

# AN IMMERSIVE VIRTUAL REALITY SYSTEM TO IMPROVE PUBLIC SPEAKING SKILLS

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## **ABSTRACT**

*Public speaking is considered one of the most important skills required for academic, social, and professional success. Typical traditional ways of preparing, such as practicing by yourself or speaking in front of a small group of classmates or friends may not entirely recreate real presentation settings accurately and properly. This paper presents Virtual Stage VR, an immersive virtual reality system created to support people in practicing and improving public speaking skills and abilities in realistically recreated environments. The system includes three main components: a web application, StageNotes, used for creating, editing, and organizing note cards during the presentation, server communication for saving as well as transferring users data, and the main VR application on Unity, that recreates real presentation conditions such as, classrooms, meeting rooms, and lecture halls or auditoriums in school. Although, along the way, several challenges were encountered during the process of development, including if note cards were included in the simulation, how users would be able to edit and organize them, limited environment choices, and communication between the web application and VR system. These challenges were resolved by designing improved and more VR environment options, and including a web application based note card editor and organizer, StageNotes, which by using server communication could transfer and store users' information between StageNotes and the VR simulation. Experiments evaluated whether the simulation increased speaking confidence and whether the note cards system included would help users remember main points during their presentation. Conclusions demonstrated that participants that underwent the experiment encountered increased confidence following rehearsing in the VR setting, as well as improved memory and being able to remember additional key presentation points while utilizing the note card system. These outcomes imply that Virtual Stage VR can serve as an effective, convenient, and accessible tool for strengthening public speaking abilities. Because the program provides users with such a good system to practice and rehearse presentations in realistic circumstances at any time, it gives a beneficial solution for students and professionals who desire to improve their confidence and speaking levels before actually going out, and presenting in public and real-world scenarios.*

## **KEYWORDS**

*VR, Public Speaking, Immersive Simulations, Confidence Building, Realistic*

## **1. INTRODUCTION**

One of the most crucial and important skills needed for academic, social, and professional achievement is public speaking. Students often are required to give presentations in classrooms, professionals present ideas in work meetings, and it's necessary for leaders to address important information to a large audience. Public speaking, even today, is still considered as one of the frequent fears among people, considering the large quantity of public speaking that is needed on a daily basis and its relevance. This fear is commonly known as, glossophobia, and it affects a

significant amount of today's population. According to studies, about 75% of people experience some degree of nervousness while giving a presentation or speech to an audience [1][2][3]. This anxiety can negatively affect an individual's performance, confidence, and communication effectiveness.

A primary reason for anxiety when public speaking is lack of opportunities to practice in realistic settings. Many people prepare for presentations by reading their notes, practicing alone or only with a small group, or even rehearsing in front of a mirror doesn't properly simulate the reality of speaking in front of a bigger audience. While these methods improve memorization and fluency, they do not accurately replicate the pressure and atmosphere of presenting in front of a real, large, audience. As a result, people frequently still feel unprepared and anxious when they face an actual presentation setting.

This problem usually affects students and young professionals who are still developing stronger confidence and communication abilities. In academic settings, students frequently are needed to present projects or research findings in classes in front of classmates. Lack of preparation results in many students experiencing increased stress, nervousness and less confidence and fluency in their work when presenting, which also follows in deduction of points on the assignment/project and more negative side effects. Over time, this anxiety can increase if never fixed and limit their ability to communicate ideas properly and effectively, as well as participating in professional opportunities.

The first method proposed was Virtual Reality Exposure Therapy (VRET), which applied simulated environments to gradually introduce individuals to public speaking situations in order to minimize and decrease anxiety. Even though this method has proven to be utilized effectively in the past for reducing anxiety levels, it mainly emphasizes on exposure, instead of supporting users to organize and prepare thoroughly for their presentation content. Virtual Stage VR improves this method by merging engaging environments with preparatory tools and elements, such as note cards that guide users structure and arrange their presentation properly and nicely.

The second method included AI-based speech analysis programs that analyze recorded speeches and presentations of people and then provide comments on pacing, tone, and clarity of your talking. Although this method is useful in development of speaking skills and techniques, they do not properly simulate realistic presentation settings. Virtual Stage VR advances this method by offering vivid and engaging environments that lets users practice speaking and presenting in realistically replicated real-world situations.

The third approach focused on traditional public speaking courses that provide communication skills and offer practice opportunities to practice as well. While these sessions can improve confidence levels, they usually need teachers and classroom environments at cost. Virtual Stage VR enhances this method as well by enabling users to rehearse and practice independently and regularly in realistic and immersive settings at any time.

