquiring new information. By eliminating redundant information the load on working memory is considerably reduced, thus facilitating better learning. The Redundancy Effect occurs when learners are required to attend to or engage in activities that are irrelevant to the task at hand [32]. The effect has been shown to interfere with the core material to be learned due to the extraneous load imposed on working memory [33]. Increasing working memory load by simultaneously processing redundant information with essential information that needs to be learned, results in the transfer of information into long-term memory becoming problematic. The Redundancy Effect is associated with materials or information that can be understood in isolation of each other [34]. Information presented in multiple forms, or information that is unnecessarily elaborated is representative of redundancy [35].

Kalyuga, Chandler & Sweller [36] again demonstrated the redundancy effect in a task involving listening and reading identical text in a series of experiments involving training materials for technical apprentices. The redundancy effect has been described in the past as counter-intuitive [37], as it is often assumed that an abundance of information is advantageous to the learner. Cognitive load theory states otherwise asserting that an overload on working memory inhibits learning. Pictures are an additional and unnecessary load for the working memory to process when learning to read, and therefore redundant. Pictures are very likely to distract the child from the text thereby drawing on working memory resources that could be otherwise used for the

processing and storing of core information associated with the decoding process [38].

The Redundancy Principle suggests improving multimedia presentation by presenting animation along with concurrent recitation and on-screen text [39]. To allow the students to choose the format that goes well with their learning style, the above principle suggests presenting the same words in two formats [40]; [41]. Therefore, the students can pay more attention to the auditory words if their learning is better compared to other learning methods. Adding on-screen text to a recited animation can be justified by better containing individual learning styles. However, the cognitive theory of multimedia learning as discussed previously, suggested that the added on-screen text will interfere with the animation of cognitive resources in the visual-pictorial channel as illustrated in creating what Sweller [16] calls a split-attention effect. Students will have to put more effort and pay more attention visually to both the printed words and the animated pictures as illustrated in Figure 2.

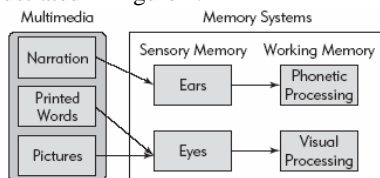


Fig. 2 Redundancy Principles [17]

Multimedia learning incorporates the presentation of visual materials (such as animations, video, or graphics) along with a synchronized text and audio [42]. However, the redundancy principle indicates that learning and its achievements of the student using animation and recitation is much better compared to the learning and its achievements of the student using animation, recitation, and text, especially if the visual information is presented concurrently with the vocal information [43]. At the same time, simultaneous presentations of printed text explanations and auditory recitation of the same information would be inappropriate as they exhaust the student's cognitive abilities of the working memory and upset learning [44] because the printed text representation will trouble the visual channel. This visual channel will instead have to manipulate the textual and graphical information, especially, when the text is redundant and auditory narrations are duplicated [45]. The redundancy effect will occur if the information that can be completely understood in isolation (as either visual or auditory information) is presented to both channels and is the same information. However, incorporating the redundant information in both working memories can eventually increase the cognitive load. This results in a split-attention dilemma. This dilemma varies depending on the learner's experience. However, a diagram with text may be favorable for beginners because they need to incorporate the text to the diagram to make more sense for them. At the same time, the same strategy might become redundant for a more experienced learner and the diagram alone makes more sense for them (ie. computer manuals that have minimal text and plenty of diagrams). In summary, the redundancy effect is that "less is

often more" in learning and that cognitive capacity is over excited [46].

IV. 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 [47]. 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 [48].

Gardner [49] 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 [50]. 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 [51]; [52].

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 [53].

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 [54] 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 [55]. According to Luiz [56] 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 [57], 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 [58], 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 [59]. Christopher and Memmott [60] 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 [61]. Further, musical intelligence not only improves musical achievement but would also have perceived effect on achievement in many subjects [57]. Gouzouasis, Guhm & Kishor [57] 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 [62].

Music improves brain functionality and intrinsic skills of learners primarily in literacy and Mathematics [56]. 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 [63].

Finally, there is a strong relationship between multi-intelligences and musical aptitude. This result received support from Chan [64] 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.

V. RESEARCH QUESTIONS

- 1) Will pupils with high music intelligence (HMI) pupils attain significantly higher post-test scores than low music intelligence (LMI) pupils?
- 2) 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?
- 3) Will 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) Are there interaction effects between treatment modes and music intelligence on the post-test scores (PTS)?

