GOODMAN RESEARCH GROUP, INC.
Program Evaluation • Consultation • Market Research

The Music Instinct

Formative Evaluation

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TABLE OF CONTENTS

INTRODUCTION

Goodman Research Group, Inc., (GRG), Cambridge, MA, conducted the formative evaluation of *The Music Instinct* project. The NSF-funded project aims to bring to PBS viewers the strong evidence of the connections between music and science, as well as to facilitate a deeper understanding of both fields. The *Music Instinct* project, presented by WNET/Thirteen, in collaboration with Mannes Productions, includes a two-hour television program, a website, and ancillary educational materials.

The purpose of the formative evaluation is to obtain timely information to support and guide the producers as they make decisions regarding the design, content, and format of the program, website, and ancillary materials. As a part of the formative evaluation of this project, the following research activities were carried out:

1. In 2008, GRG conducted formative evaluation activities during the pre-production phase of the project that focused on public knowledge of and receptivity to the music and science content of the television program.

2. During the same year, GRG also conducted a viewer study with representatives of the target audience (PBS viewers, science enthusiasts, and non-science music aficionados) to assess the overall appeal of the show.

3. In February 2009, GRG conducted a Website survey with the same sample that participated in the viewer study to assess the level of interest in the *Music Instinct* website.

4. In May 2009, GRG conducted a formative evaluation of the formal educational materials, complementary to the *Music Instinct* program, created by the LAB@Thirteen, WNET/Thirteen's Educational and Community Outreach Department.

This consolidated report includes information on the methodology used and the findings obtained from each of the four studies mentioned above.

PRE-PRODUCTION STUDY

The evaluation activity during the pre-production stage of the project, carried out in April 2008, focused on public knowledge of and receptivity to the music and science content of the television program.

METHODS AND SAMPLE

GRG conducted a Web-based survey with representatives of the target audience (PBS viewers and non-science music aficionados). The survey examined awareness, knowledge of, and receptivity by potential viewers to the music/science content of the TV show.

Through a screener, GRG researchers identified 115 eligible PBS viewers from the GRG participant database and invited them to participate in the study. Out of these 75 took the survey, yielding a 65% response rate.

To reach the other category of target audience, namely music aficionados, GRG used two methods – snowball sampling and website posting. Snowball sampling is a sampling technique wherein existing study subjects are used to recruit more subjects into the sample. GRG also posted the survey on http://melodymatters.com (a music website frequented by music aficionados and music reviewers.) The number of participants in the study reached through these methods was 38, resulting in a total number of 113 participants.

RESULTS

Demographic characteristics

Table 1 indicates the demographic characteristics of the participants in the study. Almost two-thirds of the participants (64%) were females. Seventy-two percent of the participants were between the ages of 25-54 years. With regard to race, there was an overwhelming majority of Whites. The majority of the participants in the study were from middle or middle to upper socio-economic strata and had at least some college education.

Participants were asked to indicate if they had degrees in science- or music-related fields. Sixteen percent of the participants had a science-related degree and another 9% were working toward a science degree. Twenty percent of the participants had a music-related degree and another 17% were working toward it. With regard to their present employment, 12% of the participants indicated that they had a science-related job and 21% had a music-related job.

Table 1: Demographic Characteristics of the Study Participants

		Percentage
Gender	Males	36%
	Females	64%
Age	18-24 years	11%
	25-34 years	30%
	35-44 years	27%
	45-54 years	15%
	55 years or older	15%
Ethnicity	Hispanic/Latino	11%
	Not Hispanic/Latino	89%
Race	African American	3%
	American Indian	1%
	Asian	4%
	Native Hawaiian/Pacific Islander	0%
	White	90%
	Other	3%
Level of education	Some high school	1%
	High School degree	11%
	Some college	21%
	Associate's college degree	8%
	Bachelor's college degree	28%
	Some graduate / professional school	8%
	Graduate/professional degree	22%
Income level	Low income	8%
	Low to middle income	11%
	Middle income	52%
	Middle to upper income	27%
	Upper income	2%

Previous knowledge of the music/science topics

To assess how much information the participants already had about the connections between music and science, a list of various related topics was created. The participants rated their previous knowledge about each topic on the five-point rating scale (See Table 2.) Results indicate that participants knew more about general topics, such as *"The function of music beyond its obvious entertainment value" (mean rating = 3.65)* and *"The role of music in making people smarter, happier, and healthier (mean rating = 3.51).* The participants had the least knowledge about the very specific topic of *"The field of biomusicology" (mean rating = 2.33).*