This paper proposes Virtual Stage VR, an immersive and engaging virtual reality system designed to help individuals for any cause practice public speaking in realistically simulated environments.

Virtual Stage VR addresses the worldwide problem of public speaking anxiety by providing users with a safe and realistic environment to practice presentations. Rather than rehearsing by yourself or reading from notes repeatedly, users can utilize and access a virtual environment that accurately simulates realistic presentation scenarios such as meeting/conference rooms, lecture halls, or classrooms. Throughout these given immersive environments, individuals can repeatedly practice delivering their presentations while thoroughly experiencing and practicing the actual

feeling of being in front of a real audience. This allows users to better prepare and become more familiar with the experience of public speaking before they actually perform in real life.

One of the main advantages of this system is that its users can repeatedly practice however many times they want at no cost and in a realistic environment as well. Virtual Stage VR is also much more flexible than traditional ways of preparing, such as practicing in the mirror alone or with a small group of family members or friends that do not accurately and fully recreate the pressure of speaking in front of a real audience. Virtual Stage VR can recreate this experience and environment more accurately and effectively by allowing users to view the stage, audience, and surrounding environment while presenting and practicing. This helps individuals gain confidence, reduce anxiety slowly over time, and become more comfortable presenting in front of others.

Section 4 tested two possible weaknesses and downsides of the Virtual Stage VR application. The first experiment evaluated whether practicing in a realistic and immersive virtual reality environment could enhance users' confidence in public speaking. Participants first rated their confidence level on a scale from 1 to 10 prior and following the completion of a practice session in the VR simulation. The conclusions clearly showed that confidence scores improved after going through the simulation. Before the practice, the average confidence level was about 4.5 and afterwards they rose to approximately 7 after the simulation. This implies that practicing in an engaging virtual environment assists users in feeling better prepared and relaxed when presenting.

The second experiment focused more on the usefulness of the note card system implemented in assisting users recall key points during their presentation. During the simulation, participants gave a brief presentation equally with and without a note card. The results demonstrated that participants remembered more key details with the note cards. This likely happened because the note cards provided occasional concise reminders of what to say next and main points to include when talking that assists users to maintain organized and keep the structure of their presentation arranged.

## **2. CHALLENGES**

In order to build the project, a few challenges have been identified as follows.

### **2.1. Separating Note Editing from VR for Better Usability**

A major component of my program is the note card editing feature, which allows users to create and edit small note cards they have in front of them during the virtual presentation simulation. A potential challenge is making sure that users are able to easily and conveniently edit and organize their notes without conflicting with the immersive experience of the VR environment. If simply figuring out how to edit, create, navigate, or organize the note cards is too difficult, users may be distracted while practicing their presentations and not completely focusing on practicing and improving their skills. To resolve this issue, the system could incorporate a completely separate web application which allows users to easily generate, edit, as well as arrange their notecards nicely and conveniently prior to entering the simulation. This lets users prepare their notes in a familiar format while maintaining the virtual presentation environment straightforward, simple, and directly focused on practicing repeatedly.

### **2.2. Balancing Realism and Performance in VR Environments**

The virtual environment and setting surrounding the user while they rehearse their presentation using the application is another essential component of the system. A potential challenge is

creating environments accurate and realistic enough that they authentically simulate actual public speaking scenarios while still maintaining a smooth performance and rehearsal in virtual reality. If the environment has too many intricate, detailed, and complex details and designs, it may cause lag or a reduced performance in the program, which can negatively affect users' experience and opportunity to practice. To address this issue, the program could maximize 3D models and simplified environmental assets that guarantee realism during the experience while not overloading the program and user. Additionally, multiple different types of environments for different scenarios could be included, such as classrooms, auditoriums, or meeting rooms, to enhance users' experiences.

### **2.3. Ensuring Reliable Data Sync Between Web and VR Systems**

Another primary aspect of the program is the communication between the web application, StageNotes, created for the notecards incorporated into users rehearsal, and the VR simulation. A potential challenge is making sure that the information, data, and edits from the notecards can be transferred accurately and smoothly over to the VR simulation. Users may encounter challenges and delays while trying to access their notecards during the immersive experience if there is an unstable or slow connection among the two systems. To address this issue, the system could use a server-based communication system which permits both the web application and VR program to both conveniently and smoothly access the shared data. This approach assures that users information stays synchronized, consistent, and is able to transfer between both across both programs.

