Editorial
Beyond Media Comparison: Investigating When and How Learning with Augmented and Virtual Reality Works

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At first glance, the imagery on the cover of a psychology journal dedicated to the subject of learning with augmented reality (AR) and virtual reality (VR) may seem odd, as it features apples and oranges. However, the choice of image is highly relevant given the main topic of this issue of Digital Psychology – comparative research designs where conditions cannot be accurately compared; the classic example of comparing apples to oranges (e.g. Castro-Alonso et al., 2016).

Although this problem has been widely recognized and extensively debated in educational (technology) research for over forty years (e.g. Clark, 1983; Kerres & Buchner, 2022; Lockee et al., 1999; Reigeluth & Honebein, 2023; Warnick & Burbules, 2007), there is currently a need for action specifically for research on teaching and learning with AR and VR.

This became apparent through our research on AR as an educational technology (Buchner et al., 2022; Buchner & Kerres, 2023): Our systematic and critical reviews found that the research landscape is dominated by media comparisons and that theoretical assumptions are primarily used to justify these comparisons. For instance, learning with AR is primarily linked to the Cognitive Theory of Multimedia Learning or Cognitive Load Theory, but the control conditions did not differ in design principles pertaining to these theories. However, varying the design principles would be necessary to explore if the principles are also relevant when learning with AR (Buchner et al., 2022; Krüger & Bodemer, 2022). Furthermore, as research continues to demonstrate that AR can boost learners' motivation (e.g. Bacca et al., 2019), theory-based investigations considering this effect are needed. Such inquiry should incorporate other theories of digital learning like the Cognitive Affective Theory of Learning with Media (Park et al., 2014) or the Cognitive Affective Social Theory of Learning in Digital Environments (Schneider et al., 2021). Also, effects on learning outcomes beyond the cognitive domain merit more attention.

Similar findings have been reported in previous literature reflecting on research methodologies applied in educational VR studies. For instance, Parong and Mayer (2018) as well as Makransky and Petersen (2021), Glaser and Schmidt (2022), and more recently Lawson and Martella (2023) refer to the problem of media comparisons in IVR research. Specifically, the imbalance of experimental conditions is problematic. For instance, comparing a highly interactive VR application with the passive viewing of a video is, in fact, to compare two distinct learning activities, rather than to assess the learning impact of one form of media presentation versus another. Lawson and Martella (2023, p. 6) describe such obviously inferior control groups as strawman conditions.

It is evident that, four decades after the "Great Media Debate" (Sickel, 2019), there is again a requirement for a thorough, scientific discussion about research methods and study designs – here with a focus on educational AR and VR research. The aim of this special issue in the Digital Psychology journal is to contribute to this discussion.

All submissions were subject to a rigorous double-blind peer review process. The reviewers, including Peter Honebein, Stefan Siegel, Miriam Mulders, Jorge Bacca Acosta, and David Fernes, are greatly appreciated for their work.

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Following the review process, two manuscripts have been selected for publication in the special issue.

In the first contribution, an invited letter, Noah Glaser and Stephanie Moore provide an overview of the debate on the issues of media comparisons. They further elaborate on the challenges that these comparisons pose specifically for research on learning with AR/VR. Glaser and Moore (p. 5) argue that the significance of AR/VR for learning lies in the linking of media affordances with specific learning objectives. To support this claim, they cite studies on the development and testing of VR applications for autistic learners (e.g. Schmidt et al., 2023; Schmidt & Glaser, 2021). To move beyond media comparisons, the authors call for more meaningful research in the field of educational AR/VR. Such research should be characterized by Learner-Centeredness, Iterative Design and Refinement, and Integration of Pedagogy and Technology (p. 5).

The second contribution is a letter by Miriam Mulders. The paper first overviews research designs applied in educational technology research, followed by a critical reflection. Mulders notes that simplistic media comparison studies are unable to consider the complexity of learning. In exploring alternative research methods, including moderators and mediators as variables in experimental designs may facilitate a visualization of the complex learning process through AR/VR and also invalidate the unidirectional assumption of medium impact on learning outcomes. Further, according to Mulders (p. 9) it must be considered that establishing an adequate control condition in educational AR/VR research might be impossible. This accounts for learning situations, which are either too dangerous or too costly to conduct in real life. The letter concludes by highlighting that the complex research and analysis designs described in the article, for an example see Mulders (2023), can provide more meaningful information for both educational theory and practice compared to simple media comparison study designs.

Both contributions provide a critical reflection together with solutions to (possibly) overcome the media comparison problem. These solutions must be discussed within the research community to determine potential consequences for study designs.

The discussion generated by this special issue may aid in reducing the number of studies comparing AR/VR with so-called traditional media or teaching, and instead concentrate on learning, as suggested more broadly for technology-enhanced learning and teaching by Kirschner (2015).

This will require conducting theory-based studies on learning with AR and VR, including possible influencing factors in more complex study designs, exploring the interplay of media affordances and learning in iterative research approaches, and taking a closer look at the effects of how AR/VR affects multiple learning outcomes.

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Guest Editor

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Conflict of interest

JB declares no conflict of interest