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Work-in-Progress—Career XRcade Framework: Student-Driven Collaborative Platform for Immersive Career Exploration, Insights from Stakeholders

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Abstract. The Career XRcade (CXR) Framework is our platform for college students to create educational immersive learning experiences that prepare high school students to virtually explore diverse career paths and job environments. Applying Design Science Research Methodology, we use the framework in developing two virtual worlds: Cybersecurity Land and Esports Land visualizing five career paths within Cybersecurity and Esports industries. This work-in-progress paper presents the CXR framework consisting of project roadmapping, engagement of industry experts, integration of curriculum and learning objectives, collaborative XR design and development, and feedback loop and iteration. To understand the collaborative application of our framework, we conducted user studies with three groups of stakeholders engaged in the development of our case studies: student developers, instructional designers, and industry professionals. These qualitative data and insights assist in evaluating the framework's influence in enhancing developers' career identity, self-efficacy, and collaboration. The insights motivate the implementation of collaborative frameworks for developing educational XR material in academic settings.

Keywords: Immersive Learning Experience, Extended Reality, Collaborative Framework, Career Exploration, Self-Efficacy.

1 Introduction

In an era where technological advancement redefines the boundaries of education and career paths, there is a critical need to bridge the gap between traditional educational methods and the dynamic requirements of fast-growing industries. The integration of immersive learning experiences, through extended reality (XR), offers new approaches to career exploration and skill development. Immersive learning experiences that are grounded in their educational approach can provide a sense of presence to learners and allow them to become fully engaged and immersed in a virtual environment [1]. These experiences incorporate gamification approaches by adding game elements, game thinking, and game mechanics to learning [2] that foster active engagement and sustained interest among students [3]. This approach encourages exploration and discovery and enhances student self-efficacy, pivotal in navigating career paths and career identity [4]. Self-efficacy refers to one's confidence in one's ability to achieve specific levels of performance and the influence over events that affect one's life [5]. These experiences can make students exhibit greater motivation, achieve higher levels of accomplishment, and develop a deeper intrinsic interest which can lead to developing career identities [6].

Despite the potential use of immersive learning experiences for career exploration, the creation of XR applications often presents significant challenges: high development costs, complex technical demands, and issues of scalability regarding the efficiency and accessibility of XR design and development processes due to the lack of supportive design tools [7]. These limit adoption in educational settings. In this study, we present the Career XRcade (CXR) Framework to explore collaborative patterns for efficiently creating immersive experiences around career exploration. The CXR framework serves as a collaborative platform for college students to create educational XR experiences that assist high school students in exploring diverse career paths. These experiences

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enable high school students to navigate and explore a variety of career paths through interactive exhibits. Students can thereby gain insights into the real-world requirements and environments of various jobs.

The CXR framework provides student designers with collaborative design and development templates and toolkits that streamline the design and development of educational XR experiences for career exploration. The framework is rooted in participatory and co-creative design methods, cross-functional collaboration with subject matter experts, immersive platforming for student engagement, and student-led design for scalable development [8]. To ensure the comprehensiveness of the framework for designing educational XR experiences, we draw upon established methodologies and research in XR. Co-creative and participatory design approaches actively involve subject matter experts throughout the creation process, ensuring user-centered solutions [9]. Agile development methodologies promote rapid iteration and responsiveness to feedback, which is especially crucial in the evolving landscape of XR technologies [10]. Ideation and design thinking workshops stimulate innovation and problem-solving [11]. User experience (UX) design principles, including the double diamond framework and object-oriented UX, form the backbone of XR development [12]. Prototyping, user journeys, wireframing, and mockups–while familiar in digital product design–require adaptations tailored to the immersive, interactive, and 3D nature of XR [13]. Different types of XR prototypes evolve through projects, balancing fidelity and practicality while facing challenges and addressing limitations [7]. Finally, instructional design principles must be embedded throughout XR development to align the experiences with pedagogical goals and learning outcomes [14]. Our Career XRcade framework builds upon these established methodologies while emphasizing student-driven collaboration to address the challenges of scalability in immersive learning experience creation.

We apply the framework to a set of case studies, designing Career Lands that can be experienced in VR and Desktop with interactive gamified career exhibits that showcase specific career paths in the fast-growing industries of Cybersecurity and Esports. To investigate the collaborative potential of the CXR framework, these studies gather data from student developers, instructional designers, and industry professionals involved in the process. This qualitative analysis sheds light on the collaborative dynamics, design challenges, and educational impacts associated with implementing the CXR Framework.

