

Interactive German Learning with VR: Umfassende Übung Macht den Meister!

Lauren Mentzer
Stanford University
Electrical Engineering
lmentzer@stanford.edu

June 7, 2019

Abstract

Learning foreign languages is a useful skill that helps people communicate more effectively, enhances traveling experiences, and more. Tools like Duolingo and Quizlet exist to aid in the language learning process; however, these tools are not perfect, as they don't enable users to have real-time practice conversations. I created a virtual environment for learning German, VRDeutschLernen, with the goal of providing users with more enjoyable and effective practice opportunities via virtual native speakers. I present the results for 7 users, who compared VRDeutschLernen to related language tools and identified the environment's strengths and weaknesses. I find that users would prefer German lessons with VRDeutschLernen to Duolingo, language textbooks, and online language courses, but not in-person language courses. I find that VRDeutschLernen is considered by users to be more engaging and more enjoyable than related tools. Lastly, I find that the practice conversations, practice scenarios, and written lesson notes are the most helpful aspects of the game.

1 Introduction

Today's world is more connected than ever before. We can do business with companies in other countries, we can learn about current events across the world, and we can travel to thousands of places if we desire. With an increasingly connected world, many opportunities

arise, but one important challenge remains: how to communicate with people whose native language is different than our own. The ability to speak with people in their native language gives speakers a notable advantage in developing meaningful relationships and efficiently conducting business. This is why companies often seek candidates who can speak multiple languages, and why locals typically prefer to speak with travellers in their native language.

Thus, knowing multiple languages opens up a world of job opportunities, better treatment in foreign countries, greater capacity to understand different cultures, and more. So why don't we all just learn as many languages as possible? Learning a second, third, etc. language is certainly an exciting endeavour, but it is also challenging and time-intensive. It requires hours of studying, practicing, and speaking to develop proficiency, and often also embarrassing oneself while practicing along the way.

2 Motivation

To address the challenges of language learning, many companies have developed tools to ease the process. Examples include Google Translate, online language dictionaries, and language learning apps like Duolingo. While these websites and applications can be useful aids in the language learning process, they lack in providing immersive and engaging environments where their language skills are really utilized and tested.

With these methods, a significant challenge is not being able to practice conversing with native speakers. Conversations force learners to listen closely, think rapidly, and speak clearly without (wasting time) worrying too much about mistakes. Thus, Virtual Reality (VR) is a promising alternative to language learning applications, with its ability to throw users into realistic and engaging practice situations with virtual "native speakers." The immersive factor of VR (as opposed to flashcards and worksheets) would be a more memorable experience, likely enabling users to nail down vocabulary and scenario-specific phrases more easily. This could enable language learners to absorb material better and faster.

2.1 Project Outline

In my project, my goal was to design an interactive, fun, and exciting virtual environment for learning German using Unity. Due to the limited time span of the project, I focused on a few aspects:

1. An introductory scene with a virtual "native speaker," who tells the user about the learning environment and has introductory German lessons with phrases and pronunciation prepared.
2. A followup scene after some initial language coverage, in a restaurant, where learners complete an assigned task: ordering a meal in German.
3. Within these scenes, having lesson notes in addition to verbal explanations and practice conversations so users can see, hear, and experience the material they learn. This teaching model will enable all types of learners to benefit in some way.

My goal was that through these scenes, people who knew nothing about German could learn some basic phrases and pronunciation, and enjoy doing it. Additionally, I hoped that users would find the learning experience more memorable and that they retain what they learned better. To test how well I achieved these goals, I performed an "effectiveness" analysis, i.e. I had peers compare my VR environment to a simpler language learning activity such as flashcards or a Duolingo lesson. As I will describe below, this project is not something that

has not been done before; current VR games for learning German do exist. I will as a result be adding to the set of resources that exist for learning German with VR.

