Imagined Arcade: XR Game Toolkit for Co-Imagining Career Futures with Students, Subject Experts, and AI

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Presented at the HCII Conference

Abstract. Immersive gamified learning experiences can inspire students to imagine themselves in future careers, but creating such experiences at scale faces high development costs, technical barriers, and misalignment of content with curricula. Imagined Arcade is an XR Game Toolkit system and workshop that addresses these challenges by leveraging generative AI to facilitate the collaborative design of MR games. In the process of using the toolkit, students will collaborate with subject matter experts to generate games relevant to target careers of interest. This will also result in a library of short minigames that can allow players to broadly explore various aspects of career trajectories. The Imagined Arcade system integrates three components: (1) a card-based ideation toolkit to spark narratives and learning goals; (2) gamified MR templates that allow rapid customization of interactive virtual experiences; and (3) a custom web application that integrates large language models (LLMs), image generators, and asset recommenders for co-creation of story content and visuals. We share our plans for deploying the system in educational settings through streamlined workshops, and our plans to conduct user studies on learning outcomes.

Keywords: Content Creation for Mixed Reality · AI-generated Design· Game-based Learning· Immersive Career Exploration

1 Introduction

Mixed Reality experiences can transform education by engaging students in interactive, embodied learning experiences. However, integrating MR into the classroom remains challenging. Educators and institutions face limitations around the adoption of immersive experiences in education due to development challenges, content alignment issues, and concerns about high cost and scalability [1][2][3]. These barriers contribute to XR's slow integration into mainstream education, despite its proven benefits for motivation and knowledge retention.

With recent advances in generative Artificial Intelligence (AI), many educators and students remain uncertain about how to incorporate AI-driven tools into a structured design process, especially one that scaffolds collaborative ideation and yields XR prototypes fit for further development. To help with this gap,

we introduce the Imagined Arcade workshop, a system designed to apply generative AI for collaborative MR experience design in education. We specifically aim to use AI to facilitate student conversations with career experts to imagine future career trajectories, contextualized in the exercise of developing gamified learning experiences about careers. We aim our toolkit to be broadly accessible, allowing non-technical students to engage in the design process, and instead focus their efforts on co-ideation with human subject matter experts, wrestling with challenges around career identity and skill pathways. Through this "make-to-learn" pattern, the resulting efforts generates a library of games that other students can play to inspire their thinking about future careers in "play-to-learn" engagements.

Combining principles of empathetic design, role-playing in design, learner-centered interaction, and game-based learning approaches, Imagined Arcade offers an accessible road to participate in complex mixed reality design and development. The workshop consists of three interconnected components: (1) Card-Based Ideation to scaffold brainstorming of scenarios and learning goals; (2) a Custom Web Application that integrates multiple AI services (LLMs for narrative generation, text-to-image models for visual assets, and asset recommendation algorithms); and (3) Gamified MR Templates that serve as reusable, interactive frameworks where the generated narratives and assets are inserted to create a playable experience. The system encourages a collaborative imagination process where AI acts as a creative partner, helping teams iterate on story ideas, characters, visuals, and interactions.

We frame Imagined Arcade as a response to MR-in-education challenges, review related work on AI-assisted design, describe the system architecture, and provide a walkthrough of a workshop in which students, instructional designers, and industry experts jointly create educational MR scenarios that introduce different careers to college students. By intertwining user-centered content design, empathy-driven methods, and automated content-generation mechanisms, Imagined Arcade aims to expand adoption and adaptation of XR experiences across diverse educational contexts.

2 Related Work

2.1 XR in Education: Barriers and Opportunities

Mixed Reality (MR) have attracted growing interests for their potential to create immersive, highly interactive learning experiences that can improve students' engagement and motivation in education [2][4]. Empirical studies show that integrating XR into curricula can enrich students' understanding by situating abstract concepts in visually compelling virtual environments, or by offering authentic simulations for skill practice [1]. Despite these benefits, adoption remains limited due to barriers such as hardware costs, institutional infrastructure, and the need for specialized technical skills [2][3]. Educators often cite the lack of scalable, low-cost tools and the difficulty of aligning MR lessons with established learning objectives as major hurdles [5][7].