VI. METHODS

A. Sample

The sample consisted of 405 third-grade pupils and were randomly selected from six different primary co-educational schools enrolled in the ALKORAH educational directorate in Irbid Governorate (Jordan) in the second semester for the 2008/2009 academic year. According to Gay & Airasian [47] "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.

B. Experimental Condition

The pupils' distribution within the treatment groups was conducted randomly. Then the treatment groups were exposed to the treatment consecutively. The three treatment groups are as follows:

- First treatment: The educational material was shown as images and audio.
- Second treatment: It is similar to the first treatment except that a text is being displayed simultaneously with the images, but no audio is shown.
- Third treatment: The educational material was shown as a text (as written text on the screen) in addition to the images (as in first and second treatments), the educational materials were shown in a more redundant manner than the other treatments by adding the audio effects.

C. Instruments

- 1) The music achievement test that was administered on the participants of the three groups in this study is adapted from the music theory competency test developed by the researcher. 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. and the difficulty values ranged from 0.31–0.66, and
- 2) The Music Intelligence Test: that was administered on the participants of the three 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 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.

- 3) 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 & Airasian [49] 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” [49]. 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.

D. Study Design

This study followed the quasi experimental method to measure the impact of the 3 modes of treatments on the post test scores of the third grade pupils in the music classes according to the modality and redundancy principles of cognitive theory.

D. Research Variables

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

o Independent Variables:

The independent variables in this study were the three modes of presentation:

1. Multimedia computer-based learning courseware with music theory presented in audio and text (AI)
2. Multimedia computer-based learning courseware with music theory presented in text and image (TI)
3. Multimedia computer-based learning courseware with music theory presented in audio, image and text (AIT)

o Dependent Variable

1. Post test score (Music Theory Learning)

o Moderator Variable

1. Music intelligence

VII. RESULTS

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

A. The 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 I).

TABLE I
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

From Table 5.35, 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.

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

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 II).

TABLE II
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	4886.354a	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			

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 (L & H).

C. Description of Post-Test Scores of Low Music Intelligence Pupils in Various Treatment Groups

Table III shows a difference between the means of post-test scores for the group with AI mode and the group with TI mode. The post-test scores' mean of the group with AI (23.97) mode was higher than the post-test scores' mean of the group with TI (15.54) mode, and it showed a difference between the means of the post-test scores for the group with TI mode and the group with AIT mode. The mean of the post-test scores for the group with TI (15.54) mode was higher than the mean of the post-test scores for the group with AIT (14.87) mode.

TABLE III
POST-TEST SCORES OF LOW MUSIC INTELLIGENCE PUPILS IN
VARIOUS TREATMENT GROUPS

Groups	Mean	Std. Deviation	N
AI	23.9740	3.32445	77
TI	15.5455	3.03584	88
AIT	14.8750	3.31615	80
Total	17.9755	5.18899	245

D. ANCOVA of Post-test Scores of Low Music Intelligence Pupils in Various Treatment Groups

In order to reduce the statistical error, the pre-test scores were used as the covariate and comparison was made among pupils using AI mode and pupils using TI mode, pupils using TI mode and pupils using AIT mode, again based on the means of the post-test scores using the ANCOVA procedure (Table IV).

TABLE IV
ANCOVA OF POST TEST SCORES OF LOW MUSIC INTELLIGENCE
PUPILS IN VARIOUS TREATMENT GROUPS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5453.305a	3	1817.768	392.354	.000
Intercept	839.010	1	839.010	181.095	.000
pre-test	1393.968	1	1393.968	300.880	.000
Groups	3534.924	2	1767.462	381.496	.000
Error	1116.548	241	4.633		
Total	85734.000	245			
Corrected Total	6569.853	244			

The values $F(2, 241) = 381.496$, Mean Square = 1767.462, and $p = 0.000$ show that there is a significant difference in the post-test scores of low music intelligence pupils among the three treatment groups.

The ANCOVA results of comparing low music intelligence pupils across the three groups (AI, TI & AIT) on the dependent variables indicated that there were statistically significant differences between low music intelligence pupils in groups on the dependent variable. Therefore, the researchers further investigated the univariate statistics results (analysis of covariance ANCOVA) by performing a post hoc pairwise comparison using the LSD command for dependent variable in order to identify significantly where the differences in the means resided. Table 5.39 is a summary of post hoc pairwise comparisons between pupils' learning across the three groups.

