Multimedia Learning: Effects of Background Music and Sound Effects on Space Science Concept Learning

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Abstract

This study investigated the effects of background music and sound effects with audio narration on space science concept learning. Participants were randomly assigned to three groups: (a) commercial music background and sound effects, (b) Baroque music background without sound effects, and (c) no music background and sound effects. The study’s findings provided appropriate ways of including music background into multimedia instructional materials for space science learning. Students learned better when there was no background sound and music; however, they were more engaged in the instructional video that had commercial background music and sound effects.

Introduction

Music and sound effects have been widely used as background in video production, which is a great resource for teaching and learning. The rationale for this practice is based on arousal theory (Weiner, 1990), which states that interesting music and sound effects make multimedia message more enjoyable to the learners; therefore foster their levels of emotional arousal and learning. Learning will be improved when multimedia presentation include background music than in the silent condition (Gao, Chang, Ren, Aickelin, & Wang, 2010; Groot, 2006; Schön et al., 2008; Thiessen & Saffran, 2009). Besides, background music was claimed to be a relaxation therapy for learners’ mind by its unique potential of rhythm to energize and aid information processing in the mind (Gatson, 1968). Adding Baroque music as background was believed to help the body relax and the mind alert; therefore lead to super-learning (Ostrander, Schroeder, & Ostrander, 1979).

However, Mayer (2009), who based his approach on knowledge construction and cognitive load theory, argued that adding irrelevant music and sound effects tends to have detrimental effects on learning outcomes. His experimental research supported his claims, which led him to coin the coherence principle for multimedia learning – learners learn better when interesting but irrelevant music background and sound effects are excluded from multimedia instructional materials. Many other researchers also found evidences supporting the coherence principle and claimed music background and sound effects as seductive details resulted in poorer retention and transfer performance (Garner, Gillingham, & White, 1989; Harp & Mayer, 1997, 1998; Mayer, et al., 1996; Renninger, Hidi, & Krapp, 1992; Salamé & Baddeley, 1989).

Regarding the neutral cases, which neither support nor disapprove the use of background music and sound effects, Brünken, Plass, and Lauttner (2004) found the auditory cognitive requirements of background music alone did not differ from the auditory cognitive requirements of the materials without any auditory stimuli. Likewise, background music neither enhances nor decreases learning performance (Jäncke & Sandmann, 2010). Meanwhile, other studies showed partial evidence for the hypothesis that music would facilitate retention and transfer performance (Miller & Schyb, 1989; Thaut & l’Etoile, 1993).

These confounding research findings call for further research on whether and how background music should be embedded in multimedia learning. Conceivably, the key question remained is to find the appropriate types of music in multimedia learning (Mayer, 2009; Ostrander, Schroeder, & Ostrander, 1979).

Method

Participants

In this study, there were two experiments designed to test the effects of background music and sounds on space concept learning. There were 68 participants in the first experiment (Male: 36, Female: 32; Freshman: 2, Sophomore: 6, Junior: 31, Senior: 29) and 74 participants in experiment 2 (Male: 38, Female: 36; Freshman: 2, Sophomore: 7, Junior: 33, Senior: 32). Participants were recruited from a southwestern university in the United States.
Instructional video

Instructional materials in the two experiments included two different three-minute video clips about space science adapted from Discovery Channel. Each of these two video clips was edited into three versions, i.e., with the original music background and sound effects, with Baroque music background and without music. The audio narration and volume remained the same through the three treatment versions.

Research Questions

The current study had the following questions:

1. Do the different types of background music and sound effects differ in learners’ retention of space science concepts?
2. Do the different types of background music and sound effects differ in learners’ transfer of space science concepts?
3. Do the different types of background music and sound effects differ in learners’ engagement level in space science concepts?

Data collection

Participants were randomly assigned to three groups: (1) instructional video with narration and various relevant types of music and sound effects, and (2) instructional video with narration and Baroque music background, and (3) instructional video with narration and no background music and sound effects. In each experiment, prior to taking the instruction, participants were asked to respond to demographic questions and took a pre-test to ensure they were not quite familiar with the space science concepts presented in the video clips. Next, they watched and studied the instructional videos. Dependent measures included two post-tests on retention and transfer performance and a question on participants’ engagement towards each kinds of treatment. Retention and transfer tests were in forms of short answer questions and were scored by the authors. The engagement level was measured by a 5-point Likert scale survey.

Results

Experiment 1

Table 1. Means and Standard Deviations for Level of Engagement, Retention and Transfer Performance of Experiment 1

<table>
<thead>
<tr>
<th>Learning performance</th>
<th>Types of background music and sounds</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>Narration + Original music and sounds from Discovery Channel</td>
<td>24</td>
<td>3.42</td>
<td>1.060</td>
</tr>
<tr>
<td></td>
<td>Narration + Baroque music</td>
<td>20</td>
<td>2.70</td>
<td>0.932</td>
</tr>
<tr>
<td></td>
<td>Narration only</td>
<td>24</td>
<td>2.63</td>
<td>1.013</td>
</tr>
<tr>
<td>Retention performance</td>
<td>Narration + Original music and sounds from Discovery Channel</td>
<td>24</td>
<td>4.08</td>
<td>1.840</td>
</tr>
<tr>
<td></td>
<td>Narration + Baroque music</td>
<td>20</td>
<td>4.80</td>
<td>2.262</td>
</tr>
<tr>
<td></td>
<td>Narration only</td>
<td>24</td>
<td>5.17</td>
<td>2.239</td>
</tr>
<tr>
<td>Transfer performance</td>
<td>Narration + Original music and sounds from Discovery Channel</td>
<td>24</td>
<td>1.21</td>
<td>1.351</td>
</tr>
<tr>
<td></td>
<td>Narration + Baroque music</td>
<td>20</td>
<td>1.20</td>
<td>1.508</td>
</tr>
<tr>
<td></td>
<td>Narration only</td>
<td>24</td>
<td>1.50</td>
<td>1.216</td>
</tr>
</tbody>
</table>