Addressing these challenges requires both improved usability and clearer pedagogical integration. Although some "low-code" XR prototyping tools allow educators to assemble interactive scenes or integrate multimedia with minimal coding [3][6], teachers still struggle to design lessons that align seamlessly with curricular standards. Moreover, professional development and administrative support are critical for sustaining XR initiatives beyond small pilot programs [5]. Researchers have also shown that embedding game-like elements—such as points, levels, or time constraints—can keep students more motivated and focused on learning objectives [8][25]. Consequently, frameworks like OXREF (Open XR for Education Framework) aim to guide educators in producing content that balances immersive activities with clear instructional outcomes [2]. The interplay between pedagogical alignment, affordability, and authoring complexity remains an ongoing focal point for widespread XR adoption in educational settings.

Meanwhile, studies indicate that well-designed XR experiences can significantly improve learning effectiveness through interactive content and problem-based simulations [1]. Yet to scale effectively, XR must present educators with ready-to-use templates and resources that tie directly to pedagogical goals. By reducing technical barriers, offering training, and ensuring that immersive content maps onto real-world skills or standards, XR can move from being an experimental novelty to a mainstream element of the educational landscape [5][4]. This paper addresses those goals through a system that blends card-based curriculum alignment with AI-driven content creation, and gamified XR templates providing accessible tools for teachers and learners.

2.2 Generative AI for Early-Stage Design and Co-Design

In parallel with the evolution of XR tools, researchers are increasingly exploring how generative AI can support the conceptual and prototyping phases of design. Studies demonstrate that AI can broaden creative exploration by producing a variety of ideas, sketches, or story scenarios in response to natural language prompts [9][10][11]. Designers have reported that such AI input can help them overcome creative blocks and think beyond their initial assumptions, leading to more diverse concepts [10][14]. However, researchers also caution against blindly adopting AI outputs: to yield meaningful results, human oversight is essential for refining prompts, evaluating bias, and ensuring alignment with design context [13].

When integrated thoughtfully, generative AI can act as a co-creative partner that complements human intuition and domain expertise [16][17]. For example, AI-generated mood boards or narrative snippets can jumpstart discussion within design teams, prompting them to expand or critique initial ideas. In workshops, participants who used AI-augmented brainstorming generated a wider range of possibilities compared to those relying solely on human ideation [9]. Additionally, using AI to produce quick visual assets (e.g., background scenes, character sketches) can streamline prototyping in XR or game design, reducing the time and technical barriers typically required to create such content [23]. Yet, even with these advantages, AI rarely replaces the need for human-driven curation.

Domain experts remain crucial for verifying factual accuracy, adapting outputs to specific use cases, and maintaining ethical standards—thus preserving creative control and responsibility in the design process [11][10].

Recent efforts focus on building workflows and tools that harmonize AI's generative capabilities with human collaboration. For instance, AI-Augmented Brainwriting [11] pairs group brainstorming sessions with an LLM that proposes prompts and ideas, which participants can adopt or reject. Similarly, ID.8 [16] uses an interactive interface to let designers fine-tune AI outputs to match a project's thematic goals. This hybrid approach allows AI to accelerate iteration while respecting the unique insight and context that human designers provide [17]. In educational settings—especially when preparing XR experiences—such methods help teachers and students rapidly prototype immersive narratives and scenes without requiring advanced technical skills. The Imagined Arcade system builds on these developments, positioning generative AI as an enabling force for co-designing gamified MR content aligned with instructional objectives.

3 Imagined Arcade System Components

The Imagined Arcade system integrates generative AI into a MR design workshop through three interlocking components. First, our card-based ideation toolkit augments collaborative brainstorming and ideation with AI co-creators. Second, a series of interactive gamified templates provide a starting point for minigame experiences that participants customize for career-themed scenarios. Third, our web application supports real-time co-design with immersive game type discovery and integration of AI prompts for relevant content generation, and synchronized viewing of content. These components work together: the cards shape the creative thinking, the XR templates jumpstart ideation at the intersection of fun/gamified/educational context, and the web app bridges AI content creation tools and multi-user input. In the following, we detail the technical and conceptual role of each component in enabling AI-integrated collaborative Mixed Reality design.

