CREATING A PRODUCTION PIPELINE FOR 360° LEARNING ENVIRONMENTS

D. Derichs, S. Sevón, T. Votkin, T. Kauppinen

Aalto Online Learning - Online Hybrid Lab, Aalto University (FINLAND)

Abstract

Online learning is here to stay. The current pandemic boosted its development to new heights and increased demand for arranging remote teaching at all levels of education. There have been major efforts of creating online content such as textbooks, materials to learning management systems, educational videos, quizzes and certainly combinations of them to provide facilities for online learning. However, a persistent challenge to online learning remained - learner engagement and inclusion. Campuses with their workshop spaces, classrooms or cafeterias are examples of places that can engage learners when properly designed. Online learning is mostly lacking such relatable contexts. With the emergence of virtual and augmented reality one can create 360° learning environments simulating existing places but also bringing people to new places where the environment is augmented with useful information. The challenge is, however, how can an educator design and create 360° learning environments, from start to delivery? In this paper we present our approach - a 360° production pipeline - supporting educators in their journey to provide engaging 360° spaces. We report the different elements and phases of the pipeline, resources needed and elements to consider such as funding, equipment and platforms. We further present two cases that have been our pilots for understanding what such a 360° production pipeline should include. We also outline the research and development agenda for the years to come as part of the Online Hybrid Lab activities and Unite! Virtual Campus, a task force of the European University alliance of nine partners.

1 INTRODUCTION

Learning is the key for societal renewal to identify, overcome and embrace our future challenges - e.g., sustainability, Artificial Intelligence (AI), automation and remote work. Virtual learning environments can provide an engaging way to acquire technical and non-technical skills [1]. The opportunities are to use the four C's of the future of learning: creativity, collaboration, communication and critical thinking as bases for designing the future, to contextualise their learning together with disciplinary skills in engaging ways.

360° environments can provide such contexts that can be accessed remotely via browser, phone or VR gadgets. Meaning-directed learning and application-directed learning can provide deeper processing strategies for learning [2]. Here the opportunity is that 360° learning environments can facilitate those types of learning over undirected and reproduction-directed learning by providing meaningful contexts, learning paths and relationships to the physical world.

The market provides a wide range of platforms, tools and software for consuming 360° contents. For universities, 360° environments provide promising avenues to facilitate learning as part of hybrid or fully online offerings. Such content can be accessed online at any time, can scale, and can be made very engaging with game-like triggers. Even though various studies show that 360° learning environments are found useful and engaging in education [2]), only a minority of educators have knowledge of the benefits these virtual environments can bring and familiarity with ways of designing and producing them [3].

Designing virtual toolkits to share best practices among educators is changing how we can re-use approaches that guarantee improved learning results [4]. In addition to sharing practices, we also need a better understanding of how the productions should be done and what phases and resources they include. However, to the best of our knowledge there is no documentation on streamlined production pipelines ensuring effective and efficient 360° content creation for the needs of higher education.

In this paper we contribute to the debate by providing a 360° production pipeline framework to facilitate the use of 360° learning environments for educators by offering support, concerning pedagogical and practical aspects, such as tools, funding and accessibility issues. We will also provide two case examples to illustrate the use of the pipeline in three very different learning contexts.

ISBN: 978-84-09-42484-9

This paper is structured as follows. In section 2 we describe the 360° learning environments production pipeline. In Section 3 we continue by illustrating the use of the pipeline through three different cases at Aalto University. Section 4 provides the concluding remarks.

2 360° LEARNING ENVIRONMENTS PRODUCTION PIPELINE

In this section we present our approach for developing an efficient and effective production pipeline for creating 360° learning environments and their contents. We first go over the different production phases and then outline an indicative set of resources to facilitate execution of the different phases.

Adopting a production pipeline approach allows Aalto University to streamline production and reduce redundancies in process-related aspects to reduce barriers of entry for educators. Our aim is thereby to boost and increase the adoption rate of 360° learning environments.