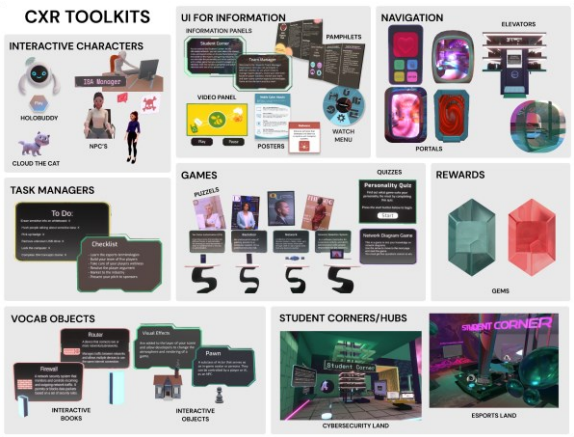

Fig. 1. CXR Immersive Learning Evolving Prototyping Toolkits.

2 Research Methods

This study employs Design Science Research Methodology (DSRM), particularly suited for research in the creation and evaluation of IT artifacts [15]. Considering DSRM, we identified a significant gap between the current educational curriculum and the dynamic demands of career paths. We also considered the challenges of high cost, complexity, and design process scalability issues in standard XR development. Our solution, the CXR Framework, introduces a scalable and collaborative approach to developing immersive learning experiences, demonstrated through the development of two virtual worlds: Cybersecurity Land and Esports Land. Fostering participatory design, these case studies have been developed in collaboration with 15-20 student developers (undergraduates and graduate students), 3 high school teachers, 3 instructional designers, and 2 industry professionals. Meetings, design sessions and workshops, demos, and focus groups were utilized, emphasizing inclusivity and alignment with educational curriculum and industry demands [16].

The framework's effectiveness was evaluated through feedback loops, surveys, and interviews with stakeholders, undergoing continuous refinement [17]. This study is focused on 13 student developers and 3 subject

matter experts including 2 instructional designers and 1 industry professional feedback. We surveyed student developers with a Likert scale survey with open-ended questions. We conducted interviews with 2 university instructional designers and 1 industry professional. The survey and interview questions were inspired and adapted from "The STEM career interest survey" [18] and structured around the framework's impact on developer identity, self-efficacy, collaboration, and the perceived effectiveness of CXR design toolkits. This will be discussed in the Discussion section in more detail.

2.1 Case Studies Design and Development

Our use of the Career XRcade framework produced Cybersecurity Land and Esports Land, each hosting five interactive Career Exhibits that can be experienced through Desktop and VR headsets. These Career Lands incorporate elements of gamification strategies: roleplaying, problem-solving, virtual assistants, reward systems, and gamified assessments to ensure student engagement. These experiences have been created through a multidisciplinary team of student developers providing a platform for students and subject matter experts to collaborate. The framework provided students with accessible design templates, prototyping toolkits (see Fig. 1), ideation, and UX workshops to assist students in development and provoke creativity and imagination. These design toolkits have been developed and improved throughout the process.

Fig. 2. Career Exhibits: Game Designer (Top Left) and Team Manager (Top Right) in Esports Land. ISA Analyst (Bottom Left) and SOC Analyst (Bottom Right) in Cybersecurity Land.

2.2 Case Studies: Cybersecurity Land and Esports Land

Our first case study, Cybersecurity Land, was designed around a cybersecurity online curriculum by instructional designers and developed through a collaboration between student developers and our industry stakeholders. This virtual world is an exploratory environment, comprising a central hub that leads to 5 career exhibits: Information Security Analyst, Security Operation Analyst, Blue Team Analyst, Red Team Analyst, and Mobile Architect (see Fig. 2). The hub is a general information center for these career paths, featuring interactive elements and gamified experiences. The five career exhibits contain mini-games, interactive vocabulary activities, gamified puzzles, quizzes, informational panels, interviews, and fun gizmos. These career exhibits translate different cybersecurity learning objectives, such as security threats, password security, spoofing concepts, Pentesting, Firewalls, Honeypots, etc. into interactive experiences. Users navigate these career exhibits with the guidance of an educational virtual assistant called Holobuddy (see Fig. 1).

The initial phase established project goals, objectives, and roadmaps utilizing the CXR design templates as a blueprint for collaborative efforts. Two 1-hour meetings aligned student developers and industry professionals to discuss project strategies and secure project sponsorship from the industry. 26 Persona and 40 user story documents were crafted to represent diverse user groups and their expectations. Two student-led ideation workshops with instructional designers, each 1.5 hours, were conducted using the Career XRcade Collaborative Ideation template in Miro, enabling idea sharing around the curriculum.

