Designing a Vocational Immersive Storytelling Training and Support System to Evaluate Impact on Working and Episodic Memory

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ABSTRACT

Working memory and episodic memory are mainly responsible for the storage and recollection of information, whereas Storytelling is the most ancient and effective way of relaying this information to the user. We have designed an interactive and immersive storytelling system using Augmented Reality to improve episodic and working memory. This paper presents an overview of the tasks we used to improve these 2 sections of memory and also presents a study design on how we plan to evaluate our system to prove its effectiveness in comparison to desktop 2D-based training.

CCS CONCEPTS

• **Human-centered computing** → **Mixed / augmented reality**.

KEYWORDS

Augmented Reality; Vocational Training

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1 INTRODUCTION

The research questions explored are (1) whether immersive technologies such as Augmented Reality provide a better environment for training and learning than traditional desktop-based 2D environments? and (2) How do interactive training in an immersive environment impact working and episodic memory? This research aims to contribute knowledge across the following four major objectives (1) Facilitating convergent research that employs the joint perspectives, methods, and knowledge of computer science, engineering, learning sciences, arts, storytelling, research on education, and workforce training, and social, behavioral, and economic sciences; (2) Encouraging the development of immersive interactive technologies inspired by their positive impact on individual workers, the way people learn and adapt to creative and supportive workplaces training systems. This research will advance our understanding of how we can leverage the ancient art of storytelling and combine it with technology in order to augment vocational performance in a natural and intuitive way.

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2 BACKGROUND AND RELATED WORK

Learning a new skill and memory are closely related and immersive environments are proving better training system [2]. Learning is the acquisition of knowledge, skill, or ability while memory is the expression of what is acquired [8]. In any workplace, there are two types of tasks: repetitive (non-sequential) and sequential that follow a particular order. Working memory and episodic memory are used to perform these tasks respectively. **Working Memory**: The multi-component approach to working memory which includes, phonological loop, central executive, and episodic buffers tries to understand how the task information is stored and maintained in the performance of complex cognitive processing [1]. It is also known as short-term memory. The information while doing a repetitive task is stored in the working memory [6] In our study, we use object sorting tasks for working memory. **Episodic Memory**:Episodic memory is built of story components. Therefore procedural tasks work best for it. Any task that is continuous in nature enhances the role of episodic memory. It is also known as long-term memory. Episodic memory creates a representation of events where the information is linked to its details. Storytelling enhances this experience for the user [4] The richness of the representation is useful to retrieve episodes of the events. Contextual details can serve as cues to help to remember the information [5]. In our study, we use picture sequence tasks for episodic memory.

3 SYSTEM DESIGN

3.1 Task selection

The task selection was based on the use cases of the project. A use case is a detailed scenario of how users will engage with the system. It outlines the training system's behavior, specifications, details, and benefits along with how will the system respond to the user's input. The goal of the study is to examine whether the training in an Augmented Reality environment outperforms web-based desktop training interface to train the user how to work at the factory by improving their episodic and working memory. For this, we have designed two tasks – picture sequence and object sorting. These tasks are inspired from NIH Toolkit [7]

Task 1: The first task is to train the user how to work at a toy factory. We are using the Picture sequence task. The user will be shown a sequence of tasks as pictures- how to assemble toys, how to use a machine, and how to make toys and then they would be asked to repeat the steps correctly. This is an episodic memory task. This task is based on the use case of 'Teaching a new Skill' [3].

Task 2: The second task is to train the user how to sort toys in size order in a toy factory. We are using the Object Sorting task. The user will be asked to sort 6 objects in size order in increasing order. This is a working memory task. This task is based on the use case of 'Adaptive task to support user'.

3.2 Evaluation

In order to examine whether the immersive platform is better than existing desktop-based training systems, we decided to design four unique training systems, keeping the tasks and the storyline the same. Figure 1 shows four systems, A and B are desktop-based systems; C and D are AR systems. Picture sequence task and object sorting task examples are also shown.

Story Plot: The user wants a job. Friend Lily (girl in red) takes the user to Mr. Roy (boy wearing cap), the factory manager (Figure 1). Mr. Roy is worried about a serious production problem and offers a trainee position to the user. Lily trains the user in two types of factory tasks - Toy assembly (Picture Sequence - Episodic Memory task), Toy packaging(Object Sorting - Working Memory task).

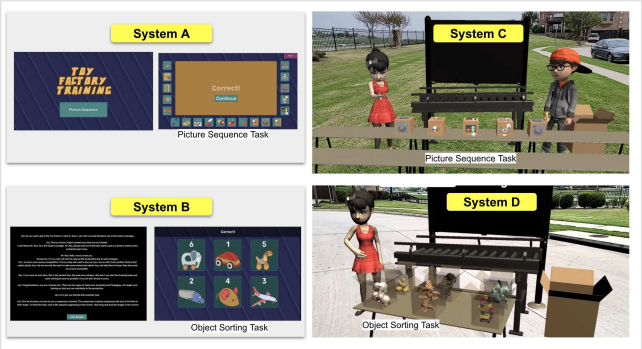

Figure 1: System Design for Evaluation

2D Generic System (A): The first system is a web browser desktop-based that can be played on the computer. The user will practice both the tasks in no specific order. After the practice session, the user will give a test. The test will be the same two tasks but no feedback or support would be given from the system.

2D Storytelling System (B): The second system is a web-browser desktop-based game that can be played on the computer. The user would be shown a story where they will be walked through a scenario. The scenario is that the user is a factory trainee and they need to start training. The user will practice the picture sequence task and then the object sorting task. After the practice session, the user will give a test. The test will be the same two tasks but no feedback or support would be given from the system.

AR Storytelling System (C): The third system is Augmented Reality mobile app which can be played on the user's personal mobile phone. The user will download the app and begin the user study. The user would be shown an immersive story with sound and 3D objects in their space where they will be walked through a scenario. The scenario is that the user is a factory trainee, and they need to start training. The user will practice the picture sequence task and then the object sorting task. After the practice session, the user will give a test. The test will be the same two tasks, but no feedback or support would be given from the system.

AR Adaptive Storytelling System (D): The fourth system is an Augmented Reality mobile app that can be played on the user's personal mobile phone. System D is exactly similar to System C. The only difference between System C and D is that system D is adaptive and helps the user to perform better.

Data Collection: For each of the above study groups, we will collect the following data: 1. Time taken to complete each task 2. Time taken to complete the game 3. User's score for each level in the game 4. How many tasks the user completed successfully at each level 5. Time spent on each level of the game 6. Survey data

Duration: Each participant will participate in one of the four groups described above and participate in two sessions. The second session will be conducted one week after the first session.

4 OUTLOOK

In order to evaluate the impacts of vocation immersive storytelling training system on episodic memory and support system on working memory, we are going to conduct the user study in the future and publish our findings and detailed description of user study design. In case the evaluation reveals a prominent element to focus on, further scenarios, different story lines, and tasks can be tested. We also plan to find the impacts of head-mounted displays for immersive environments on working and episodic memory in the future.

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