TABLE V
SUMMARY OF POST HOC PAIRWISE COMPARISONS

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.a
AI	TI	7.919*	.337	.000
	AIT	8.529*	.345	.000
TI	AI	-7.919*	.337	.000
	AIT	.611	.333	.067
AIT	AI	-8.529*	.345	.000
	TI	-.611-	.333	.067

Table IV and Table V show that there are statistical differences among learning of low music intelligence pupils in the three groups. There are statistical differences between learning of low music intelligence pupils in AI and TI group in music theory learning. There are statistical differences between learning of low music intelligence pupils in AI and AIT group in music theory learning. Finally, there are no statistical differences between learning by low music intelligence pupils in TI and AIT group in music theory learning. The differences are presented below.

The AI (Mean = 23.97, SD = 3.32) of low music intelligence pupils' learning significantly outperformed the TI (Mean = 15.54, SD = 3.03) and the AIT (Mean = 14.87, SD = 3.31) However, there were significant differences between learning of low music intelligence pupils in AI group and learning of low music intelligence pupils in TI group ($p = 0.000$), There were significant differences between low music intelligence pupils' learning in AI group and learning of low music intelligence pupils in AIT group ($p = 0.000$). Finally, there were no significant differences between learning of low music intelligence of pupils in TI group and learning of low music intelligence in the AIT group ($p = .067$).

E. Description of the Post-test Scores by Music Intelligence for Treatment

Table VI presents the overall means and standard deviations of each post-test score by the interaction between the treatment modes and music intelligence levels (low and high). The mean scores of the AI group reported low music intelligence ($M = 23.97$) and high music intelligence ($M = 26.98$). The mean scores for the TI group reported low music intelligence ($M = 15.54$) and high music intelligence ($M = 18.94$). The mean scores for the AIT group reported low music intelligence ($M = 14.8750$) and high music intelligence ($M = 19.1607$).

TABLE VI
THE MEAN SCORE AND STANDARD DEVIATION OF THE POST-TEST
SCORES BY MUSIC INTELLIGENCE FOR TREATMENTS

Groups	Music Intelligence	Mean	Std. Deviation	N
AI	Low	23.9740	3.32445	77
	High	26.9804	2.50990	51
	Total	25.1719	3.35817	128
TI	Low	15.5455	3.03584	88
	High	18.9434	3.93903	53
	Total	16.8227	3.77072	141
AIT	Low	14.8750	3.31615	80
	High	19.1607	4.39742	56
	Total	16.6397	4.33534	136
Total	Low	17.9755	5.18899	245
	High	21.5813	5.24191	160
	Total	19.4000	5.49464	405

F. ANCOVA of Interaction Effects between Treatment Modes and Music Intelligence

To examine if the effects of treatment modes on the post-test scores depend on the music intelligence level of pupils in AI group, TI group and AIT group, multivariate analysis of

covariance (ANCOVA) was conducted while controlling for pre-test scores.

TABLE VII
ANCOVA FOR MUSIC INTELLIGENCE BY INTERACTION
TREATMENT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10198.681a	6	1699.780	338.507	.000
Intercept	1169.783	1	1169.783	232.959	.000
pre-test	2697.362	1	2697.362	537.173	.000
Groups	4927.142	2	2463.571	490.614	.000
Music Intelligence	151.802	1	151.802	30.231	.000
groups * Music IQ	48.798	2	24.399	4.859	.008
Error	1998.519	398	5.021		
Total	164623.000	405			
Corrected Total	12197.200	404			

Table VII presents the results of the ANCOVA test, showing the overall differences for the interaction between treatment modes and music intelligence level effects on the post-test scores while controlling pre-test scores. The ANCOVA results of the interaction effects on the post-test scores were statistically significant $F(2,398) = 4.859$ and $p = 0.008$. This means that there were some statistical interaction effects on post-test scores across the three groups.

The ANCOVA results, as shown in Table VIII indicate that the main effects were found for either music intelligence or group; however, both were almost significant, $F(1, 398) = 30.231$, $p = 0.000$ and $F(2, 398) = 490.614$, $p = 0.000$. This means that there is a significant difference in the adjusted mean of the post-test scores among the three treatment modes of pupils' music intelligence. Although the effects of the treatments on the post-test scores depend on the music intelligence level of the pupils, there were differences in the post-test scores among the treatments for pupils of different musical intelligence level. The AI group had higher post-test scores than the TI group, and the TI group had higher post-test scores than the AIT group.

The ANCOVA results of the interaction effects on the post-test scores indicated that there were statistically significant interaction effects between the treatment mode and pupils' music intelligence level. Therefore, the researchers further investigated the interaction effect results by plotting interaction between the effects, between the treatment mode and pupils music intelligence level on the post-test scores to identify significantly where the interactions resided. The results indicated that this interaction effect between treatments and music intelligence was statistically significant.

