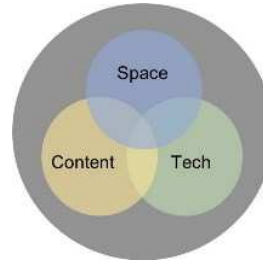


Audiovisual Technologies in e-Learning

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As we progress through the times since the start of the pandemic, there has been a major shift in the notion of Learning spaces, the conventional classroom as we knew them. These are specially built physical **Spaces** with all the **Technology** to enable delivery of **Content** by the Educator to the eager Learners – together termed as the **Users**, all of them present in physical form. The term Audiovisual is related to both technology and content – in terms of what the users can see and hear (or talk) in the process of learning (or teaching) and will continue to do so along with, possibly a wholesome aspect of **Experience**. E-learning has always been considered learning augmented by multimedia, specifically using computers and electronic devices as the medium.



Ex 1 – e-learning and combining of space, technology, and content with the user as the core purpose.

As we read through the introduction of this article, it becomes imperative to understand key terms and their relevance for enabling a good implementation of an audiovisual solution in a learning space – whether they are happening as “in-person” in a physical space or “virtual” or a combination of both – commonly referred to as “hybrid.” We could say that a well-designed learning experience combines space, technology, and content to eventually result in outcomes that the users desire, fulfilling their learning or teaching needs.

Space

A place of learning - physical space – be it your school or home or any other such facility with its build and ambience- is a complementary factor that enables learning. It begins with the human element or ergonomics – comfortable seating, ability to see and hear the teacher and other participants, and more importantly, the instruction materials including but not limited to the black (or green) board, books and notes, charts, and of course, the digital formats of the content in terms of images and video displayed using a screen. The ability to see means suitable and adequate lighting (and sometimes not too much light too!) to be able to see the content delivered or presented and make notes of their own. Speaking and listening means the right acoustic environment and tools to enable such activity. The collective sensation is always more significant than the sum of the individual parts. The ability to fully comprehend the messages being communicated without any form of external distractions, including but not limited to noise from adjacent spaces, visible movement of people, etc., is a crucial consideration.

The delivery is not restricted to “one-to-many” but has metamorphized into “many-to-many” interactions in a controlled way (collaboration), making full use of the aids that were available for such interactions. The in-person physical setting enables immediate feedback by two-way or multi-way communication amongst the users. Bringing in this experience to the virtual space has now been made easier. As a matter of fact, the technology has enabled a rapid shift to virtual participation with existing tools, to begin with, especially during these trying times, and is in pursuit of even greater adoption by enabling new features to be added now and then.



Ex 2: Learning spaces as we know them

The present-day spaces for virtual learning are what we know as a **digital platform** – the likes of Zoom, Meet or Teams that we use day in and day out. The platform adoption does give a unique dimension to the way learning can occur. It brings both the teaching and learning experience to your devices and sharing content, collaboration, and interactions. It adds to the conveniences, albeit with many challenges, especially on the experience front. And these challenges are not just for the education provider or user or the platform creator but all of them.

For example, a typical physical space is a home. So, the comfort depends on what infrastructure is available, from a comfortable, adequately sized desk and chair to a sufficiently lit enclosed space. A display device of the right size to view the content properly and suitable quality devices to capture the video are essential elements that facilitate human comfort – ergonomic factors, environmental factors such as lighting, acoustics, isolation from external disturbances, safety possibility of collaboration and interaction. This will be unique to individuals, and bringing in a factor of equity in each participant's experiences is not just a technical problem but also a social and economic one.

Adding the hybrid spaces – a mix of physical and virtual participants- is expected to be the norm and is already becoming the new normal. The hybrid format brings challenges on all the above fronts and contexts. It will be pertinent to address these while implementing the audiovisual design. For example, a straightforward problem we see regularly is - what happens to the audio (and our hearing experience) when multiple microphones from different devices are on in the same physical space, where the educator is presenting live? Technology will address some of these problems, but many of these must be discussed with the users and incorporated during the initial design phase of the project. Talking about technology, a lot is being heard and seen around, and let's have a look at some of them in the following section:

Technology

One big question is how specifically AV technology can enhance user experience – ultimate stakeholders – teachers/professors & students in performing their tasks. The shift in technology has gone far beyond mere digitization – converting images, sound, etc., to digital bits for its superior transmission, storage, and distribution capabilities. The rapid adoption of learning platforms in such a short period has shown us the exponential nature of technology.

From an IT perspective, the adoption of standardized IP-based protocols for transmission of AV means efficient use of infrastructure available for all the communication needs and the security and trust built by the IT team.

In the AV world, whether it is the smart and invisible microphone (usually an intelligent array of a number of them) neatly tucked in the ceiling and automatically seeking and passing sound from the desired person speaking or the beam array loudspeaker panel directing sound to specific areas of the space, a smart camera (often multiple too) to be able to view the teacher presenting and making sure that he fits the frame in the right way, every time, were few of the possibilities that got implemented in the recent past. Added to these were the ability to connect and switch multiple sources of content or even interactive touch-enabled displays taking in the annotation notes and saving and archiving all the discussions in the class, available to the student immediately after and remaining with them in a drive for access anywhere, anytime forever. These are now being improved upon drastically with the advent of newer technologies facilitating their adoption on a large scale in the learning spaces.



Ex 3: Emerging digital technologies

Digital Technologies

Digital technologies have had a significant impact across all industries, and audiovisual communication tools are inherently getting built-in to these. These general-purpose, pervasive, and combinatorial technologies would mean they are more use-dependent. They create new ways of addressing the challenges to create exceptional user experiences. Let's look at a few of them, with an example of each, and how they are being applied now.