3.1 Card-based Ideation Toolkit

To align workshop participants on content and context for specific target career scenarios, we introduce a physical-digital AI-integrated ideation toolkit. This consists of four decks of physical cards, including: Engagement, Content Design, Scenario, and Moodboard, each targeting different stages of immersive experience design. Each set of cards is assigned to different groups of participants (college students, instructional designers, industry experts), where they are instructed on how they can collaborate with each other and guided on how to use AI.

Throughout the ideation process, instructional designers and industry experts are responsible for managing the use of AI, and ensuring content relevancy to career topics. Following emerging design principles for generative AI [12] our

toolkit incorporates AI to improve idea fluency, broaden perspectives, provide rich visual inspiration, provide narrative details, and prompt reflection and critiques while ensuring that designers ultimately make creative decisions. We also deliberately differentiate which cards do or do not use AI, aligning with findings that designers often benefit most when AI augments (rather than replaces) their own ideation process [10].

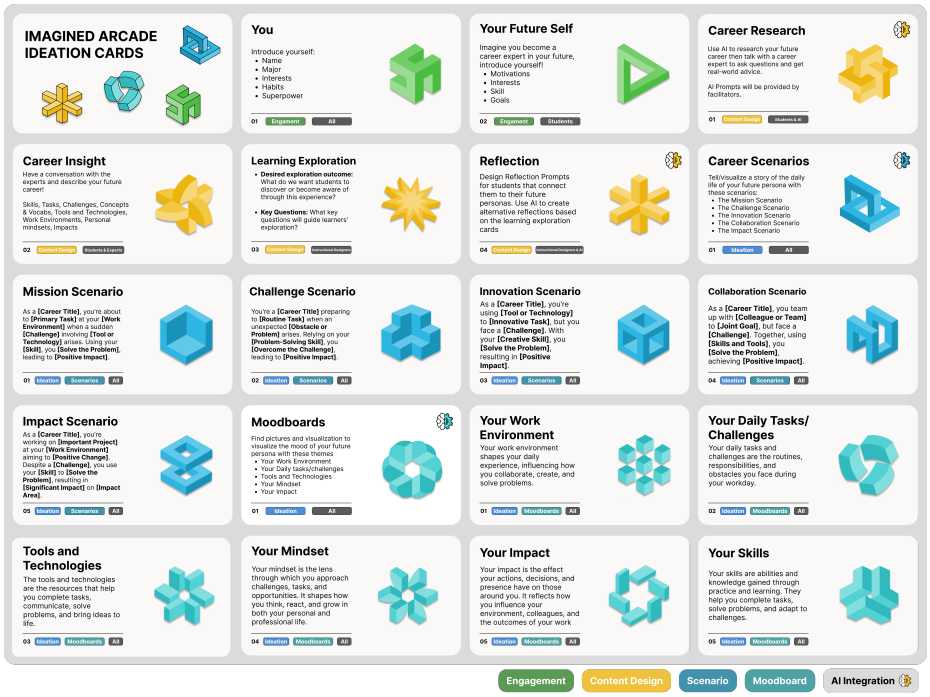

Fig. 1. Imagined Arcade AI-Integrated Ideation Toolkit

Engagement Cards The first deck includes engagement cards, including the You Card and Your Future Self Card. These cards are used to initiate human-human interaction: Participants first introduce themselves and envision a player's future professional identity by having an informal conversation with industry experts present in the workshop. Generative AI is intentionally excluded at this early stage to encourage authentic dialogue, preserve participant agency, and facilitate player empathy. This design choice aligns with recent HCI findings that prematurely introducing AI can disrupt face-to-face interpersonal dynamics [13] and diminish users' sense of ownership over the creative process [14].