Further analyses of these ratings on the basis of age, race, and gender in the sample yielded no significant differences. With regard to the two subsets within the sample, the music aficionados rated their knowledge higher than the PBS viewer for only one topic, *"The function of music beyond its obvious entertainment value"* (p=.000)

The participants were also asked to report their sources for gathering information on the topics mentioned in Table 2. The most common source reported (by 67% participants) was *"Through someone I know (e.g., a friend, family member, etc.)"*. Following that was *"Through school" (55%)* and *"Through media/news" (49%).*

Table 2: Ratings of Participants' Previous Music- and Science-Related Knowledge

	Nothing (1)	**Only a little (2)**	**Some (3)**	**Quite a bit (4)**	**A great deal (5)**
The function of music beyond its obvious entertainment value (mean =3.65)	.9	16.4	31.8	18.2	32.7
The field of biomusicology (mean = 2.33)	32.1	26.6	23.9	11.0	6.4
The relationship between the brain and music (mean = 3.19)	13.0	25.0	34.3	24.1	3.7
The effect of vibration on the human body (mean = 2.79)	8.2	20.0	30.0	26.4	15.5
Technology used in research on music and the brain (mean =2.79)	11.1	18.5	28.7	21.3	20.4
The origins of music (is music learned or innate?) (mean = 2.98)	10.0	28.2	26.4	20.9	14.5
The scope of music (is music a uniquely human trait?) (mean = 2.94)	7.3	30.3	25.7	22.0	14.7
The effects of training in music on language (mean = 2.95)	12.7	22.7	27.3	20.9	16.4
The evolutionary origins of music (how and why music developed) (mean =2.9)	8.3	26.6	25.7	25.7	13.8
The role of music in making people smarter, happier, and healthier (mean = 3.51)	24.5	24.5	30.9	17.3	2.7

Interest in the music/science topics

The participants were provided with the same list of topics as in Table 2 and were asked to indicate how interested they were in each topic and how likely they would be to watch a PBS show on those topics (See Tables 3 and 4). Overall, the participants gave high ratings to indicate their interest and likelihood of watching a show, with almost all topics receiving mean ratings higher than 4 (the second highest rating on a scale from 1 to 5).

The highest ratings for both the questions on interest and the likelihood of watching were given for the topic *"The role of music in making people smarter, happier, and healthier,"* followed by the topics *"The relationship between brain and music"* and *"The function of music beyond its obvious entertainment value."* Two out of these three topics were also the topics that the participants knew comparatively more about.

The lowest interest and likelihood of watching ratings were given to the topic *"The field of biomusicology"*, a topic about which participants knew the least.

Table 3: Ratings of Participants' Interest in the Various Topics

	Not at all interested (1)	**Somewhat interested (2)**	**Moderately interested (3)**	**Very interested (4)**	**Extremely interested (5)**
The function of music beyond its obvious entertainment value (mean = 4.38)	0	5.5	12.8	20.2	61.5
The field of biomusicology (mean = 3.93)	6.4	7.3	20.2	19.3	46.8
The relationship between brain and music (mean = 4.39)	0	4.6	12.8	22.0	60.6
The effect of vibration on the human body (mean = 4.13)	2.7	9.1	12.7	23.6	51.8
Technology used in research on music and the brain (mean = 4.13)	6.4	2.7	13.6	26.4	50.9
The origins of music (is music learned or innate?) (mean = 4.07)	3.6	6.4	18.2	22.7	49.1
The scope of music (is music a uniquely human trait?) (mean = 4.12)	3.7	6.4	15.6	22.9	51.4
The effects of training in music on language (mean = 4.12)	1.8	8.2	16.4	23.6	50.0
The evolutionary origins of music (how and why music developed) (mean = 4.09)	2.7	8.2	15.5	24.5	49.1
The role of music in making people smarter, happier, and healthier (mean = 4.48)	1.8	.9	10.0	21.8	65.5

