

Language Immersion

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ABSTRACT

This research looks at the effect of Virtual Reality gaming on vocabulary retention of a foreign language. A comparison is analysed between Virtual Reality gaming (VR), Computer gaming (PC) and Fill in exercises to determine the effect of the different methods on remembering French vocabulary by junior high school students

Author Keywords

Virtual Reality; Education; Foreign Language Learning; Immersion; French; HTC Vive; High school; Self-Reference Effect; Negative Evaluation Anxiety; Games.

INTRODUCTION

How long has it been since you last took a language course or class? Maybe you can relate back to the times you had to sit with your classmates and practice the example sentences in front of you, or you had to reply to your teacher in the target language. Do you still remember the adrenaline racing through your veins?

Learning different languages has become a very important aspect of the personal and professional development [3, 12], for example, analytical and problem solving skills improve by the learning of a second language and one is at an disadvantage of the global market when one is not bilingual, and it is thus a necessary subject in the high school curriculum. However, the way it done now is not very efficient. A lot of students suffer from anxiety when speaking the target language within language classes [2]. *Anxiety is the subjective feeling of tension, apprehension, nervousness, and worry associated with an arousal of the autonomic nervous system. Teachers and students generally feel strongly that anxiety is a major obstacle to be overcome in learning to speak another language* [2]. The students are afraid to make mistake in the presence of their peers. This is really quite the missed opportunity. While students spend between 4 - 6 years learning the specific target language, they often still can't speak it fluently at the end of this period. This time period should give students the chance to become much more fluent speakers than they currently are when they graduate. The current form of education tends to focus mostly on reading and writing, and less on speaking and listening. This is a shame if you take into consideration how communication is an important aspect of society nowadays. Classes can be spent more efficiently, so at the end of the ride, students have a

sufficient understanding and practical knowledge of the target language.

When immersed in a language, one learns it faster [6,9]. This is the case in, for example, exchanges or immersive classrooms. Usually the earlier one starts with these immersive PRACTICES, the better the foreign language is spoken [3]. Although immersive PRACTICES are very promising in the field of language education, it is by far not the most accessible. Exchanges tend to be very expensive, and not every child is allowed to participate in these, as parents can be very worried and forbid their child from going. The alternative, immersive classrooms, are not available in every school and doesn't provide any solution for the anxiety issues that are still present in these classes.

With respect to speaking, a more affordable solution could be digital games involving multimodalities, which could provide vocal affordance on language learning. Young and Wang (2014) [23] discovered that digital games were effective at improving vocabulary pronunciation, which was perceived as a linguistic component. Furthermore, Wu et al [22] suggest that digital-game learning led increased transferability of learning knowledge into daily communicative speaking. Informal learning opportunities have proved themselves more effective, especially on low-level students [5] which proves this to be beneficial for people that have just started learning a foreign language.

This research focuses on the possibilities of methods that are more easily accessible, such as Virtual Reality (VR), which has a high rate of immersion. One can look and walk around in a different environment while wearing the device, just as one would do while in another country. The following question was tried to be answered; *Can Virtual Reality (VR) benefit vocabulary learning in terms retention and motivation in a junior high school environment.*

RETENTION AND MOTIVATION

There a lot of factors surrounding language vocabulary retention and motivation in a junior high school environment. In regards to the use of Virtual reality in the classroom the following three stood out as they might be improved by the use of VR.

Self-reference Effect vs Encoding

The self-reference effect relates to the tendency for people to process information differently when they themselves are implicated in the information. Retention rate tends to be higher when information can be related to oneself [20]. This is an opposite concept when comparing it to current educational methods, where students just have to learn a string of letters, which they then have to link to a certain word or translation, which is also a string of letters. Not only is this method less effective, it is also not very motivating. Gaming could be a solution. The advantage of learning through playing or gaming, is that the user can link this certain string of letters not only to another string of letters but to an actual object with which they can interact in an engaging 3D environment. This relation between a person and the object/word, gives them more reference points to remember a word by. They can relate it to themselves as they held the objects in their hands, using the mouse or the VR controllers as a medium. They looked at it from all sides, thrown it, seen it in its environment and were exposed to many other details which the brain interprets when interacting with an object in an 3D environment. This way it's more likely for the brain to make the connection to a certain word when trying to remember it, as there are way more connections to the word.

There are 3 stages to retention. The first is Encoding. Encoding [15] is the process of getting information into memory for storage (2nd stage). There are three types of encoding; Acoustic Encoding, which refers to storing memory through audio, this is often a short-term storing. A well-known example is repeating words to oneself to remember them. Second is Visual Encoding. Visual Encoding is the storing of memory through visuals, e.g. pictures. Humans are visual creatures. Vision is a big part of the brain, therefore having a good image of what the object looks like helps to remember the word (reference 'Half of the human brain is directly or indirectly devoted to processing visual information.' 'There are countless studies that have confirmed the power of visual imagery in learning. For instance, one study asked students to remember many groups of three words each, such as dog, bike, and street. Students who tried to remember the words by repeating them over and over again (acoustic encoding) did poorly on recall. In comparison, students who made the effort to make visual associations with the three words, such as imagining a dog riding a bike down the street, had significantly better recall.'))

