



Using Music Videos to Inspire Engineering (Evaluation)

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Abstract

The OK Go Sandbox project is a free resource website for K-12 educators. Launched in Spring 2018, the site currently contains 15+ videos and educator guides on topics ranging from engineering concepts (such as simple machines, sensors, and design process) to teamwork and artistic exploration. The content is created in a collaboration between the band OK Go and the Playful Learning Lab at the University of St. Thomas, with K-12 educators involved throughout the planning and implementation phases. Since its launch, educators have used the materials in a variety of ways, some of which the development team had not previously considered. This paper will particularly focus on the implementation and evaluation of the engineering content on the site. We will present and discuss results from (1) educator feedback surveys, (2) website analytics, and (3) educator focus groups. We will also reflect on the challenges and opportunities in promoting new web-based educator materials. Our team has implemented a number of strategies to reach teachers, including social media, conference attendance, and email newsletters. Now that the materials have been available for over 18 months, we are able to share lessons learned from this project and identify the areas that are being explored for further investigation and refinement.

Introduction

The Grammy Award-winning band OK Go is known for its entertaining music videos which involve a unique integration of science, math, engineering, and/or technology with their music. The band was pleased to learn that teachers were using OK Go's music videos in their classrooms as an exciting way to show the design process in action. This led to the band members wanting to provide teachers with more real-life material to share with their students. When the band crossed paths with an engineering professor, that desire became more plausible and the idea for OK Go Sandbox began to take form. Through collaboration among the band, college professors and students at the Playful Learning Lab at the University of St. Thomas, and K-12 educators, STEAM resources based on OK Go's music videos have been created for elementary through high school classrooms to learn from. It is hoped that through OK Go Sandbox, the band is able to inspire students to jump deeper into engineering and take risks by trying new things.

OK Go Sandbox Resources at a Glance

The OK Go Sandbox website is the home for all of these educational resources. Content is organized by the music video with which it relates, and based on teacher feedback, now also can be organized by grade level and subject areas involved. These resources are split up into an educator guide with information for the teacher and directions for instruction, and a student guide that helps lay out the activities for students. The guides outline an inquiry activity that is followed by a challenge activity that typically occurs in an out-of-school engineering setting (real-world applications of engineering principles). These activities allow students to first interact and deepen understanding of the concept at hand. Secondly, the activities provide the students with the opportunity to apply this newly developed knowledge in a design-centered task.

All worksheets are available in PDF format directly downloadable from the website. In addition to lessons and activities, there are supplemental videos of OK Go band members completing some of these activities themselves. This connection between band and student can motivate students who have lower self efficacy in certain subject areas, such as engineering, to approach the task with more confidence knowing that it is applicable in careers outside of the perceived “typical” STEM realm. The website also provides behind-the-scenes content showing how the music videos were made. These videos often describe the math and science behind the visual effects the band is known for. This again offers students a look into how engineering and other STEAM concepts can be applied in the real world, especially in jobs that seem unrelated. Students may feel more inclined to attempt the task at hand when they see that it can be used in atypical ways that serve a practical purpose.

Literature Review

Bybee offers perspective into engineering education standards: What are the opportunities? What are the barriers? He argues that “students should learn concepts such as systems, optimization, and feedback; they should develop the abilities of engineering design and habits of mind [1],” which is exactly what OK Go Sandbox strives to support by connecting learning to the engineering of OK Go’s music videos. The rise of engineering education stemmed from standards-based reform; however, common standards across the United States for technology and engineering have not yet been adopted like the Common Core State Standards (mathematics and English language arts) that are used throughout the OK Go Sandbox resources. He adds that “the power of national standards lies in their potential capacity to change the fundamental components of the education system at a scale that makes a difference [1],” which again connects to the goal of OK Go Sandbox: to offer a resource for teachers throughout many locations with which students can be motivated to engage with engineering concepts and principles through hands-on experiences. One opportunity that Bybee addresses is the rising need to include engineering in K-12 education due to the increasingly STEM-oriented world students are growing up in. Now more than ever, the issues of engineering education are at the forefront: What can we do to solve these problems and teach students about engineering early on? One barrier identified is the lack of preparedness in many spheres (time, money, resources, etc.) to integrate engineering education into schools across the nation. Adopting national engineering education standards would benefit not only teachers, but also teams developing resources. The full adoption of these standards would allow OK Go Sandbox to align their materials strongly with teacher needs, as we have identified this as one area of improvement for the project.

