Special Series: Natural History in the Digital Age

The Use of Original Music Videos to Teach Natural History

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We describe the use of original music videos as instructional aides for a large non-science major course in natural history. The course meets university general education requirements for life sciences and environmental literacy. Over two class years (Fall 2012 and 2013), the senior author wrote and recorded five music videos to reinforce class lecture materials including songs on: (1) conceptual topics, (2) important habitats, and (3) important species. The purpose of the videos was to utilize a multimodal form of instruction in a format (music videos) commonly used and appreciated by university students. The videos were uploaded to YouTube between 18 August 2012 and 13 November 2013. Anonymous, voluntary questionnaires in both years indicated that students' perceived that videos improved their learning and attitudes towards both class and studying. We assume that a portion of the positive responses was due to the fact that the class instructor generally created and sang the songs in the videos, rather than employ materials from other sources. The results reveal potential for measuring actual gains in learning and retention and an investigation of their correlation with different video content (e.g., natural history concepts, habitat types, and species information) is ongoing.

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Introduction

One of the major challenges of university science education is to increase the quality of the undergraduate educational experience. Undergraduate classes in basic sciences such as biology have relied for several centuries on a traditional model of passive learning in large lecture courses, interspersed with laboratory sections to provide active learning for students (Freeman et al. 2014). Increasing enrollment in universities as the children of the "baby boomer" generation enter college, concomitant with significant declines in educational funding in public universities, have created substantial need for reevaluation of traditional educational models (Brewer and Smith 2011). University faculty face the conundrum of transforming large depersonalized lecture classes traditionally taught via passive learning, into more personal and engaged learning experiences in a time of declining financial resources.

Although the lecture format still forms the core of instruction in higher education, the research question regarding the value of active learning was answered decades ago (McKeachie et al. 1987). We now know that students learn more when they are actively engaged with course content, and there is compelling evidence that active learning approaches contribute to higher-order gains in areas such as problem-solving and critical thinking (Prince 2004, Freeman et al. 2014).

Although selection of an instructional strategy must be guided by the learning outcomes established by the instructor, an additional criterion also should be "Will the approach under consideration require students to actively process the content they are expected to learn?" If a faculty member is confident that their approach is fostering active processing, then the probability of substantive learning is increased.

Parallel to the benefits of active learning are additional instructional strategies that increase cognitive processing of content. Changing instructional delivery methods captures attention, and as a result, helps students focus on content (Willingham 2009): a desirable pedagogical strategy. In addition, visual modes of presentation result in greater student recall of information than that presented orally (Najjar 1998, Zull 2011). Combined, instructional approaches that are unique to an instructional context and incorporate visual imagery should result in positive educational outcomes likely similar to those obtained via active learning.

Extending this discussion of pedagogical novelty and modalities, there is considerable evidence that multimodal instructional techniques aid in students' acquisition and retention of knowledge in the natural sciences (Najjar 1998, Mayer 2005, Jaipal 2010, Arroio and de Souza 2012). At their best, multimodal techniques utilize as many sensory modalities as possible for both active and passive learning (Jewitt et al. 2001, Mayer 2005, Sorden 2013, Hackling 2013). Music and music videos hold great potential as a form of multimodal information transmission in university classes, because they utilize virtually all neural pathways in the brain (Levitan 2011) and are commonly viewed by students for recreational purposes.

However, there has been little research on the use of music as an instructional technique at the university level (but see Boyle 2011 and Crowther 2006, 2012a, 2012b, 2013). Much of what is discussed as multimodal instruction focuses only on written and visual communication presented in varying formats (Gunel et al. 2006, Sorden 2013, Yore and Hand 2010). Some literature exists on the effect of song on learning for kindergarten through high school students (Smolinski 2011, McFadden 2012, Govenor et al. 2013). These studies show that music enhances the learning experience via several mechanisms: (1) creating a more positive class-room atmosphere, (2) increasing the potential for greater knowledge acquisition and retention via multimodal learning, and (3) potentially enhancing recall and longer-term learning.

