

## Smart Pianos Are Changing How We Teach Music

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Music education is extremely valuable for young minds. Studies show that teenagers who play a musical instrument do better in school as a result. Yet despite music being so beneficial, music teachers are often starved of valuable resources. Specifically, they are most dissatisfied with the technology available in the classroom. Improving technology therefore poses the greatest potential benefit to students and teachers across the country. Musical instrument manufacturers like Yamaha have taken notice and begun marketing smart instruments as educational platforms, such as Yamaha's Disklavier. The Disklavier, which can record music performed on it and then play it back, could benefit educators in many ways, such as allowing for remote music instruction and digital music production.

### Introduction

Music education is an important part of a well-rounded education, yet many children in the United States are deprived of a quality education in the subject. Music instruction is valuable, as it has been shown to create stronger students. High school students who study music tend to hold higher grade point averages than non-musicians attending the same school. Additionally, students struggling in math have shown significant improvements after taking up music (Arete Music Academy, 2014). Despite the benefits of studying music, music teachers and students often don't receive the resources they need. Although music instruction is found in 91% of public secondary schools, the

quality of the education can vary. Figure 1 shows the satisfaction levels of the country's music teachers for a variety of important resources.

The first thing to notice about these satisfaction levels is that teacher satisfaction is poor across the board, with at least 20% of teachers rating every category minimally adequate or worse. Looking closer, dissatisfaction with technology far surpasses the other categories presented. More than half of teachers across the U.S. rate the technology available to them as minimally adequate or worse, and 39% feel that it is not adequate at all (Parsad & Spiegelman, 2012). For students to get a quality education, it's important for their teachers to have the resources they need. It's clear from the data that if improving technology is prioritized, then the greatest number of classrooms will benefit.

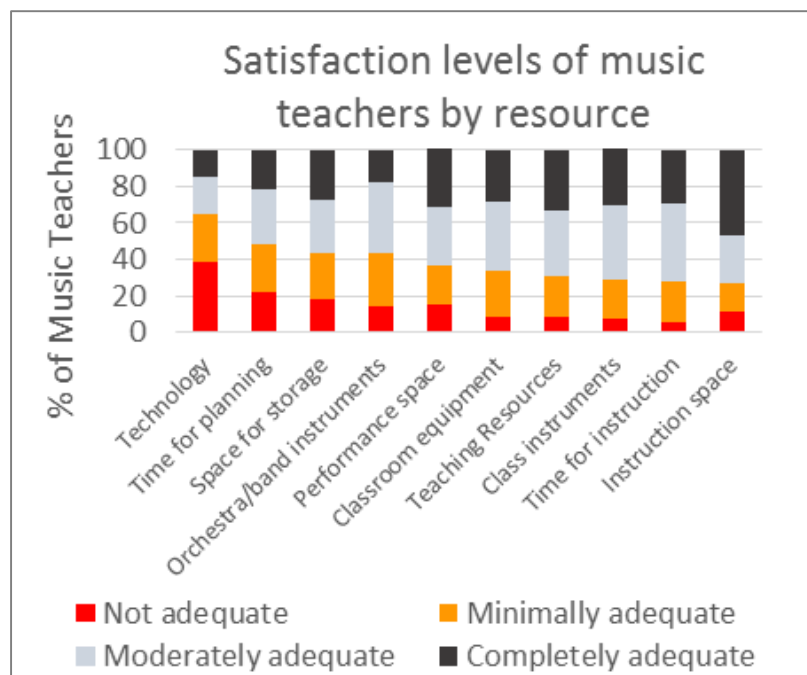


Figure 1. Data from Supplemental Table 48, Parsad & Spiegelman (2012). Responses are sorted from lowest to highest levels of satisfaction.

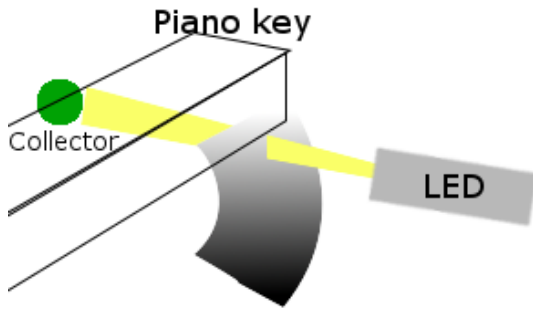


Figure 2. Diagram of the Disklavier's key sensor (Litterst, n.d.). An LED shines through a plastic gradient onto a sensor on the other side. The brightness of the light coming through corresponds to the position of the key.