3 Related Work

3.1 Recognition of VR for Language Learning

VR has been defined as I^3 for "Immersion-Interaction-Imagination" [3], and many believe these qualities are vital to truly master a language [7] [4]. Additionally, VR enables teaching for a variety of types of learners: visual learners, verbal learners, and physical learners (via embodied learning, which is a notable strength for VR education tools [1]). My project embodies these identified strengths of VR education tools, being immersive, interactive, and helpful for multiple types of learners, to be as effective as possible. One example VR language application that does this is Mondly, which offers interactive learning environments for 30 languages, including German [2].

3.2 Combining VR with AI

VR language applications often utilize extensive artificial intelligence, with tutor figures for example, to support learners. In Johnson et al's work on learning Arabic with VR, aids assist struggling learners and provide voice feedback [8]. Shih and Yang's work incorporates real-time voice interaction for support [7]. Real time feedback is valuable, in that it lets learners correct their mistakes, know when they're doing well, or have an actual conversation. As outlined in section 1.2, I do not use AI for real-time feedback or voice detection. The extensive forms of feedback these existing VR language games have is more helpful than what I implement, but my implementation is simpler and thus more compatible with time constraints.

3.3 Reducing Cost with AR and Video-Capture VR

To provide a cheaper, less hardware intensive option, Yang et al. use video-capture VR for English learning

[5]. As another example of a cheaper option, Perry created an AR mobile application for learning French, that users did identify as more effective and entertaining than traditional classroom learning [6]. The main advantage of these options is that their reduced cost could make them more accessible. But, while these approaches are still interactive with their video feedback and augmentation, they would be regarded as less immersive by other VR researchers, given users can still find ease in the fact that they are interacting with a screen and not a virtual person right in front of them. To be more immersive and as a result more effective, I create a VR environment instead using video-capture VR or AR.

4 Methods

In this section I detail the design and implementation of VRDeutschLernen. I used a combination of game development software, online 3-D models, and online text to speech converters. For the VR hardware, I used the ViewMaster headset from class.

4.1 Environment Design

I did the majority of the work for my environment in Unity. The virtual world has a medieval German theme, and to create this theme I downloaded various assets from the Unity Asset Store and Turbosquid. In some cases, I modeled the 3D assets myself using Autodesk Maya. The welcome scene for lesson 1 is shown below.

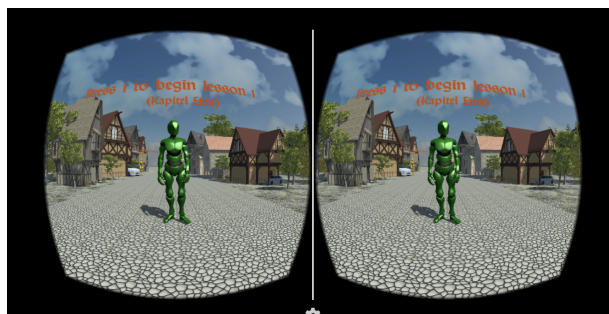


Figure 1: Lesson 1 welcome scene

Users can explore the neighborhood by moving forwards and backwards, as well as up, down, left, and

right with keyboard keys. They can also rotate their head to look in different directions, using orientation tracking with the VRduino. As users move around, they will find various robot native speakers, with "press x to begin lesson x" text nearby. By pressing the indicated key, the robot native speaker will begin an introductory German lesson. The idea of the game is for users to move around and interact with the native speakers they come by.

4.2 German Lessons

The German lessons were designed based on my experience as a German learner of 3 years and feedback I received from fellow language learners. Peers described that when beginning a new language, learning simple phrases as opposed to specific vocabulary can make us feel more accomplished. As such, each robot teaches learners a set of phrases.

4.2.1 Lesson Content

In lesson 1, users learn how to introduce themselves and how to ask others their name. In lesson 2, specific restaurant vocabulary for getting a table and ordering is discussed. Finally, there is Ludwig's restaurant, where users can go in and practice ordering food off of the menu, as seen in Figure 2. This scene introduces more vocabulary through the menu items with labeled food and drink options, as well as a labeled exit sign, and labeled entrance to the restaurant's kitchen.