The 360° production pipeline approach is organised at the university-level (as opposed to school- or department-level), but ownership of the individual implementation is decentralised around the departments and specific educators. The 360° expert team takes the role of education consultants (as opposed to managing all productions as a central authority) offering self-service content, workshops, as well as individual consultations.

Next we discuss the different phases present in developing a 360° implementation; then we discuss the resources entailed to provide educators and developers with accessible solutions.

2.1 Production Phases

The 360° production process largely follows three stages: planning, execution and post-production.

2.1.1 Planning the learning strategy (e.g., content and pedagogy)

The planning phase begins with defining the learning goals to be achieved in the educational setting and ascertains the relevant learning activities and content provision methods to achieve the learning goals.

360° learning environments can be used in various ways - as individual assignments, as part of a course or as a setting for a whole course. In this phase the added value with 360° learning environments should be considered, as well as the challenges.

Added value can include acquaintance with interesting settings for the specific field of study, immersion in inspiring settings and access to places that are otherwise difficult to access in a normal course setting. If the educator supports the adoption of 360° applications, there are a series of questions that need to be addressed:

- **Access to content**: How will the learning environment be accessed (like via smartphones, laptops, vr-headsets or how)?
- **Learning pathways**: Documented decisions about learning path(s), i.e. will students follow a certain path in the 360° learning environment or will there be room for choosing different ways of assimilating the content in forms of different paths or completely free exploration?
- **Benchmarking**: Obtaining inspiration of possible existing 360° learning environments in own or related fields and identifying pre-existing content. What have others done?
- **Preproduction**: Scripting, cinematics, collaboration partner (e.g., studio, equipment rental) and personnel identification and hiring, negotiating access to the setting to be digitalised - obtaining necessary rights for usage of the content. Do we need to outsource some of these parts, or acquire new tools or licences?
- **Milestone definition**: Setting up key planning dates, filming days, editing schedule and publishing schedule. How will all activities show up as a set of calendar events?

During this first phase both the educator and the 360° pipeline experts are strongly involved - with ownership resting on the educator. The production process is outlined, and milestones are defined.

2.1.2 Content Production Phase

During the content production phase, the educator manages the different parties involved in producing 360° content. Those parties include audio/video experts from for example a studio, editors etc or the production can be run by the educator alone.

The first step of the production process is creating the 360° content with suitable equipment (see next section for overview). Most equipment is easily learnable and requires little time to set up - nevertheless, hiring an expert is advisable. Using a suitable 360° camera, pictures of the location are taken.

In the second step the pictures need to be edited (assembled) so they can be uploaded into a suitable software (see next section for overview) - this step is usually straightforward and automated in the software.

Thirdly, a 360° format is chosen, and the pictures integrated according to plan (e.g., pictures related to each other to simulate a tour, or independent pictures for different contexts). In our experience this step can well be outsourced and usually does not require much time, typically ranging from a few days to a few weeks.

Once the pictures are inside the software, the educator needs to assess whether the content should be augmented (e.g., by providing additional information such as videos, exercises, links to outside content) or whether the images work by themselves and are integrated otherwise into the learning process. This part can require extensive time as content needs to be created and coherence needs to be assured, while at the same time it needs to be aligned with the learning pathway defined previously.

The educator should consider hosting information that is updatable through links to cloud drives (e.g., google drive) as this reduces the burden later on as the software does not need to be reopened but just a text or excel file needs to be updated. Finally, the content will be exported into a hostable format (e.g., website integration, hosting on software provider's cloud, VR-headset format).

The overall phase length depends on the extent of the tour and on how many parties need to be aligned / the expert level of the educator and others involved. If budget is available outsourcing picture taking and editing is strongly encouraged.

2.1.3 Post-production phase

During the post-production phase, the educator properly integrates the 360° content into the course setup. This entails ensuring that there are no barriers to accessing the content. An updating schedule should be determined in case there is a need for it - for example if a business is portrayed then the financials should ideally be updated annually to keep the experience relevant. Moreover, in case a licence or hosting fees occur, their financing should be planned over the plannable future.