NASA has developed a program called HUNCH, or High Schools United with NASA to Create Hardware. A common goal shared with OK Go Sandbox is to “increase student interest in STEM [2].” Undergraduate students partnered with students at local high schools to learn more about project management through workshops, stressing “learning by doing” and project-based learning [2]. This project, like OK Go Sandbox, connected students to real-world projects and jobs which use engineering. Fostering these meaningful connections could be one reason why students in this study showed increased learning; however, this study also needs to expand upon the original research to see if this factor alone has contributed to this evidence of learning.

Research suggests that “STEM integration can provide students with one of the best opportunities to experience learning in real-world situations, rather than learning STEM subjects in silos [3].” OK Go Sandbox provides students with an opportunity to dive into unique, real-world applications of engineering and design. It is suggested that STEM subjects should be taught together as they then offer a meaningful learning experience. OK Go Sandbox offers a variety of activities that are accompanied by different STEAM standards, meaning that the resource offers a comprehensive approach that students benefit from. Reference [3] also discusses that motivation and engagement can be increased by implementing engineering/STEM instruction through different integration techniques. Also discussed are different methodologies of teaching engineering in K-12 schools. OK Go Sandbox allows engineering instruction to occur in a variety of settings, especially when students are able to connect their learning to previously learned knowledge and skills.

Reference [4] discusses the necessity for teacher self efficacy to be measurable because it impacts a teacher’s actions in the classroom. This study identifies that teachers are not required to learn about engineering in order to get a teaching license, which often leaves teachers feeling that they are not adequately prepared to teach engineering content in their classrooms. With the push to integrate engineering into the curriculum, teachers across the board likely have different levels of self efficacy when it comes to their ability to teach engineering. This study developed a way to measure teacher self efficacy in engineering education which will act as a basis for further research and literature on engineering education. This is important because levels of teacher self efficacy directly affects student attainments in the given subject area. For teachers with lower self efficacy, OK Go Sandbox can act as a resource to start developing a meaningful engineering curriculum: “many professional development programs have been created to help teachers become qualified and confident in engineering and teaching engineering [4].”

Another program also designed to increase student engagement with STEM subjects targets both seventh grade and eighth grade students in science classes through the creation of a summer camp with research results suggesting that “underserved populations of both female and male students experienced increased interest and attitudes toward science and technology [5].” Additionally, professional development measures were taken so that teachers could successfully integrate hands-on learning into their classrooms. By teaching both educators and students, the impact of this program can reach a larger audience and potentially increase student interest in STEM through these educators and peers if not the program itself. OK Go Sandbox also attempts to increase student interest in STEM subjects, as well as provides resources for both educators and students, hoping that by supporting both, student learning will be as successful as possible.

Survey Logistics

OK Go Sandbox has an email list of educators who have expressed interest in their content, and this population of individuals was presented with a survey regarding their use and opinions of OK Go Sandbox. 88 participants responded to this survey and the data collected indicates the effectiveness of OK Go Sandbox, the majority of which were educators (59 of 73 that responded to the question). The respondents also included parents, students, and other school staff. Of the educators that responded to the survey, the majority teach grades 4 through 6 or 7 through 12. These two age ranges each consisted of 28% of the respondents, meaning that over fifty percent

of the respondents teach above the 3rd grade level. Additionally, respondents most often taught science (22.45%), with engineering being the second most taught subject (16.33%). Some teachers responded that they teach all subjects (9.18%), which overlaps with this data as well. This indicates that OK Go Sandbox is indeed reaching teachers who seek to use it as a resource in STEM classrooms; particularly in science and engineering settings. OK Go, therefore, is inspiring engineering work in the classroom.