Content Design Cards Learners use the Career Research Card to query AI about tasks, tools, and skills of a target career, broadening their knowledge base at high speeds [11]. However, without expert oversight, AI-generated content may lack contextual relevance or accuracy [10]. The Career Insight Card prompts semi-structured interviews with industry experts present at the workshop, who validate and enrich the AI-curated information by sharing up-to-date practices and clarifying role-specific details. This aligns with co-design frameworks that emphasize the need for expert validation to ensure alignment with real-world practices [10].

Instructional designers then use the Learning Exploration Card and Reflection Card to design learning outcomes and deepen student understanding. Learning Exploration Card helps specify the competencies to be addressed, ensuring alignment between AI-generated content and pedagogical goals [12]. Reflection Cards encourage deeper thinking, and can optionally use generative AI to prompt alternative perspectives or scenario-based questions. However, this requires scrutiny to avoid surface-level engagement. Research shows that structured reflection, guided by human facilitators, leads to more meaningful learning outcomes [11]. Together, these cards demonstrate a co-designed process where AI contributes to expand the range of ideas, while instructional designers guide the process to ensure depth, relevance, and alignment with learning objectives.

Scenario Cards Participants are asked to translate the content from the Future self and Career Insight Cards into concrete story scenarios using the Career Scenario Cards. These cards incorporate Mad Lib-style format to guide narrative development [15]. Each team selects three out of five predefined scenarios: Mission, Challenge, Innovation, Collaboration, and Impact. Participants fill in the blanks with the guidance of industry experts and instructional designers. These prompts cover skills, tasks, positive impacts, and other essential details around each scenario. Throughout this process, generative AI is employed to suggest or elaborate upon story ideas, effectively using AI as co-writer to help teams add depth and detail to their scenarios [16]. Building on prior research indicating that large language models can expand creative possibilities during early-stage ideation [11], our system ensures that even participants with limited writing experience can develop richer narratives by delegating certain creative tasks to the AI. Crucially, the human remains in control and participants can accept, refine, or reject AI-suggested content [17]. Ultimately, the Scenario Cards scaffold participants' narratives while the AI offers inspiration, enabling each team to craft a personalized, career-oriented story arc that reflects real-world insights from their industry mentors.

Moodboard Cards Following the creation of these preliminary stories, teams move on to visual prototyping using the Moodboard Cards. Building upon the thematic elements identified in their Scenario Cards and Career Insight Cards, participants articulate the look and feel of their envisioned scenarios. They might specify, for instance, "a futuristic open office overlooking a city," "collaborative

holographic screens," or "calm blue color scheme" in text prompts provided to a generative text-to-image model. The AI then produces multiple candidate images, which groups review, refine, or regenerate until the visuals align with their narrative's atmosphere. By integrating AI-driven image suggestions, our system reduces the need for manual illustration or extensive stock-image searches, enabling participants, regardless of artistic background to rapidly capture the aesthetic essence of their scenarios [17]. This approach echoes findings that AI-generated images can spark fresh ideas and lower the skill barrier for non-designers [23].

3.2 Mixed Reality Game Paradigm Templates

Building on the narrative and visual concepts established through the Scenario and Moodboard Cards, Imagined Arcade integrates five gamified XR templates such as Whack-a-Mole, Tower Defense, Memory Matching, Dodging Game, and Interactive Quiz to transform participants' ideas into interactive prototypes. Each template is grounded in a distinct game paradigms with targeted learning objectives and offers customizable options via the web app for text, visuals, 3D assets, and interactive mechanics. By blending the AI-driven content creation with these XR templates, learners can engage with content that is both relevant to their career scenarios and motivating to play, reflecting research indicating that goal-oriented, game-based activities can improve engagement and retention in educational settings [25].

The Game Paradigm Templates The five templates have built on a variety of career-oriented learning objectives. Whack-a-Mole, for instance, the quick-fire nature of whacking pop-up challenges can evoke real-life urgencies such as reacting to cybersecurity threats or medical triage situations, reinforcing rapid recognition skills and immediate feedback loops [18]. Meanwhile, Tower Defense allows teams to explore strategic planning by placing customized "towers" as analogs to problem-solving tools (e.g., software patches or physical safety measures), fostering systemic thinking and the resource allocation demands seen in professional fields [19]. In Memory Matching, learners reinforce conceptual understanding by pairing challenges with solutions, tasks with required skills, or domain-specific vocabulary with definitions, thereby enhancing associative memory in a playful format [22]. The Dodging Game emphasizes spatial reflexes, asking players to avoid obstacles that represent workplace hazards, while collecting skill-boosting power-ups, aligning with prior findings that reflex-based or movement-focused games can sharpen attention and visual processing [20]. Finally, the Quiz Show transforms knowledge checks into a lively, game-like experience where participants race against the clock to answer scenario-themed questions, leveraging the competitive or cooperative elements of quiz platforms shown to improve classroom dynamics [21].