In the subsequent phase, student developers engaged in weekly meetings, ideation workshops, and design sessions to start designing and developing the immersive experience. This involved in-depth research of career paths, creating user journey flows, ideation, designing wireframes, developing mockups, prototyping, building, and testing for VR and Desktop inside the Unity game engine, inspired by previous literature [2, 7, 12, 13]. We also considered user engagement, motivation, and immersion in achieving learning outcomes [14]. Throughout weekly and biweekly meetings, in-person demos involving industry professionals and student developers, the

Career XRcade Framework iterative approach ensured continuous improvement to align with educational and industry standards, highlighting the synergy between research, creativity, and technical execution.

The design of Esports Land is built upon the previous case study to enhance the framework and its application. Esports Land is structured around a central hub, leading to five career exhibits: Game Designer, Game Developer, Team Manager, Esports Marketer, and Content Creator (see Fig. 2). These career exhibits translate different Esports learning objectives, including level design, introduction to game engines, Esports marketing, Esports event planning, etc. into gamified experiences. Utilizing strategy, role-playing, and adventure gamification strategies, these exhibits offer engaging visualization of career paths. Notable enhancements include the evolution of the Holobuddy into an interactive NPC, a Gem and Collectable system to track user progress and a virtual Smartwatch Menu. The design and development process introduced improved templates and toolkits, making the framework more accessible and user-friendly for student developers, while aligning with industry needs.

3 Career XRcade Proposed Framework

The proposed framework, based on the provided case studies, outlines a comprehensive, collaborative, and iterative process for developing immersive learning experiences for career exploration. The CXR Collaborative Framework streamlines student-led design sessions, accessible design templates/toolkits for immersive learning experience development, gamification strategies, curricular relevance, iterative expectations, and feedback loops. The framework consists of (i) project road mapping, (ii) engagement of industry experts, (iii) integration of curriculum and learning objectives, (iv) collaborative XR design and development, and (vi) feedback loop and iteration. These processes include relevance cycles and design cycles that target continuous improvement and alignment with industry needs, towards an effective learning experience for students (see Fig. 3).

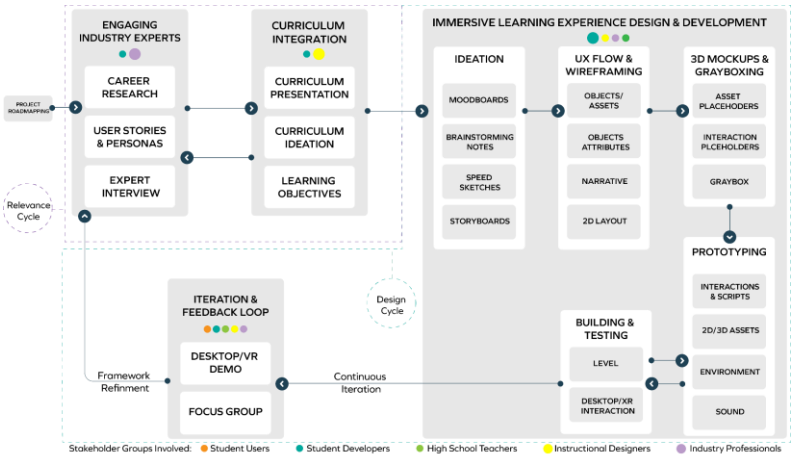

Fig. 3. Career XRcade Framework.

The initial phase included project road mapping which set the foundation by encompassing strategic planning, objectives/goals, stakeholder identification, and industry partnership/resourcing. This phase involved forming student teams and hosting strategy meetings with industry professionals to outline project aspirations and timelines. Throughout this phase, CXR toolkits helped facilitate collaboration planning and documentation.

Engagement between industry experts and student developers aligns the project with real-world industry demands and expectations. Practical insights and expertise from the field ensure that the immersive learning experiences are relevant and valuable for students aspiring to enter the industry. To this end, the CXR template includes user story and persona boards in Figma and career subject matter interview templates.

Curricular Integration with learning objectives weaves learning objectives into the fabric of the experiences. Student developers work alongside instructional designers in ideation sessions and throughout the development in weekly meetings to ensure pedagogical soundness. This integration is facilitated by CXR template tools, such as curriculum ideation and mapping in Miro and curriculum summary documentation.

