A Systematic Review of Research on Augmented Reality and Cognitive Load

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Poster

A Systematic Review of Research on Augmented Reality and Cognitive Load

Josef Buchner & Katja Buntins

Earli Sig 6-7 Meeting

24.08.2020, Online format due Covid19

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Main research questions:

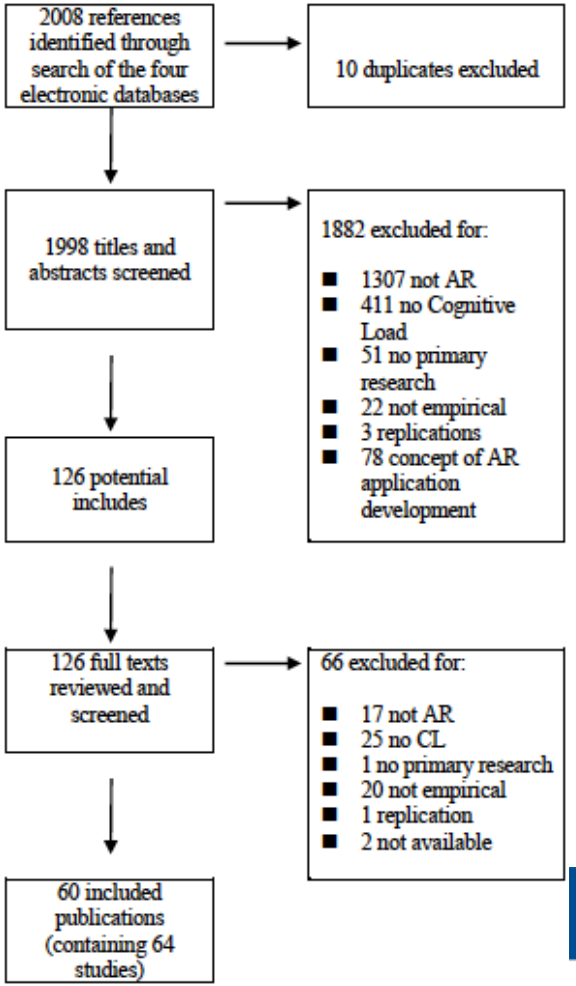
- **How** is research on AR and CL conducted to date?

- **What is the role** of CL in AR enhanced learning and training?

Systematic Review

…systematically performed literature review with the aim to answer specific research question(s).

e.g. Newman & Gough (2020)



PRISMA flow chart
(Moher et al., 2009)

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How is research on AR and CL conducted to date?

- Type of research (based on Mayer, 2019)*
  - Media comparison: 81% (= AR vs. Print and/or Display and/or Audio and/or IVR)
  - Value-added: 32% (= e.g. AR with 2D/3D or different game-based learning approaches)
  - AR comparison: 9% (= e.g. assemble a furniture with see-through AR or spatial AR)

- CL measurement (selection for presentation)
  - 56% Nasa TLX (Hart & Staveland, 1988)
  - 8% 5ML & 3ME (referenced as based on Paas, 1992)
  - 6% 2ML & 2ME (referenced as based on Sweller et al., 2019)
  - 4% 9-Point CL scale, dual-task approach, self-made scales
  - 1.6% (= 1 study) IL/EL/GL scale developed by Leppink et al., 2013

* Note: Summed percentages higher than 100% because many studies compare several media and/or AR types

What is the role of CL in AR enhanced learning and training?

- Purpose of AR:
  - Reduce load / types of load & enhance performance
  - 30% declarative / 70% procedural knowledge

- Results (selection for presentation)
  - varying results in media comparison studies
    - e.g. complex assembly task lead to higher CL with AR compared to print
    - Spatial-ability training lower CL and higher performance with AR
    - Evidence for reduction of extraneous load
  - Spatial AR outperforms see-through AR
  - Visual cues improve see-through AR

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References

Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research. *Advances in Psychology*, *52*, 139–183. https://doi.org/10.1016/S0166-4115(08)62386-9.

Leppink, J., Paas, F., Van der Vleuten, C. P. M., Van Gog, T., & Van Merriënboer, J. J. G. (2013). Development of an instrument for measuring different types of cognitive load. *Behavior Research Methods*, *45*(4), 1058–1072. https://doi.org/10.3758/s13428-013-0334-1

Mayer, R. E. (2019). Computer Games in Education. *Annual Review of Psychology*, *70*, 531–549. https://doi.org/doi.org/10.1146/annurev-psych-010418-102744

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *BMJ (Clinical Research Ed.)*, *339*(b2535). https://doi.org/10.1136/bmj.b2535

Newman, M., & Gough, D. (2020). Systematic Reviews in Educational Research: Methodology, Perspectives and Application. In O. Zawacki-Richter, M. Kerres, S. Bedenlier, M. Bond, & K. Buntins (Eds.), *Systematic Reviews in Educational Research: Methodology, Perspectives and Application* (pp. 3–22). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-27602-7_1

Paas, F. G. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. *Journal of Educational Psychology*, *84*(4), 429–434. https://doi.org/10.1037/0022-0663.84.4.429

Sweller, J., van Merriënboer, J., & Paas, F. G. W. C. (2019). Cognitive Architecture and Instructional Design: 20 Years Later. *Educational Psychology Review*, *31*(2), 261–292. https://doi.org/10.1007/s10648-019-09465-5

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Thank you!

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