Use and Sharing of OK Go Sandbox

When asked if they had used OK Go Sandbox in the classroom in the past, 65.38% responded “yes,” 23.08% responded “not yet!,” and 11.54% responded “no.” Those who responded “no” were asked to share why not. Some comments offered that the content is too advanced for their length of lesson or ability of students. Others have shared that it does not fit into their curriculum or meet the proper standards. One respondent wrote, “I have not used the lessons as is. However, I use the music videos and the behind the scenes videos. I have my own Rube Goldberg unit and the OK Go content is such a great way to introduce concepts and heard about habits, perseverance, and struggle.” This comment suggests that OK Go Sandbox resources can be adapted to fit each classroom. Because a large amount of feedback says that the activity does not fit the proper standards or age range, one change that could be implemented by the OK Go Sandbox team is a resource such as “Suggestions for Adaptation.” This would take in the teacher feedback and use it to further provide and adapt existing materials so that more teachers can use the materials advantageously in their classrooms. Most specifically, this could benefit teachers of the younger grades, as they have voiced that OK Go Sandbox material may be too advanced or not developed for their grade. The website could then serve a larger range of teachers and meet more educators’ needs.

Based on feedback, OK Go Sandbox has primarily been discovered through the band’s social media websites or music videos. Another source has been professional development events and word-of-mouth. This data suggests the need for better reaching the intended audience. One teacher wrote, “I discovered it while looking for engineering lessons. I have used OK Go music videos for the past 6 or 7 years to introduce or explain various concepts.” The OK Go Sandbox team would like to see an increase of teachers responding that they found the content when looking for lesson resources online, as all of the content and curriculum developed by OK Go Sandbox is accessible online and free for everyone to use. Based on feedback, the promotion of this website through social media has been particularly successful; however, the OK Go Sandbox team desires to reach an even larger audience. When asked what the primary channels for getting education ideas and resources was, the number one response was tied for videos and social media, each with 26.89% of the response. OK Go Sandbox is promoted through both of these means, which indicates that this must be done more intensively to reach a larger audience.

Conclusions gathered from our 88 survey responses include areas of success and areas of improvement. Positives about OK Go Sandbox include teachers’ appreciation for the fun, unique content that engages their students. A surveyed educator wrote, “I have never had my kids so engaged. They were collaborating and problem solving as I’ve never seen. I was worried that they would just be fooling around, but they were very focused and always disappointed time was up and the class was ending.” The unexpected integration of art, science, technology,

engineering and math in OK Go's music videos allows for students with an interest in any one of these areas to connect it to a new discipline. On this topic, one educator explained, "My students were loving the connection between math/science principles and the creativity/talent of making music. A lot of times people separate the two as being two different types of intelligences, but this shows that being creative ALSO requires the math/science skills." This feedback shows the goal of OK Go and their collaborators has been successful: students and teachers are benefitting immensely by using this content in their classroom. The connection between music and engineering has allowed for classrooms to approach these two subjects in a different way than before, which allows students to become engaged and interested in their own learning. On the other hand, constructive criticism from teachers has served the purpose of informing the collaborative team's approach and development of new materials. Teachers included comments that the activities are either too easy or too challenging, and that they do not align with specific standards teachers need to use.

When asked "How likely are you to share OK Go Sandbox materials with other teachers (scale 1-10, 10 being extremely likely)? What would make you want to do so more?" 31 out of 48 responses gave a 10. The lowest response was a 2, with the accompanying comment:

"I would have to say a '2'. I was really excited when it first came out, but found the materials to be light on science and very short and not too engaging. The kids want to know how to do what you do on the videos, which is why the flipbook one is the best of all your materials. The accompanying videos you have on the site are awesome...just the activities are very much for younger kids. which is great if you're teaching 3rd grade...not so much if you're teaching middle and high school."

Again, this reiterates that the materials created by OK Go Sandbox have not adequately met all teachers' needs. This is extremely difficult to do and one issue that has been present throughout the data presented in this paper is that the ability level and range of difficulty ranges widely, even for educators teaching at the same age level. Each student in a classroom has a different level of ability and in reality, each school has different achievement levels based on a variety of internal and external factors. Thus, as previously mentioned, in order to accommodate all teachers and meet these needs, it might be most beneficial for OK Go Sandbox to offer a variety of differentiated materials that teachers can use determined on the needs of their own classrooms.

Classroom Implications

One survey question asked, "How would you rate your experience using OK Go Sandbox challenges?" This was evaluated on a variety of scales: quality of content, ease of use, student engagement with materials, usability of educator guides, and usability of student guides. Figure 1 illustrates the responses to this question.

Q31 - How would you rate your experience using OK Go Sandbox challenges?