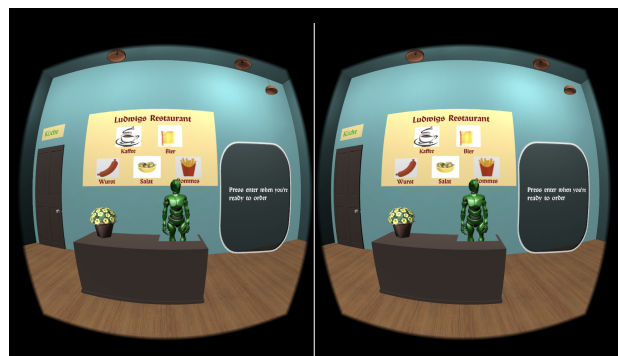


Figure 2: Ludwig's Restaurant

4.2.2 Communication of Material

The lesson material is all introduced by the robots. It is taught verbally as well as with lesson notes. For example, in Figure 1 after the user presses 1 to begin, lesson notes with all discussed phrases appear on a board next to the robot, as shown in Figure 3. This is the same board shown in Figure 2, with the "press enter when ready" label. This addition of lesson notes was included based of initial feedback I received, where language learners described that hearing as well as seeing a new word helps them remember it better. The robot's audio components

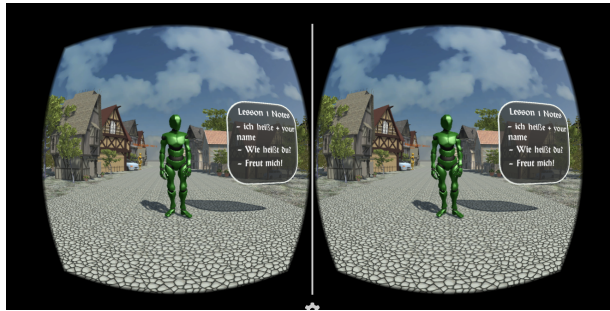


Figure 3: Lesson 1 with notes

were generated using an online German and English text to speech convertor. After the robot introduces a phrase, he or she instructs the learner to repeat the phrase, then waits a scheduled amount of time before continuing. The robot also does practice conversations, where they either ask the user questions or engage in a conversation, that they previously outlined to the user in English. There is no voice detection, thus in practice conversations, the robot waits a defined amount of time, which with good understanding of the phrases, the participant should be to answer within.

As users continue, the lessons and practice conversations get harder, with more complex phrases. This was partially inspired by [6], where Perry found benefits in "gamifying" French learning, and how that increased engagement. If a user can't complete a conversation in the allotted time the first time around, the idea is for them to study the vocab and practice more, then try again. This way, they will have motivation to review and feel more accomplished when they do complete the task.

5 Results

To evaluate VRDeutschLernen, I conducted a user study with 7 participants. Each user tried out 2 introductory lessons and the restaurant practice scenario. All users had limited to no experience with German. After they tried out the game, they filled out a survey where they could provide feedback in various forms. It should be noted that not every participant answered every question.

5.1 Quantitative results

First, I had users rank learning German with VR to other language learning tools they had used in the past. Such tools include: Quizlet, Duolingo, flashcards, language textbooks, online language courses, and in-person language courses. The results were as follows below.

User	Rank 1	Rank 2	Rank 3	Rank 4
1	In-person language courses	Learning German with VR	Duolingo	Language book
2	In-person language courses	Learning German with VR	Flashcards and other non-auditory tools	
3	In-person language courses	Learning German with VR	Language book	Online language course
4	Learning German with VR	Duolingo		

Figure 4: User rankings of preferred language learning tools

From these results, we see that 100% of participants would not prefer to use VRDeutschLernen over an in-person language course. However, learning with VR is preferable for many to the typical non-auditory modes of language learning: textbooks, online classes, and flashcards. 0% of users preferred these over VR. Lastly, learning German with VR is preferable to Duolingo for 100% users who have experience with this app.

