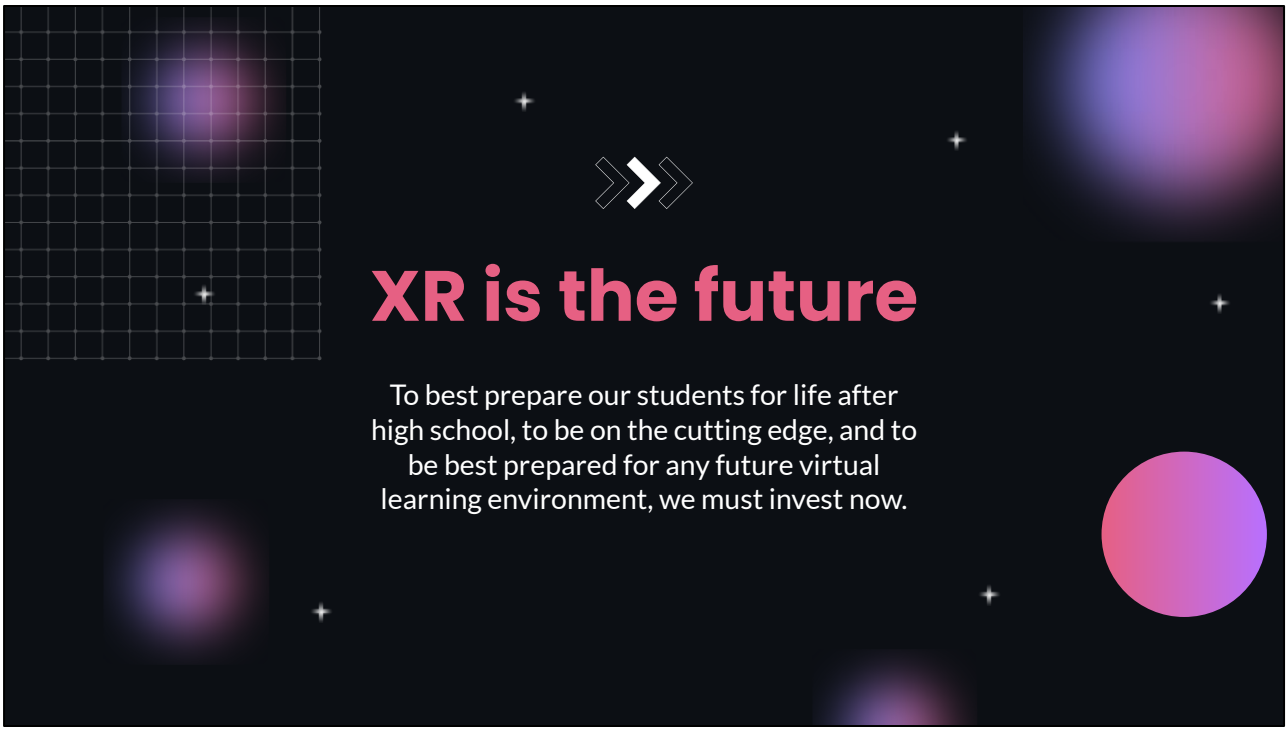
Reflection and context

For this project, I wanted to embrace the idea that XR should be used in secondary education (high school), despite the fact that I'm not completely on board with this myself. I thought it would be helpful to have this point of view in order to change my own mind on the use of this technology. The audience for this pitch is my school's principal and potentially board of directors. But I'd imagine that this could be used for any secondary school, but would need to be scaled up, as our school is very small. A quick note on the audience: The Nora School is an intentionally small school, enrolling about 70 students each year in grades 9-12. Our students have been frustrated and unsuccessful in their traditional school environments and often come with a set of neurodiverse diagnoses such as ADHD, learning disabilities, or ASD. Our students also often have mental health and physical health challenges that have interfered with their learning. And some students just need a smaller, calmer environment to learn in. We are a college preparatory school, with most graduates enrolling in 4 years colleges within 1 year of finishing high school. Our average class size is 8 students, with the max class size being 12. So when I say that 4-6 iPads would be enough for each student to work in a group of 2-3, that's not a typo.