With regard to gender differences on the two questions, women were more likely to watch a PBS show on the topics *"The role of music in making people smarter, happier, and healthier"* and *"The effect of vibration on the human body."* No differences based on race were found in the sample ratings for the two questions. PBS viewers in the sample were more interested than were the music aficionados in the topic *"The role of music in making people smarter, happier, and healthier"* and were more likely to watch PBS shows on the topics *"The effect of vibration on the human body"* and *"Technology used in research on music and the brain."*

With regard to age, significant differences were found for two of the ratings for likelihood of watching shows; older people rated the following higher than did

younger people: *"The effect of vibration on the human body"* and *"The origins of music (is music learned or innate?)."*

Table 4: Ratings of Participants' Likelihood of Watching a PBS Show on the Various Topics

	Not at all likely (1)	**Somewhat likely (2)**	**Moderately likely (3)**	**Very likely (4)**	**Extremely likely (5)**
The function of music beyond its obvious entertainment value (mean = 4.39)	1.8	2.8	10.1	25.7	59.6
The field of biomusicology (mean = 4.07)	5.5	5.5	15.6	22.9	50.5
The relationship between the brain and music (mean = 4.39)	1.8	4.6	8.3	22.9	62.4
The effect of vibration on the human body (mean = 4.17)	3.7	5.5	14.7	22.9	53.2
Technology used in research on music and the brain (mean = 4.25)	2.8	4.6	9.2	32.1	51.4
The origins of music (is music learned or innate?) (mean = 4.21)	4.6	3.7	9.3	30.6	51.9
The scope of music (is music a uniquely human trait?) (mean = 4.23)	3.7	4.7	11.2	25.2	55.1
The effects of training in music on language (mean = 4.24)	1.8	7.3	8.3	30.3	52.3
The evolutionary origins of music (how and why music developed) (mean = 4.26)	2.8	3.8	14.2	22.6	56.6
The role of music in making people smarter, happier, and healthier (mean = 4.54)	.9	.9	8.3	22.9	67.0

CONCLUDING STATEMENT

GRG conducted a Web-based survey with representatives of the target audience (PBS viewers and non-science music aficionados) for the *Music Instinct* television program. The survey was aimed at assessing the awareness, knowledge of, and receptivity to the music/science content of the TV show. Results indicated that the sample had little to some knowledge about the various science- and music-related topics that the producers plan to address in the show. The sample was highly interested in gaining more information about these topics and also highly likely to watch a PBS show related to the specific science and music topics.

VIEWER STUDY

In October 2008, GRG conducted a viewer survey with representatives of the target audience (PBS viewers, science enthusiasts, and non-science music aficionados). The survey focused predominantly on the overall appeal of the show and the extent to which it provided the audience with new information.

METHODS AND SAMPLE

GRG collected data from 101 viewers. Table 5 provides the demographic information of the participants in the study. The participants were predominantly White and highly educated, but showed wide range in terms of age and income.

Table 5
Demographic information of the participants

		Percentage
Gender	Males	43%
	Females	57%
Age	< 24 years	19%
	25-44 years	25%
	45-54 years	21%
	55-64 years	25%
	65+	11%
Race	African American	0%
	American Indian	3%
	Asian	5%
	Hispanic/Latino	0%
	Native Hawaiian/Pacific Islander	0%
	White	93%
	Other	1%
Highest degree received	None	0%
	Elementary school diploma	9%
	High School diploma or equivalent	12%
	Associate's college degree	2%
	Bachelor's college degree	31%
	Master's degree	23%
	Graduate/professional degree	11%
	Doctorate degree	12%
Income level	Less than 20,000	9%
	20,000 to 24, 999	3%
	25,000 to 34,999	12%
	35,000 to 49.999	8%
	50,000 to 74,999	11%
	75,000 to 99,999	15%
	100,000 or higher	40%
Do you ever watch NOVA shows on PBS?	Yes	80%
	No	20%

N = 101

Viewers came from all across the country from Massachusetts, New York , New Jersey, Missouri, Colorado, Arizona, and California.

Eighty percent of the participants indicated that they watch NOVA shows on PBS. The most common frequency of watching NOVA was *"less than once a month."*

With regard to the science and music interests of the participants, 43% indicated that they had a degree in science or a job that involved science and another 13% said the same about music.

