DURHAM COLLEGE | CTL

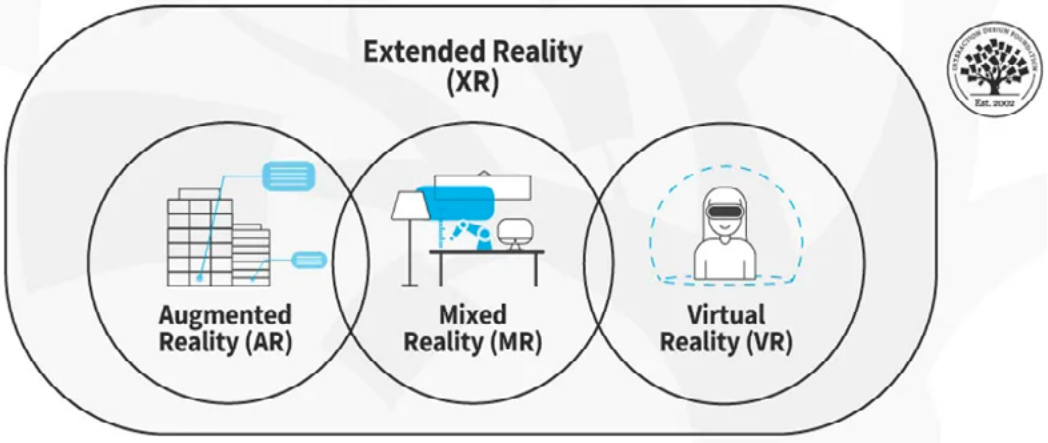
XR TECHNOLOGY FRAMEWORK

The Extended Reality (XR) Technology Framework is a reflective and evaluative tool that is intended to provide faculty with support on how to integrate appropriate XR technology. Faculty are encouraged to examine their chosen XR technology using each of the five dimensions: *faculty, curriculum, students, logistics, and environmental scan.*

This framework can be used as a starting point to evaluate the feasibility of using extended reality in your course.

OVERVIEW

The following chart examines differences and similarities in definition and characteristics of aumented reality, mixed reality and virtual reality. Within each technology, there is also a range of complexity, equipment and level of student agency.



XR					
	AUGMENTED REALITY (AR)	**MIXED REALITY (MR)**	**VIRTUAL REALITY (VR)**		
DEFINITION	AR is an enhanced version of reality created by overlaying digital content onto the real-world, in real-time. Typically, through use of technology such as smartphones or headsets.	MR is a combination of AR and VR, allowing digital objects to interact with the real-world and users physical movement by using a high-end headset. *For example, digital objects such as a hologram can be anchored to the real-world and interacted with, as if it's actually there.*	VR is an immersive experience created using digitally generated content (e.g., 3D objects), previously captured real-world content (e.g., 360 video/images), or a combination of both. The level of immersion and interaction can vary depending on the type of VR being used.		
			SEMI-IMMERSIVE	**FULLY IMMERSIVE**	**COLLABORATIVE**
			Using a computer, mobile device, or headset, user can look around a virtual environment typically generated from real-world content. *For example, a 360 tour or 360 video.*	Uses a headset that will transport the user into an immersive experience within a digitally generated environment, with no visual of the real-world. Users can move around and interact with digital objects.	Same as fully immersive except users are interacting in a virtual environment with others who are also in a fully virtual environment and represented as avatars.

	AUGMENTED REALITY (AR)	MIXED REALITY (MR)	VIRTUAL REALITY (VR)		
			SEMI-IMMERSIVE	FULLY IMMERSIVE	COLLABORATIVE
CHARACTERISTICS OF WHEN BEST USED IN EDUCATION	When it is beneficial to have digital content overlaid onto the real-world. *For example, learning how to use a particular machine.* See how something would look/fit into the real world. Transform content from the real world into something else. *For example, Google Translate Lens.* Benefit from seeing something full scale and be able to look/walk around it.	Potential for high learner agency where learners actions can affect outcome. When a blend of physical and virtual world is beneficial. Dangerous scenario that can be modeled. Equipment is too expensive or not attainable for all students to gain regular hands-on experience. When it's difficult or impossible for students to have the same experience in real life.	Can vary from a passive learning experience to an interactive one where learners complete activities that are embedded in the 360 content. When learners benefit from being in control of where they look, 360 degrees around the space. Visit a space or scenario that may be difficult or impossible to visit or experience in real-life. Dangerous scenario that can be modeled. No ability for students to change the outcome unless a branching framework is used.	Potential for high learner interaction and agency where learners can effect outcome. High immersion, can elicit an emotional response required to make a simulation impactful. When it's difficult or impossible for students to have the same experience in real life, such as ethical issues. *For example, performing surgery, first responder scenarios or exploring inside a functioning body.* Equipment is too expensive or not attainable for all students to gain regular hands-on experience, such as crane education. Dangerous scenario that can be modeled.	High immersion; users in different physical locations can interact with each other in the virtual environment. Anonymity, user is represented by an avatar. When live social interaction is needed. When it's difficult or impossible for students to have the same collaborative experience in real life.
EXAMPLES	• Google Translate Word Lens • SkyView • AR at Leeds College of Music	• MR Blends the Physical & Virtual Worlds • Microsoft Mesh • HoloAnatomy	• Google Earth VR • Nefertari's Tomb Nowadays • Boiler Room • Church Architecture • Paramedic – Cardiac Arrest	• Bodyswaps - Soft Skills • Mondly VR Learn Languages • Fire Fighter Training • The Body VR • SpaceEngine	• Virbela Virtual Space • EngageVR • Remio • Meta Horizon Workrooms