To illustrate template customization through our web App AI-generated content, consider a cybersecurity career path workshop that selects the Whack-a-Mole template to emphasize the fast-paced and reactive nature of online threat

detection. In this adaptation, the "moles" represent different cybersecurity threats such as phishing emails, malware downloads, and network intrusions—that "pop up" unpredictably within a virtual environment. Participants replace the default game mallet with a symbolic "security toolkit" (e.g., an AI-generated digital shield) and customize background textures to match the futuristic, data-centric look drawn from their earlier moodboard. By combining narrative insights (e.g., the most common cybersecurity challenges) with AI-generated visuals and 3D assets(e.g., stylized representations of viruses or malicious links), the Whack-a-Mole prototype offers a playful, rapid-fire way for participants to grasp fundamental concepts in cybersecurity while immersing themselves in a gamified MR environment.

XR Interaction Design The XR application portion of Imagined Arcade is designed to enhance the learning experience provided by the unplugged portion of the workshop by bringing the ideas created by workshop participants into an immersive space. The XR application consists of a set of customizable templates that have been designed to be fun to interact with while still educating the user. In its current state, the application supports user input to customize various text fields, images, and 3D models within the template. The application leverages Meta Quest's pass-through feature to ensure that the person using the headset still feels comfortable and connected to the rest of their workshop group.

3.3 VR App + Web App for Live Game Prototyping

Participants use a web application to enter the Card data, as well as to create and customize various career-oriented games. Meanwhile, a companion VR app shares a session with the web app to view and play a prototype of the games in real-time as they are edited in the web app. To achieve this, the VR headset and the web application join the same game session and together go through the process of learning, selecting, and finally customizing the different templates before playing the game. We used Google Firebase and its Firestore to provide live update functionality by using document subscriptions; this enables a common game state between the VR game and the web app connected in the same game session.

On the web app, the user's first page displays available game templates, covering their descriptions, learning objective slots, and skill level. After selecting a template, the users can customize the template to insert the learning goals and career paths, derived from the Card data. Their inputs on this page are utilized as prompts for the AI generation of either text, images, or 3D models. After generation, the users are able to preview the AI content on both the web application and VR game. The generated content is either confirmed to be included in the game or regenerated with different prompts if the current content is not desired. After the templates are fully customized, the web app is taken to a viewing page where gameplay from the VR headset is live streamed.

Generative AI Integration The form fields for AI-generated images and 3D models facilitates the generation process. We create a set of manager classes to keep a list of provider objects that conform to specific provider interfaces and delegate tasks to these providers as needed. This system ensures that as the generative AI landscape evolves rapidly, new technologies can be implemented quickly and non-disruptively. Currently, Google's image service is being used for image generation, but it would be trivial to switch to another service such as DALL-E or Midjourney.

The generation of 3D models is currently handled by a service called Tripo [24]. When the template has a 3D model form field, they are first instructed to enter a prompt and a set of images is generated. When sending these images to the generative image service, a suffix is added to the prompt that the user provides, ensuring the images generated are not too complex for the 3D model generation and are placed on a white background to assist the 3D generation in understanding the desired object's shape. Once the user selects an image to use as a starting point, that image is sent to the 3D model generator. 3D model generation takes about 2 minutes, with the status being periodically fetched from the provider and synchronized with the application to assure the user that the generation is happening.