I think this format, while ultimately, with the speaker notes, is just a paper with visual anchors, helped me craft my argument more clearly. Speaking directly to an audience was helpful in having to pick a stance, stick to it, and back it up with evidence. It also allowed me to show different examples of XR in education without taking up too much space in a paper. I used both QR codes and links, as I imagine that the person grading this will not want to take their phone out just to access a link, but I'd like an attendee of a live presentation to open the links and either try some of the apps or just explore the websites on their own. I wish I had incorporated more of my own AR creations, but they did not quite fit into any part of the presentation, except where I have it. For my next steps, I'd like to use an AR or VR tool in my classroom, perhaps with some video or photo footage and student experience quotes, and include that in my pitch and presentation.



I'm here today to present the case for investing our time and money into XR or Extended Reality. 3 years ago, we were caught off guard by having to move our program entirely online. At that time, we, like most other schools, had to learn to use video conferencing software, more robust LMS, and switch to a digital only format. Though we made it through, it was with much learning loss, lack of engagement, and "Zoom fatigue," (Speidel et al.). Now that we know the possibility of virtual only learning could exist, we can prepare for that future by creating more engaging virtual experiences today. Regardless of how close or far away the next pandemic might be, XR is a rapidly growing field that will impact our lives and students' lives in the future. Rather than being Laggards, or in the Late Majority, we can be Early Adopters (Rogers) of XR in Education, bringing in competitive advantage in enrollment in our area, while also improving the learning experiences of our students.

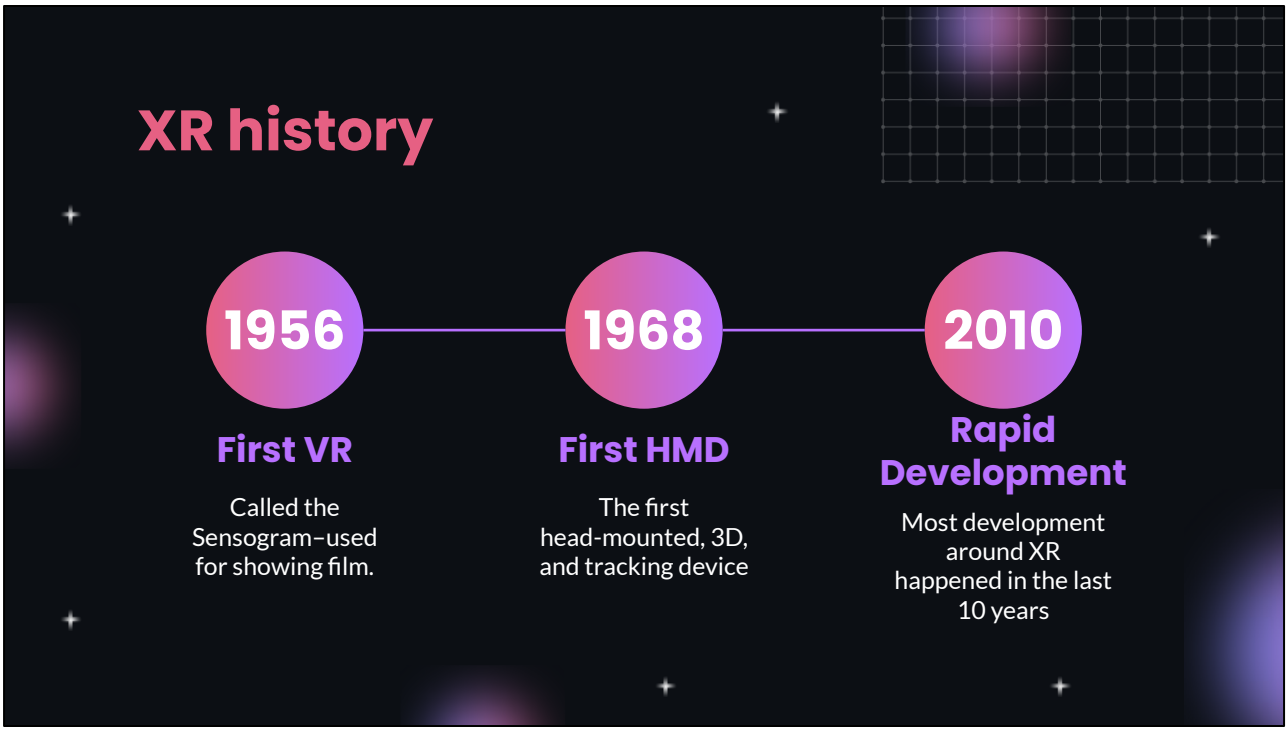
What is XR?

XR stands for Extended Reality, which is essentially comprised of 3 areas of innovation:

- Virtual Reality
- Mixed Reality
- Augmented Reality

These technologies exist on a spectrum of immersibility, ranging from fully immersive to non-immersive.