Immersive Learning Experience Design and Development goes through ideation workshops, user journey and user experience flow workshops, wireframing, 3D mockups and grayboxing, prototyping, and building inside the Unity game engine. In each step, developers used CXR design templates and toolkits to facilitate collaboration, creation, and development. Ideation workshops use a Miro CXR template to share mindmaps, mood boards, speed sketches and storyboards around the gamification of career paths with minigames and interactive activities. A

User Journey Flow workshop and its Miro template help to understand user interaction points, behaviors, and flow. These ideas transitioned from abstract concepts to a concrete visual representation in the CXR Wireframe template in Figma, which finalizes the floorplans of each Exhibit and specifies narrative and user interactions. Then the team creates 3D mockup prototypes for early testing and iteration. Our framework's Unity prototyping Toolkit includes reusable assets, games, and interaction such as UI for career information, interactive characters, minigames/quizzes/puzzles, navigational elevators and portals, Gem/Collectable reward systems, VR watch Menu, and more (see Fig. 1).

Iteration and feedback loops ensure continuous improvement and alignment with educational and industry standards. This phase involves gathering and acting on feedback from a wide range of stakeholders, including student developers, student users, teachers, instructional designers, and industry professionals. Through in-person VR demos with usability surveys, pilot studies, and monthly meetings, the project team collects valuable insights that inform refinements and enhancements to the immersive experiences.

4 Discussion

We explored how the Career XRcade Framework aided groups of stakeholders to collaborate effectively in the creation of the two immersive learning experiences. We surveyed 13 student developers with a Likert scale survey with open-ended questions. We conducted interviews with 2 university instructional designers and 1 industry professional. Through qualitative analysis, we measured four impacts of the Framework: developer identity, self-efficacy, collaboration, and the perceived effectiveness of CXR design toolkits (see Fig. 4).

To explore the impact of CXR on developer/designer identities, we conducted Likert-scale student developer surveys (see Fig. 4). Survey data revealed an average Likert scale of 4.25, illustrating a positive impact on student perception and exploration of their own developer/designer career paths. One developer mentioned, "CXR has opened my eyes and doors in my brain for thinking about different career paths and made me think about my future career in sound design." Another stated, "The project profoundly impacted my career identity, allowing me to explore various professions and understand where my passions and skills align."

Our observations of student developer self-efficacy emerged through the impact on students' confidence levels, skill development, and strategies for overcoming obstacles within the development of a career-focused XR experience. Survey data revealed an average Likert scale of 4.05, demonstrating increased self-efficacy among student developers, post-involvement with CXR. While CXR did not transform the developers to visualize themselves as career experts - with 53.8% noting neutral influence in this - the process did encourage creativity, skill development, and engagement with industry experts. Testimonies from student developers support the valuable experiences gained from skill development, with one mentioning: "Working on the Career XRcade project has provided me with an enhanced opportunity to build skills in the fields I enjoy." This was echoed by another developer: "Learning a new programming language and technology helped me feel confident about learning new skills." Furthermore, instructional designers highlighted that CXR enables students to develop skills in these different career paths, while also learning how to apply them to real-world situations. One instructional designer noted: "It provides students with not only insights into these specific fields but also valuable, transferable skills. This goes beyond a mere understanding of the careers themselves; it encourages students to identify their skill sets and recognize how these skills can be applied to a wide range of professions."

The multi-generational nature of CXR collaboration involves high school students, university students, and professionals. The use of collaborative design methods facilitates iterative development and responsiveness to feedback, nurturing students' immersive design and development skills and career exploration. Survey data revealed an average Likert scale of 4.19, signifying a strong consensus among student developers regarding the effectiveness of creating a meaningful collaborative approach. During interviews, an industry professional stated: "Collaboration has been the driving force behind its success. The ability to tap into the collective intelligence and creativity of the team has led to innovation and a well-rounded project." This is affirmed by a student developer: "The collaborative processes were very helpful since they fostered a dynamic environment where ideas could be shared and workshopped." Another student developer mentioned, "I got to understand the thinking process of my teammates and also learn from them during these processes."