Another statistic from this study is that 6 out of 7 of participants spoke out loud during the lessons and conversations. This is noteworthy, as pronunciation is

vital to mastering a language, and something that often does not occur when using other tools, like books and apps.

5.2 Qualitative results

In addition to the rankings in Figure 4, I had users explain their rankings. Regarding the preference of in-person courses to VR, and VR to non-auditory tools, user 3 stated, "Of course, in person is the best because there is live feedback and pronunciation. However, what I really like about this is the simulated scenarios and voice audios to help with pronunciation because textbooks cannot do that." User 1 explained, "It was fun to control the character and look around but it was hard to not be able to control the pace of the lessons being delivered. I think Duolingo and books are a bit rote and repetitive. The changing environment and audio component made the VR engaging but less so than talking to a real human. Also, the robot people were a bit creepy because they didn't move or have mouths but were talking."

Users were also asked which features they found most and least helpful within the environment. 3 users said the practice scenario (Ludwig's Restaurant) was most helpful, 2 users said the practice conversations with the robots were most helpful, and 2 users said the lesson notes were most helpful. Interestingly, for the least helpful feature, 2 users said that the practice scenario was least helpful. 1 user filled in an "Other" option and said the pace of the lessons was too quick. The other 4 users did not identify a least helpful feature.

Lastly, I included an open ended feedback section where users could put any additional comments or suggestions. I received a few comments here. One participant wrote, "I loved how there was basically a word bank visible mid-conversation. It disturbs the conversation slightly less than if you had to look down at a piece of paper." This word bank they refer to is the lesson notes board that is shown in Figure 3. Another participant described how they loved the idea of learning a language with virtual native speakers in VR, because it means we don't have to travel to the country where the language is spoken to get practice conversation opportunities. They mentioned that they've thought about this multiple times as a learner of Chinese with little access to native Chinese speakers nearby.

6 Discussion

Overall, VRDeutschLernen appears to be a promising start to a successful language learning tool. One success was the usefulness of the lesson boards. These could be referred to mid-conversation, which is much less disruptive than looking at notes on paper in real-life conversations. Participants utilized and benefited from this support. Another success was the use of native speakers as a way of communicating with learners. These speakers taught users how to say words, had them engaged by repeating phrases, and provided practice conversation opportunities. Almost all users completely engaged with the robots, and walked away with new knowledge of how to say their name or order something.

Somewhat controversial was the practice restaurant scenario. Some users found this the most helpful aspect, while others found it least helpful. I hypothesize that this discrepancy can be explained by the level of difficulty of the scenario. Successfully completing the ordering conversation required the use of more complex phrases. From observing studies, I noticed users who had a little knowledge German could keep up better. Thus, to accommodate the absolute beginner, an easier version of this scenario should probably happen first. The use of a level 1 restaurant and then Ludwig's as a level 2 restaurant could make this scenario useful for everyone, and discouraging for no one.

One concerning piece of feedback was the description of the native speakers as "creepy." I do agree and recognize that a robot makes the experience feel less real than if it were a human 3D model. I made this decision in the interest of cost rather than appearance. Since the native speakers speak, if it were a human speaking, this would require mouth animations. This effect cannot be done easily without purchased speech animation packages. Thus, with more time or funding, I would replace the robots with virtual humans to make the experience more realistic.

The environment had its ups and downs, but the fact that all users would prefer to learn German with this instead of Duolingo or Quizlet is a success. This VR environment thus achieved my goal of it being a better alternative to existing language learning tools, rather than courses. This is beneficial, because not everyone has access to or the financial means to partake in well

taught foreign language courses. This tool could provide language learning opportunities for a wider variety of communities, especially as VR hardware becomes more financially accessible, like with Google Cardboard. Additionally, my work provides a model for a way for other developers to design VR language games in a cost effective manner. No assets or software programs were purchased to make this game. Thus, if developers are interested in replicating it in the future, they could do so as long as they had access to any headset.