Most importantly, however, the tour should be piloted, and regular feedback should be obtained. Piloting is important from the implementation perspective and regular feedback more important from the pedagogical perspective to understand whether the intervention yields the desired results.

2.2 Resources

When creating a 360° learning environment several resources are needed. The first thing is to find 360° pictures or videos. Some software providers have a picture bank that can be used. There are also commercial 360° picture banks. The best way to acquire tailor made pictures is to have them taken for a specific purpose. This requires a 360° camera and other equipment and suitable software for editing the pictures.

Software for editing the environment is also needed. There are several software providers for different needs. Some are easy to use and provide educators an opportunity to create 360° learning environments themselves with a low budget. Some of this software also include hosting. Some software offers more functionalities, but at the same time require more expertise, are more costly. In case of higher end production, it is advisable to outsource the production.

For creating engaging content, it is advisable to use different types of content, like videos, texts, pictures, quizzes and assignments and this requires both pedagogical expertise and knowledge in media production, including writing scripts, directing the filming sessions, filming, editing and publishing.

The aim of the pipeline is to help educators to choose the most adequate resources for their case and even help with finding funding for their project.

3 EXEMPLAR 360° LEARNING ENVIRONMENTS

The ultimate aim with the 360° production pipeline is to ensure there are high quality learning environments that students can access through their browsers, phones or virtual gadgets. In the following we describe two such cases to give an idea of why these 360° learning environments were built, what kind of elements of the pipeline they benefited from and also outline the way forward.

These two cases have both produced 360° learning environments but are rather different. While the first one - 360° Business cases - was designed and produced in collaboration between the educator and audio-visual experts, the latter case - Learning Swedish in 360° - was a quite low budget production by educators themselves.

3.1 360° Business Cases

This section describes a 360° application implemented in MSc-level business education (more specifically financial planning), where a classic course setup (lectures + business cases) was converted to a flipped classroom setup embedded in a 360° context (a local microbrewery). The case can be accessed online. The case addresses the topic of scenario planning, covers a total of 3 ECTS (of a 6 ECTS course) and is implemented over a period of 3 weeks.

The rationale for redeveloping the learning activities is found in the more ambitious learning goals faced by our business school, e.g., educating game changers that address complex issues such as sustainability, and a consequent need to rethink the design of the course and delivery method. In this specific setup the learning goals were of high order [5] and required activities that suit the development of such outcomes. Core to achieving those outcomes was students developing ownership of their work rather than mostly passive consumers of knowledge.

The main changes in this course were the content provision methods - students were provided with weekly modules of diverse content, e.g., pre-recorded lectures, articles, books, other video and audio content, and both an asynchronous and synchronous learning activity to implement the content of the module. The content provided should provide a balance to accommodate different learning styles and provide enough variety in a semi-controlled environment for learners to pick according to their interest with the goals for the session in mind. The goal of the module was to address a business case delivered through the 360 °learning environment.

The 360° learning environment portrays a local microbrewery. Students can explore every locality in the microbrewery in a similar fashion to google street view. The learning environment is enriched with additional content, such as recorded interviews with key staff, data on production and financials, as well as snippets of other relevant information. When starting the 360° case, students are confronted with an engagement letter outlining the tasks of the next weeks as well as an empty data sheet which they can use to structure their data search.