## **3. SOLUTION**

The program's three primary components that communicate with each other and cooperate to support the entire Virtual Stage VR platform: a web application, server communication system, and a virtual reality application. These three components work collectively to allow users to practice their presentation materials as well as public speaking in an engaging virtual environment.

The web application role is the primary interface for users to produce and compile their presentation notecards. In this application, users can log into their account, create new sets of notecards, modify existing sets if needed, and organize them in preparation for the presentation. The web application lets users manage their content and material within the different set of notecards utilizing a more familiar display before engaging in the VR simulation. Once the notecards have been created, edited, and or updated, the information is securely saved and stored in a database and transferred over to the VR simulation.

The server communication enables the web application and VR application to exchange and share data/information with one another. The server is responsible for preserving user accounts and notecard data in order for both applications to be accessing the same information. When users open the VR application, the program connects and communicates to the server to get the user's saved notecard sets and account data. This guarantees that the user can smoothly access the information generated in the application within the VR simulation.

Finally, the VR application offers an overall immersive, realistic practice environment where users can practice, rehearse, and simulate public speaking situations thoroughly and repeatedly. Users can select from various different presentation settings such as classrooms, lecture halls, or offices and frequently practice delivering their presentation while viewing their small prepared notecard if needed. By connecting these three components together, the program lets users

preserve, prepare, and view their presentation materials and notes while engaging and rehearsing in a realistic virtual environment.

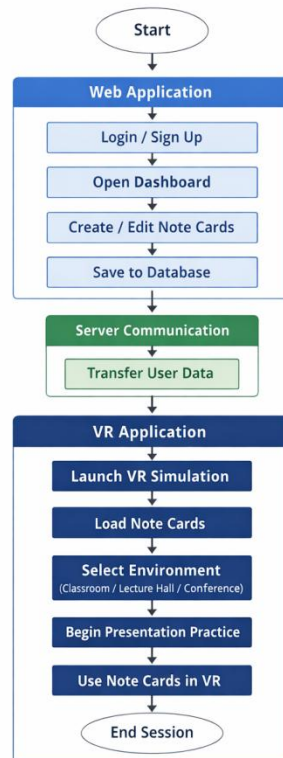


Figure 1. Overview of the solution

The web application, StageNotes, acts as the main interface for users to generate, edit, and sort their presentation notecards. Users can easily and conveniently finish preparing and creating their presentation materials before entering the VR simulation experience. The system relies on user identification and database storage to securely and safely save user's information, data, and notecards for later usage and access in the VR application.