RESULTS

Quality of the show

Overall, the participants appeared to enjoy the show. When asked whether, hypothetically, they happened to watch the show on television and not in a paid research study, 64% indicated they would still watch *most* or *the entire* show. Participants seemed particularly satisfied with the **theme** of the show. Forty-two percent mentioned that it was an interesting topic for a show, while 28% said that they found it fascinating. Another 9% were happy with the music and science talent displayed on the show. Some actual quotes from the participants include:

> *"The program was extremely interesting and very educational. The material and substance was very fascinating for me as a non-musician."*
>
> *"Utter and complete fascination. There is enough material to fill up many programs and keep me interested."*
>
> *"Interesting overview of the connection between music and the brain. It was thorough in covering a number of perspectives & aspects of the relationship whether through history, education, child development, animals or cross-cultural comparisons."*

Participants' responses were more varied when giving their opinions about specific aspects of the show. They were asked to rate (on a five-point scale) the various aspects that determine the quality of a show. As Table 6 indicates, the participants seemed satisfied with the general content (scope of information) presented by the show, its highest mean rating. The science and music sequences were also easy to follow. However, the participants were least satisfied with the overall organization of the show. While it was the lowest mean rating of the seven elements rated, it nonetheless was seen as fair to good.

Table 6
Participant ratings for the quality of the show

	Poor (1)	Fair (2)	Good (3)	Very good (4)	Excellent (5)
General content (scope of information) (mean = 3.79)	0	9%	27%	41%	24%
Ease of understanding the science sequences (mean = 3.44)	1%	18%	29%	40%	12%
Ease of understanding the music theories (mean = 3.47)	1%	15%	30%	42%	11%
Overall organization (mean = 2.85)	10%	35%	25%	20%	10%
Visual effects and quality (mean = 3.44)	3%	16%	33%	30%	18%
Audio effects and quality (mean = 3.50)	1%	13%	38%	32%	17%
The overall quality of the show (mean = 3.53)	1%	10%	43%	27%	19%

N= 101
Mean rating was out of 5.

Viewers' dissatisfaction with the organization of the show was also evident from their open-ended responses to the question about their first impressions of the show. A number of participants commented on the organization of the show. Themes based on these responses included:

- Reorganization of the format (19%) – Participants indicated that the show was too broad and needed to be better organized thematically.
- Length (16%) – Participants believed that there was at times too much information presented that made the show too long. The kind of information presented also made it "too academic."
- Multiple episodes (11%) – Related to the above opinion was the suggestion that pace of the show could be changed by presenting the information in multiple episodes.
- Better introduction (7%) – Some participants indicated that the introduction of the show could be improved to attract and sustain the attention and interest of the viewers.

Information acquired through the show

All the participants indicated that *at least some* of the information presented in the show was new to them. Thirty-five percent also indicated that *all* or *most* of the information was new to them.

When asked to indicate how effective the show was at informing them about the specific science and music related topics, the participants gave favorable responses (see Table 7). According to the participants, the show was most effective at conveying information about *"the connections between the brain, the human body, and music,"* and least effective about *"the effect of vibration on the human body."*

In an open-ended question participants were asked to indicate one interesting thing they learned from the show. Common responses given by the participants fell into the following categories:

- Effects of music on the brain; connection between brain and music
- Universality of music
- Information about music therapy or speech therapy
- Exploration of innateness of music

Table 7
Participant ratings for information acquired through the show

	Not at all effective (1)	Only a little effective (2)	Somewhat effective (3)	Very effective (4)	Extremely effective (5)
The effect of vibration on the human body (mean = 3.47)	3%	10%	38%	37%	13%
The technology used in research on music and brain (mean = 3.63)	0	11%	29%	47%	14%
The origins of music (i.e., whether music is innate or learned) (mean = 3.63)	1%	10%	38%	42%	17%
The connections between the brain, the human body, and music (mean = 3.88)	0	6%	27%	47%	24%
The educational aspect of music (mean = 3.74)	2%	7%	27%	44%	21%
The connections between culture and music (mean = 3.80)	2%	8%	26%	37%	28%

N=101
Mean rating is out of 5

CONCLUSIONS AND RECOMMENDATIONS

- Overall the music instinct show seemed to appeal to most participants. The participants found the concept of the show fascinating and interesting.

- The show received favorable ratings for its content and information about various science and music topics. Participants gained new information about science, music, and the connections between the two.