The advent of **cloud** technology means that the physical infrastructure and space remain an option and that anyone can choose either one that is more beneficial. It is much more than just a fad for institutions and providers – it turns out to be more economical to pursue cloud solutions. And these could be upgraded and scaled very quickly based on actual needs. You could transfer a lot of data, usually the learning multimedia content, between the storage and the users without worrying about the costs or your infrastructure being the roadblock – whether you are an incumbent, a large-scale education institute, or a small startup in the education space.

With **IoT**, the devices' addressability in the physical space and connectivity over cloud-enabling remote management, monitoring, and operations lead to enhanced offerings. With the rollout of IoT-enabled devices and their management suite and platforms, it is becoming easier to deploy across solutions. Enterprise-grade software applications are now accessible using open microservices to be accessed, and this means you could outsource or seek them as services.

Artificial Intelligence and its subset, **Machine Learning**, continue to be revolutionary in many potential AV applications. Natural language processing has already found use in language translation, transcending the language barriers for learning. With computer vision and speech recognition technologies already inbuilt in many devices, it is now possible to recognize participants from the image or sound captured and perform predictive actions based on who it is and what might be needed. It could mean that as soon as a learner logs in, all the requisite information based on their activities could be predicted and a set of choices made available without the user's direct input. The idea of using **Adaptive Learning** as per user is now viable with the power of AI and more so with the vast amount and variety of multimedia content being available from various sources. It becomes almost impossible to self-choose and plan.

Virtual Reality is a simulation model with numerous use cases in education and learning spaces. One of the best use cases of VR could be in medical education. 3D models of the whole human body and parts are created, and with the advances in haptics, digital displays, and sensory capabilities, realistic and interactive learning experiences for surgeries and other interventional procedures are learned. Virtual reality can also be a valuable tool in re-creating the environment of the learning spaces to a great extent!

We could see many of these functionalities being provided along with the products used, be it cameras, microphones, loudspeakers, headsets, displays, cameras, or even platforms and companies providing education technologies. There is a lot of work happening in this domain.

Robotics is another digital technology with immense potential, and when integrated with audiovisual cognitive use cases - interactivity is brought closer to the user into learning spaces. A real-world test case example is Yuki, the humanoid robot lecturer and can be watched at [1] https://www.youtube.com/watch?v=Amfrm2V_KO0&t=248s. It has to be understood that the process of training and re-training of the machine, while slow and time-consuming, does not mean it will take an infinite amount of time for them to be deployed. The exponential nature of the growth of technology and the fact that they are pervasive would mean that they can be rapidly applied and scaled once they pass the experimental stage.

Blockchain, being an electronic digital database, can play a crucial role in preserving the record of data and trust without needing a third party – a trust that is important for user-generated content and the protection of creator's rights. Although already implemented and popular in cryptocurrency and more recently as NFTs in digital art, it would be no time to find its use in digital rights management of multimedia content.

Let's now look at how Content adds value and is relevant to Space and Technology for the user experience.

Content

Audiovisual content is the essence of meeting communication needs in learning spaces, like any other application. It could be simple notes made on a board or screen, available in printed form as physical book or pdf, presentations, and graphics, multimedia content, or special 3D content that are key for e-learning.

The ability to share content and thereby impart knowledge and archive information has been the core to learning spaces and more so with e-learning when the delivery methods are digital. The digitization of the content – mostly print- has been the first step and has happened rapidly as the storage technologies grew along with the cloud. We have every knowledge repository available in the digital format – but primarily stored passively. The advent of emerging digital technologies discussed above requires content to be available in an active form, and this requires finetuning it to suit the end delivery methods.

For Example, the NPTEL, a project funded by the Government of India and leading technical institutions, has a vast technical and management learning content repository, offering education and learning to students pursuing STEM without any boundaries and restrictions. Many such platforms, both government and others, are expected to bring in a richer content experience for use by all. Moreover, using any existing information with futuristic digital technologies such as VR for medical

applications or even practical laboratory uses certainly requires regular updating, tweaking, and possibly customization for specialized applications.

User Experience

Audiovisual Technology plays an integral part in the digital ecosystem in physical, virtual, or hybrid form. The big question is how AV technology can enhance user experience to the ultimate stakeholders – educators & learners alike. While the goal of AV technology is to connect people, the AV experience has evolved over the years in significant ways to include the broader and newer digital technology tools and understanding of how all of these will play together, eventually resulting in the achievement of the end goals of learning!

Design thinking and user experience are critical to the core of such spaces and are often thought to be a prerequisite when using digital technologies. Adopting standards as a tool provides a significant alignment to experience, right from conceptualization to implementation of projects in learning spaces. These could be product, design, process, and performance standards, and organizations and institutions are striving to work diligently on those. It would be worthwhile to keep learning about them and using them.

To conclude, we are still in the evolving stages of incredible new technologies coming our way. Technology is not the end but the means to the goals. While technology may indeed influence how we think and work, it is very important to keep sight of the content being delivered and the spaces therein. The end users have similar experiences irrespective of the mode of learning they choose. The real opportunity is to continue engaging with them and not lose sight of their learning and teaching needs in the midst of all we do. And look forward to the world of **experiential learning!**

Get exclusive access to **AV/IT Infrastructure Guidelines for Higher Education** - a comprehensive guide for professionals planning and implementing AV/IT technologies in higher education learning spaces.
[2] <https://www.avixa.org/standards/av-it-infrastructure-guidelines-for-higher-education>

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