Collaborative Learning & Co-Creation in XR

Figure 1: Artist's impression of collaborative learning and co-creation in XR

Anna Vasilchenko
Newcastle University
Newcastle upon Tyne, UK
a.vasilchenko@ncl.ac.uk

Yoichi Ochiai
University of Tsukuba
Tsukuba, Ibaraki, Japan
wizard@slis.tsukuba.ac.jp

Jie Li
CWI
Amsterdam, NL
j.li@cwi.nl

Kai Kunze
Keio University
Yokohama, Japan
kai@kmd.keio.ac.jp

Bektur Ryskeldiev
Sayan Sarcar
University of Tsukuba
Tsukuba, Ibaraki, Japan
bektour@slis.tsukuba.ac.jp
sayans@slis.tsukuba.ac.jp

Iulian Radu
Graduate School of Education
Harvard University
Cambridge, MA, USA
iulian_radu@gse.harvard.edu

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Abstract

In this SIG, we aim at gathering researchers and practitioners to reflect on using XR technologies to support collaborative learning and co-creation, and to foster a joint force by connecting the Learning and Education community and the XR community at CHI. We witness a significant increase in CHI publications relating to these research areas: 292 titles about "collaborative learning" or "co-creation" since 2015 compared to 96 in 2010-2014; and 1180 titles about XR since 2015 compared to 288 in 2010-2014[1]. This SIG will bring together researchers, educators, designers and practitioners to 1) stimulate a cross-disciplinary discussion on the opportunities of collaborative learning and co-creation in XR; 2) foresee the future directions, standards and obstacles to introduce XR to education; and 3) build a joint community connecting XR and education research at CHI.

Author Keywords

Extended reality, virtual reality, augmented reality, mixed reality, collaborative learning, co-creation, CSCW, CSCL

CCS Concepts

•**Human-centered computing** → **Mixed/augmented reality; Virtual reality; Collaborative interaction;** *Collaborative content creation;* CSCW;

Why Collaborative Learning & Co-creation?
We bring collaborative learning and co-creation together in this SIG, since we believe they are interrelated concepts, both of which propose the idea of students as interactive partners, and co-creators of their learning [2]. We posit that co-creation could be one of the means of collaborative learning and effective collaborative learning is the outcome of co-creation activities.

Collaborative learning invite students to interactively learn in small groups with shared authority and responsibility for group actions and outcomes, which has significant academic, social, and psychological benefits [6]. A number of studies have identified factors that boost collaborative learning (e.g., [13, 18], which generally agreed that collaborative learning requires active social interactions, group goals, and individual accountability.

Introduction
XR technologies as defined by Fast-Berglund et al.[3], including Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR), have seen a drastic increase in commercial popularity. However, these technologies, so far, have focused mainly on individual experience [15]. As technologies and connectivity evolves, XR is expected to become social experiences, inviting multiple users to interact and co-create with the virtual representations of other users [7]. This social trend in immersive experience requires a new understanding of how communication and collaboration between users would happen in the context of XR, and what principles of collaboration in the real world and what new rules should be considered in XR environments.

Another trend we witness in HCI is the rise of interest in XR technologies to support collaborative learning, ranging from specific learning domains such as physics [9], medicine[4] or choreography [10] to more general applications like skills training [5] and delivering instructions for physical tasks [17]. XR technologies have potential to support both physical aspects of learning (visualization of invisible concepts, e.g., electromagnetics, molecular biology) as well as learner's cognitive processes [14]. Previous studies suggest that individual XR experiences have a positive impact on learning outcomes such as better content understanding, long-term memory retention, and increased motivation [8]. With the advocacy for collaborative learning, it is logical to start thinking about how collaborative XR technologies can be employed for the same purposes.

Goal
We aim at connecting two communities at CHI: the XR and the learning/education community. Therefore, we would like to invite participants who are interested in related research directions to establish a dialog, exploring the challenges, opportunities and long-term research plans of XR technologies for collaborative learning and co-creation.

Stimulate cross-disciplinary discussion
The first goal is to stimulate a cross-disciplinary discussion on the opportunities of collaborative learning and co-creation in XR. We would like to provide a platform for professionals from different domains to share their expertise and thoughts on this SIG topic. These professionals can be researchers who are working on various aspects of collaborative learning, co-design, co-creation, participatory design, ethical issues of XR, social XR; developers or content creators who are actively making XR applications; practitioners, policy makers who are working on regulations and policies for the new technology.

Raise awareness about opportunities & obstacles
The second goal is to foresee the future directions, standards and obstacles to introduce XR to education with a specific focus on collaborative learning activities, as well as co-creation. So far, many commercial XR products have been primarily developed for entertainment. We would like to explore the existing applications for XR co-creative learning and see what benefits are observed there, in terms of learning and collaboration. We aim to raise the awareness on the unique benefits that XR can bring to education and collaboration; the standards to define and measure XR experiences (e.g., visual quality, latency standards); and also the challenges to make XR acceptable and available to larger audience at affordable cost.

Build a joint community
The third goal is to build a joint community connecting XR and education/learning research at CHI. With the access of XR technologies, models of education and collaboration

[1] We performed the search on Google Scholar and obtained the search results on December 16, 2019

Co-creation has been associated with many research areas, including co-design and participatory design of new products or services [12], content co-production [1], and co-creation with citizens in public innovation [16]. Ramaswamy Ozcan [11] provide a new perspective on co-creation and define it as the "enactment of creation through interactions". They stressed that co-creation is not just two or more human actors coming together in activities, but entails various types of interactions among human actors, technological systems, and environments.

must be evolved. We would like to invite professionals from both communities to think about future research on how XR technologies can push further the geographical boundaries, simplify the access to educational resources and offer customized/experienced-based education support; how XR technologies motivate students and improve their creativity and collaboration skills; what hidden health risks we might overlook about XR technologies.

Discussion Topics

We will host discussion around collaborative learning and co-creation in XR. We propose (but not limited to) the following topics (T1-T4) :

T1: What are the added values and missing aspects in XR compared to non-XR methods in facilitating collaboration? XR technologies have the potential to portray 3D spatial information, to exploit learners' natural behaviors, and to immerse them in the virtual learning world. XR can use avatars or photo-realistic holograms to offer appearance, gestures, directional voice, and ability to interact with other learners, and with the virtual artifacts. XR can also go beyond reality, providing learning materials that are not possible in the real world. However, it is not realistic to have XR technologies replicate the real world interactions. Specific new interaction techniques (e.g., mid-air haptics, automatic object recognizing, viewports sharing) should be designed for XR collaboration.

T2: What are the obstacles for introduction of XR technologies to regular education? We foresee some obstacles: (1) the cost of XR tools may be daunting for large-scale adoption; (2) the educators and parents lack knowledge about the potential of the technology, and tend to be anxious about the effects of XR on children; (3) the availability of advanced education content in XR.

T3: How can XR co-creation be scaled up? Although growing fast, XR technologies are still niche as commercial products. Enabling low-latency interactions in XR require enormous amounts of data to work effectively. So far, lack of mobility, bulky headsets and network lag may still prevent it to scale up. The roll-out of 5G may provide the capacities to enable stable and consistent connection for XR at larger scale.

T4: What risks of XR on learners we should think of and how to address them? XR technologies bring along new ethical challenges. Using XR tools, we can expose vast amounts of private data, such as facial expressions, speech data, and even retina patterns that can be used to uniquely identify us. The frequent and prolonged exposure to XR environments could be harmful to our mental health, and lead to social isolation.

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