

Evaluating Affective and Cognitive Outcomes of GAMVR, a Cost-Effective VR Game-based Learning Tool for Basic Mathematics

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Game-Design vs. Assessment [Gangavarapu *et al.* 2019]

- ❖ Game-Design:
 - ❖ *Universal Principles of Designing Interactive Interfaces*: equitable use, flexibility, simple and intuitive UI, perceptible information, error tolerance, and low physical effort

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 - ❖ *Summative*: aimed at assessment of learning outcomes via end-goal assessments!
 - ❖ *Formative*: improves subject's learning capabilities via constant monitoring
 - ❖ *Stealth*: tasks are highly interactive and assessment is carried out non-invasively

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Rule of the thumb: Game *assessment* in educational context is far more crucial than the *design* itself!

Game-Design Frameworks [Alysson and Piero 2015]

- ❖ The **RETAIN** model
 - ❖ *6 key elements*: relevance, embedding, transfer, adaptation, immersion, and naturalization

Aim: Ensure that *learning* and *gameplay* function seamlessly!

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- ❖ **Three Layered Thinking** (TLT) model
 - ❖ *3 levels*: pedagogic (knowledge production), achievement, and core design

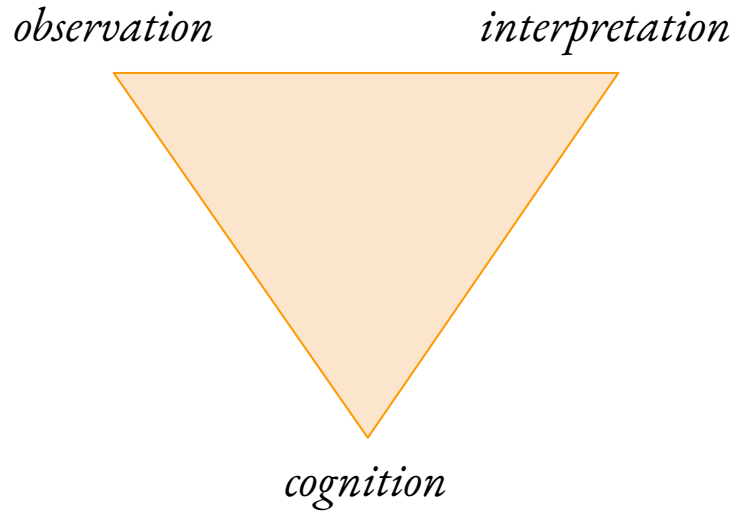
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- ❖ Many others: application-centered frameworks
 - ❖ **Game Object Models** (GOM), GOM-II,
 - ❖ **Educational Games Design Framework** (EGDF), ...

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Assessment Triangle Framework [Pellegrino *et al.* 2001]



A model of student learning
and cognition in the assessment
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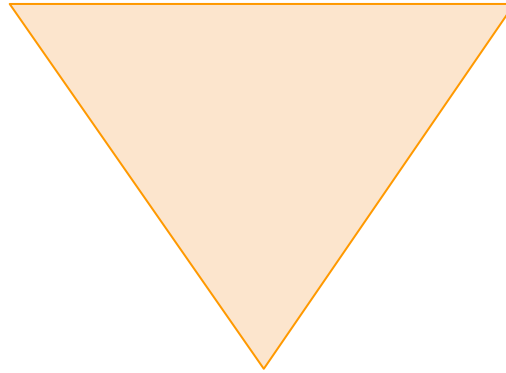
Aim: Evaluating the *validity* of
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Assessment Triangle Framework [Pellegrino *et al.* 2001]

Set of principles and assumptions about the type of observations which will provide evidence of students' competencies

observation

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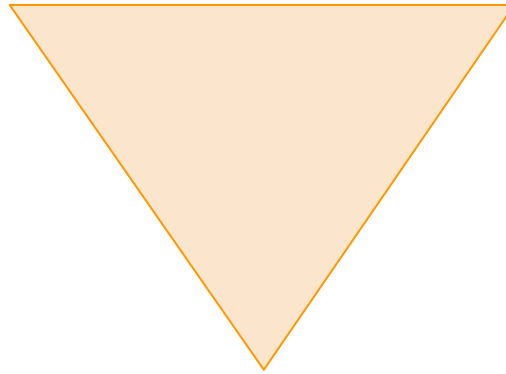
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The process of understanding the evidence with respect to assessment goals