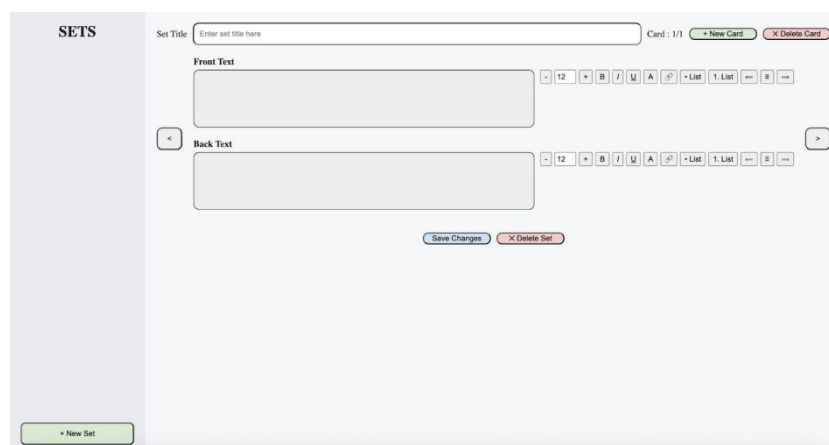


Figure 2. User interface of the VR simulation environment used for public speaking practice

```

2 <html Lang="en">
9 <body>
10 <div class="wrap">
16 <main>
31 <div class="grid">
36 <div class="editor-panel">
37 <div class="field">
38 <div class="label">Front Text</div>
39 <div class="editor-wrap">
40 <div id="front" class="editor" contenteditable="true"></div>
41 <div class="toolbar" id="frontToolbar">
42 <button class="tool" data-cmd="decreaseFontSize"></button>
43 <input type="number" class="font-size-input" value="12" min="5" max="100">
44 <button class="tool" data-cmd="increaseFontSize"></button>
45 <button class="tool" data-cmd="bold">B</button>
46 <button class="tool" data-cmd="italic">I</button>
47 <button class="tool" data-cmd="underline">U</button>
48 <button class="tool" data-cmd="foreColor" data-value="#111111">A</button>
49 <button class="tool" data-cmd="createLink">Link</button>
50 <button class="tool" data-cmd="insertUnorderedList">List</button>
51 <button class="tool" data-cmd="insertOrderedList">L List</button>
52 <button class="tool" data-cmd="justifyLeft"></button>
53 <button class="tool" data-cmd="justifyCenter"></button>
54 <button class="tool" data-cmd="justifyRight"></button>
55 </div>
56 </div>
57 </div>
58 <div class="field">
59 <div class="label">Back Text</div>
60 <div class="editor-wrap">
61 <div id="back" class="editor" contenteditable="true"></div>
62 <div class="toolbar" id="backToolbar">
63 <button class="tool" data-cmd="decreaseFontSize"></button>
64 <input type="number" class="font-size-input" value="12" min="5" max="100">
65 <button class="tool" data-cmd="increaseFontSize"></button>
66 <button class="tool" data-cmd="bold">B</button>
67 <button class="tool" data-cmd="italic">I</button>
68 <button class="tool" data-cmd="underline">U</button>
69 <button class="tool" data-cmd="foreColor" data-value="#111111">A</button>
70 <button class="tool" data-cmd="createLink">Link</button>
71 <button class="tool" data-cmd="insertUnorderedList">List</button>
72 </div>

```

Figure 3. HTML structure of the StageNotes notecard editing interface

This code represents the note card's editing feature on the StageNotes web application. It starts when the user opens the card editing page and chooses a card/set to create or edit. The HTML structure of the front and back editor windows of each individual notecard is highlighted by the screenshot. Each window includes a text field, where the user is able to type the text and information content needed on the note card, plus a toolbar next to it that has tools to edit the format of the text. The code generates a distinct section for entering text into the front and back of the note card making it convenient and clear for users to use. It also provides text formatting tools as in, adjustments of your font size, bolding, italicizing, underlining, text color, list options, linking websites, and indentation choices. With these tools, the user can modify the appearance of the text on their note card to their own liking and choice making the most suitable for them when practicing their presentation. The code utilizes variables, identifiers, and classes to organize and arrange the editor layout accordingly and correspond each button to its specific formatting action. Overall, this section of the whole program lets users prepare efficiently and format their presentation notes to their own desire before saving them to use later in the practice VR simulation.

The VR application is the primary setting where users can practice and rehearse their presentations. It allows users to access virtually simulated locations and environments such as classrooms, lecture halls, or meeting rooms while being able to read their written notecard. This element depends on real-time 3D modeling and VR engagement to provide and offer an accurate and engaging practice experience for public speaking training.



Figure 4. VR public speaking simulation environments

```

public class FlashCardPreview : MonoBehaviour
{
    2 references
    public List<Dictionary<string, string>> flashcards = new List<Dictionary<string, string>>()
    {
        ("front", "What is the capital of France?"),
        ("back", "Paris")
    },
    new Dictionary<string, string>()
    {
        ("front", "What is 2 + 2?"),
        ("back", "4")
    },
    new Dictionary<string, string>()
    {
        ("front", "What is the largest planet in our solar system?"),
        ("back", "Jupiter")
    }
};

2 references
public FlashCard flashCards;
1 reference
public GameObject setList;
1 reference
public GameObject settings;

1 reference
public GameObject previewCardPrefab;

0 references
public void ConfirmFlashCards()
{
    flashCards.cards = flashCards;
    flashCards.ResetCards();

    // hide all panels
    setList.SetActive(false);
    settings.SetActive(false);
}

```

Figure 5. Flashcard preview and loading module in the VR application

This code represents the flashcard preview display and loading system used inside the VR application. It activates when the VR program imports the user's note card systems into the program and edit them so that they are ready to be throughout the presentation simulation. The class displayed in the code manages the list and sets of flashcards and the interface panel that lets

the user pick which specific set of note cards they want to use. The information for the flashcards is saved as a list of dictionaries. Each dictionary has an individual card, which has two primary parts: the “front” text and the “back” text. The structure of this allows the program to run smoothly and allows users and the server to easily access and display each side of the card when necessary. The Flash Card Preview components serve as the UI panel where users can select their created note card sets. Once a set is chosen, the system loads the corresponding note cards selected and gets them ready to use while in the VR simulation so the user can refer to them when needed when rehearsing their presentation.