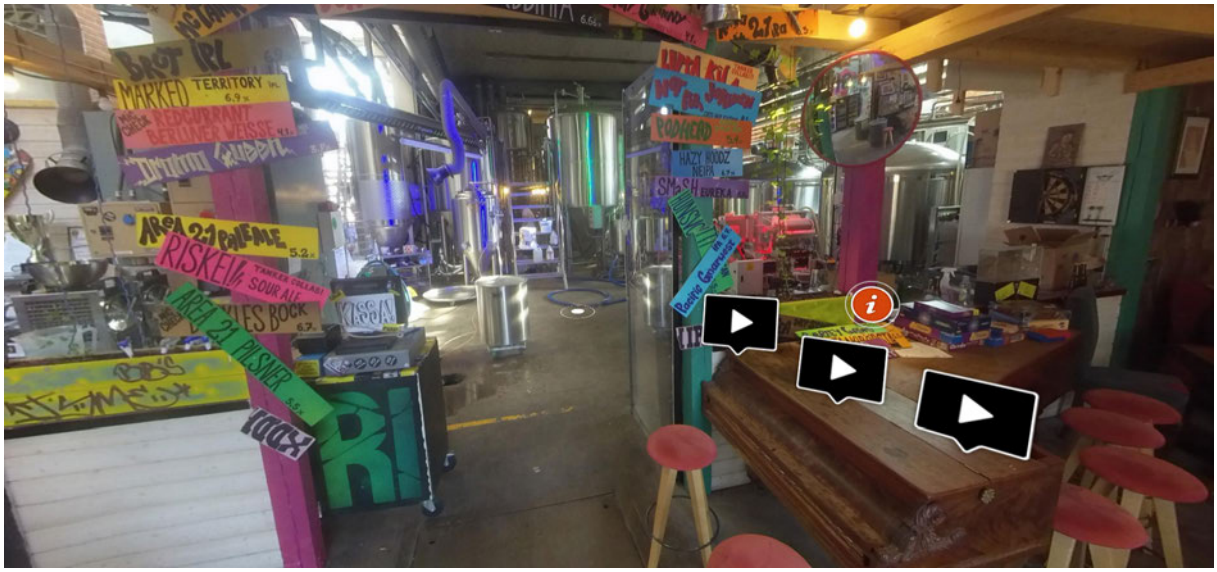

Figure 1. Screenshot from the Olarin Panimo 360° Business Case.

The problem the students are facing is open and different pathways to a solution can be explored and delivered - accommodating the context richness of the case. Students explore the problem in groups. During weekly challenge sessions, students present the work to each other and obtain feedback as well as perspectives of different solutions. The setup can be characterised as a flipped classroom setup [6].

The 360° experience showed high levels of student engagement as well as an improvement in learning outcomes, measured by case and exam performance as well as regular case reflections. Students noted high levels of inclusion and enjoyment when performing the learning activities.

Production was supported with pilot funding. Image and video production was outsourced to the university's film studio. The tour itself was assembled by a Teaching Assistant. The educator performed the planning phase and managed the execution phase. This pilot was the basis for developing the 360° pipeline and its steps due to its efficient execution.

Apart from the described context the 360° case was used in BSc studies as well as executive education.

3.2 Learning Swedish in 360°

Learning Swedish in 360° is an environment which can be used as part of a wide range of Swedish courses at Aalto University. In Finland, all students with Finnish as their language of education need to learn Swedish as their university studies, since Swedish is a minority language in Finland. The aim is to learn to communicate in the working life within one's old field. At Aalto University this translates into the disciplines of arts, business, and a range of technical subjects. Learning Swedish in 360° offers a solution to this need in a form of 360° learning environment designed so that it can be used in a wide range of different Swedish language courses and learning contexts.

The aim is that students learn to communicate in Swedish about their own field of interest. The pedagogical backdrop is content-based language instruction, where students learn language by using it and communicate about subjects that are meaningful to them. Content based language instruction has been used in many alternative forms for decades already and has been shown to be efficient in improving functional language competence [7].

To motivate communication about field specific issues, 360° learning environments from workshops, laboratories and other spaces that students spend time in during their field specific courses have proven to make students engaged and motivated. The learning environments have been augmented with different kinds of material, such as videos and multimodal glossaries, helping students learn vocabulary as well as pronunciation.