The last form of Encoding, is Semantic encoding. This is a specific type of encoding in which the meaning of something (a word, phrase, picture, event, etc) is encoded as opposed to the sound (acoustic encoding) or vision (visual encoding) of it. Semantic Encoding is the most long-term storing of the three. Research suggests that we have better memory for things we associate meaning to and store using semantic encoding. According to Symons and Johnson, Self-reference has shown to be even more effective than just semantic encoding. Both from a motivational and mnemotechnological point of view [8]. Self-reference creates an even more elaborate memory trace than semantic encoding does.

After everything is safely encoded and stored in the memory, it can be retrieved. This is retention.

The matter of Self-Reference is certainly an aspect that need to be taken into account when researching whether immersive methods such as VR can have a benefit for foreign vocabulary retention, VR gives more options of self-reference. It can both create visuals and a specific (personal) experience, which is more easily remembered.

Anxiety

Anxiety is not uncommon in high school classrooms. Guiora argues that language learning itself is "a profoundly unsettling psychological proposition" because it directly threatens an individual's self-concept and worldview (Attributed tpo Guiora by [2]).

Research done at the Learning Skills Centre (LSC) at the University of Texas found the following problem; Students often report that they feel fairly comfortable responding to a drill or delivering prepared speeches in their foreign language class but tend to "freeze" in a role-play situation. [2]. This points to the fact that the students are not comfortable within the foreign language. They do not learn things within context, hence they only feel comfortable speaking prepared texts. The target language does not come naturally for them.

Horowitz et al notes that a number of students believe nothing should be said in the foreign target language, until it can be said correctly. Such beliefs create anxiety, as it is expected of students to speak in the target language before they are fluent in it. However, learning a language without ever making mistakes, is next to impossible. Even excellent students make mistakes or forget words [2].

Students often show a fear of getting negatively evaluated by others. This can happen in a test-setting, but also in any social situation. This is why just practicing sentences with classmates usually doesn't result to much. This anxiety of negative evaluation blocks them so that they tend to either not practice, or don't remember anything of it. This results in them thinking they are less competent than other students.

Research done by Wu et al shows that students perceived less stress while learning within a digital learning playground when learning foreign language, than they did with paper board games. The paper board games caused higher anxiety [22]. Horowitz suggests that creating a learning context that is less stressful, is one of two successful methods to reduce learning anxiety for language learners. Whether or not VR is a valuable method, is researched within this paper.

Play

After insights gathered from multiple meetings with a language centre, it was clear that the game needed to be playful. Play gives students something to look forward to during lessons, which then increases motivation.

Both psycholinguistic and sociolinguistic frameworks emphasize the significance of interaction and motivation in the foreign language learning process [4, 13, 14]. Foreign language learners are more likely to achieve higher learning curves when they have high motivation, a positive attitude, high confidence, and less anxiety [10]. Fittingly, the characteristics, virtual environment and design principles of digital games are perceived as being able to create a relaxed and engaging learning platform [7]. Thus, games can enhance language learning.

It is indicated that playing and learning are connected theoretically [1]. Thus with interaction and motivation as its connecting points, it can be argued that digital games are valuable to add to the foreign language learning curriculum. Furthermore, recent studies have a positive attitude towards the Game Based Language Learning (GBLL) framework as well. For example, stimulating games can benefit the development of foreign vocabulary learning [16, 18]. Moreover, foreign language learners experience significant improvement in their communicative skills when playing digital games [17]. Partly because they are more engaged in game-based learning and therefore have higher levels of motivation to engage in the learning process [21]. This also displays valuable evidence on the positive impact that digital games have on the foreign language learning.

Playfulness comes from informal settings. Unlike formal learning, which relies on the fixed contexts or settings, informal learning is not limited by this space and time and “can be seen as a transitional route into the formal study and a complementary as well as an alternative mode of learning” [11]. Therefore, integrating a target language into video games can promote informal learning and could serve as an innovative way to stimulate language learning. This was incorporated in the game by several things; objects could be thrown, there were torches that burnt several painting in the castle, a witch flew around and there were several other easter eggs.

It is very important that a user gets satisfaction from a game, when they do something correct, there needs to be feedback that tells them that they’re doing the right thing.

This creates both more clarity and motivation, while in fact, they are being praised by the game.

Nothing can completely be learned by playing games, just as nothing can completely be learned just by taking classes. However, when both are combined, they add a lot of value to each other.

METHODOLOGY

Quantitative and qualitative data is preferred, the quantitative research (vocabulary test) can be used to analyze the effect of the VR, PC and Fill in on the amount of words one remembered. Qualitative research (surveys and observations) is conducted to explore and determine the reason(s) why the quantitative data came out the way it did.