- Participants were least satisfied with the organization of the show. Although the participants agreed that the show provided them with a lot of new information, they indicated that the same information could be better organized. Specific suggestions included: dividing the show into multiple segments, adding a good introduction of what is to be expected in the show, better organization around various topics (there was a bit of jumping around), and better transitions from one topics to another.

We realize that, at this late date, most of these suggestions will not be implemented by the production team. However, an introduction that is "more catchy" and that gives the viewer a kind of auditory roadmap for what's to follow will greatly help to situate the nearly two-hour program.

Furthermore, the narration could provide better transitions between the segments, thereby helping the viewer understand the connections between them.

WEBSITE STUDY

In February 2009, GRG conducted a Website survey with the same sample that participated in the viewer study. These respondents had already viewed the *Music Instinct* 'rough cut' and had completed the Viewer Survey in 2008. The purpose of the Website Survey was to assess the level of interest in the *Music Instinct* website and to learn about the website topic preferences of the target audience.

METHODS AND SAMPLE

Of the 68 survey respondents, 44 were female and 24 were male. A majority of respondents were white, non-Hispanic, between 25 and 34 years old or above 50 years of age, and had received a bachelor's degree. More than half of the respondents (53%) held advanced degrees, and 26% had science-related jobs. Fifty-one percent of the respondents were either working on a degree or already had a degree in science-related field.

RESULTS

Respondents' Interest in Science- and Music-Related Research

A majority of the survey respondents indicated that they had an interest in learning about advancements in science. Nearly 70% of respondents indicated that they sought up-to-date scientific information either *once a week* or *a couple of times a month.* Respondents gathered information from a number of different types of paper and web-based publications. Interactive tools, such as Wikipedia, were the most widely used method of research (used by 88% respondents), though essays (47%) and interviews (43%) were also read widely. Regarding their knowledge about the Music Instinct program content, a number of respondents had learned about the topics covered. The most frequently checked topics were *the benefits of music in learning* and *the relationship between music and culture* (50% respondents). The other common topics were *the healing powers of music* (46%) and *the relationship between music and emotions* (43%).

Respondents' Feedback about the Upcoming Music Instinct Website

Forty-one percent of respondents indicated that they would be *extremely* or *very likely* to visit the future *Music Instinct* website, and additional 37 %said that they would be *somewhat likely* to visit it. When asked to rank their interest in certain website components, the following website features generated the highest levels of interest on a 5-point scale (where *1* indicated *not at all interested* and *5* indicated *extremely interested)*:

- Background essays explaining the concepts behind each chapter of the film (Mean ranking = 3.56)

- Interactive online audio tools that allow users to remix audio clips, view their wave length, alter their sound, and understand the mathematic concepts behind rhythm and frequency (Mean ranking = 3.40)
- A blog written by guest writers and producers of the series exploring current topics related to the series (Mean ranking= 3.26)

A space to share stories of how music had influences their lives held less interest for the respondents (Mean ranking = 2.80). Respondents were least interested in the creating music contest on the website (Mean ranking = 2.08).

When asked to rank essay topics of interest using the same scale as mentioned above, respondents indicated a high level of interest in several concepts related to music:

- The benefits of music in learning (Mean ranking = 4.11)
- The relationship between music and culture (Mean ranking = 4.00)
- The relationship between music and emotions (Mean ranking = 4.05)
- The relationship between music and language (Mean ranking = 4.02)

Finally, respondents chose the bloggers whose writing they would prefer to read on the *Music Instinct* website. The respondents were provided with a list of potential bloggers and a short description about each of their roles in the filed of science and/or music. The survey also provided the ability to click on a link to find out more about each of these experts. The most popular choices selected by the respondents included:

- David Sulzer / David Soldier (18% respondents' first choice)
- David Byrne (12% respondents' first choice and 9% respondents' second choice)
- David Rothenberg (11% respondents' first choice and 12% respondents' second choice)
- Dianna Deutsch (11% respondents' first choice and 9% respondents' third choice)

CONCLUDING STATEMENT

GRG conducted a Web-based survey with representatives of the target audience (PBS viewers and non-science music aficionados) for the *Music Instinct* television program. The survey was aimed at assessing the level of interest in the *Music Instinct* website and understanding the content preferences of the target audience. Results indicated that the sample had a strong interest in gaining scientific information and used Internet frequently as a tool to achieve this goal. Respondents indicated a moderate interest in accessing the future *Music Instinct* Website. Background essays on the *Music Instinct* website on topics such as *the benefits of music in learning* and *the relationship of music with culture, emotions, and language* would highly interest the respondents.