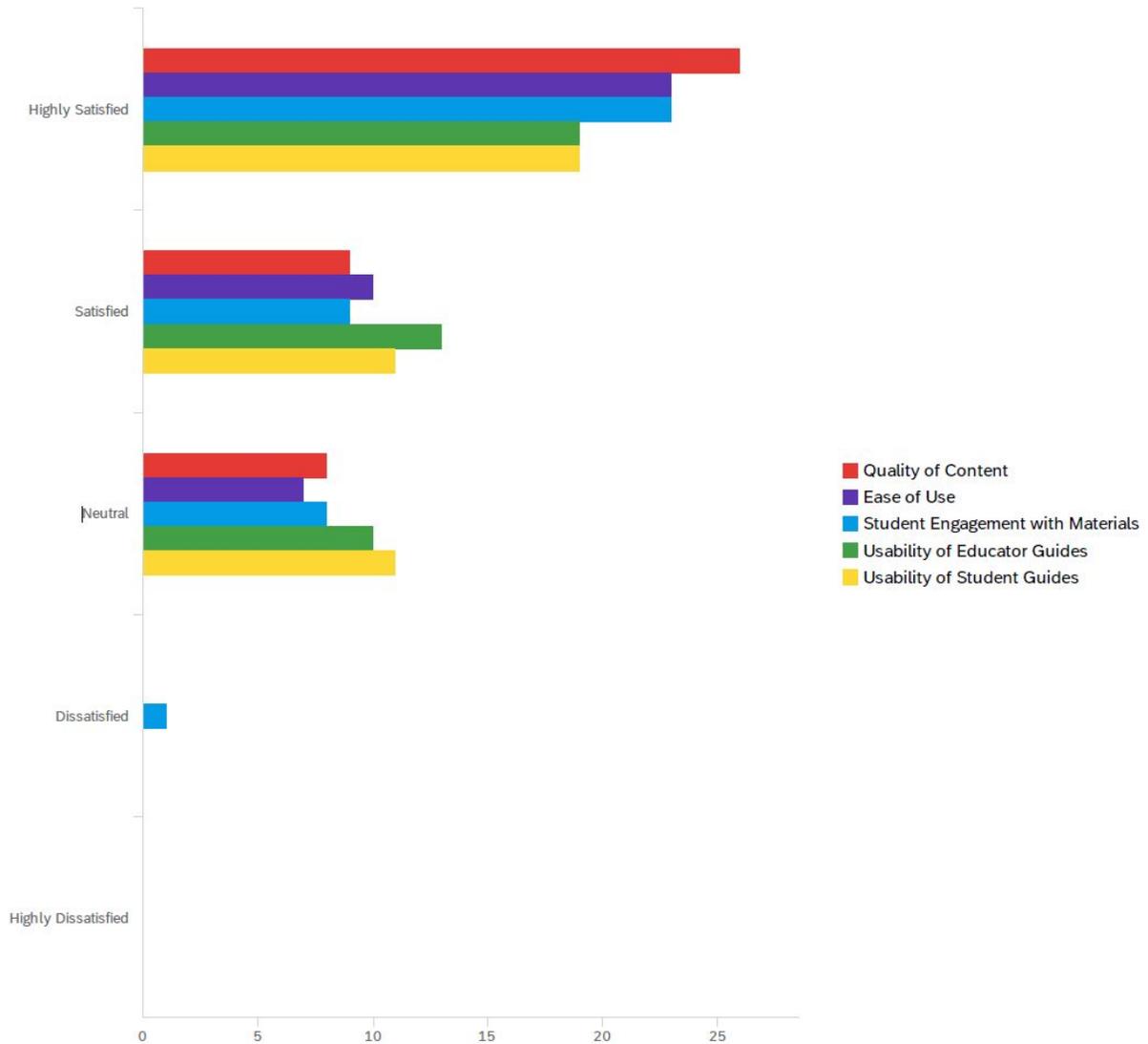


Figure 1: A graph depicting satisfaction levels of various aspects of OK Go Sandbox.

It is evident that the users of the resources have mostly had a positive experience with the resources offered by OK Go Sandbox. In terms of quality of content, 61.90% responded that they were highly satisfied, with an additional 19.05% responding that they were satisfied. No respondents were dissatisfied with the quality of content. This reinforces that the use of music videos indeed is successful in connecting real-world products with classroom content learning, approved by teachers. Similar statistics are shown with ease of use, where 58.97% responded they were highly satisfied, 23.08% were satisfied, and 17.95% were neutral. Again, no respondents were dissatisfied with the ease of use. Student engagement with materials was also showing promising results: 57.50% were highly satisfied, 20% were satisfied, and 20% were neutral. Here we see that there was 2.50% dissatisfied with levels of student engagement.