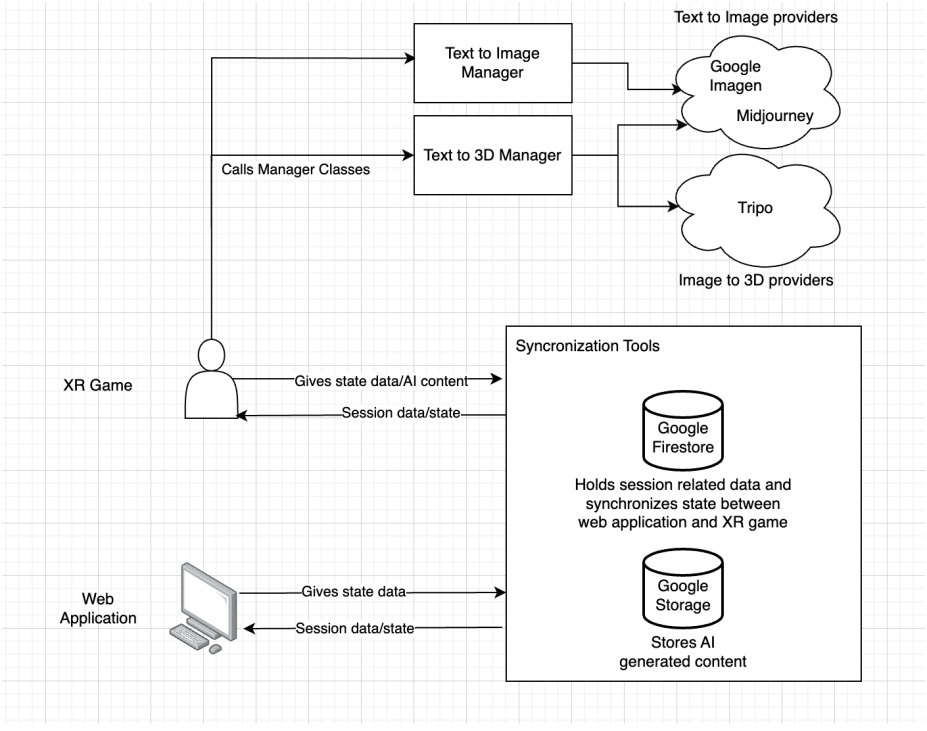

Fig. 2. Imagined Arcade System Components

4 Planned Workshop Flow: AI-Integrated Collaborative XR Design in Action

To implement and assess the toolkit, we are planning to execute multiple workshops, each designed as a multi-phase, collaborative learning experience that blends AI-supported career exploration, immersive design practices, and collaborative storytelling. Drawing from empathetic design, learner-centered instruction, and game-based learning, the experience blends role-playing with real-world career exploration, encouraging students attending the workshop to envision themselves in future professions and talk with industry professionals through active imagination and play. Each workshop highlights the specific career of the industry expert present at the session, offering students the opportunity to engage directly with real world professionals. Student participants gain a broader understanding of the specific career paths and how gamified immersive experiences can be used to represent them. The learning outcome emphasizes empowering those students to use the provided templates to bring their imagined future career personas to life. This is achieved through careful integration of learning objectives by instructional designers combined with storytelling, creativity, and skill development in the context of career exploration. The workshop will include 10 students, one industry expert from corporations with established educational programs, two instructional designers from universities, and two design research facilitators. They will be divided into two small collaborative groups. The facilitators will guide participants through the five interactive blocks including Engagement, Content Design, Ideation, Prototyping, and Feedback. Each block incorporates analog and digital tools, including the Card-based Ideation Toolkit, custom web app with gen-AI integration, and gamified VR templates. Artificial Intelligence (AI) technologies are strategically embedded throughout the experience to enhance ideation, customization, and content generation.

Engagement Block (10 minutes)

- Participants use the You Card to introduce themselves
- The industry expert has an informal conversation with participants, helping them imagine themselves in that expert's role in the future.
- Students use the Your Future Self card to envision their future professional identity (no AI tools used at this stage).

Content Design Block (20 minutes)

- Participants research a target career using AI with the Career Research Card.
- Participants use the Career Insight Card to do a semi-structured interview with the Industry expert present at the workshop for real-world validation and insight.
- Instructional designers define learning goals, using the Learning Exploration Card and plan reflection prompts using Reflection Cards.