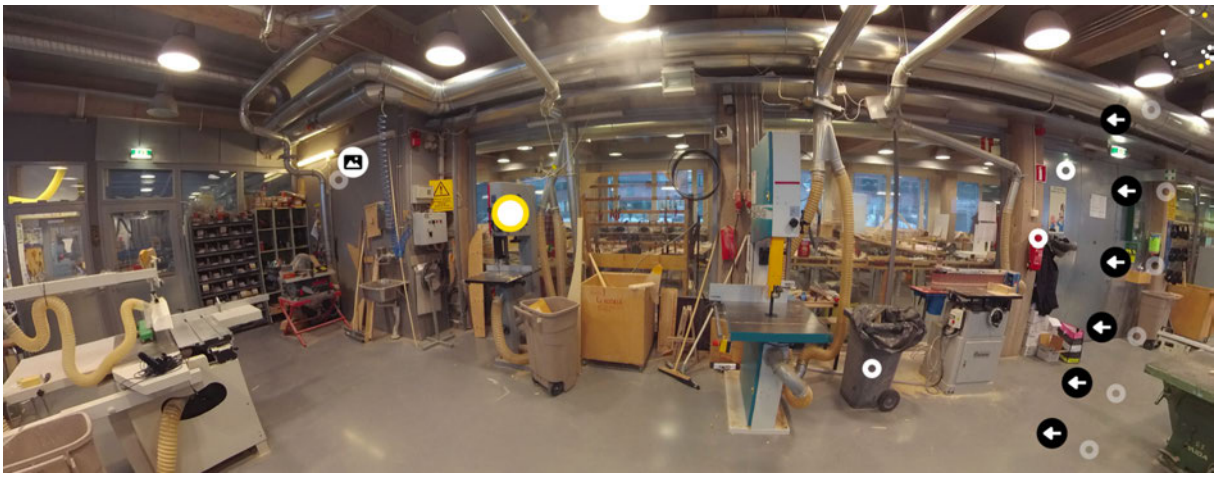

Figure 2. Screenshot from Learning Swedish in 360°- Wood Workshop.

Provided in the learning environments are also guidelines for communication exercises. As an example, architecture students can visit the 360° wood workshop environment together and there discuss in Swedish about what machines they have used for different purposes. These exercises preferably take place after practising vocabulary exercises provided in the same 360° setting. Furthermore, the 360° learning environments have provided possibilities to integrate language studies into field specific courses and collaboration between Language centre and field departments.

For example, first year chemistry students have been able to practise Swedish in the 360° laboratory environment before visiting the physical laboratory. In times of the covid 19 pandemic, the 360° laboratory environment was even the only way to access the lab for the students. By entering the virtual lab from their homes, they have been able to simultaneously learn Swedish and laboratory safety

through video instructions and other material in the 360° learning environment, designed in collaboration between educators from the Language Centre and the Chemistry Department.

The overall feedback from students who have used the 360° learning environments for learning Swedish in different courses have in surveys been very positive. The sense of immersion in familiar environments has been engaging and often recurring words used for describing the learning experience have been inspiring, fun and interesting.

The production was carried out as a pilot funded by Aalto Online Learning. The software used for production and hosting is ThingLink, and the environment can be accessed through this link: Svenska för Aalto i 360 grader (thinglink.com): Future plans include moving some of the 360° learning environments to software that allows for more elaborated content elements and design. The Learning Swedish in 360° pilot was designed and produced by the educators. Image and video production was done in collaboration with specialists from Aalto Online Learning and Aalto Studios.

4 FUTURE DEVELOPMENT AND RESEARCH

Our aim is to lower the threshold of producing 360° learning environments. Thus, with the case of "Learning to produce 360° in 360° we provide a range of options from a rather self-service to larger productions. To facilitate this, we are currently building a template including a selection of 360° spaces from Aalto University campus. Educators can use the environments also in casual settings such as giving a lecture using slides placed in the 360° environment and thus get experience and confidence of using the environment as part of their teaching.

Moreover, research on the result of using 360° implementations remains scant. Understanding what delivery setups, contexts and student learning styles benefit from 360° implementation would guide further development and provide more evidence of their effectiveness. The illusion of "presence" in virtual environments is linked to emotions [8]. It will be crucial to understand exactly how emotions and virtual presence can enable learning.

There is evidence that context immersion enhances learner engagement and inclusion [9]. We advocate that future research investigates how those aspects are achieved exactly through 360° content. Especially interesting would be a comparison to more classic methods such as case teaching or physical experiences to tease out the exact benefits of 360° relative to other choices. We are interested in understanding more about the role of immersive storytelling for 360° videos [10] and 360° learning environments.