It makes sense that users would still prefer in-person classes, which touches upon perhaps the biggest limitation of my approach: lack of artificial intelligence. Because this project did not implement any artificial intelligence, users could not get feedback on how they were doing. They also could not ask questions if they were confused. This level of engagement with native speakers is vital to producing the optimal learning environment. Additionally, this meant the pace of the courses could not be adjusted, which some users did point out. The inability to adjust pace could be seen by some as a positive, in that it encourages users to study and practice until they can complete a given conversation with a robot, thus "gamifying" German learning. In other games, rarely is it trivial for players to defeat each level on the first round; doing so would be quite boring. With this approach, it could enhance the learning process, but ultimately whether it does will depend on the learning preferences of the person using this software.

7 Conclusion

In this project, I developed the framework for a virtual environment that teaches users the German language. I created a few initial lessons, where virtual native speakers taught users how to say their name and how to order in a restaurant. Users overall responded positively to these lessons, and found them more engaging and enjoyable than other language learning apps, books, and websites. Limitations of this work include the use of robots as native speakers, the fast pace of the lessons, and the lack of artificial intelligence. Advantages include the lesson board and its accessibility in conversation, the ability to engage most users in speaking out loud, and the many practice conversations and scenarios. This content is not

regarded as a replacement to learning in a traditional classroom environment.

8 Future Work

To make an environment like this be most effective, several improvements should be considered. I have compiled a list below with ideas for the most important improvements and extensions to my project, based on the results I found. Future developers of VR language learning games could consider these when designing their environment.

1. The numbers of lessons should extensively increase to cover a large subset of the German language.
2. There should be a more gradual increase of the level of difficulty from lesson to lesson. Users should ideally not get discouraged by not being able to keep up.
3. Users should be able to access a "skills bank," where they can see a list of the concepts they've learned. This can be used to review as the progress.
4. The robot native speakers should be replaced by modeled virtual people. This will require the use of mouth animations on the people when they speak.
5. The software should include artificial intelligence. Voice detection and chatbot features should be implemented so users can ask questions.

9 Acknowledgements

Thank you to the EE267 course staff for the support and feedback throughout this project. The starter code for getting orientation data from the VRduino is also very much appreciated. Thank you to the residents of Haus Mitteleuropa who participated in this study and took the time to provide constructive feedback. Lastly, thank you to the many online communities on how to make things happen in Unity.

References

- [1] 2019 ieee vr fourth workshop on k-12+ embodied learning through virtual and augmented reality.
- [2] Mondly: Learn languages in vr.
- [3] G. C. Burdea and P. Coiffet. *Virtual Reality Technology*. John Wiley and Sons, 2003.
- [4] S.-S. Hsiu-Mei Huang, Ulrich Rauch. Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers and Education*, 55(3):1171–1182, 2010.
- [5] M. C. J. Jie Chi Yang, Chih Hung Chen. Integrating video-capture virtual reality technology into a physically interactive learning environment for english learning. *Computers and Education*, 55(3):1346–1356, 2010.
- [6] B. Perry. Gamifying french language learning: A case study examining a quest-based, augmented reality mobile learning-tool. *Procedia - Social and Behavioral Sciences*, pages 2308–2315, 2015.
- [7] Y.-C. Shih and M.-T. Yang. A collaborative virtual environment for situated language learning using vec3d. *Journal of Educational Technology and Society*, 11(1):56–68, 2008.
- [8] H. V. W. Lewis Johnson and S. Marsella. Serious games for language learning: How much game, how much ai? *Artificial Intelligence in Education*, pages 306—313, 2005.