Within XR, there are three categories of immersibility: fully immersive, semi-immersive, and non-immersive (Meccaway). Fully immersive experiences require special equipment, such as a headset, whereas non-immersive experiences use a mobile or desktop device. Semi-immersive systems use special equipment that allow users to interact with digital objects in real space.

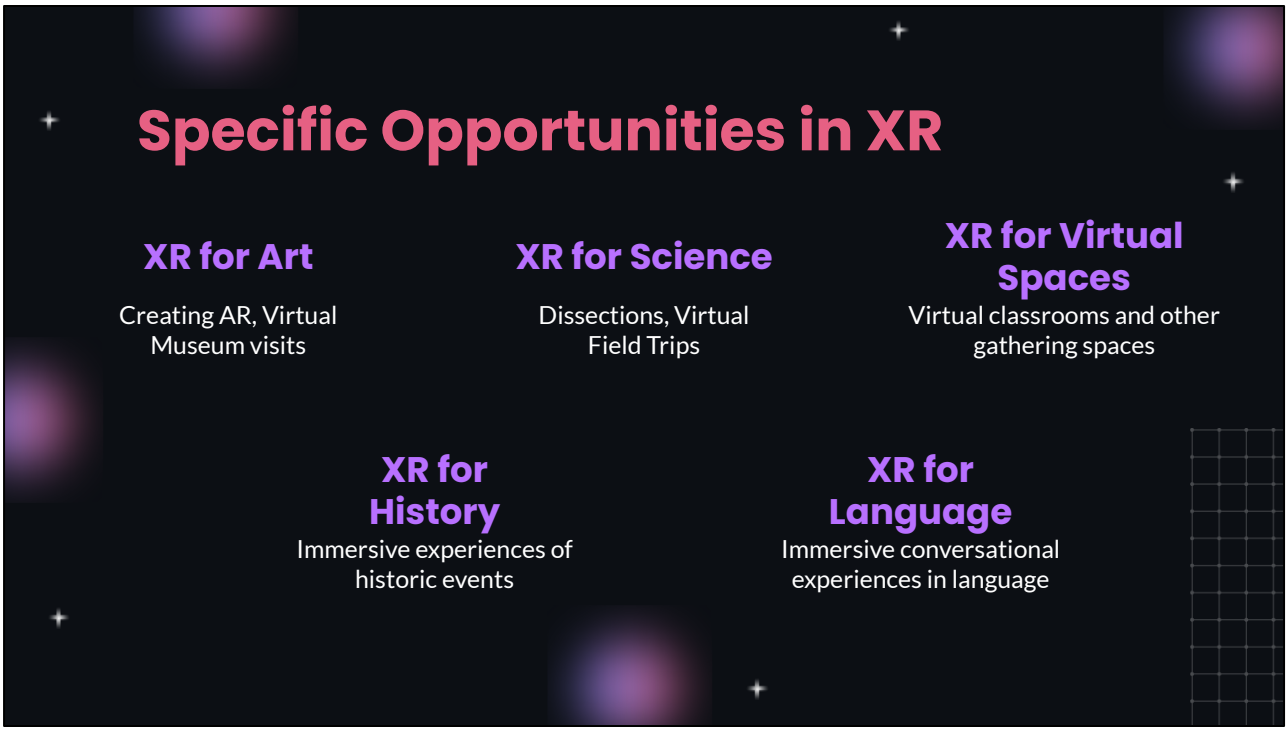


While the building blocks of virtual reality starting their development in the 1830s, the first virtual reality device, called the Sensogram, was created in 1956. It was essentially a video box with multiple sides, which not only created 3D video for a group of 4 people, but also added multi sensory effects such as wind and scent. The Sensogram was created and later patented by filmmaker Morton Heilig He later created a headset in the 1960s, though it was just an immersive 3D experience and did feature a key aspect of VR–motion tracking. The first head-mounted device or HMD was created by Ivan Sutherland in a project called the Sword of Damocles. During this time, the U.S. military also invested heavily in virtual reality, as flight simulation became a useful training tool. Throughout the 70s, 80s and 90s, more improvements came to head-mounted devices, gaming became a major draw for virtual reality application, and NASA started to use VR for simulations. But until 2010, VR was only seen in popular culture as part of video games. An 18-year old name Palmer Luckey created a prototype of his Oculus Rift design, which renewed interest in VR with its 90-degree field of view. In 2012, he raised $2.4 million on Kickstarter and two years later, Facebook (now Meta) bought his company for $2 billion, launching the rapid development of VR, AR, and MR (*History of VR - Timeline of Events and Tech Development*). The history is certainly more complex, with many more innovations along the way, including failed ideas like Google Glass and stunted development like the Microsoft HoloLens. However, we are currently in a time of rapid innovation and development for XR, as the market for this technology is expected to reach almost $400 billion by 2026, and education expected to factor heavily into that figure (Meccaway).