Two schools were chosen to test at, to rule out the chance of the game working or not working only because of the specific vision or educational approach of the high school.

Participants

The research was conducted on students of two different high schools, both Gymnasium high schools (highest level of high school education in The Netherlands), with 12 participants at the first school and 12 participants at the other. All the students were first or second year students and had been following French at their educational institutes.

Testing was done on three students at a time. They would be seated in the same room, but apart from each other.

Experiment

The effects of three different methods were tested: VR, PC and fill in exercises.

VR

This method consisted of the game, made specially for the purpose of this research, a HTC Vive VR-headset, a computer, one researcher and a test subject.

Before starting the game, the researcher would give an explanation of the controls and give the subject a little bit of time to get used to the controls. This to make the progress of the game as smoothly as possible. After this, the game was started.

PC

The game used for this method is an exact copy of the VR-game made compatible with PC, playable through Unity on any computer. The reason for this being that there needs to be a verification/reference if the VR-environment with the bigger immersive aspects is the thing what is making students remember words better, and not just the game created for this research purpose.

Fill-in

The fill in exercise consists of 10 practice sentences, the students could use the sheet with the targeted words in order to practice. This sheet can be found in the appendix.

Measurements

In order to get information about the current situation of the students and to measure their motivation and enjoyment of the method questionnaires were prepared to be taken before and after the experiment. The full questionnaires can be found in the appendix.

Procedure

After the participants were welcomed and introduced to the topic, they were given a seat and the assignment to look at 10 words for 5 minutes (table/figure). They would be tested on these words later. Through a dice roll, it was then determined what participant could do what method. The one that rolled the highest, could choose first, the one who rolled the second highest got to pick after and the one who rolled the lowest had to do whichever method was left. There were three platforms that could be chosen from; VR, PC and Fill-in exercises. Once the methods were divided, each participant would do a survey before the test was initiated.

At this point the participants got to play the VR game, play the PC game or do the fill in exercises. They were given a brief overview of the controls as the games began, and also received hints if they got stuck at a certain section of the game for too long.

The game itself consisted of a French introduction, where the player was explained their objective. This was followed by two missions, baking a cake and washing a cat, in which the players collected various objects around the area to complete the missions. While picking up objects the French word of the object was visible on top of it so the player could learn and memorize it. The words they got to interact with were the same as the ones they were given at the beginning of the experiment. After completing the main missions the player received one final mission in which they had to recall each of the words they encountered throughout their time playing. They had to name each the words out loud in order to succeed. Upon failure they had a chance to go back and study the words within the 3D environment.

After finishing, all students would get the same test that they would have to complete individually. The test consisted out of the same 10 words as they got on paper at step 1. Unlimited time was given for the completion of this task. To conclude every round, a final survey was given to look how they enjoyed the method in comparison to their normal lesson.

After all data was collected, the tests were checked and processed. There were 4 possible outcomes:

1. The word entirely correct (correct spelling plus correct article)
2. The word is partly correct (small mistakes in spelling or article, but still recognizable as the correct word when pronounced)

3. The word is incorrect (unrecognizable when trying to read or pronounced)
4. The word is not filled in

Apparatus

The VR game was played on a desktop pc powered by an Nvidia Geforce 1080 GTX graphics card, connected to an HTC Vive virtual reality headset.

The PC game was played on an HP zbook studio laptop, connected to a separate monitor so the researcher could look at the screen without interrupting the participant.

The game mentioned before was created using the Unity game engine. Its virtual world was created using multiple POLYGON asset packs. This world was then brought to life using extra scripts written in C# to control the different characters and interactions of the game. Characters were given animations and dialogue in French to further immerse the player. The animations used came from the Idle Mocap asset pack. Lastly the game contained several particle systems to create effects at key moments and sound effects were added to make the world more engaging.

RESULTS

In this chapter the gathered data will be explained. The chapter is divided into observations (these are significant things the researchers noticed), the results of the surveys and the result of the test.

OBSERVATIONS

1. Some students did not look around that much in the VR game, they needed more time to get used to the VR than the time provided.
2. During the user test and at the demo day some adults tested the VR, the researchers noticed that the students get used to the VR much faster than adults (all test subjects were junior high students, but there were some other, older, visitors).
3. It was noticed that some students needed a lot of hints in order to understand what they needed to do, they needed additional help to complete the game.
4. Some students got frustrated fairly quick when something in the VR did not work properly, such as failing to grab objects.
5. The explanation at the beginning of the game was all in French which was hard to understand for the beginning language learners. This caused unclarity and disinterest.
6. The researchers needed to explain all the controls of the VR while the PC game was clear to most of the students as they are used to the controls.
7. The students with the VR were screaming out the words while the students doing the PC were quite shy and hesitant.

8. When students were doing the final battle they had to say all the targeted words, when they did not remember the words they failed and went back in the virtual environment to grab the objects and check the French words. The students did remember the visuals and environment (characteristics) of the item but not the French word.