In the last two years, we have investigated new techniques to increase students' learning capabilities, class involvement and attitudes in a class on the Natural History of Georgia. This course is a large course (140-170 students) designed for non-science majors that meets University of Georgia general education requirements in life sciences for many majors, and environmental literacy for all majors. Despite the lack of research on university-level biology instruction and song, evidence from other areas suggests that song can aid in both the acquisition and retention of knowledge, as well as possibly increase general cognitive skills (Levitin 2006, 2011, Crowther 2006, 2012b, Crowther and Davis 2013). Higbee (2001) has shown that mnemonics, generally, are useful tools for knowledge retention; we need only recall our youth to acknowledge that we likely learned the ABCs, color wheel and how to tell time, via song.

Although the need for innovative approaches to instruction in biology education at the university level is indisputable, this research also was motivated by the senior author's interest in combining original music with pedagogy. Specifically, the senior author found that many basic ecological and evolutionary concepts lent themselves to presentation in a song format, including such topics as speciation, natural selection, binomial nomenclature, interspecific competition, and schooling/flocking, as well as biological information about important habitats and species. In 2011, the senior author began playing the ukulele, which became the main instrument for the subsequent music video recordings. In this paper we present results of anonymous voluntary questionnaires designed to assess students' perceptions regarding the effects of the music videos on learning and attitudes towards class and studying.

Methods

Questionnaire development and administration.— Results presented in this report are based on two voluntary anonymous questionnaires administered by the senior author during autumn 2012 and 2013 classes. The 2012 questionnaire was a general questionnaire regarding a variety of digital instructional practices used in class (e.g., Facebook), and we present only the two relevant questions from that instrument. These two yes or no questions were conceptually identical to those of Crowther (2006) and focused on class enjoyment and aid in studying. The 2013 questionnaire dealt only with the music videos, and responses were based on a five-category Likert Scale, ranging from completely true to completely false. Questionnaires were written for evaluative purposes and were reviewed by the respective Teaching Assistants for validation, but did not contain elements for internal validation.

Class sizes during questionnaire administration were estimated because attendance was not taken on these days to minimize class disturbance. Roll normally was taken on eight dates chosen haphazardly during a total of thirty class sessions, and class attendance represented 20-25% of the final grade. Although our paper is basically a qualitative demonstration report, we used chi-square to test the null hypothesis that the sample of students answering the questionnaires between 2012 and

2013 classes did not differ in year-class composition (number of first-year students, number of second-year students) or proportion of non-science vs. science majors.

Video construction.—Five music videos were involved in this study (Table 1). The senior author wrote the music for all songs except for *Speciation Stylin'*, sang the lyrics for all the music videos, and played the ukulele on all videos except *Speciation Stylin'* and *Natural Selection.* The music on the latter two videos was performed by a professional musician, who also provided back-up music and vocals for the remaining videos.

Music was recorded on multi-track analog and digital recorders and processed using widely available music production software; the senior author produced all videos. Four of five videos consisted of text only, which was created using a commercial video processing program; however, *Rat Snake Blues* was based on video footage of the snake in the natural habitat, with lyrics presented in the video description on YouTube. Videos ranged in length from 1:59 to 3:52. Video content ranged from mnemonics for the Linnaean hierarchy of life (*King Philip*), to evolutionary concepts (*Speciation Stylin', Natural Selection*), to habitat vegetation descriptions (*Piney Flatwoods Blues*), to descriptions of the biological characteristics of common and important species (*Rat Snake Blues*). The senior author produced all videos.

Video exposure.—Videos were posted on YouTube during both 2012 and 2013 classes, and were first played during the relevant class lecture period, where it was suggested to the students that learning the song lyrics would improve their performance on exams. To facilitate access to the videos, internet links to the videos were posted in the downloadable study guide for each lecture, as well as on both the University of Georgia instructional site for the class and the class Facebook group. Students were then able to watch the videos *ad libitum*.