VIII. DISCUSSION

The result has demonstrated that pupils with high musical intelligence were more likely to succeed compared with low musical intelligence who were unable to reach better learning because their mental ability of data processing was less than that of higher musical intelligence pupils.

This result can be understood in light of Gardner's multiple intelligence theory. Many studies confirmed a strong

relationship between multiple intelligence theory and improved academic performance in various subjects [53]. This result receives support from Afanan & Khazendar [52] who found that mathematics learners who were taught using the multiple intelligence approach were best able to develop their talents and individual abilities and their progress was further motivated. Further, the students' understanding of difficult problems was improved; they were involved in their learning in terms of creating reasonable thinking and problem solving skills. As music intelligence is a form of multiple intelligence it contributed to the results concluded by this study, which proved that pupils with musical intelligence perceivably outperformed their peers in learning musical theories. This result would be attributed to the observation that pupils with high music intelligence have mental abilities higher than pupils with low musical intelligence would have had.

Hussein [59] reported that high musical intelligent pupils have better memory. Learning and training on music improves achievement in various subject-matters which received support from Christopher & Memmott [60] who demonstrated that American students who attended training classes on music showed impressive improvements in learning Mathematics and English. This result is consistent with Gouzouasis, Guhn, & Kishor's [57] who found that music trainees in Britain showed improvements in their academic achievements. Luiz's [56] study showed that learning music improved the students' achievements in Mathematics. Gur [62] too identified the role of listening to classical music in the cognitive construct of Turkish children performing drawing tasks.

The results of this study also correspond to that of Babo's [61] study. He found a positive relationship between middle school students' participation in music activities and academic achievements in language, literacy, and arts in New Jersey. The study found that students involved in music exercises had higher intellectual and intelligence abilities than non-participants. Perceivably, Chan's [64] study emphasized the role of musical intelligence among Chinese students in the study of their aptitude to music.

However, Al-Darris [67] which mainly sought to explore the potential effects of multiple intelligences that would help teaching primary students with learning difficulties found no effect of musical intelligence in the increased learning. This could be attributed to the sample which requires special education programs for their learning to occur. The results from this study showed that AI group pupils with low musical intelligence learned better than their counterparts in TI group. Similarly this result can be explained by the cognitive theory of multimedia learning when two channels are used to receive learning (music theory). In this study low music intelligence pupils using the AI mode performed significantly better than high low music intelligence pupils using the TI and AIT mode. Apparently, the AI mode enabled an increase in the capacity of the working memory and resulted in better learning. Low music intelligence pupils using the TI mode and AIT mode showed no significant difference in the post-test scores. This could be attributed to the high cognitive overloads in the visual channel of the working memory. This can also be due to the split attention effects.

The present study's results showed there were interactions between musical intelligence and treatments. Learning with the three modes of treatment was influenced by the musical intelligence level of the pupils. However, AI mode positively influenced the overall learning of the pupils regardless of their individual musical intelligence levels, primarily with pupils of low musical intelligence. The improved learning seen in the pupils with AI mode was in compliance with the human processing system in that the two channels are employed, without having overloaded either channel, thus reducing the load on the working memory of pupils with low musical intelligence. In consequence, data processing of music theory was best accomplished and regulated by the working memory and data retention, storage and retrieval were perfectly carried out in the long-run memory as evidenced by the performance on the musical achievement post-test scores.

Low musical intelligence Pupils using the TI mode did not significantly have better post-test scores compared to pupils using the AIT mode. According to Clark & Mayer [15], loading redundant onscreen text to a multimedia presentation could overload the visual channel because the image enters the pupils' cognitive system through the eyes and is processed in the visual channel, whereas the audio enters the pupils' cognitive system through the ears and is processed in the auditory channel. Since the printed text enters through the eyes and must be processed in the visual channel, and since the limited cognitive resources in the visual channel must be shared in processing both the image and the text, an overload occurs.

According to the cognitive theory of multimedia learning, learners have limited cognitive capacity in the visual and auditory channels. Pupils may pay so much attention to the printed text that they pay less attention to the image. When their eyes are on the printed text, the pupils cannot be looking at the image at the same time. In addition, the pupils may try to compare and reconcile the printed text with the narration text, which requires extraneous cognitive processing to learning the content. This will result in a cognitive overload. Split-attention effect holds that the use of materials that require pupils to split their attention between two sources of information causes a higher cognitive load on working memory and therefore impedes the learning process [44].

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