The server communication component enables the web application component and VR application to transfer user data and information, and notecard sets. This system primarily relies on a database and network connection communication, to preserve and access user’s information conveniently. When the VR application launches, it asks for the user’s retrieved data from the web application so that the presentation content is able to be inputted into the simulation smoothly.

```
cd: string not in pwd: WEB
● catherine@Mac Public-Speaking-Help % cd Web\ Companion\ Se
rver
● catherine@Mac Web Companion Server % ls
FEATURE_GAPS.md      package.json
data                 public
node_modules         server.js
package-lock.json
○ catherine@Mac Web Companion Server % npm start

> web-companion-server@1.0.0 start
> node server.js

Server is running on port 3000
```

Figure 6. Web–VR data synchronization architecture

```

498 }
499
500 app.get('/api/health', (req, res) => {
501   res.json({
502     ok: true,
503     lastUpdated: db.lastUpdated,
504     setCount: db.sets.length,
505     publishedSetCount: db.sets.filter((set) => set.sentToVr).length,
506   });
507 });
508
509 > app.get('/api/sets', (req, res) => {
510   // ...
511 });
512
513 > app.post('/api/sets', (req, res) => {
514   // ...
515 });
516
517 > app.put('/api/sets/:id', (req, res) => {
518   // ...
519 });
520
521 > app.post('/api/sets/:id/send-to-vr', (req, res) => {
522   // ...
523 });
524
525 > app.get('/api/vr/sets', (req, res) => {
526   // ...
527 });
528
529 > app.get('/api/vr/active-set', (req, res) => {
530   // ...
531 });
532
533 > app.delete('/api/sets/:id', (req, res) => {
534   // ...
535 });
536
537
538 if (require.main === module) {
539   const PORT = process.env.PORT || 3000;
540   app.listen(PORT, () => {
541     console.log('Server is running on port $(PORT)');
542   });
543 }
544
545 module.exports = { app };
546
547
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```