EDUCATIONAL MATERIALS STUDY

In May 2009, GRG conducted a formative evaluation of the formal educational materials, complementary to the *Music Instinct* program, created by the LAB@Thirteen, WNET/Thirteen's Educational and Community Outreach Department. These materials are a part of an extensive community-based education initiative that also includes partnership with nine other PBS stations on educational outreach efforts, creation of informal educational materials, and attendance at national conferences.

The formal educational materials include five lesson plans that encourage middle school students' understanding about the powerful connections between music and science and bring the topic to life in school classrooms. The final lesson plans, which will adhere to national learning standards, will contain comprehensive instructions for classroom implementation, utilizations of the Music Instinct online features, streamable and downloadable segments of the broadcast program, printable student handouts, and suggestions for cross-curricular extensions. According to LAB@Thirteen, the primary goals of the educational materials are:

1. fostering meaningful, inquiry-based science learning experiences based on program content for underserved, middle-school aged students, and
2. promoting deeper understanding of the relationships between music and science, and encouraging further student exploration of both.

METHODS

At the beginning of this evaluation study, in April 2009, GRG's lead evaluation researcher for this project attended the *Music Instinct* Advisory Board meeting, at which the outreach and evaluation plans were presented and finalized. Early in May, LAB@Thirteen sent GRG rough drafts of two of the five activities, which GRG used for the formative evaluation. The first activity, *Good Vibrations*, focuses on connections between vibrations and creation of musical sounds. The second activity, *Can You Feel What I'm Saying*, demonstrates that sound travels through different substances and that human voice can create specific vibrations.

For the purpose of this research activity, GRG collected evaluation data from middle school science and music teachers. Through its participant database and by using snowball sampling, GRG recruited 14 middle school teachers to participate in the study. Out of the 13 who completed the study, 11 had a master's degree and currently teach fifth through twelfth grades. These math, science, and music teachers came from states across the country: Arizona, Florida, Maine, Massachusetts, Michigan, Missouri, Montana, Nebraska, New Jersey, Oregon, and South Carolina. Number of years of teaching experience ranged from three to 35 years. Eight of the 13 teachers were women.

GRG sent the teachers copies of the two activities and instructed them to write notes directly on the lesson plans as they evaluated the activities. Accompanying

the lesson plans were questions to guide the teachers' assessment of the activities. These questions were:

- Is the activity age-appropriate?
- Are the instructions adequate and clear?
- Can the materials be easily obtained?
- How engaging is the activity likely to be for the students?
- In your opinion, what is the educational value of the activity?

After evaluating the activities, the teachers completed a brief survey on their impressions of the various aspects such as the appropriateness of the activities, the likelihood of student engagement, and the overall quality. After the teachers returned the activities with their notes and the survey, they received a stipend (in the form of a $65 online gift certificate).

RESULTS

Overall, the teachers gave high ratings to the two activities. The teachers appreciated the underlying premise of the activities – a fusion of science and music concepts in experiential activities for students.

- Eleven teachers rated the two activities as either "*excellent*" or "*very good*". The teachers agreed that the hands-on nature of the activities would make them very engaging for the students.
- Eleven teachers rated the *Good Vibrations* activity as potentially "*extremely engaging*" or "*very engaging*" for the students.
- Ten teachers gave similar ratings for the *Can You Feel What I'm Saying* activity.

The qualitative and quantitative analyses of the data gathered from the teachers revolved around a number of themes, presented in the following sections. These included highlights, potential difficulties, and suggestions for changes.
For more information on the quantitative data, please refer to the annotated survey in the appendix.

Appropriateness of the activities

According to the teachers, both of the activities were appropriate for middle school students. The science and music concepts illustrated in the activities could be grasped and understood by children of that age. The teachers indicated that the activities were most suited for 6th through 8th grade students – the potential target audience specified by LAB@Thirteen. The only exception to this is the extension challenge for the *Good Vibrations* activity. According to the teachers, this activity is more appropriate for high school students due to the inclusion of advanced mathematical concepts such as constants and an elaborate set of instructions.