Overall, data on student engagement is showing that the use of the music videos in the classroom is an engaging way to learn the content offered in OK Go Sandbox lessons.

In a classroom, there is always going to be the recurring challenge of keeping students engaged, and not all students are going to respond in a similar fashion to the same materials. Keeping this in mind, the OK Go Sandbox team can brainstorm ways to create content or edit existing curriculum to offer multiple opportunities of engagement for students who have varying interests. Particularly with engineering, the music videos offer a challenge for students to attempt in the classroom. The challenge section of these lessons can be intimidating to students who do not feel confident or comfortable with engineering. Thus, Sandbox attempts to make this more approachable through first inviting inquiry and then posing a challenge, although students who become frustrated with the content during the inquiry phase are not likely to stay engaged for both parts of the lesson. The usability of both educator guides and student guides were rated lower by the respondents of the survey. For educator and student guides, respectively, 46.34% and 47.50% responded that they were highly satisfied. Compared to other data collected, these two sections scored around 10% lower in the highly satisfied section. Additionally, 29.27% and 25% responded that they were satisfied and 24.39% and 27.50% were neutral. Again, neither were rated dissatisfied. The usability of the educator and student guides can deter some teachers or students from use if it is found to be hard to follow or overwhelming. Thus, some changes should be made so that the usability of the guides is more satisfying for all of the users; this would likely increase the overall success of the materials created by OK Go Sandbox. For each of the five fields polled, around 20% of respondents were neutral on the scale. This statistic alone suggests that OK Go Sandbox has room to improve the already existing materials and should incorporate this feedback into future content creation and development.

In response to the question, “Are the challenges difficult enough?” we also see a range of responses. The majority of responses stated something along the lines of “yes, they are difficult enough” or “I was able to adapt it to my classroom’s needs.” Another common response was the lack of material for younger students. Those who responded “no” mentioned primarily that they were not difficult enough for high school aged students.

The next question asked if the challenges are engaging enough. An overwhelming majority responded that the material, in fact, was engaging enough. This is interesting given the data about student engagement that is displayed and analyzed above. One teacher opposed the majority, writing:

“I don’t feel like they’re very engaging at all. My middle schoolers can accomplish them in about 8-10 minutes . . . These are fantastic for 3rd graders, but not middle/high schoolers. That being said, I think that you could work with your committee/staff to extend these and create some differentiated experiences for a variety of levels. Again, my kiddos tend to test well above grade level - just a consequence of how my private school operates and selects students - but I think even in the public school system, these need more differentiation.”

This teacher brings up a very important point. Differentiation is necessary in every classroom to create a setting in which all students can successfully learn. One way to greatly improve OK Go

Sandbox resources is to offer different ways to differentiate the curriculum. This will ensure that the curriculum meets the individual needs of all students.

Most Helpful Video Resource

One of the questions in the survey was, “Which OK Go music video has been the most helpful when teaching OK Go Sandbox?” As the graph of results shows below, the most helpful music video for surveyed educators was This Too Shall Pass (52.17%), OK Go’s music video utilizing a chain reaction machine. One potential reason for this result could be that the scientific concepts touched on in the video (simple machines, cause and effect, chain reactions, and pitch) are relevant to science standards taught in many classrooms. This video may be the most popular because it encourages students to work together with materials that are accessible in all classrooms. Teachers and students can use anything to create a chain reaction machine, meaning that this activity is extremely low cost. Additionally, the time of the activity can be manipulated based on what teachers have time for in their classroom fairly easily for this lesson. One may speculate that chain reaction machines are less daunting because of the simple test result of “yes, it all worked,” or “no, the entire chain did not react.” The main issues with a chain reaction machine not working can easily be solved, as students can observe at which point their design has failed and then redesign from that point. The activity can be easily adapted as well. Teachers can implement more design constraints or remove design constraints in order to accommodate the students in their classroom. Some examples of such would be increasing or decreasing the time of the chain reaction machine or having students incorporate a specific material into their chain reaction machine design. Finally, This Too Shall Pass is one of OK Go’s music videos that has been out the longest. This means it had more time to gain popularity and for teachers to incorporate it into their classroom curriculum.