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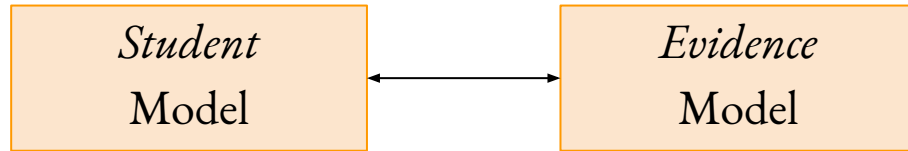
Evidence-Centered Design [Mislevy *et al.* 2003]

Student
Model

What complex skills,
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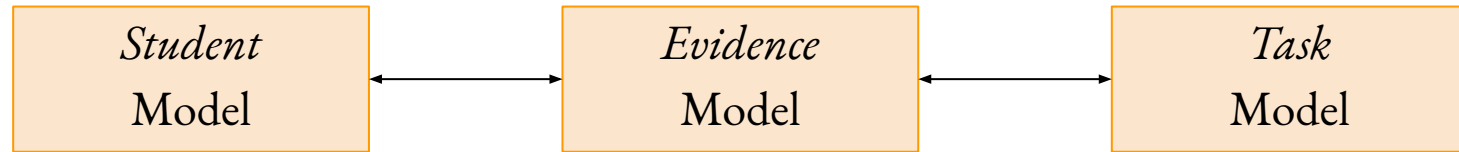


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What performances or behaviors must reveal the relevant skills and knowledge described in the student model?

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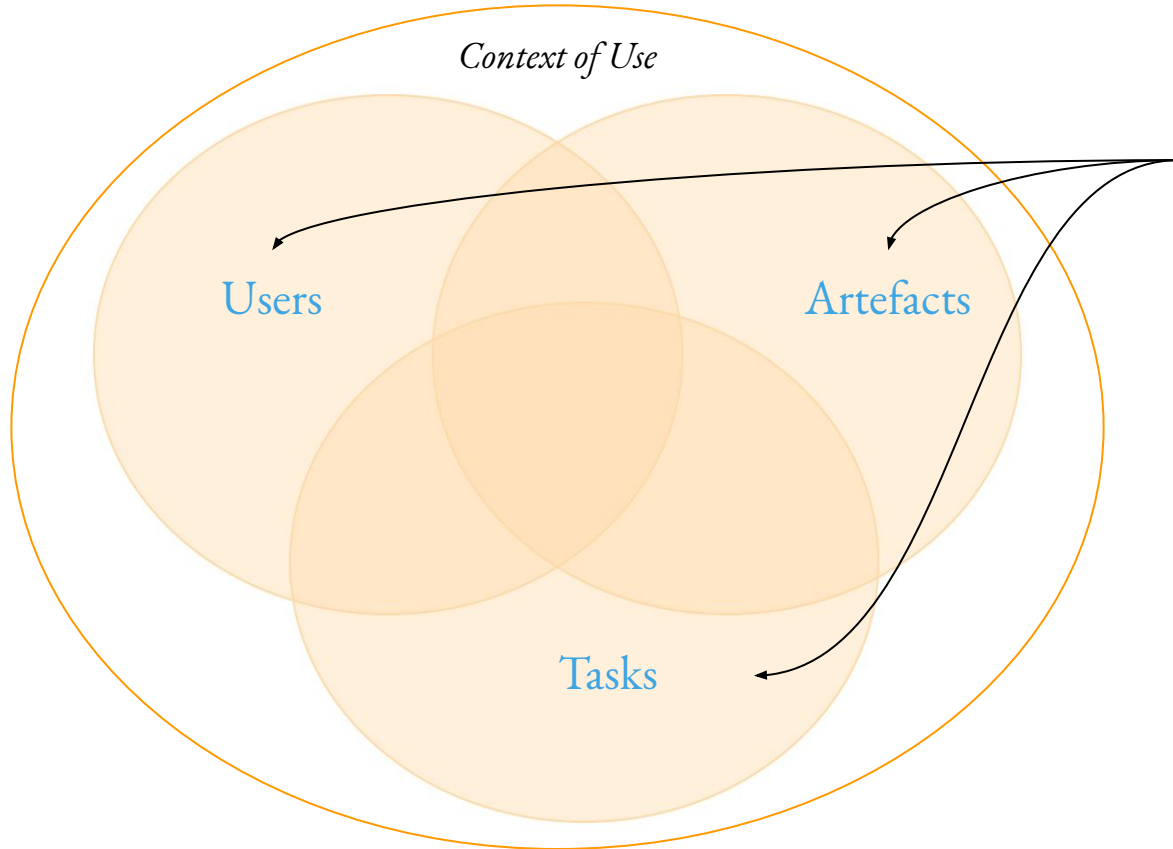
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What performances or behaviors must reveal the relevant skills and knowledge described in the student model?