The teachers indicated that the two activities were appropriate for both science and music classes. The teachers also agreed that the activities would be most

effective if they were co-taught by science and music teachers. In the words of a teacher,

> *"Great ways to cross curriculum and engage other subjects. Maybe even invite the science teacher to help teach the lesson if possible or have the science teacher teach along with the lesson in science class (same lesson/ subject matter different class)"*

Background information

The teachers felt that the two activities have the potential to teach the concept of connection between music and science. The activities are good examples of an interdisciplinary curriculum. However, an overarching theme that was evident among the teachers' comments was that they would like to see an *explicit* emphasis on the inter-connections between the three fields, in addition to a more in-depth discussion of the science, math and music concepts used in the activities. For example, one teacher suggested that once students had learned that vibrations set up sound waves and that different lengths of strings produce different waves with different frequencies to give different pitches, then the students should be encouraged to use that information to understand how different instruments produce different sounds. The teachers reported that if such in-depth discussion was not included, the activity would be more recreational than educational.

It was also critical to the teachers that a description of vocabulary words such as 'octave,' 'vibrations,' or 'fret' be included. The teachers further elaborated that instead of just providing some possible questions for discussion, it would be beneficial for them if the lesson plans provided them with pre-written discussion material in a question-answer format and a precise direction in which the conceptual discussion should progress.

Materials

The teachers appreciated the fact that the materials required for the activities were simple and could be easily made available. However, these materials were not necessarily a part of a classroom and would need to be specially assembled. Also, the number of materials required is high and the activities are to be carried out individually. Because of these reasons, the teachers were concerned that the total cost of the materials would rise. They also worried about not having access to certain musical instruments, such as a guitar or a piano, which are a required part of the activities.

The teachers raised the question of the reusability of the material. They would prefer materials that can be recycled and reused with successive classes. This could, potentially, also help in reducing their preparation time.

A need for more information about the materials was a common theme across all activities. The teachers indicated that they would benefit from more specific details about the materials. For example, "size and gauge of nails" and "particular

number of the rubber bands" for part I of *Good Vibrations* activity or "size/ type of tuning fork" for part I of *Can You Feel What I'm Saying* activity.

The teachers appreciated having possible alternatives for the materials. However, they wanted to know the optimum requirement for the activity. In the words of a teacher:

> *"Because the materials used will make a difference in quality of experiment, it would be good to list specific items as "best" and then give suitable substitutes. Then, refer only to the specified items. Using all 3 choices makes it a bit cumbersome and confusing."*

Safety issues

Another major theme that was consistent across the teachers' feedback was the need to explicitly state and emphasize the safety issues involved in both the activities. Specific examples of safety concerns cited by the teachers included:

> *"Having students nail a board inside a classroom would be very noisy and likely result in injury and/or damage to classroom furniture."*

> *"Some [teachers] might wonder if there are any potential safety issues with placing tuning fork against bone behind ear lobe and you may want to mention this in the description."*

> *"[Part 2 of Good Vibrations activity] might be difficult with child scissors and it might be dangerous with scissors sharp enough to cut holes in a straw."*

The teachers suggested that reviewing safety rules, setting explicit limits for the activity, using less hazardous materials (e.g. hole punchers instead of scissors), and having adequate adult supervision would minimize the risk of injury.

Preparation

The teachers agreed that both the activities will be most effective if they are co-taught by science and music teachers because they include both science and math concepts. However, if a science or a math teacher chooses to individually conduct the activities, s/he might need extra preparation time in terms of gaining background knowledge and connections between science and music.

In terms of advance preparation, it was also suggested that teachers should practice the activities themselves before conducting them with their students – and that this should be specified in the instructions. This practice session would help them anticipate any potential issues when the students are engaged in the activities. Also, the models made by the teachers could be used as prototypes by the students when they conduct the activities.

Format

Because of the length and the complexity of the activities, the teachers suggested that the format could be changed from individual activity to group activities. If the format could not be changed, an alternative suggestion was to involve more adult helpers (parent volunteers) during the activity. Having more adults involved would also help eliminate some of the safety concerns mentioned previously.

Instructions and Procedures

Appropriate wording

The teachers addressed the use of certain words, indicating that they should be changed in order to be sensitive and consistent with standard practice. For example, the teachers suggested changing the word 'children' to 'students' and using the word 'hearing impaired' instead of 'deaf.'