Knowing that the most useful video among surveyed educators was This Too Shall Pass, it is not surprising that the video’s accompanying challenges were the most popular as well, as illustrated in Figure 2. The challenge that most surveyed educators (18) have used is the “This Too Shall Pass - Chain Reaction Machines (Chain Reaction Machine Building Challenge).” Additionally, 12 used “This Too Shall Pass - Simple Machines Scavenger Hunt (Identifying Simple Machines Challenge),” and 4 used “This Too Shall Pass - Hit the Note (Tuning Glass Cups Challenge).” This is likely due to the hands-on, design challenge aspects of this chain reaction challenge. Building offers students the opportunity to collaborate, be creative, and add a surprise element to their chain reaction machine like OK Go does in This Too Shall Pass.

Q33 - Which OK Go music video has been the most helpful when teaching OK Go Sandbox?

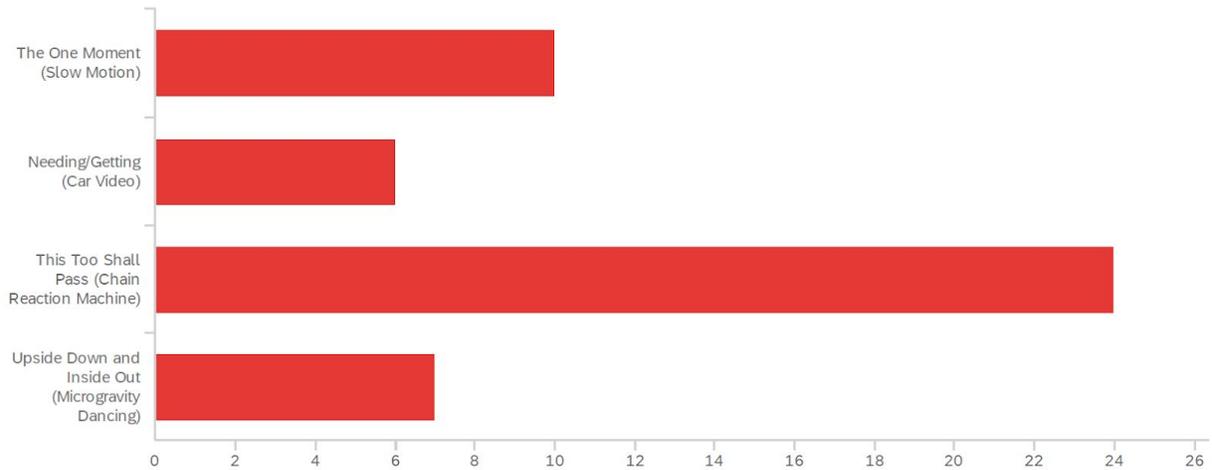


Figure 2: A poll of which OK Go music video has been the most helpful for teachers using OK Go Sandbox.

Open-Ended Feedback

When respondents were asked to explain their answers to the question, “How would you rate your experience using OK Go Sandbox challenges?” in terms of quality of content, ease of use, student engagement with materials, usability of educator guides, and usability of student guides, they offered a variety of valuable feedback. One teacher wrote,

“I would love Love LOVE this resource if it fit better for elementary students. We explore with everyday materials for STEM lessons all the time. In kindergarten, were learning about force and motion which would fit perfectly with the this too shall pass video, but the lessons and resources are just not helpful for little ones. Kids cant sit and watch a 10 minute interview video. Great idea though.”

Clearly, teachers are passionate about the content that is shared through OK Go Sandbox, but again, we are hearing that the lessons would be immensely better with adaptations for different grade levels.

The connection of the band to the students also offers an important motivation factor:

“Before Sandbox I made up my own lessons for simple machines, and forces and motion. The lessons with the videos of the band explaining how they made the video and showing the different simple machines got the students so much more engaged. The kids love that the guys in the video are part of the lesson.”

While some teachers comment that the lessons are too difficult, others suggest that they are too simple:

“I teach at a place that happens to have a very high percentage of really bright kids. These “challenges” aren’t really challenges and the kids bore quickly. I have used many of these concepts as part of a larger challenge for years - they’re not terribly original and aren’t meaty enough for a class period. They are nice to pull out as a supplement when I have extra time in my classes.”