Just before the pandemic, a Horizon Report on the future of teaching and learning was published, predicting increased use in XR in education, as it became more widely used in society overall (Brown et al.). However, the rapid increase in digitization of learning pushed educators to adopt the most straightforward technology, pushing XR adoption to the side for a few years. While educators have slowed considerably on adding XR to their teaching, the development of XR technology has continued in other sectors, even more so during a highly digital world (Seidel). In other words, while educators did not have the capacity to continue to develop their individual XR practice, the technology itself continued its rapid development during the pandemic. To be clear, I am not suggesting that we, or any school, abandon “Zoom school” in favor of XR, but that we expand our toolkit to better serve our students.

XR is generally used in educational settings to do one of the following three things: first-modeling complex structures or concepts and allowing students to manipulate these objects by changing scale, rotation or placement. This is currently used in engineering and architecture, which are generally taught in higher education, but could also be used to work through complex mathematical problems, laws of physics, or other topics where student exploration and experimentation is key to deep understanding. Second–XR is useful in practicing skills in a low risk environment. We see this primarily in medical school, where students can move in a VR space through surgical procedures, without risking a real-life patient. In K-12, many hands-on labs could be replaced or complemented by an AR or VR version of that experiment. And third–being immersed in a new environment that is otherwise inaccessible, which could be places like space or deep underwater, or could simply be locations on Earth

that are too expensive, difficult or dangerous to access.



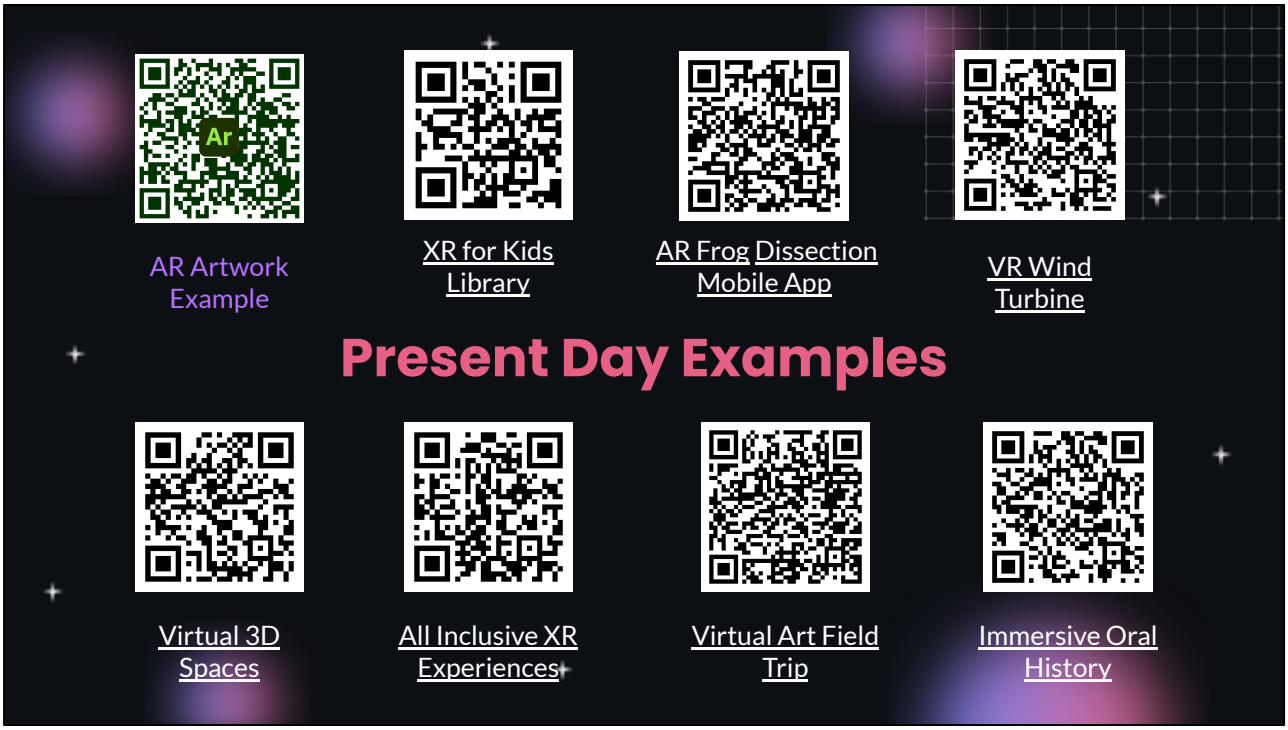
Through my research, I saw current opportunities for XR in high schools use in a few different fields. The most developed for XR in education has been in the STEAM field, particularly in science classes. In K-12 spaces, this is primarily used for simulations and labs in life science classes. In our current curriculum, this could look like virtual frog dissections in Biology, augmented reality simulations in Anatomy, and virtual reality field trips to space, the deep ocean or up a wind turbine.