When looking at observation number 8, a similarities to the earlier discussed self-reference effect can be seen. The fact that they can much easier recall the environment and characteristics of an item, something they have held and can relate to because of the experiences they had with it, gives promising reason to believe that VR can indeed be a valuable asset to the high school curriculum.

Results Pre-Test Survey

Before the students played the game or did the fill in exercise, they filled in a survey about the current experiences in the French classes and any prior experience with VR and PC gaming. The data is translated, summarized and elaborated in table 1.

Question	Results (translated from Dutch)
How many lessons of French per week?	Average 2.125
How many French lessons do you do fill in exercises?	Average 1.874
How many French lessons do you do speaking exercises?	Average 0.916
What do you think about French speaking in class?	Fun, Difficult, Informative, You learn how to have conversations
How do you currently study for an oral exam?	Reading and speaking with peers
What feeling do you have before doing an oral exam?	Nervous, unpleasant, "I hope I don't get picked", Tensive
How would you describe the current French lessons?	Always the same, tests, sometimes fun, sometimes boring, good, normal
Would you like to have it different?	6 Yes 14 No 4 Don't know
If yes, how would you imagine this?	More talking, more playful lessons
Have you ever played a VR game?	13 Yes 11 No

Have you ever played a PC game?	21 Yes 3 No
What class are you in?	15 First years 9 Second years

Table 1: Results pre-testing survey

French class division

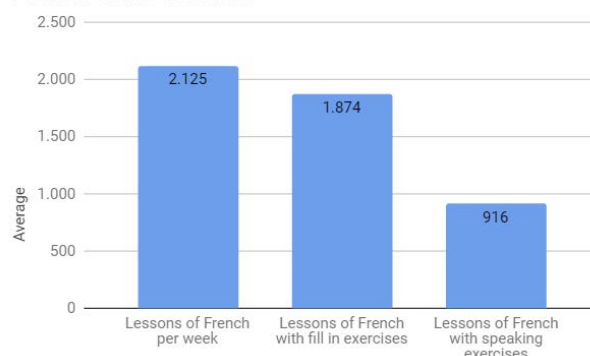


Figure 1: French Class Division

This data indicates that students speak/listen a significant amount less than they write/read. Students expressed that they currently don't especially enjoy the lessons. They feel quite neutral about this. Most of the students hadn't before tried a VR or PC game, which means they still had to get used to the controls and overall experience. Add alternative text to all figures

RESULTS AFTER-TEST SURVEY

After the students did the game or the fill in exercises they filled in another survey about how they enjoyed the platform they tried out. The data is translated and elaborated in table 2;

Averages of the survey	VR	PC	Fill in
How interesting did you find your method?	4.375	3.75	2.888
How aware were you of the environment?	2.75	3.125	3.333
How aware were you of the other people?	1.875	2.375	3.666
How easy was it to talk in the game compared to real life?	3	3.375	

Do you feel like you learned more this way than by remembering cramming the words?	3.5	3.5	
Do you feel like you remember the words longer compared to cramming words?	3.125	3.75	3.111
Do you think it is a fun method to learn?	4.75	4.875	3.222
Would you like to have this:	6x as addition 3x as replacement 1x not in relation with school	5x as addition 4x as replacement	3x as addition 4x as replacement 2x not in relation with school

