INCREASED EMOTIONAL ENGAGEMENT IN GAME-BASED MATH LEARNING

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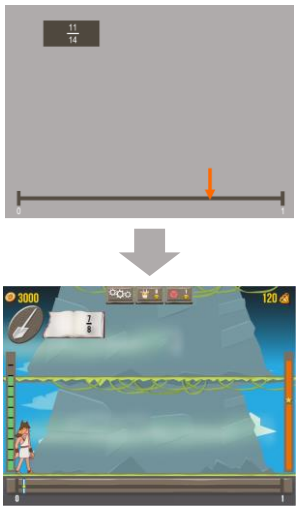
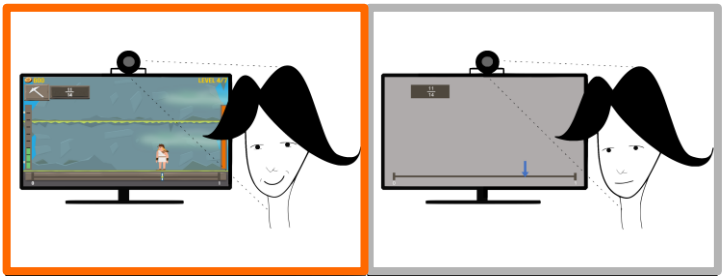


BACKGROUND

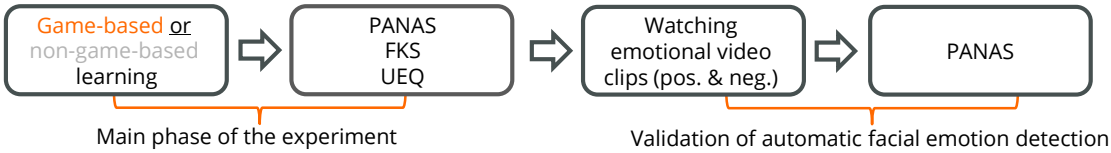
- There is accumulating evidence that game-based learning approaches seem to be superior to conventional instruction methods (for meta analyses see Clark, Tanner-Smith, & Killingsworth, 2016; Wouters et al., 2013)
- Game-based learning is argued to be particularly effective because of the emotionally engaging nature of games (Howard-Jones, Demetriou, Bogacz, Yoo, & Leonards, 2011; Plass, Homer, & Kinzer, 2015)
- Game-based math learning seems to be particularly successful (e.g. Wouters et al., 2013)
- Fraction understanding is an important aspect in math education (Booth and Newton, 2012), but students as well as adults struggle with understanding and appropriately dealing with fractions (Siegler et al., 2013)
- We employed a game-based fraction number line estimation task and compared it with a non game-based equivalent in terms of emotional engagement

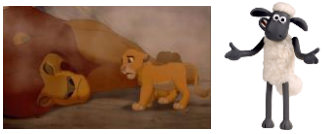
➢ **Is game-based learning associated with higher emotional engagement?**

METHOD

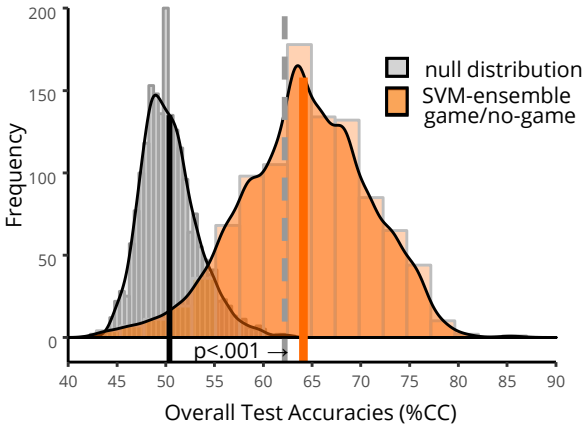


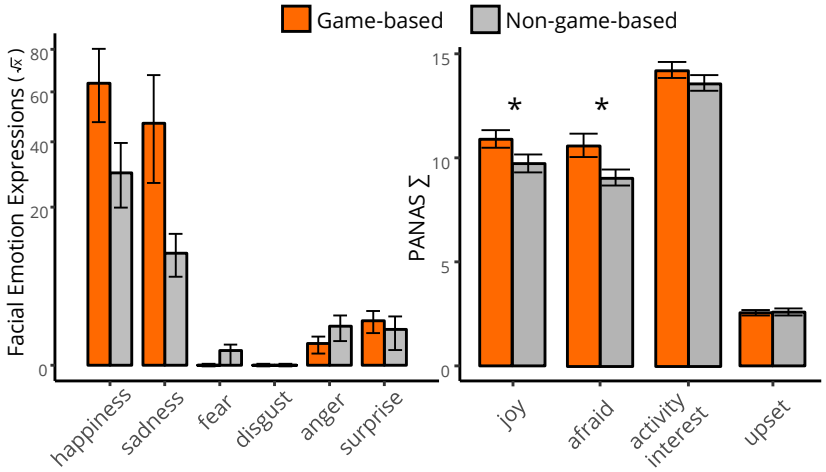
- *N* = 150 adult university students
- 27 participants excluded - missing valid facial emotional expression
- Fraction learning with either game-based or non-game-based environment (~ 15 minutes)
- $N_{game\text{-}based}$= 62, $N_{non\text{-}game}$= 60 (age *mean* = 23.84 years, *SD* = 3.04)
- Webcam recording of participants faces
- Automatic facial emotion detection (Microsoft Emotion API) and machine learning approach using support vector machines (SVM)
- Questionnaires:
  - Positive and Negative Affective Schedule (PANAS) (Janke & Glöckner-Rist, 2014)
  - Flow Short Scale (FKS) (Rheinberg, Vollmeyer, & Engeser, 2003)
  - User Experience Questionnaire (UEQ) (Laugwitz, Schrepp, & Held, 2006)





RESULTS





DISCUSSION

- Differential emotional engagement in game and non-game-based learning
- Process measure of emotional expressive behavior was further substantiated by post-hoc subjective ratings of experienced emotions

➢ **Increased positive and negative emotions in game-based learning as compared to non-game-based equivalent**

➢ **The identified increased emotional engagement might be one factor contributing to superior learning and retention in game-based learning as compared to conventional instructional approaches**

References: Booth JL and Newton KJ. Contemp. Educ. Psychol. (2012) 37:247–253; Clark DB, Tanner-Smith EE, and Killingsworth SS. Rev. Educ. Res. (2016) 86:79-122; Granic I, Lobel A, Engels RCME. Am. Psychol. (2014) 69:66-78; Howard-Jones P, Demetriou S, Bogacz R, Yoo JH, and Leonards U. Mind Brain Educ. (2011) 5:33-41; Plass JL, Homer BD, and Kinzer CK. Educ. Psychol. (2015) 50:258-283; Siegler RS, Fazio LK, Bailey DH, and Zhou X. Trends Cogn. Sci (2013) 17:13-19; Wouters P, van Nimwegen C, van Oostendorp H, and van Der Spek ED. J. Educ. Psychol (2013) 105:249-265.

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