XR also has potential for use in art, both in viewing and in creating art. We have already used XR in a way, during the virtual photography festival held in 2021. We can use similar software today for displaying student art digitally and students could even use that to display their art portion of the senior portfolio project. XR can also be used for visiting art museums around the country and world, immersing students in the space without having to leave the state. And creating XR experiences, particularly many current forms of AR, could be considered art, as 3D graphics have to be created, animated, and placed together to create the AR experience (think Instagram filters, for example). There could be a class devoted to the artistic creation of XR experiences.

XR has also been used to bring life to history, creating immersive experiences of different historical events or using immersive technology to create more engaging oral history experiences for students. Google Street View can also be used as a tool to visit historic landmarks abroad without having to leave the classroom or the home (Meccaway).

I came across an interesting study in my research, which discussed the role of XR in language and cultural learning. Immersion is a word closely associated with language learning, so it's no surprise that some language teachers have sought to find ways to use immersive technology in teaching language and culture. Through using VR experiences, both student creation and consumption, students were able to learn more deeply about the culture of the language they were speaking (Mills et al., Caspar).

Finally, XR can be used to create immersive virtual spaces, which make the learning experience feel more familiar or interactive, compared to video conferencing. Multiple spaces can exist, allowing for the informal interaction critical to learning in K-12 to continue without dominating the entire video call.



On this slide, there are links and QR codes to current XR experiences that we could deploy today, in our school, including an original AR piece of art that I created.

Certainly XR is not going to solve all of our problems, and the places where it can make an impact require time and training. The two main arguments against XR use in education is the current state of the technology, which is limited and can be glitchy. Not all devices are able to run XR experiences and most educators are only able to use the applications that currently exist. Most teachers can create new worksheets or assignments, but lack the technical skills to create new computer programs (Meccaway). The second major argument is the cost. Much of the equipment is expensive and to outfit a standard class of 28-30 students would cost tens of thousands of dollars. However, there are low cost alternatives and many mobile and desktop friendly applications. Another major barrier is teacher development around XR use themselves and the ability and expectation to teach their students how to use the technology. And finally, XR, particularly VR is not for everyone. Many users experience nausea or vertigo (Kluge et al.) and it is not accessible to all users. There are a variety of design and accessibility issues for those in wheelchairs, unable to use their hands, or are visually or hearing impaired (VRINFLUX). Though work is being done on this issue, the solutions are not universally present. Ultimately, in order for XR to be adopted in a school setting, the experience it provides must be better in terms of learning, ease of use, cost, and accessibility than the current practice.

In order to address these concerns, and create a sustainable program, I've put together a 5 year plan that will allow us to add XR to our program over time. This plan provides a structure for gradual adoption and was created following multiple frameworks that were studied and peer reviewed (Bucea-Manea-Tonis et al, Meccaway, Kluge et al.). While this is outlined over the course of five years, what I've designed for is performance benchmarks, rather than time-based deadlines. However, given the annual cycle of education, I believe it will help to have these benchmarks tied to a time-based goal. Additionally, this plan is left somewhat vague because the technology is changing and developing so rapidly. The costs and equipment available to us in five years time will likely look very different than it does today.