Table 2: Results after-testing survey

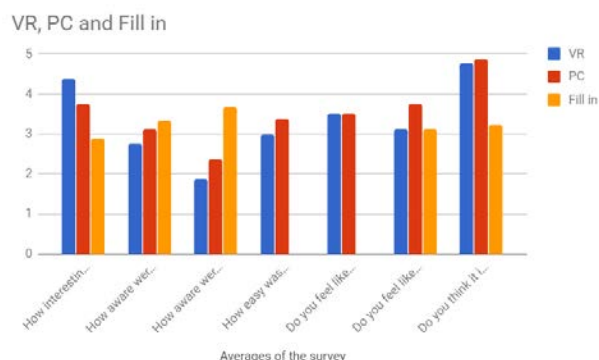


Figure 2: Averages of after-testing survey

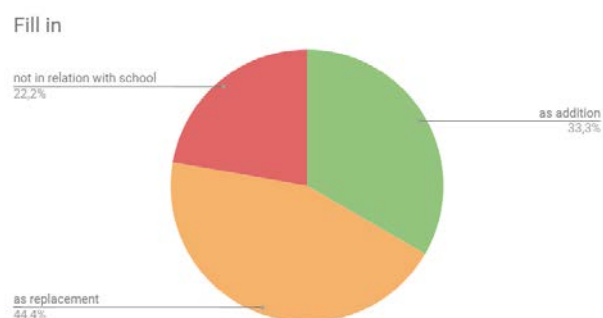
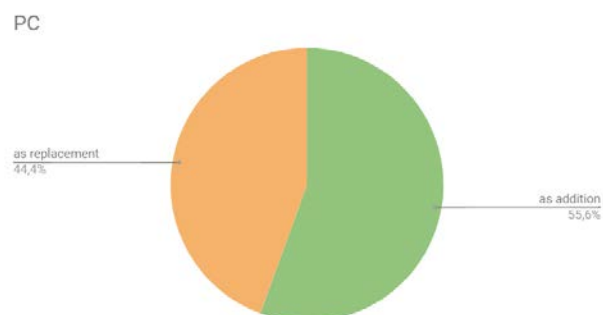
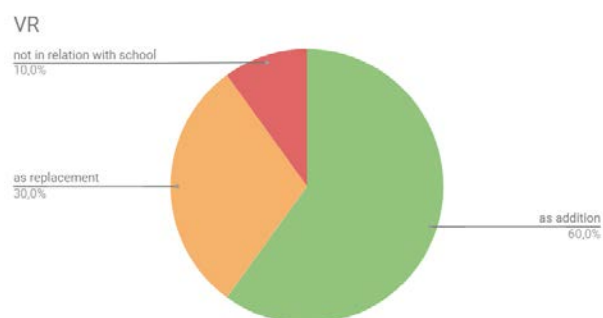


Figure 3: Comparison of VR, PC and Fill-in opinions on the question: *Would you like to have this; as addition on the curriculum, as replacement of the curriculum, not in relation with school*

RESULTS

	Total correct answers (correctly spelled and correct article):			Total partly correct answer (small mistake in spelling or article)			Total correct including partly correct answers:		
	Fill in	PC	VR	Fill in	PC	VR	Fill in	PC	VR
Mean	5.75	4.625	4	2.25	3.375	4.25	8	8	8.25

Standard Deviation	2.81 577 190 6	2.66 926 956 3	1.19 522 860 9	1.75 254 916 4	2.13 390 989 2	1.66 904 592 1	2.26 778 683 8	2.3 299 294 9	1.03 509 833 9
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Table 3: Final test results

Overview average results test

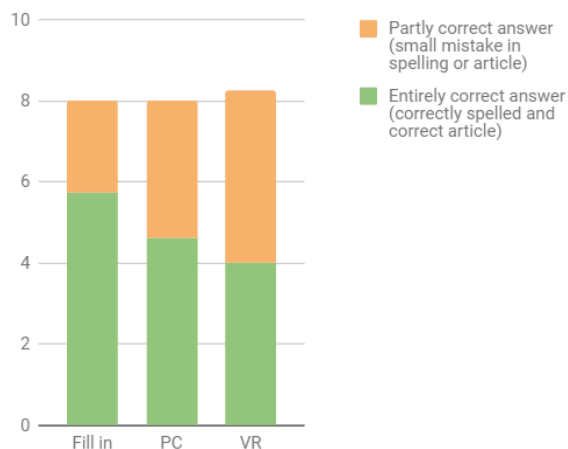


Figure 4: Overview of average test results

It can be seen in the gathered data that the Fill-in exercise participants scored the highest overall. Furthermore, the VR students scored highest in the amount of total words right including spelling or article mistakes, though only by a small margin. Both PC and VR do have similar results counting the partly correct answers. The standard deviation is much higher with fill in exercises when comparing it to PC and VR.

DISCUSSION

There are several limitations to the research. Firstly, as VR is limited to vision, audio and position of the body it cannot give the user the experience of certain things such as smell or structure of objects. This could be a future design; to make VR more realistic in order to make the learning curve better. Furthermore, the game now projects the word above the object which you are holding. This is something one doesn't have in real life. What now is not clear, if the immersive 3D environment in combination with the projected words is the thing making the retention better, or just the environments and the experience the test subjects are having. To distinguish this, an AR tool might be a prospective tool to use when researching this difference. Using an AR tool, the words and translations can simply be projected next to the object one is using in real life. If retention rate then is also increased, it could mean that the VR is not especially necessary for this.

Secondly, a thing that influenced the testing, is that the students needed help from the researchers to complete the game. The rate of immersion could be brought down by this. Furthermore, in the first round(s) of testing, the test subjects were only vocally and visually explained how the controls of the VR game worked. After a while, it was discovered, that giving them a minute to walk around in the game and testing out the controls, made it a lot easier for them to start the game without being too confused. This also created an increased learning curve, where it proved that they enjoyed the game more. However, all test subjects got unlimited time for every exercise, except for the initial phase where they got 5 minutes to look over the words. People who played on the VR or the PC, generally took a lot longer than the ones doing the fill-in exercises. Therefore, PC and VR might have scored higher simply because they had more time to practice the words. On the contrary they also had a longer period of time between their initial study of the words so they might have forgotten a few.

Thirdly, lots of positive reactions were given to the VR. And certainly, the researchers believe the VR could have a really positive effect on the memorization and understanding of languages. However, many children hadn't tried a VR console before. Which means the positive reactions could deducted from the novelty effect, where people are excited about something because it's new or they haven't experienced something like it before. Further and longer testing needs to be conducted to see the real long time results on the language education of high school students to prove this. If excitement decreases over time, focus, participation and motivation could also decrease and with that, the effectiveness of the game.