What tasks or situations should elicit the behaviors or performances described in the evidence model?

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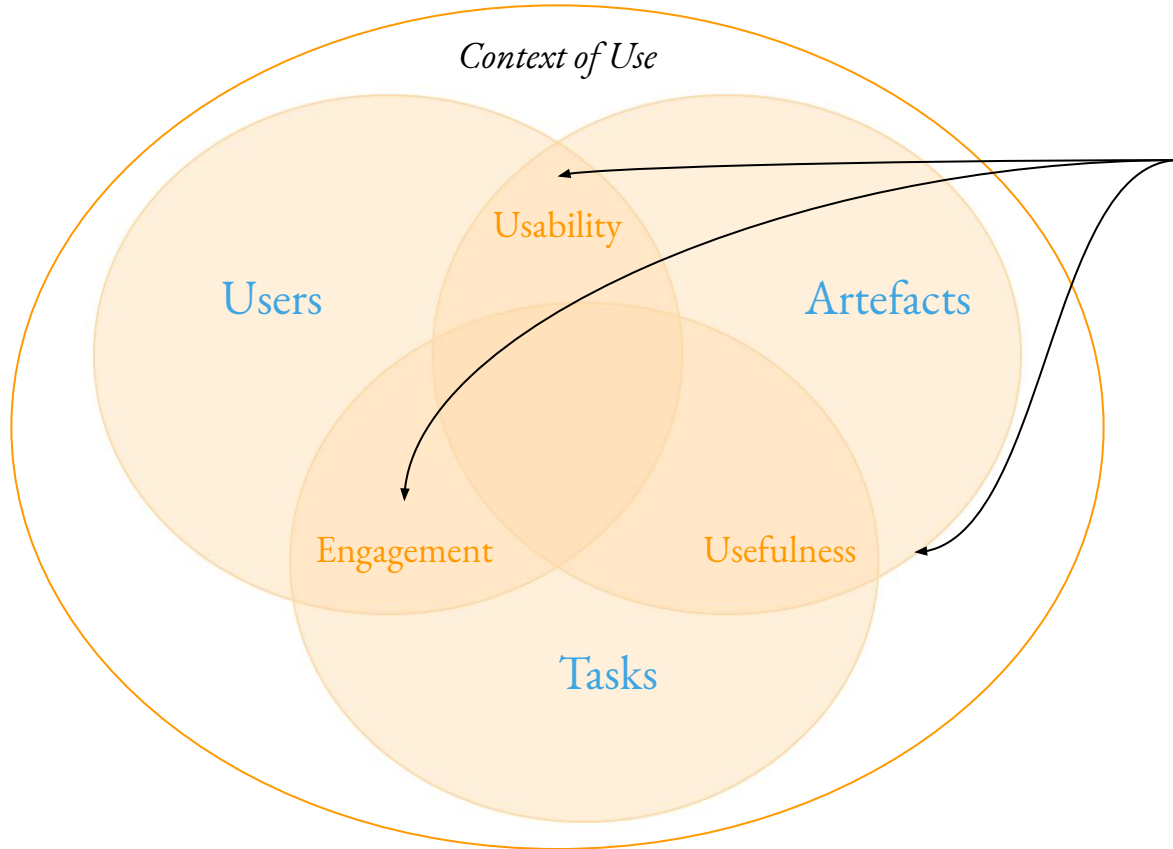
User Experience Framework [Kiili *et al.* 2014]



Three base pillars of any game-design and assessment. User experience emerges from the interplay between these elements!

Aim: Evaluating the *affective outcomes, quality* of a game!