```

69   private IEnumerator FetchSetData()
70   {
71     using (UnityWebRequest request = UnityWebRequest.Get(companionVrSetsUrl))
72     {
73       request.timeout = requestTimeoutSeconds;
74       yield return request.SendWebRequest();
75     }
76     if (request.result != UnityWebRequest.Result.Success)
77     {
78       Debug.LogWarning($"Failed to fetch VR sets: {request.error}");
79     }
80     if (useDemoSetWhenRemoteUnavailable)
81     {
82       LoadDemoSet();
83     }
84     yield break;
85   }
86
87   VrSetResponse response = JsonUtility.FromJson<VrSetResponse>(request.downloadHandler.text);
88
89   if (response == null || response.sets == null || response.sets.Length == 0)
90   {
91     Debug.Log("No published VR sets were returned by the companion server.");
92   }
93   if (useDemoSetWhenRemoteUnavailable)
94   {
95     LoadDemoSet();
96   }
97   yield break;
98 }
99
100 ApplyRemoteSets(response);
101
102 }
103
104
105
106
107 private void ApplyRemoteSets(VrSetResponse response)
108 {
109   sets.Clear();

```

Figure 7. Server-side API structure for data synchronization between web and VR systems

This code represents the server communication system that links the VR application with the web application. The server locally controls how the note card data is preserved and exchanged between the two systems. When the server initially starts, it listens on port 3000 and offers several API endpoints that let the web application and VR application to communicate and interact between each other. One endpoint monitors the health of the server to verify that it is running accordingly. Other endpoints handle note card set operations, as in retrieving all sets, transferring the selected sets to the VR application, and activating the specific selected sets. These endpoints let the VR program request the correct and accurate presentation content information for the VR rehearsal simulation. On the VR application side, the FetchSetsData() function delivers a request to the server to gather all the accessible and available note card sets. Once the server replies, the program analyzes and reads the returned data and then transfers the sets of note cards into the VR environment simulation in order for the user to access their note cards during their rehearsal of the immersive VR presentation simulation.

## 4. EXPERIMENT

This section explores the experiments held to assess the effectiveness of Virtual Stage VR. The system was validated utilizing a user-based experimental evaluation, where participants engaged with the Virtual Stage VR system both prior and following the experiencing the simulation. The primary evaluation criteria were the self-reported confidence scores (on a scale of 1 to 10) and the number of important presentation points remembered throughout the presentation. The experiment's main goal is to evaluate improvements in presentation performance and user confidence.

### 4.1. Experiment 1

This experiment included a total of ten participants (N=10), all who were students of some sort. A potential blind spot in the program is whether practicing and rehearsing in a virtually realistic environment actually helps and improves individuals confidence in public speaking. It is crucial to evaluate whether the simulation successfully and effectively assists users in preparation for presentations.

To test whether Virtual Stage VR actually improves public speaking confidence levels of people, the experiment could compare and evaluate confidence levels of users' before and after practicing with the simulation. A selected group of participants could first rate their confidence level on a scale of 1 to 10, prior to using the program. And then, after completing the practicing session with the VR application, the participants could rate their confidence on a scale of 1 to 10 again to see if it's improved. This setup is beneficial and effective because it helps clearly measure changes in the same users rather than comparing various different groups. The control data would be the participants' initial confidence scores.

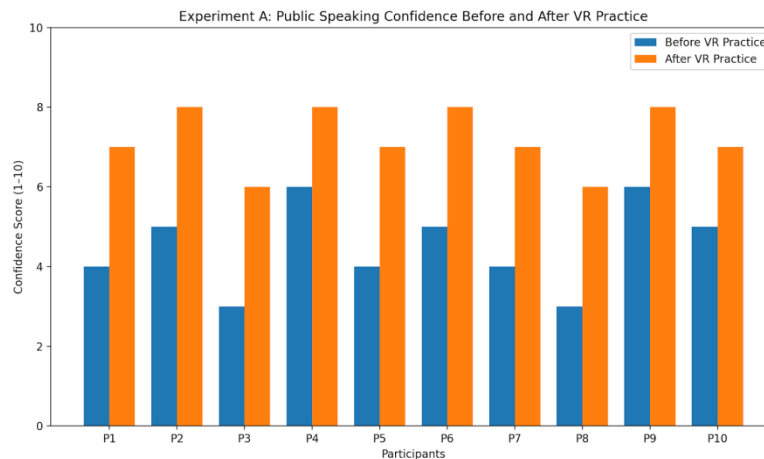


Figure 8. Confidence scores before and after VR training

The conclusions of the experiment show a significant improvement in confidence levels after the use of the VR simulation. Prior to practicing in the VR setting the participants' confidence scores ranged from 3 to 6 with a mean of 4.5 and a median of 4.5 as well. Following the completed VR practice session confidence scores rose to a range of 6 to 8 with a mean of 7.2 and a median of 7. The lowest value recorded afterwards was only a 6, with the highest value being an 8.

An additional observation was that following the VR simulation participant showed an improvement in confidence scores. This implies that practicing in a simulated setting assists users

increase their confidence and preparation level for real presentations. The results indicate a consistent improvement across participants because the increase in confidence levels were pretty much consistent across all participants rather than only a few of them.

The primary factor affecting these results are likely the engaging environment and nature of the VR setting. By recreating realistic presentation settings users are able to feel more comfortable and familiar having the experience of speaking in front of a bigger and greater audience, which assists in decreasing anxiety when presenting and improving confidence levels. Compared to traditional practice techniques, like practicing individually or in small groups, the VR environment is able to provide a better and more immersive as well as realistic experience, which may explain the greater increase in confidence noticed in the study.