Companies in the music industry have noticed music teachers' dissatisfaction with classroom technology, and have begun marketing smart instruments to meet their demand. Yamaha is one such company that has developed a smart piano called the Disklavier (Yamaha, n.d.). The Disklavier is capable of both transcribing music and playing it back. It uses sensors beneath the keys and on the hammers to tell which keys are being pressed and magnetic solenoids to move the keys up and down. Figure 2 illustrates exactly how the key sensors work. The end result is what Yamaha likes to call the modern player piano: a piano that records your performance and then plays it back. The Disklavier has many applications relevant to music teachers, such as remote music instruction and easy integration with computer software.

### Remote Music Instruction

One of the most impressive features of the Disklavier piano is that it can enable two people anywhere in the world to play together. It uses the power of the Internet to connect to another Disklavier piano; then, what you play on your piano will automatically play on theirs, and vice versa. Couple this with a simple video chat and it's almost like you are playing together in the same room. The appeal for music educators is that they can use these technologies to teach students regardless of where they are in the

world. Such technologies also expand the pool of available teachers.

Already, Yamaha is seeing interest from music educators and is partnering with school districts. The Washington D.C. public school district recently began offering students access to Disklavier pianos, with a focus on its distance learning feature. In a demonstration of the technology, students from the Duke Ellington School of the Arts took a remote lesson from classical recording artist Simone Dinnerstein via two connected Disklaviers (Students, Artist Simone Dinnerstein Take Part in 'Remote' Piano Lesson to Kick Off Partnership With Yamaha, 2014). Students were effectively able to share a keyboard with an expert pianist despite being miles apart, transcending geographical obstacles. The learning opportunities afforded by such a close connection to an expert are numerous, and could seriously benefit underserved music programs across the country.

### Interfacing with Software

Another strength of the Disklavier is that it can be used as a digital MIDI instrument, allowing students to digitally compose music. MIDI is a long-standing interface standard for digital instruments, so the Disklavier should be compatible with most computer software. Figure 3 shows a sample MIDI message from

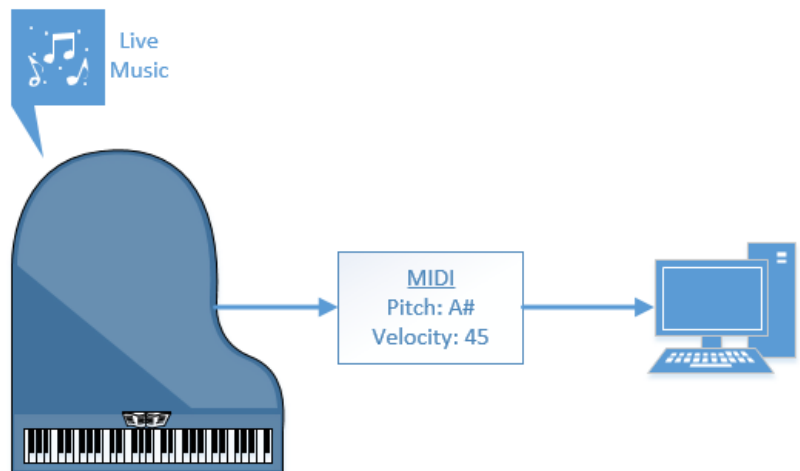


Figure 3. Diagram showing the contents of a typical MIDI message from the Disklavier piano. It contains information about the note's pitch and the velocity with which the key was stroke (correlating with volume).

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the Disklavier. Digital music production is important to bring into the classroom because it gives students the opportunity to engage personally with music as they create something truly their own. In 2013, teachers at P.S. 38 in Brooklyn, New York began teaching digital music production to their students. Hassan Salaam who leads the program says, “They can start to own it, they can start to say this is my composition” (Warren, 2013). With the Disklavier and other smart pianos that double as MIDI keyboards, students will be able to easily capture the music they play live and then mix and remix it on the computer.

## Conclusion

The Disklavier represents a very powerful leveraging of technology for the advancement of music and music education. It can enable two people to collaborate on music no matter the distance between them; it can allow anyone to play, record, and edit music with ease. The only barrier to adoption in classrooms is the price tag; the most affordable new Disklavier still costs just over \$25,000. School districts, especially disadvantaged ones, will need a cheaper option. There exist products on the market such as the PNOScan which will make a regular acoustic piano MIDI-compatible, meaning it can be used as a digital instrument. However, these solutions fall short in terms of latency and overall musicality. As part of the Rust Team’s senior design project at Tufts University in 2016, we seek to make a more affordable alternative to the Disklavier that is more musical than devices like the PNOScan. This will be accomplished this using magnetic pickups like those one might find in an electric guitar. Our design should be roughly one hundred times cheaper than a Disklavier and could be equipped to a piano that a music teacher or school already owns. Regardless, the Disklavier shows the impact technology can have upon music education. Now the question is whether a monetarily-viable solution will arrive on the scene that teachers can bring into the classroom.

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