Moreover, with the current research, it cannot be seen what the effects are on the long run. The researchers don't know if the words learnt during the test, will eventually reside in the long-term memory. The VR is now only used for learning foreign vocabulary, but the question is if this is also the case for learning grammar. However, this also depends a lot on the specific language to be learned. Only the French language was incorporated in this test. Further testing should include other languages to, to see if the results are not only language specific.

An interesting concept, which has not been tested yet, would be that students help each other complete the game. Playfulness would this way be increased and multiple people at the same time will be learning the language. If this increases or decreases the learning of the language, would have to be inspected in further research. A chance that students would become more comfortable speaking and practicing in front of each other on the long run is also present.

"The use of digital games is usually a complement to [an] existing course, and as such, it is difficult to control for all the variables that can have an effect on learning outcomes" [19] Further research would need to be done to validate if VR gaming could be implemented in a high school curriculum. A lot of variables are part of this process, which possibly could make it hard to implement (e.g. costs).

Lastly, what also had a significant impact on the results was the fact there were only 8 participants per method. Due to the small test group and external factors, the quantitative results are not significant enough to make bold statements about the effectiveness of VR, PC or Fill in exercises however these results act as an indication/pilot to show the potential of these different methods. This illustrates the possible effect of the game and its effectiveness.

CONCLUSION

This research shows that, although the difference is not significant, students do tend to memorize more words after playing the VR game in comparison to the other methods. However, while there is only a 0.25 difference, which could also be considered statistic noise. This is why results look promising, but research needs to be done on a larger scale to receive clearer results. Furthermore, it does stand out that the students have more trouble remembering the correct spelling of the words when playing the VR or PC game. The subjects who did the game might have focused more on speaking as this was the final goal of the game and less on the spelling/articles than the Fill-in exercise group.

What is worth noting is the large difference in the standard deviation between fill in and the games. While the game participants all scored very similarly, the fill in participants' scores varied a lot more. For schools it might be desirable to have such results as it could mean more students passing.

VR creates a realistic and detailed environment for its users, when they interact with the objects they do not only link the French word that appears above the object to the dutch word, but unconsciously also the color, shape, sound, size, environment etc. Additionally, the characteristics of an object can trigger certain events in the brain for example shampoo in bathroom triggers washing. This, according to the self-reference effect, should make it easier for the user to relate to the object and remember it as the associations you make in your brain help you to recall information.

Research done by Young & Wang [23] stated that learners pointed out that speaking the target language with computers was easier than practicing with a real person. With VR the difference is even stronger. As stated in the observations, the immersive environment of the VR provided that practicing was even easier than practicing with computers.

It can be concluded that VR games including speech, can be an effective and more playful alternative method to be an addition to foreign language vocabulary education, but research on larger scale needs to be conducted to validate this.

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APPENDIX

A. Personal Reflections

Kay van den Aker

Starting of this project, I did not have much experience in designing games nor in designing for children, also doing a research project was something I had not done before. For me this was a completely new experience, it gave me a lot of new insights in how education works and how a game can help with that.

Throughout the span of the project I focused mostly on the vision/goal of the research and achieving this. I did this by providing clear structure in the group by using for example Trello and a shared Google Calendar to keep a clear overview of the to-dos and meetings. The basic structure of the Trello lists are as follows: Maybe, Inbox, To do, In progress, Waiting for, Done. In these lists the progress of all the tasks were easily kept track of and managed. This resulted in a structured overview, goal oriented to-dos and effective meetings. Having an efficient work flow and efficient meetings is in my opinion the best tool to be a good team, this also reflects to my competences as management is something I am currently passionate about and focused on. I feel like by applying this structure and keeping structure in the group I am now a more competent leader. The personalities of the group members are quite different therefore this was good practice. In the future, I want to keep developing this skill. I will be chairman of the study association next year which will provide me with a lot of practice in this area to keep learning.

At the beginning of the project, everyone focused on learning how to build a VR game. We created a group Unity project in which everyone got their own 'scene' in which everyone worked, this for the reason that if two people are working in the same scene and one publishes its work the other persons work gets lost. After applying this structure, we all efficiently worked together on the game and created a beautiful 3D environment. For me this all was very new, I have never been into gaming or unity but it was a good skill to practice. I now have the capabilities to build a 3D environment and walk through it with VR. A useful skill for future projects as I now can quickly build a prototype game and test it. I did not focus on the programming as I focused more on the research procedure and the user testing therefor I did not develop in this area, this is something I do want to learn in the future however as if now I am content with my development.

This research project was the first time I prepared and executed a user test with children and with such big group, 24 people. This was one of my focus points of the project, I, together with Natanya, focused on every aspect of the procedure. We taught everything through, created the surveys, the consent forms, the tests and the exercises for the children. This resulted in a smooth user test with almost

no difficulties, only the HTC Vive did not work out of the box at the first user test however this was fixed. Doing this taught me a lot about user testing with children and gave me interesting insights about education and immersion. I feel like I am now a more competent researcher and have more knowledge about the researched group. In future design or research projects this competence will be useful to create a 'user centered design'.