To evaluate student interest, we recorded the date a video was posted and the number of views recorded by 19 April 2014. However, because the videos were not hidden on YouTube, video statistics could include outside user views as well.

Results

Class composition.—Response rates and class composition of the two classes were similar between years. In 2012, 120 students out of approximately 150 attendees (total enrollment 170) answered the voluntary anonymous questionnaire, and in 2013, 98 out of approximately 110 attendees (class size 140) answered a more detailed questionnaire specific to the videos. In 2012, respondents included 28 first-year students, 43 second-year students, 25 third-year students, 14 fourth-year students and 10 fifth-year students. In 2013, respondents included 37 first-year students, 31 second-year students, 19 third-year students, 3 fourth-year students, and 4 fifth-year students. In 2012, there were 10 science majors and 109 non-science majors, whereas in 2013 there were 12 science majors and 80 non-science majors. Comparisons of class "student year class" composition and the frequency of science versus non-science majors demonstrated a lack of significant difference between 2012 and 2013 classes (both Chi square values, $p >> 0.05$).

Student responses.—Student perceptions of the videos were strongly positive. The 2012 questionnaire contained two questions regarding student perceptions of the two videos posted at that time: (1) "I found the *Speciation* and *Natural Selection* songs helpful study aids," and (2) "I found the *Speciation* and *Natural Selection* songs fun." There were 120 responses to each question of which 67% were "yes" and 33% "no" for Question 1, and 92% "yes" and 8% "no" for Question 2.

The 2013 questionnaire included seven questions regarding video viewing (of all five videos) and their perceived effect on learning and attitudes towards the class environment. The first two questions addressed video viewing, querying the number of times students actually watched the videos. Responses revealed that the majority of students watched the videos at least once (69 students from a total of 98). Many students watched the videos more than once, for instance watching it 2-3 times ($n = 18$), 4-5 times ($n = 9$), or > 5 times ($n = 9$).

Table 2 shows the results for the remaining five questions (Questions 3 through 7), which addressed intended use and perceived effects. Counting positive responses as those ranging from "somewhat" to "completely true," the majority intended to watch the videos prior to the final exam. The responses to questions that assessed students' perceptions of the video's impact on learning (Question 4), attitudes about the class and class environment (Questions 5 and 6) and attitudes towards studying (Question 7) were all positive (ranging from 67 to 86% affirmative). It appeared that the strongest positive perceptual responses of students referenced improved attitudes towards class and class environment above potential value as a study aid (Table 2).

Discussion

Several studies demonstrate that songs can be used to produce positive educational outcomes in university classes (Crowther 2006, 2012b, McLachlin 2009, Boyle 2012), however, the topic has not been well studied at the university level. This is unfortunate because the trend for increasing class sizes at many universities calls for development of innovative approaches to instruction, especially those leading to improvements in student motivation and class involvement. At the pre-university level, multiple studies have demonstrated positive outcomes for educational songs and music videos including improvement of student perceptions and in some cases, class performance (McCurdy et al. 2008, McFadden 2012, Smolenski 2012, Governor 2013). These results are not surprising given that performing and listening to music results in dopamine release in the brain (the same neurotransmitter released during pleasurable experiences including sex; Salimpoor et al. 2011, Kaplan 2014).

Our results suggest that original music videos that communicate important content on ecological/evolutionary concepts, species' biology, and habitat characteristics led to improved students' perceptions of class and studying. Further research involving pre-and post video exposure testing in treatment and control groups is required to test for gains in learning and retention via results derived from performance exams (and is currently is being undertaken). Nonetheless, substantial improvements in students' attitudes towards subject matter and class are not trivial findings, especially given that generally more than 90% of the students in the class, Natural History of Georgia, were non-science majors who likely took the class primarily to fulfill a general education science requirement.