The teachers recommended that the objectives of each activity should be checked for logical progression of goals. Also, some objectives may be more apt as sub-objectives of an overall, broader objective rather than stand-alone objectives by themselves.

Sequence of the instructions

The teachers recommended checking the logical flow of instructions for the two activities. For example, one teacher felt that procedure numbers 4 and 5 in Part II of the *Good Vibrations* activity would work better if they were switched. It would be more instructive for students if they are allowed to experiment with different straw lengths in order to come to the conclusion that shorter straws produce higher sounds and longer straws produce lower sounds, rather than providing that conclusion for them. Another example is reversing the order of Part I and Part II of the *Good Vibrations* activity. According to the teachers, Part II is a simpler activity and the reversal would help in terms of successive concept development.

Simplifying and enhancing instructions

The teachers appreciated the pictorial representation for building the wooden board to produce musical sounds through vibrations, as shown in part I of the *Good Vibrations* activity. They felt that the diagram simplified the instructions. However, it was suggested that the pictorial representations be placed before the instructions so that the final prototype is visible before the students actually begin constructing it (especially in case of the Extension Challenge in the *Good Vibrations* activity).

Additionally, some teachers found the long list of instructions to be cumbersome and confusing. They indicated that depicting the instructions in a successive

pictorial form (often seen in 'do-it-yourself' manuals or wiki 'How to') would help them understand the instructions better.

Another valuable suggestion from the teachers was to have the pictorial representations drawn to scale in order to make the diagrams more accurate. An alternative to pictures and diagrams was providing a video that depicted an adult creating the instruments while using the instructions in the lesson plan.

Enhancement of the activities

Teachers had several suggestions for enhancing the activities to make them more inclusive and relevant. The activities could be made more multi-culturally sensitive by talking about stringed instruments from around the world. In the words of one teacher:

> *"It would be good to make reference to instruments such as koto (Japan) and zither (Vietnam), to illustrate the multi-cultural component. The DVD made reference to the "western notion" of pleasing sounds…it's good for students to learn the connections/ variations with others instruments in the world."*

Another way in which the activities could be enhanced would be to relate the activity to the students' everyday lives. For example, in reference to the *Can You Feel What I'm Saying* activity, one teacher suggested, "*students should be asked to write down a list or make a KWL [What I Know, What I Want to Know and what I Learned] chart of places where students can "feel" music; e.g. a concert, from a car with loud radio, etc."*

Length of the activities

With respect to the number of class periods required for the *Good Vibrations* (Part I-III and the Extended Challenge) activity, teachers were of the opinion that it would take from two to ten class periods, with each class period ranging from 45-60 minutes. On the other hand, in order to complete the *Can You Feel What I'm Saying* (Parts I-III), they felt that it would take approximately one to five class periods, with each class period ranging form 45-60 minutes.

The extensive length of time required to complete these activities was one of the concerns among the teachers. A second concern was that they would have to invest more time and energy in preparing for these activities. It might be beneficial to explicitly mention that each part of *Good Vibrations* or *Can You Feel What I'm Saying* activity can be used as a stand-alone activity. Teachers can choose which part they want to conduct with their students. Also, depending upon the time they have at hand, the teachers can decide the extent to which they want to engage in the conceptual discussion.

Post activity follow-up

The teachers indicated that the activities lacked any post-lesson extended learning objectives. They suggested that adding worksheets or assessment tools within the lesson plan, and providing post-activities review materials, would help the students retain the scientific concepts learned during the activities. Also, because the activities are heavily focused on experiential learning, the teachers suggested that the students should be asked to record their observations and hypotheses. To allow the students to experience the various processes in a scientific inquiry, they could be asked to maintain a response journal during and after the activity. This would also add to the "hands-on" nature of the activities.

CONCLUDING STATEMENT

Overall, the teachers had a positive impression of the two hands-on activities, *Good Vibrations* and *Can You Feel What I'm Saying.* They found the activities both age- and subject matter- appropriate. They believe that the activities have a high potential to engage the students. In order to enhance the effectiveness of the activities, the teachers requested the following: some additional background information in science and music concepts conveyed through the activities, specific details about materials used, graphical representation of the instructions, explicit mention of safety issues, flexibility with the format, and suggestions for follow-up activities.

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