After the user tests were done, I focused on the data analysis. I created an overview of all the gathered data and analyzed it using the knowledge I have gained throughout the course design research; I calculated the Mean, Median, Mode, Range and Standard Deviation of the gathered data and created graphs to analyze the data. This resulted in clear data to verify our research with. Doing this taught me how to analyze a lot of data and translate it to useful information. I want to keep developing this skill in the course Making Sense of Sensors to keep improving in this competence as it is of high importance to understand data as a researcher.

To conclude, I learned a throughout the span of this research project. I focused more on the bigger picture and on the practicalities of the research such as the procedure and the management. I gained interesting insights in language learning, the self-reference effect and VR gaming. This all together made me, in my opinion, a more capable designer.

Additional comment:

Throughout the semester the coach meetings were in my opinion a little chaotic and somewhat short in time, I really missed the 'squad' and structure in Play and Learn. I only saw the projects of the fellow students at the midterm and at the demo day, in my opinion this is way too less as one can learn a lot from the work and progress of others. I believe Play and Learn can learn a lot from for example the C.R.I.G.S. squad, in this squad every project had to present weekly, we received feedback from two or three professors. I am by no means dissatisfied by the squad as it gave me one of the most valuable insights a professor can give a student which is the definition of one's preference. I just like feedback.

Jurrien Brondijk

Not long before I started this project I got interested in doing more with videogames during my studies. I was very glad to be able to do something of the sort in my project as well, so I could get some hands-on experience. I was interested in designing the game, creating assets as well as learning how to work with Unity, mainly focusing on building the world, not too much on programming per se.

While designing the game I made some sketches of how I imagined the world would look so we could try to recreate those. I also suggested the use of a state chart to determine what each character would have to do at every point of the game, this later helped when programming the character interactions.

Overall I would have liked to do more planning ahead of time, as we spent a lot of time during the making of the game rethinking how to do certain things.

While creating the game I kept trying to keep in mind how to make things clear to the player. As I was building the world I populated areas in such a way they would attract the players to certain areas, mainly by making areas the players have to visit more detailed. While we tested the game with high school students I took the opportunity to take a good look at the paths players took and bottlenecks that occurred, I found it very interesting to see players trying to interact with certain objects (especially doors) that they couldn't interact with. I later removed some of these to prevent these confusions. I actually learned a lot by doing this, and looking back I would do a few things differently, like making the marketplace less obscured by hedges as some players didn't initially notice it.

When we got to building the game it immediately became clear we wouldn't be able to make all the assets ourselves. There simply wasn't enough time and we had to focus on learning unity first. Sadly this caused me not to complete my goal of learning blender to be able to create assets.

I started building the world with the assets we ended up buying. Unity was actually quite easy to work with. Building the world was very similar to creating things in games like Planet Coaster. We used Unity's group feature, thus the world was built by the team as a whole. I focused mainly on detailed areas such as the market and castle interior. I started detailing the world with not only assets but things such as particle systems as well, which took me a while to figure out but ended up becoming quite acquainted with.

When it came to the programming part of the game we ran into some issues with the unity group feature. We each were working in separate scenes, but in order to reference objects they had to be in the same scene, which meant less people could be working at a time. We decided me and Niels would continue working on the game and I started doing more programming. I focused mainly on interactive systems, like the buckets and torches. I also focused on atmospheric aspects like sound and music. I came to realize that even simple things like these still require quite some programming. I learnt much more programming than I intended, but in the end I'm very glad I did as I believe it will help me later on if I want to do more with videogames.

In the end I'm very proud of what I have accomplished during this project. I went from having no knowledge of this program to being responsible for a large chunk of our own game. Seeing our design in action taught me a lot about things I would do differently if we had more time and skill. I'm happy to have my C# skills at a level I feel I could at least make prototypes for game ideas in the future.

I was interested in doing more with games, and this project definitely confirmed my interest.

Natanya Cornet

Starting of this project, I did not have much experience in designing games nor in designing for children, also doing a research project was something I had not done before. For me this was a completely new experience, it gave me a lot of new insights in how education works and how a game can help with that.

Niels Jansen

As a person I am very interested in new technologies, including of course augmented reality and virtual reality. That is why I choose to join the Connecting Realities squad for my previous project. I was hoping that there I would be able to do a AR/VR project, but unfortunately we ended up working with projections instead. Because of this I was really excited with the assignment for this project and made sure that I was heavily involved in the realization of our research tool/prototype. As a group we sort of split up in two teams. Jurrien and I build the VR game, while Kay and Natanya were setting up the research.