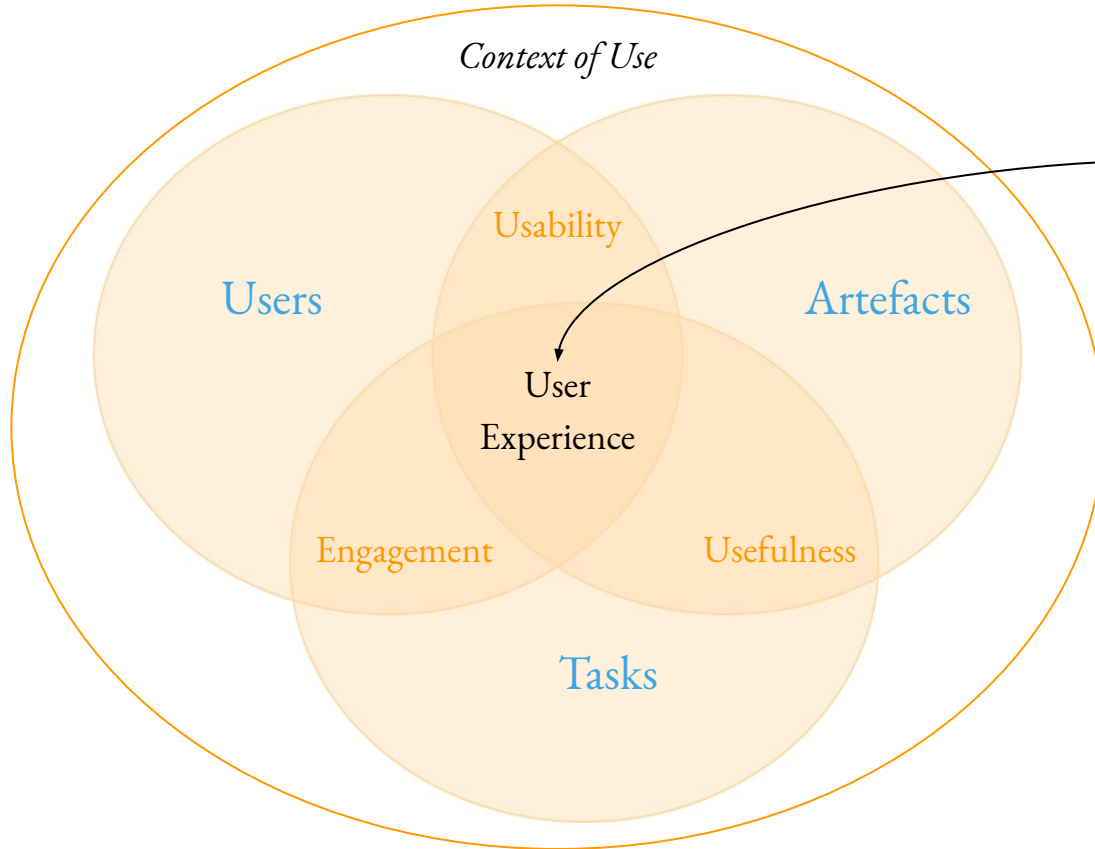
User Experience Framework [Kiili *et al.* 2014]



Base interactions creating higher level outcomes needed to evaluate various game-based outcomes

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User Experience Framework [Kiili *et al.* 2014]



Good usability, a useful artefact, and an emerging task (challenges in the game) are the prerequisites for good educational experience

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Further Reading

- [1] T. Gangavarapu, T.S. Ashwin, and G. Ram Mohana Reddy. "*Evaluating Affective and Cognitive Outcomes of GAMVR, a Cost-Effective VR Game-based Learning Tool for Basic Mathematics.*" IEEE Transactions on Learning Technologies. Under review. 2019.
- [2] Pellegrino, James W., Louis V. DiBello, and Susan R. Goldman. "*A framework for conceptualizing and evaluating the validity of instructionally relevant assessments.*" Educational Psychologist 51.1: 59-81. 2016.
- [3] Alysson, Diniz Dos Santos, and Fraternali Piero. "*A comparison of methodological frameworks for digital learning game design.*" GALA Conference. 2015.
- [4] Pellegrino, James W., Naomi Chudowsky, and Robert Glaser. "*Knowing what students know: The science and design of educational assessment.*" National Academy Press, 2102 Constitutions Avenue, NW, Lockbox 285, Washington, DC 20055, 2001.
- [5] Mislevy, Robert J., Russell G. Almond, and Janice F. Lukas. "*A brief introduction to evidence-centered design.*" ETS Research Report Series 2003.1: i-29. 2003.
- [6] Kiili, K., Lainema, T., de Freitas, S., and Arnab, S. "*Flow framework for analyzing the quality of educational games.*" Entertainment computing, 5(4), 367-377. 2014.