One question allowed respondents to request one thing from the OK Go Sandbox team and responses varied widely. One suggestion was that OK Go Sandbox should include “any tips or tricks for getting the experiments/activities to work smoothly. Otherwise it can be a lot of trial and error as a teacher.” Another wrote,

“I mentioned earlier making modifications to lessons to make them appropriate for multiple grade levels. I think it would be great to have a place on your website where teachers could share their successes with your lessons and changes they have made to fit their classroom. I would love a lesson about environmental impact because I think that is an exceptionally important topic to involve students in (and just more lessons in general because all the ones you have are great!).”

This comment shows how essential collaboration and feedback can be in a classroom. By providing a forum or other sort of open chat on the website for teachers to enter recommendations or successes, other teachers can use it to help develop the lessons in their own classrooms. In addition, the OK Go Sandbox team can use the feedback from teachers to better develop and edit curriculum as well.

The final question included in the survey was “Is there anything else you want us to know about your experience using OK Go Sandbox?” A few of the responses are listed below:

- “The videos are awesome!!! The combination of art/music/science is what we should all be trying to achieve.”
- “I’m just always appreciative of innovators in education! This is my 23rd year to teach and my goal is to keep loving my job despite the challenges of keeping kids engaged. I feel like you all have a cool factor that not everyone has. Keep doing what you’re doing!!”
- “I really want to see you be successful! I’m SO glad you are doing this survey!!!! I hope it is successful and there can be a strong and useful connection between OKGo (and schools) and people. Perhaps, reaching out to other groups would be beneficial-after school programs, clubs, church youth groups, social media groups, etc. OKGo Sandbox is PERFECT!!!!!!!!!! It was a desire of my heart before it ever came into existence! As a former math major and science, music, university lover, I adore OKGo! When I first saw them, I saw, in a good, amazed way, geeky guys as a rock ‘n roll band?!?! I saw university oozing out of their videos and I loved that! I use OKGo as an example throughout the year of the power and purpose of mathematics. We use their videos, as I can, in Writing Workshop when writing our opinions of what’s the best video. Hmm..., perhaps include ideas for using the videos in other subject areas, if you don’t already.

Thank you for your work!!! Please, tell the band, “THANK YOU FOR YOUR WORK!””

Limitations

One key limitation of the OK Go Sandbox project is that the accompanying resources must relate to OK Go’s original music videos in some way. The need for this connection is the basis of the resource, which in turn makes it difficult for OK Go Sandbox to offer more engineering-inspired ideas that are unrelated to the music videos. The grade levels of the material offered has also proven to be a limitation. Some concepts used in OK Go’s music videos simply are too difficult to be adapted for the younger grades (most specifically, K-2).

Another limitation is that the survey results we received were completely voluntary. Only those who wanted to offer feedback did, meaning that there are likely many more opinions and experiences that have not been voiced. One goal of OK Go Sandbox is to continue receiving feedback from educators who are using the resources so that they can continue to be improved, whether the feedback is positive or negative.

Directions for Future Research

In the future, as previously mentioned, the OK Go Sandbox team should continue to stay in contact with educators of all varieties and learn what the team could do to better support them, within the logical constraints of the project. One question that arose was: How can we gather more meaningful data and extend our reach to more educators and students? Similarly, a question that many educators grapple with is: How can this content keep our students motivated and engaged in STEAM fields? How can we use outside resources to enhance classroom instruction? These questions are only a few of many that could be considered in future research, as there is always more to be done to better support students’ learning.

Conclusion

The survey has identified both stronger and weaker aspects of OK Go Sandbox, which the Sandbox team will continue to use to develop more useful curriculum for teachers to implement in their classrooms. At this point, OK Go Sandbox has achieved the goal of providing a unique learning opportunity that connects STEAM concepts in a whimsical and unexpected way to real-world applications. Students can take inspiration from the band’s music videos and supplemental materials to inquire and expand upon engineering concepts, as well as formulate concrete experiences in their classroom that reinforces the knowledge students have already developed. Data gathered through this study of OK Go Sandbox’s effectiveness has shown that when teachers can align it with their school’s standards, it becomes an even more valuable resource. The OK Go Sandbox team is already implementing changes to the website and additional curriculum that have incorporated teacher feedback to improve the usefulness of these resources.

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