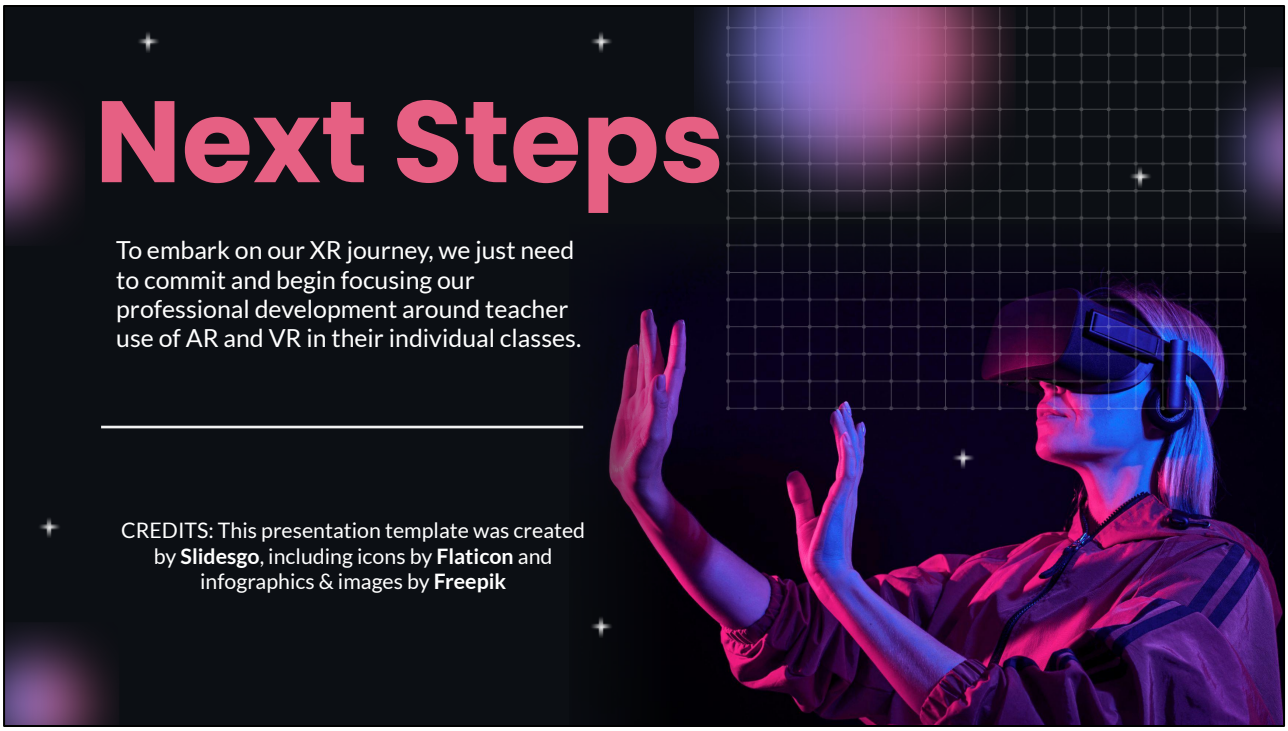
Our first year should focus on developing teacher comfort with XR products. We can do this with minimal financial investment, having teachers use personal devices to experiment with AR educational experiences. A low cost VR option is Google Cardboard, which allows users to use their smartphones to experience virtual reality experiences on YouTube and other applications.

In the second year, we should invest in four to six Apple tablets, which can be used as a class set with students working in pairs or groups of 3. This would allow our teachers to work with more advanced AR experiences, such as virtual museum visits or AR frog dissections (seen earlier in the presentation). On the administrative side, Year 2 would be an appropriate time to develop virtual classroom spaces that could be deployed if we needed to move to a virtual only environment.

In Year 3, teachers will be encouraged to put XR into their curricula, whether it's through virtual field trips, virtual labs, creating XR experiences in art classes or other applications that are not currently available. After two years of training, teachers should be able to find their own resources and ways to incorporate this into their class structure.

In Year 4, we will focus on our students' capacity with XR use, ensuring their comfort with the technology in the classroom applications. To help develop more experience with XR, Year 4 would be the appropriate time to add courses in XR development, as an extension of our coding and digital art programs.

The goal by Year 5 is for all teachers to be comfortable using XR in some way shape or form in their classrooms. If this goal is achieved, it would be time to make a larger investment into XR technology, such as headsets and sensor and Mixed Reality technology, such as HoloLens, or whatever may come next. While it could be tempting to purchase headsets in the immediate future, the technology is improving so quickly that it makes little financial sense to purchase the equipment until our institutional capacity is much higher. This benchmark could come sooner than five years,



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