5 CONCLUSIONS

Designing education and learning has become a necessity in the current world full of ambiguity, uncertainty, rapid changes and challenges. Designing includes how to orchestrate key parts in an engaging learning experience. These parts include a range of activities like motivating students to learn, sharing research-based knowledge and relevant information, allowing to apply all that to real-world challenges. Physical spaces, studio environments and workshops and actual physical buildings can provide that.

However, these limit how much students and faculty can travel to far away spaces, and how many students those spaces can serve. Having online access to environments otherwise restricted or not accessible has become crucial to tackle these issues. With online 360° learning environments educators can provide not just the feeling of a physical space but also augment those environments with relevant inspiring examples, backstories, assignments and orchestrate all of that into a meaningful, engaging virtual learning experience.

In this paper our contribution and approach was to design a 360° learning environment production pipeline to facilitate creating engaging 360° learning environments for teaching. We outlined the phases of the production pipeline: Planning, Production and Post-Production. We further described resources needed for productions. We illustrated the use of the 360° learning environment production pipeline via two cases we have been involved with: 360° Business Cases and Learning Swedish in 360°. These cases show the usefulness of a systematic approach to producing 360° learning environments.

We plan to continue to develop the 360° learning environment production pipeline to include a range of options from self-service to large-scale productions. There the key is also to include research-backed evidence to ensure immersive learning experiences that truly enable achieving learning outcomes.

Comparisons to traditional methods (both offline and online) are also needed to understand the value of 360° learning environments.

ACKNOWLEDGEMENTS

The research is funded through Aalto Online Learning - Online Hybrid Lab, a strategic educational development initiative at Aalto University, Finland.

REFERENCES

[1] Aussama K. Nassar, Farris Al-Manaseer, Lisa M. Knowlton and Faiz Tuma (2021) Virtual reality (VR) as a simulation modality for technical skills acquisition. Annals of medicine and surgery. https://doi.org/10.1016/j.amsu.2021.102945.

[2] Vermunt, J.D. (2007). The power of teaching-learning environments to influence student learning. *British Journal of Educational Psychology Monograph Series II, 4,* 73-90.

[3] Lampropoulos, G., Barkoukis, V., Burden, K. et al. 360°-degree video in education: An overview and a comparative social media data analysis of the last decade. Smart Learn. Environ. 8, 20 (2021). https://doi.org/10.1186/s40561-021-00165-8

[4] Blecher, L., Riefle, L. and Kauppinen, T. Designing Virtual Toolboxes to Guide Educators in Creating Online Learning. 17TH International Conference on Design Science Research in Information Systems and Technology (DESRIST 2022), June 1-3 June 2022, FL, USA.

[5] Bloom, Benjamin S. "Reflections on the development and use of the taxonomy." Yearbook: National Society for the Study of Education 92.2 (1994): 1-8.

[6] Bergmann, J., & Sams, A. (2014). Flipped learning: Gateway to student engagement. International Society for Technology in Education.

[7] Genesee, F., & Lindholm-Leary, K. (2013). Two case studies of content-based language education. *Journal of Immersion and Content-based language Education*, *1*(1), 3-33.

[8] Riva, G. et al. (2007) Affective Interactions Using Virtual Reality: The Link between Presence and Emotions. CyberPsychology & Behavior. [Online] 10 (1), 45–56. https://doi.org/10.1089/cpb.2006.9993

[9] Schnall, S., Hedge, C., & Weaver, R. (2012). The Immersive Virtual Environment of the digital fulldome: Considerations of relevant psychological processes. International Journal of Human-Computer Studies, 70(8), 561–575.

[10] Elmezeny, A., Edenhofer, N., & Wimmer, J. (2018). Immersive Storytelling in 360-Degree Videos: An Analysis of Interplay Between Narrative and Technical Immersion. Journal For Virtual Worlds Research, 11(1), 1–13.