It is important to note that all vocals and most of the instrumentation were performed by the instructor, such that the effects of instructor contribution and performance cannot be separated from the effects of the medium itself. Certainly when a professor writes, performs, and records videos for presentation in class, it is likely that a combination of both the medium and personal connection will increase student's interest, attention, and receptivity towards the material. Such personal interactions may be particularly helpful for students who are not predisposed towards the subject matter (e.g., non-science students satisfying basic science and environmental literacy requirements). This raises an additional confounding factor, which is that the teaching ability of the instructor is not separated from the technique itself. As noted by Andrews et al. (2012), university instructors who develop innovative teaching techniques are likely to have greater experience in pedagogy than those who use standard techniques. Hence, in our study, the teaching ability of the professor is not separated from the efficacy of the technique itself. However, substantial evidence exists that varying pedagogical modes produces positive outcomes in the class room (Najjar 1998, Willingham 2009, Jaipal 2010, Arroio and de Souza 2012), and it seems unlikely that our results were a consequence of student affinity for the professor's involvement alone. Follow-up querying of the student self-report data, via semi-structured interviews, would provide clarification, but was beyond financial and logistical constraints of the project.

Although our results are positive, some faculty may find the technical requirements necessary for producing videos prohibitive, or feel their musical skills are inadequate for such an approach. However, the senior author has only been playing the ukulele for three years and it is not a difficult instrument to learn. There are also a large number of songs that are uncopyrighted (e.g., traditional ballads, folk songs, etc.) and available on the web. In the United States, the Fair Use Doctrine allows for the educational use of copyrighted materials in some circumstances). In addition, music videos on YouTube frequently are listed under Creative Commons licensing, which allows for broader use than United States Copyright.

Finally, from our experiences it is clear that students are not just interested in high quality musical performances on music videos, but also find compelling the personal involvement of the professor. Consequently, quirky but informative videos performed by a professor (using as little as a kazoo, triangle, or tambourine) may invoke greater interest than videos made by professional musicians and producers with no connection to the class.

Determining the generality of the positive outcomes observed in our study will require the testing of ours or similar music videos in other classes and at other universities. The University of Georgia is somewhat unusual in that it is located in a small town that has an extensive music culture, and some students attend school here to avail themselves of that culture. Although we have just begun to explore the use of videos in student-directed learning, clearly this is an extension that should be undertaken to further increase student engagement. With video-capture possible on cellular phones, this approach is highly feasible (see Prof. Garry Hoban's web site Slowmation for a useful introduction to this approach).

In conclusion, our results demonstrate the positive impacts of content-based music videos on student attitudes towards a large natural history class satisfying several general education requirements. Further research will help (1) assess the generality of these responses, (2) disentangle confounding factors such as the effects of the instructor's performance from the effectiveness of the technique itself, and (3) establish whether learning and information retention also increased as an effect of watching the music videos. Nonetheless, even if the sole effects of the videos are improvements in the class environment and student attitudes towards subject matter and studying generally, such gains are particularly desirable in the large impersonal classes of modern academia.

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Table 1. Music videos produced for the class, Natural History of Georgia.

Title	Subject	Link
Speciation Stylin'	concept	www.youtube.com/watch?v=zuG2wxH-zyg
Rat Snake Blues	species	www.youtube.com/watch?v=utCJy315FYI
King Philip	concept	www.youtube.com/watch?v=BRvRzaeadN0
Natural Selection	concept	www.youtube.com/watch?v=rRlbLJY-Uig
Piney Flatwoods Blues	habitat	www.youtube.com/watch?v=vICvNmphsZE

Table 2. Study questions from the voluntary questionnaire given to students in the class Natural History of Georgia during Fall 2013. Data represent the percentage of answers in each category, from a total of 98 responses.

Question	Completely true	Mostly true	Somewhat true	Mostly false	Completely false
3. I plan to watch the song videos before the final	36	12	20	10	15
4. The song videos helped me learn material for class.	16	19	32	14	12
5. The song videos made a positive contribution to the class atmosphere.	44	25	15	2	7
6. The combination of lecture materials and song videos improved my attitude towards class.	30	33	23	3	6
7. The combination of lecture materials and song videos improved my attitude towards studying.	27	28	23	10	6