**Testing Plan 3: Gamified Assembly in XR**

**Project Overview**

This project leverages Extended Reality (XR) and a gamified puzzle assembly system (9×9 grid) on via an Odoo-like platform. The goal is to improve learnability, spatial reasoning, and industry interest among young girls, promoting diversity and inclusion in construction education It fits with BuildSkills that encourages young girls to participate and succeed in technical fields, supporting a diverse construction workforce.

**Testing Objective**

**Assumptions:**

* Users know how to manipulate virtual objects (move, rotate, drop, select). ( Evaluation 1)
* Participants can interpret feedback cues in the XR environment. (Evaluation 2)
* All users have basic digital literacy and some familiarity with puzzles.

**Unknowns:**

* Is the grid-based interface intuitive?
* Do game mechanics (points (not tested in XR, feedback) improve accuracy, speed, and confidence?
* Are usability and ergonomic challenges present for this?

**Test Goals:**

* Measure how gamified grid assembly improves learning, motivation, and spatial reasoning.
* Assess engagement and frustration reduction through game elements (levels, points, feedback)
* Observe teamwork, creativity, and alternative problem-solving strategies.
* Do users share the timings and engage in sense of engagement.
* Analyse usability and accessibility for target demographic.

**Testing Methodologies**

* **Think-Aloud Protocol:**  
  Participants verbalize decisions and reactions during play.
* **Time on Task:**
  + Task 1: Assemble puzzle with visual cues

**Metrics:**

* + Completion time per task
  + Error count (misplacement, overlap, failed snap, or didn’t complete)
  + Strategy and collaboration notes (observer)

**Test Features**

* 9×9 interactive grid for puzzle pieces
* Real-time feedback (visual cues for correctness)
* Instructions/onboarding for beginners
* Ergonomic

**Testing Setup**

* XR device
* The Block Puzzles game
* Quiet, comfortable test environment
* Consent forms, briefing materials, and reference images( if any)
* Real-time recording (screen/video/audio)

**Testing Procedure (~10–15 minutes )**

1. Welcome, consent, and introduction to platform/device
2. Teach basic controls (if needed)
3. Task 1: Standard grid assembly (record time, errors, feedback)
4. NASA TLX questionnaire (workload, frustration, satisfaction)
5. Debrief and thank participant

**Data Collection**

* Task completion times for each challenge
* Error log: type, frequency, circumstances
* Points achieved – Successful number of puzzles placed
* Observational notes (strategy)
* NASA TLX scales
* Audio/transcripts records

**Post-Task Interview Questions**

* Was grid assembly easy to understand and use?
* Was feedback useful for correcting mistakes?

**Usability & Learnability Metrics**

* Time on Task: Measure speed to complete each puzzle stage.
* Task Success Rate: % of participants completing all puzzles unaided.
* Workload: NASA TLX scores for mental, physical, and emotional effort.

**Research Objectives**

Incorporating challenges, reward systems, and instant feedback in XR assembly tasks leads to fewer mistakes and increased user confidence and satisfaction. [1]

***Objective 1 To determine if challenges, reward systems, and instant feedback in XR assembly tasks lower error rates and boost user confidence and satisfaction***

Competitive elements stimulate sustained effort and improvements in both speed and accuracy. This motivational structure mirrors real-world manufacturing where productivity and precision are crucial, thus making training more transferable [2]

***Objective 2 To investigate how competitive game elements in XR modules impact user effort, speed, and task accuracy, making skills more adaptable to real-world manufacturing settings.***

Playful, immersive gamified XR environments are especially effective at engaging and retaining young girls and other underrepresented groups in technical activities, fostering positive attitudes towards STEM fields and reducing participation gaps [3]

***Objective 3 To assess whether playful, gamified XR environments increase engagement and retention for young girls and other underrepresented groups in technical fields, helping to close participation gaps in STEM.***

***Sub Objective This could be measure will people like to share their score with others?***

**References**

[1] Garbaya, S., et al. (2019). Gamification of Assembly Planning in Virtual Environment. Discovery UCL.

[2]Hainey, T., et al. (2022). Effects of games in STEM education: a meta-analysis on learning outcomes.

[3] The Effect of Gamified STEM Practices on Students’ Learning Outcomes, Participation, and Attitudes

**Gen AI Acknowledgement**

| Tool | Use | Prompts | Date |
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| Perplexity | Improve Sentence Structure | Improve grammar and spelling for the following sentences | 24 October 2025 |