	AUGMENTED REALITY (AR)	MIXED REALITY (MR)	VIRTUAL REALITY (VR)		
			SEMI-IMMERSIVE	FULLY IMMERSIVE	COLLABORATIVE
EQUIPMENT	• Phone, tablet • Headset such as HoloLens, Meta Quest 2, AR Glasses	• High-end headset such as HoloLens, Meta Quest Pro	• Phone, tablet, computer • Phone + Google Cardboard (or similar) • Headset such as Meta Quest 2	• Headset such as Meta Quest 2	• Headset such as Meta Quest 2

CONSIDER THE DIMENSIONS

FACULTY

Are faculty comfortable with technology?
Are faculty willing to learn?
Do they have the time to implement?

Based on faculty current skillset and willingness to learn, next consider curriculum.

CURRICULUM

Is there a gap in teaching, practice or assessment that this technology can fill? (see characteristics section)

What do students need to learn to meet the course learning outcome(s)? (see characteristics section)

How much student agency is required to meet the learning outcome? *For example, based on Blooms Taxonomy if your CLO is to 'define', maybe XR is not needed to meet that CLO; if students need to 'experiment' or 'investigate', XR may be more appropriate.*

Can XR be implemented based on the course delivery format (F2F, Online, Hybrid, Flex, HyFlex)? *For example, in the HyFlex course, can online students work on a desktop version and have an equivalent learning experience as the in-class students?*

Will the XR experience be realistic enough to learn the required outcomes? *For example, electrical students may need to feel the physical pressure of stripping wire, but could use XR for additional practice along with hands-on aspects.*

Consider how this will be implemented in the classroom:

- Will students work in groups and take turns with XR equipment?
- Is there a desktop or mobile version so everyone can participate at the same time? Will students be expected to use this tool at home?
- Will it be used as supplementary material during the lesson or as an activity?
- Will grades be attached?
- Can the headset be projected to a screen and used as a teaching aide?

Based on the characteristics of the XR investigated and the learning outcome or assessments – what is the right tool?
If there is alignment, are the students ready?

STUDENTS

There is a learning curve to new technology, based on student skillset, can they handle the cognitive requirements for learning a new tool and new content without going into cognitive overload?

What type of onboarding will be required? Is an orientation or practice activity with the equipment needed? Is there sufficient class time to do this?

Keeping accessibility in mind, how can the learning be adapted for students who are unable or uncomfortable to use the technology? *For example, option to sit or stand, text-to-speech, use of a desktop version, or alternative format, etc. This is important for reasons such as disabilities and accommodation needs; VR sickness; unease of headset surface contact or use in public space, psychological safety, etc.*

Does in-class use of XR equipment meet student needs for practice?

Based on students, can XR be implemented as intended to support the curriculum? If student considerations have been met, consider logistics.

LOGISTICS

Where will students use the XR?

- Privacy: Some students may feel uncomfortable wearing an XR headset in front of others.
- Sufficient space: Use of VR headset requires at least 6.5 x 6.5 ft per user as recommended by Meta.
- Accessible outlets (in some cases)

What XR equipment is needed?

- Can students use their own devices?
- Are headsets needed? How many? What kind?
- Does DC have equipment available for loan? If not, is there funding? (see next step)

Based on logistical considerations being met, complete an environmental scan.

ENVIRONMENTAL SCAN

Does an app, platform or web-based product already exist? A thorough search should be done to determine if something exists that will meet the learning requirements. (see repository)

If a custom solution is required for semi-immersive, development can be completed by the CTL.

If a custom solution is required for all other XR, keep in mind:

- Time commitment from subject matter expert, developers, and other stakeholders
- Longer preparation time before implementation
- Higher cost
- Development may require a phased approach that can span over multiple years and funding grants
- Ongoing maintenance

Consider if funding is available to support a custom solution, application purchase, or hardware.

- What funding opportunities are available? (Grants, departmental funding, CTL SoTL fund, etc.)
- Will ongoing funding be required for aspects such as licensing, hosting, phased development and updates?
- Can the XR experience be used by other areas? Is there potential for collaboration with other faculties, programs or courses?

SUMMARY

Based on the answers to these questions, a determination can be made on appropriate XR technology use in the classroom.
Please consult with CTL for support. If funding is required consult with your ED/AD.

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