The analysis of variance (ANOVA) tests showed that the effect of background music and sounds on student engagement on the instructional material was significant ($F(2,67) = 4.442$, MSE = 4.487, $p = .016$). Post-hoc tests showed engagement of the original video of discovery channel is significantly higher than the narration only group ($p = .022$). Meanwhile, there was no significance on retention and transfer performance among the three groups. ($F(2,67) = 1.625$, MSE = 7.258, $p = .205$; $F(2,67) = .370$, MSE = .678, $p = .692$).
We also found a medium negative correlation between transfer performance and student engagement \((r = -0.395, p = 0.001)\) and a rather weak negative correlation between retention performance and student engagement \((r = -0.249, p = 0.040)\).

**Experiment 2**

**Table 2. Means and Standard Deviations for Level of Engagement, Retention and Transfer Performance of Experiment 2**

<table>
<thead>
<tr>
<th>Learning performance</th>
<th>Types of background music and sounds</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>Narration + Original music and sounds from Discovery Channel</td>
<td>25</td>
<td>3.16</td>
<td>0.987</td>
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<tr>
<td></td>
<td>Narration + Baroque music</td>
<td>23</td>
<td>2.48</td>
<td>0.947</td>
</tr>
<tr>
<td></td>
<td>Narration only</td>
<td>26</td>
<td>2.65</td>
<td>1.018</td>
</tr>
<tr>
<td>Retention performance</td>
<td>Narration + Original music and sounds from Discovery Channel</td>
<td>25</td>
<td>6.68</td>
<td>2.428</td>
</tr>
<tr>
<td></td>
<td>Narration + Baroque music</td>
<td>23</td>
<td>6.09</td>
<td>2.275</td>
</tr>
<tr>
<td></td>
<td>Narration only</td>
<td>26</td>
<td>6.81</td>
<td>2.466</td>
</tr>
<tr>
<td>Transfer performance</td>
<td>Narration + Original music and sounds from Discovery Channel</td>
<td>25</td>
<td>1.72</td>
<td>1.242</td>
</tr>
<tr>
<td></td>
<td>Narration + Baroque music</td>
<td>23</td>
<td>1.04</td>
<td>1.186</td>
</tr>
<tr>
<td></td>
<td>Narration only</td>
<td>26</td>
<td>2.04</td>
<td>1.455</td>
</tr>
</tbody>
</table>

We found that the effect of background music and sounds on student engagement on the instructional material was significant \((F(2,73) = 3.145, MSE = 3.055, p = 0.049)\). Post-hoc tests showed engagement of the original video of discovery channel is significantly higher than the baroque music group \((p = 0.05)\). On the other hand, there was a significant difference in transfer performance \((F(2,73) = 3.653), MSE = 6.224, p = 0.031)\). Transfer performance of the narration only group is significantly higher than the baroque music group \((p = 0.026)\). Meanwhile, there was no significance on retention performance among the three groups. \((F(2,73) = 0.617, MSE = 3.537, p = 0.543)\).

We also found a medium negative correlation between retention performance and student engagement \((r = -0.407, p < 0.001)\) and a rather weak negative correlation between transfer performance and student engagement \((r = -0.114, p = 0.333)\).

**Discussion and Conclusions**

The results of the correlation prove that there was a negative relationship between level of engagement and transfer performance (experiment 1) and retention performance (experiment 2). The results of ANOVA tests and post hoc tests in both experiments showed learners in the narration and original sound and music of Discovery Channel are more engaged in the instructional video than learners of the other two groups where baroque music and no music was used. Nevertheless, learners in the Discovery Channel group learned less than students in the narration only group. Even though the results from the two experiments were somewhat inconsistent, they all together suggest learners are more engaged when they are learning with interesting sounds and music. This is consistent with arousal theory. The results are also consistent with Mayer’s coherence principle, which stated learners would learn better without background sounds and music. Suggestopedia’s argument of using baroque music would enhance super-learning was not found to be significant in this study.

The study has a number of limitations. First, the narrators are not the same throughout all experiments. The narrator in the narration only group and the narration and baroque music is different from the narrator of Discovery Channel, who is a professional voice actor. This may lower the reliability of the instruments used in the study. Second, the experiments were to be completed online at students’ own pace. This might have negatively affected the quality of responses since participants may get distracted from doing the experiments. We were not able to identify the types of music and sounds mixed in the original music used by Discovery Channel; therefore we could not embed the same background music and sounds in the condition with narration and baroque music.

Based on the findings of this study, we would suggest no background sounds and music should be used simultaneously with auditory narration. The issue remains is if we do so, learners’ engagement is lowered. Further
research on the effects of other different types of music and sounds should be added to increase learners’ engagement without trading for learning performance should be done.

References