## 4.2. Experiment 2

This experiment included a total of five participants (N=5), all who were students of some sort. Another potential blind spot is whether the notecard system actually helps users recall their main presentation points throughout the simulation. This is crucial because easy and clear access to notes significantly enhance the delivery and structure of presentations.

To evaluate this function, participants could be requested to provide a brief presentation in the VR setting utilizing note cards provided by the system itself. Each of the following participants would initially try to give a short presentation without using any note cards. Following this attempt, the same participants would repeat the presentation, but this time, while using notecard provided during the VR simulation. Observers could note how many key details from the presentation outline were correctly stated in each attempt. The comparison between the two attempts would assist in measuring whether incorporating the notecard system increases users' capability of remaining organized and recalling important, significant presentation detailed elements during practice or not.

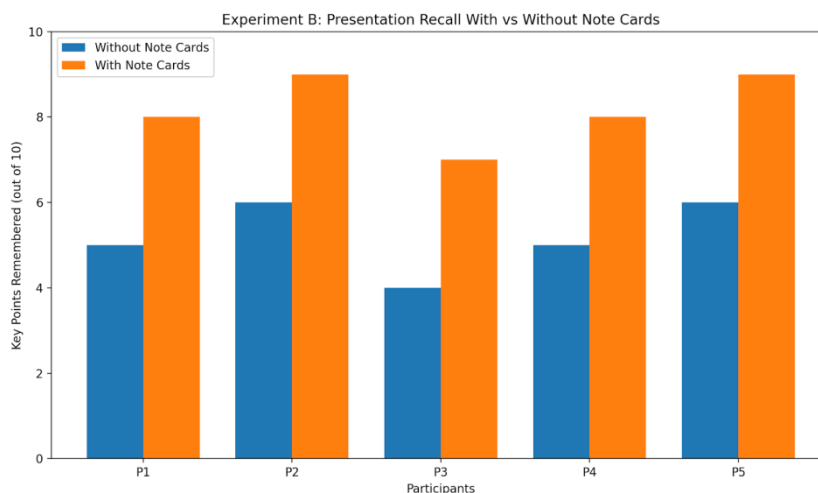


Figure 9. Recall performance with vs. without notecards

The conclusions implies that throughout the VR simulation the notecard function assists users significantly in recalling more of the presentation material. Not having a note card, participants were able to remember between 4 to 6 important points. with a mean of 5.2 and a median of five. On the other hand, when the note cards were provided, participants could think of between 7 to 9 key points, with a mean of 8.2 and a median of 8.

The lowest value recorded with the notecards were 7, with the highest value being 9. This shows an obvious increase compared to the outcomes without the notecards. One interesting observation I noticed is that all participants significantly improved their memory and fluency during their presentation when the note card was available based on their own scale.

The findings are most likely because the note cards function as a brief reminder of key points of information during the presentation when you're a bit nervous and blanking that you have to remember to speak about. Rather than attempting to memorize every little detail, users can focus more on speaking fluently, clearly, and very confidently. The most significant contributing factor influencing the outcomes the most are probably, the easy availability and accessibility of the note cards throughout the simulation, which clearly remarkably assists users in staying organized and following the structure/outline of the presentation.

## 5. RELATED WORK

A frequently studied approach to reduce people's public speaking anxiety is Virtual Reality Exposure Therapy (VRET) [4][5][6]. This method puts the individuals in a simulated speaking environment where they are able to consistently train in giving a presentation in front of a virtual audience. Based on studies, it shows that repeated VR exposure can help minimize anxiety and improve people's comfort when public speaking because users will be able to eventually get more used to the environment under stressful circumstances. Researchers have proven that VR-based exposure therapy can be as beneficial as traditional exposure therapy for managing public speaking anxiety [7]. However, rather than assisting users prepare for their actual presentation content, these programs and systems are primarily focused more on decreasing people's anxiety levels. Many of these systems also need therapist supervision or clinical settings. Virtual Stage VR improves this method by combining engaging practice environments with tools to help, such as notecards, along with preparation tools that assists users plan, organize, and practice better and more effectively for real presentations.

An alternate method to enhance public speaking skills is AI-based speech analysis tools that assess users' presentation performance. These systems examine recordings of speeches and offer back feedback and comments on pacing, redundant words and or phrases, tone, and clarity of your speech. Studies have proven that auto-generated speech feedback and evaluation systems can actually help people significantly improve their communication abilities by highlighting the weaknesses in their speech delivering and offering specific suggestions and advice for further and greater improvement [8][9][10][11]. However, although these advanced tools are very helpful, again, they mainly only emphasize on evaluating users speech performance, instead of recreating the physical environment around you when public speaking. They frequently miss the most captivating and engaging elements of the practice, such as realistic audiences and different presentation settings. Virtual Stage VR improves on this aspect by combining organized preparation methods along with realistic virtual environments that recreate real presentation settings accurately as well.

Another approach used to overcoming public speaking anxiety and stress is simply, traditional public speaking training classes and communication classes. These courses teach techniques such as, speech structuring and organization, breathing and different anxiety relief strategies, and repeated practice speaking, but mostly only in front of small groups of people. Research has demonstrated practicing and rehearsing presentations and learning stronger strategies and skills can substantially reduce anxiety, and instead enhance people's speaking confidence gradually [12][13][14][15]. However, these programs often require teachers, classrooms, or group participation, which usually only a limited number of people participating, not accurately