While working on the game I learned a lot. I obviously learned how to work with Unity and how to code in C#. Apparently you can also use Java in Unity, a language I already knew, but I'm glad I didn't use it and learned a new language instead. It was definitely hard to get everything working and some of the C# mechanics still seems confusing and stupid to me, but we managed to get everything working in the end. I think I personally worked on the game for about four days a week for five weeks long. I was very frustrated at times and the team would want to help me, but before they could I'd have to explain the entire code to them and that often did not seem worth the effort.

Apart from the technical part I also learned how to create 3D models and textures using blender. We originally wanted to create the entire game from our own models, but we quickly found out that this would take way too long. In the end however I did edit one of the castle walls from an asset pack to include a window, I created a bag of flour and I edited a gravestone from our assets to include our names and a cause of death. It was very fun to do and hopefully I

can do more of it in the future and also learn how to create animations for my models.

Like I said before I wasn't very involved in a lot of the research. I knew how to build up the game to suit our research and what the underlying effects were that we were using to better teach our users, but that's about it and I'm very happy with that. I followed the Psychology and Technology USE line "Human In Technology", so I'm very interested in psychology, but I've had to read a lot of papers for those and some other classes over the past year. Reading papers is not something I enjoy very much, so being able to simply learn about the effects without having to read entire papers and being able to practice my coding skills was ideal for me during this project.

Overall I'm very happy with our results and how we functioned as a team. Both teams really had to trust each other to do their part properly and in time. There was little time for us to redo or get stuck on certain things, but luckily everything went smoothly. Of course I do feel there were a few things we could have done better. I feel like Kay and Natanya would have liked to be more involved in the realization of our research tool and I could have spent more effort in getting them something to do. I also think we should have involved Una Paloma Blanca or a different French teacher a bit more during the realization, because our game seemed a bit difficult or inconsistent in some places. I also missed the weekly squad meetings more than I thought I would. There is a lot to learn from the ideas and choices from different groups and just seeing what they're working on is fun. I hardly had any time to look around during the Demo Day, so I don't even know what most of the Play and Learn projects were about.

B. Pre-test Survey

C. After-test Survey

D. Test

ID (in te vullen door researcher):

Toets

Vertaal de onderstaande woorden in het Frans, vergeet het lidwoord niet!

Nederlands	Frans
De bloem	
Het water	
Het ei	
De kom	
De taart	
De kat	
De badkamer	
De keuken	
De handdoek	
De zeep	

E. Fill-in Exercises

ID (in te vullen door researcher):

Invul opgaven

1. Mets les ingrédients dans (de kom)
2. (het ei) est pourri!
3. Est-ce(de meel)?
4. Peut-tu trouver(de handdoek) pour le sécher?
5. Vite, trouve-moi (de shampoo) pour mon adorable chat.
6. Jette un oeil à l..... (de badkamer)
7. Va dans..... (de keuken) sur la gauche.
8. J'ai entendu que Marc (de kat) avait besoin d'être nettoyée.
9. Avez-vous de (het water)?
10. J'entends que tu est venu pour aider le chef avec.....(de taart)

Consent Form

Onderzoek

Deze projectgroep van de TU Eindhoven doet onderzoek naar verschillende lesmethodes voor het onderwijzen van talen.

Procedure

Gedurende het onderzoek is het de bedoeling dat u meewerkt aan verschillende testen die op deze dag plaatsvinden in het kader van bovengenoemd onderzoek. Deelname aan deze onderzoeken is geheel vrijwillig. Als u van deelname aan het onderzoek af zou willen zien, om welke reden dan ook, kunt u dat op ieder moment doen. Als u aarzelt over deelname of vragen heeft over het onderzoek, kunt u die altijd stellen aan de een van de onderzoekers.

Bij dit onderzoek wordt gewerkt volgens de Code of Conduct van de Technische Universiteit Eindhoven. Het gedrag van onderzoeksdeelnemers kan voor onderzoeksdoeleinden worden geregistreerd. De verkregen gegevens worden altijd anoniem verwerkt.

Bij deze verklaar ik, (NAAM)..... dat ik deze werkwijze begrepen heb en ermee instem om deel te nemen aan dit onderzoek.

Handtekening

Datum

Consent Form

Onderzoek

Deze projectgroep van de TU Eindhoven doet onderzoek naar verschillende lesmethodes voor het onderwijzen van talen.

Procedure

Gedurende het onderzoek is het de bedoeling dat de leerlingen meewerken aan verschillende testen die op deze dag plaatsvinden in het kader van bovengenoemd onderzoek. Deelname aan deze onderzoeken is geheel vrijwillig. Als een leerling van deelname aan het onderzoek af zou willen zien, om welke reden dan ook, is dat op ieder moment mogelijk. Als een leerling aarzelt over deelname of vragen heeft over het onderzoek, kunnen ze die altijd stellen aan de een van de onderzoekers.

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Bij deze verklaar ik, (NAAM)..... dat ik deze werkwijze begrepen heb en ermee instem de leerlingen deel te laten nemen aan dit onderzoek en verantwoordelijk ben voor als hen iets overkomt.

Handtekening

Datum