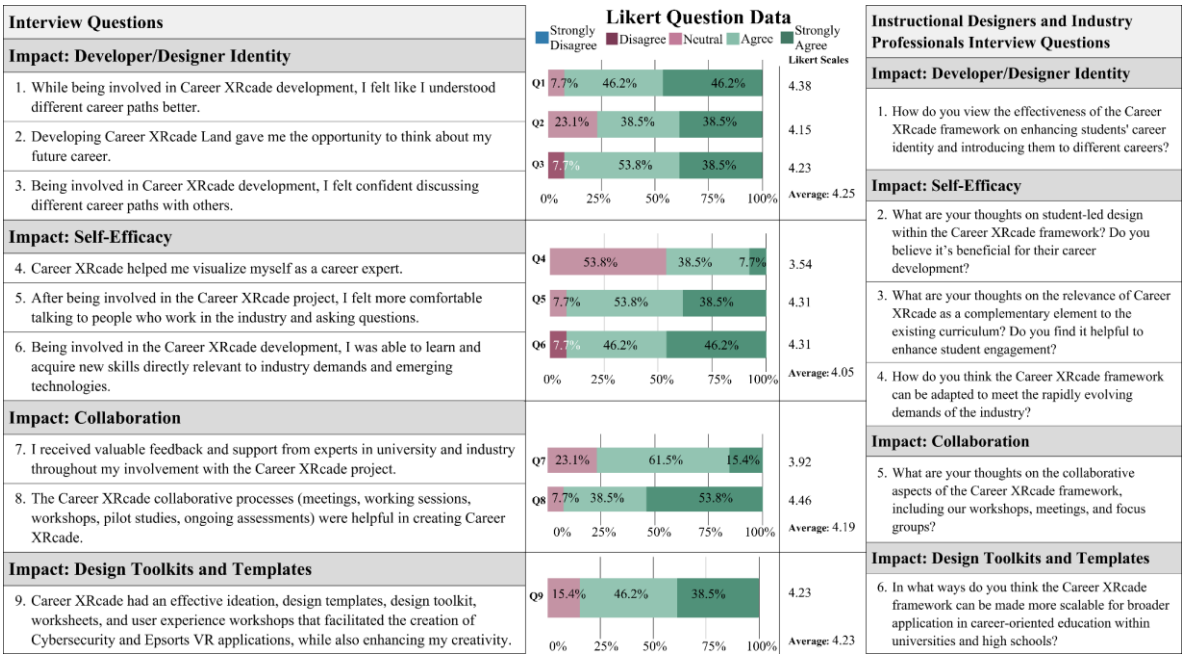

Fig. 4. Student Developer Survey and Subject Matter Experts Interview Questions for CXR Framework Use (Likert Scale).

The Career XRcade Framework provided students with comprehensive and accessible ideation and design toolkits and templates for creating XR experiences. These supported the needs of stakeholders involved in creating career-oriented immersive experiences. The survey data revealed an average Likert scale of 4.23, demonstrating the effectiveness and usability of the CXR Toolkits and Templates in providing accessible resources and support for student developers of varying levels of expertise. Testimonials highlighted the impactful nature of these toolkits, with one student developer noting toolkits: "helped provide a structured approach to maximize my creative thinking and brainstorming process, and helped maintain consistent documentation..." While another mentioned: "Using a step-by-step method helps us turn our ideas into real games." Stakeholders found that the CXR Framework enhanced engagement efficiently for students by integrating gamified strategies into the CXR Design Toolkits. An instructional designer observed: "It will, and it did enhance student engagement since students can take any approach that they want to, but they're all going to walk away having learned something and have fun along the way."

To gauge the effectiveness of the CXR learning environments, our future work entails a plan to study the influence of CXR exploration on the career identity of high school users. However, our discussions with instructional designers lend confidence to such potential impact. One instructional designer remarked, "The immersive learning environment is likely to capture students' attention, leading to longer engagement and higher retention of information. The uniqueness of the framework allows students to explore careers in a novel way, moving beyond traditional research methods." Another mentioned, "Career XRcade was created in a way that kept students in mind, especially, again, in their age group, where they are developmentally, and how they could actually use that information to possibly decide a future career for themselves that they did not picture themselves doing before."

5 Conclusion and Future Work

The Career XRcade Framework presents a student-driven collaborative platform for immersive career exploration. We have explored the collaborative use of the framework through the development of Cybersecurity Land and Esports Land, which are virtual environments that facilitate interactive career learning experiences. The iterative process of design, development, and evaluation, guided by DSRM, has been fundamental to the framework's development. By incorporating feedback loops and stakeholder collaboration, the framework ensures continuous improvement and alignment with educational standards and industry needs. Career XRcade Framework's positive impact on student developers highlights the framework's potential to nurture future XR creators while simultaneously providing high school students with career exploration opportunities. However, there are potential barriers to wider adoption of the framework, such as resource requirements (for VR headsets) and the need for educator training in high schools. As we plan to continue building and testing, the future work involves expanding

user studies to consider high schoolers' use of our case studies and refine the framework based on the effectiveness of our case studies in classrooms. The open release of CXR Templates and the conduct of prototyping workshops will aim to inspire further adoption and innovation within various educational and professional development contexts.

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