simulating the experience, and also limiting how frequently people are able to practice. Virtual Stage VR enhances this approach by allowing users to practice presentations and or speeches independently and repeatedly at no cost, in immersively simulated environments that accurately recreate realistic speaking situations.

## 6. CONCLUSIONS

Although Virtual Stage VR provides a useful and effective platform for users to practice public speaking, there are unfortunately some limitations and weaknesses that could be further improved in future development and updates. One current limitation is the variety and number of presentation settings currently available to practice in, in the overall program. While the system includes basic environments such as classrooms, auditoriums, or conference rooms, real speaking scenarios can differ significantly based on the conditions. Incorporating more scenarios, like bigger conference meeting places or an outdoor park for outdoor speeches would enhance the simulation's realism and effectiveness for various different types of users. Furthermore, this study primarily tests and evaluates short-term improvements in confidence, immediately following the VR practice. Future studies could examine if these improvements remain over time and can be applied to real-world speaking scenarios.

Another limitation of the overall program is the virtual audience's behavior and response. The current audience may not accurately represent how the actual audience responds and reacts to your speech and content during the presentation. In future developments, the program could also include more dynamics in the audience's behavior, such as varying levels of attention, interaction, and or distractions during your rehearsal presentation, since audiences might not always agree or find content during your presentation engaging.

With additional development time, more different settings and advanced audience engagement could be incorporated, in order to simulate a further realistic, immersive, and useful public speaking practice experience.

Virtual Stage VR portrays how advanced immersive technology can greatly support public speaking training and practice by offering realistic practice settings. By combining virtual simulations along with realistic preparation tools such as, notecards, in the virtual simulation, it helps users build confidence significantly in a minimal amount of time as well as strengthen their communication skills and abilities. Along with further advancements, this strategy could potentially become a very effective tool for presentation training and improving skills for everyone. A practical use of Virtual Stage VR would be helping students in preparing for presentations in class or professionals practicing speeches before meetings or major public events since the system lets users constantly rehearse repeatedly in realistic environments and gain enough confidence before actually presenting in front of an actual audience in real-world situations.

## REFERENCES

- [1] Tejwani, Vickram, Duc Ha, and Carlos Isada. "Public speaking anxiety in graduate medical education—a matter of interpersonal and communication skills?." *Journal of graduate medical education* 8.1 (2016): 111-111
- [2] Heeren, Alexandre, et al. "Assessing public speaking fear with the short form of the Personal Report of Confidence as a Speaker scale: confirmatory factor analyses among a French-speaking community sample." *Neuropsychiatric disease and treatment* (2013): 609-618.
- [3] Esposito, Janet E., and Janet Esposito. *Getting Over Stage Fright: A new approach to resolving your fear of public speaking and performing*. In The Spotlight LLC, 2009.

- [4] Takac, Marcel, et al. "Public speaking anxiety decreases within repeated virtual reality training sessions." *PloS one* 14.5 (2019): e0216288.
- [5] Reeves, Rachel, et al. "A meta-analysis of the efficacy of virtual reality and in vivo exposure therapy as psychological interventions for public speaking anxiety." *Behavior Modification* 46.4 (2022): 937-965.
- [6] Seuling, Patrik D., Nathaly S. Czernin, and Miriam A. Schiele. "Virtual Reality exposure therapy in the treatment of public speaking anxiety and social anxiety disorder." *Neuroscience Applied* 3 (2024): 104074.
- [7] Lindner, Philip, et al. "Virtual Reality exposure therapy for public speaking anxiety in routine care: a single-subject effectiveness trial." *Cognitive Behaviour Therapy* 50.1 (2021): 67-87.
- [8] Cherner, Todd, et al. "AI-powered presentation platforms for improving public speaking skills: Takeaways and suggestions for improvement." *Journal of Interactive Learning Research* 34.2 (2023): 339-367.
- [9] DeLacey, Brian J., and Dorothy A. Leonard. "Case study on technology and distance in education at the Harvard Business School." *Journal of Educational Technology & Society* 5.2 (2002): 13-28.
- [10] Malik, Radosław, and Yuanping Yu. "AI-enhanced public speaking and its applications: a systematic literature review." *Multidisciplinary Movements in AI and Generative AI* (2025): 220-241.
- [11] Isotalus, Pekka, Marja Eklund, and Karoliina Karppinen. "Artificial intelligence as a feedback provider in practicing public speaking." *Communication Teacher* 39.1 (2025): 78-85.
- [12] Munankarmi, Prateek. "Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange."
- [13] Pribyl, Charles B., James Keaten, and Masahiro Sakamoto. "The effectiveness of a skills-based program in reducing public speaking anxiety." *Japanese Psychological Research* 43.3 (2001): 148-155.
- [14] Quinn, Sally, and Adam Goody. "An Evaluation of a Course Aimed at Reducing Public Speaking Anxiety among University Students." *International Journal of Teaching and Learning in Higher Education* 31.3 (2019): 503-511.
- [15] Knight, Misty L., Karen Gabrielle Johnson, and Frances Stewart. "Reducing Student Apprehension of Public Speaking: Evaluating Effectiveness of Group Tutoring Practices." *Learning Assistance Review* 21.1 (2016): 21-54.