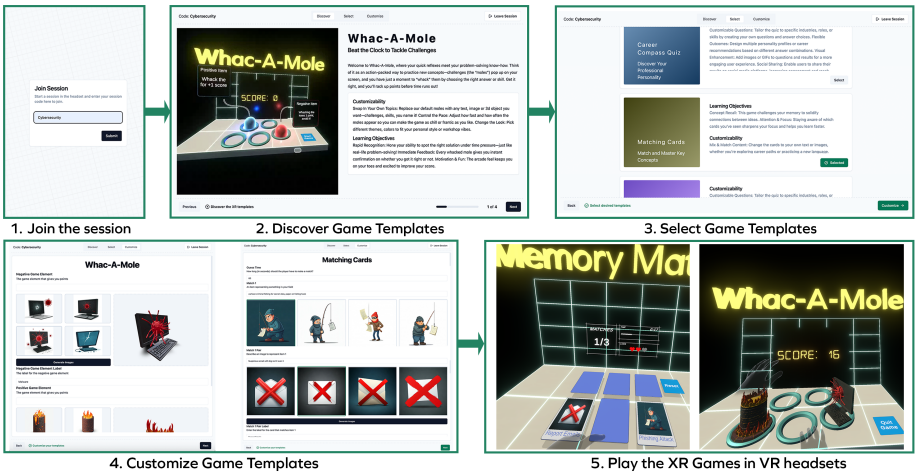

Fig. 3. Overview of the Prototyping Block, illustrating how participants: (1) join a session via the web app, (2) discover the XR game templates (3) Select the XR game templates based on scenbario in this case Memory Matching and Whac-A-Mole (4) customize those templates with AI-generated text and visuals based on Career Scenarios and Moodboard, and (4) ultimately experience the playable MR games in a VR headset.

Ideation Block (30 minutes)

- Teams select 3 out of 5 Scenario Cards (Mission, Challenge, Innovation, Collaboration, Impact).
- They Create stories using MadLib-style templates.
- Participants use AI to generate detailed narrative content.
- They use the Mooodboard Cards to create AI-generated visuals for scenario setting.

Prototyping Block (45 minutes)

- Participants use a custom web app and XR platform to Discover, Select, Customize, and Explore their chosen XR game templates (Whack-a-Mole, Tower Defense, Memory Matching, Dodging Game, Interactive Quiz).
- Through the web app, participants adapt the Games templates by adding customized AI-generated text, imagery, and 3D assets
- All group members collaborate on creating the template: one person wears the VR headset, while others observe the VR session via web-app casting and provide real-time input.
- Participants test and refine the immersive MR experience immediately, adjusting gameplay elements and content based on team feedback.

Feedback Block (15 minutes)

- Groups present their MR experience to industry experts, instructional designers and facilitators to receive feedback.
- Instructional designers use the Reflection Card to guide a debrief discussion, highlighting learning outcomes.

5 Conclusion and Future Direction

Imagined Arcade presents a collaborative approach to immersive career exploration, blending together design methodologies, generative AI, and XR technologies into a cohesive and participatory workshop. By integrating a card-based ideation toolkit, web application, and gamified XR templates with human and AI collaboration, the workshop empowers students, industry experts, and instructional designers to imagine meaningful future scenarios grounded in real-world career insights. Generative AI is used deliberately across the toolkit to amplify idea generation, generate visuals, and accelerate prototyping, while human experts ensure accurate alignment with career insights.

In this future workshop, we aim to run a user study and gather feedback through questionnaires and pre/post assessments to better understand how students interact with the AI-Integrated ideation cards, web application, and XR templates. This study will inform how these interactions shape student learning outcomes and perceptions of career paths, while empowering them to imagine their professional futures. By integrating AI tools, students will gain insight about creating immersive career-focused XR content, and how AI generated content creation for XR can open up new possibilities for storytelling, interactivity, and learning in virtual spaces. This feedback will help streamline XR prototyping, focusing on how to make customization of immersive content faster and more intuitive through AI prompt engineering and template improvements.

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