Does gamification in virtual reality improve second language learning?

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***Abstract*—Previous works have shown the great potential of Virtual Reality (VR) in the area of Education. This paper studies if users can learn a second language when using a gamified VR application through an English learning test and how learning influences user satisfaction, sense of presence, cybersickness, and quality of experience through questionnaires. For this purpose, the VirtualeaRn game was developed. 20 Portuguese participants were exposed to the application, and the learning test was used before and after using the application. Result analysis shows an increase in learning results after using the VR gamified application, indicating the technology's efficacy in learning a second language. A positive user satisfaction, sense of presence, and quality of experience were also found. Some cases of cybersickness were reported. The outcomes are promising and provide enough information to show the potential of the gamification of VR technology for the area of learning a second language.**

***Index terms*—virtual reality; gamification; learning; education; foreign language; second language.**

I. Introduction

Some of the issues related to the traditional learning are associated with the lack of training, lack of proper facilities; for example, some classes are over crowded, and lack of oriented material that is dependent on the learner needs and knowledge, and the reactions towards the mistakes made by the learners during the process of learning [1][2]. The learning of the English language has been used the most diversified technology, being virtual reality (VR) one of them. It has been proved that its usage can bring benefits to English learning [3] and that professionals are open to its application since they believe it can motivate the learners [4].

The technology of VR allows the user's transportation to another dimension, the virtual world. Instead of being just an observer, the user can become the actor of the digital world, interact with it and receive feedback from those interactions [5]. Since this world is digital, it means that can be manipulated. It can simplify the production of a perfect learning environment where the user can learn by practising without the fear of failure, acquiring in this way the knowledge similarly to how it would be in the real world. In this way, gamification techniques can be introduced to improve the user's engagement and to achieve the most satisfactory results.

Gamification can be seen has a collection of steps to solve an obstacle using game-related elements' characteristics [6], such as score points, rewards that the user can win by achieving objectives, and the change of difficulty to challenge the gamer abilities. VR and games have been brought together through time with the most diverse purposes, e.g., training [7], entertainment [8] and education [9]. Therefore, VR can be a powerful pedagogical instrument for the evolution of methodologies in education. Serious games do not have entertainment as the primary objective. However, they can bring added value to the field of education since they can, in a way, entertain the user and at the same time provide learning in a particular topic. What highlights the technology of VR from others, such as mobile phones and personal computers, is that it can fully immerse the learner in a virtual environment, providing a mental and physical immersive experience, giving the sensation of being fully absorbed in the digital world.

In this paper, a case of study was developed through a game called "VirtualeaRn", which is contextualized in a job interview for a travel consultant position in a travel company. In order to get the job, it is needed to play three different levels with different challenges related to the English language. Confronted with these scenarios, the user needs to face the challenges and win them to end the game and get to know if got the job. Aiming to the contribution with new results for the area, this study was made to understand the impact of being exposed to a gamified VR application for English learning on the user satisfaction, the sense of presence, the cybersickness, quality of experience and the user learning results, using the VirtualeaRn game as a case study.

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II. Related Work

Although it has been already found a lack of similar work in the area, that is, the gamification of VR to learn a foreign language, empirical research has been made to gather available published studies and clarify the role of gamified VR in the area of learning a foreign language. Pinto et al. [10] in their systematic review of empirical research, found that more than half of the found articles proved that virtual reality technologies with gaming strategies could be used to learn a foreign language. The remaining articles had no obvious evidence that VR could decrease the learner scores. However, it was also found that the most used VR technology has been augmented reality, meaning that there is still also a lack of studies adopting the use of a fully immersive environment.

To expand scientific results on this area of education, some authors have been developing applications/games so their experiences and evaluation of learning outcomes are conceivable. One of those examples is the work of Tazouti, Boulaknadel and Fakhri [11]. The authors presented a 3D serious game ongoing project called "ImALeG" which provides an environment to learn the vocabulary of the Amazigh language. Their objective was to exploit the 3D VR environment to implement immersive and learn-by-doing techniques and evaluate it. Their results showed that ImALeg achieved better results in learning success, motivation, fun, and satisfaction than frontal lessons with the same content.

In another study, Garcia et al. [12] performed an experience using an interactive VR demo for the learning of Spanish. The demo allowed the users to enter a virtual world, to explore and interacting with their surroundings while learning the language. The focus group results indicated that the learners enjoyed learning through VR and that it was even more fun than the previous traditional methods that they had previously experienced. Besides, the experience participants also refereed that they believed that the virtual environment helped them remember the names of the objects in Spanish even better. Thus, the authors concluded that the feedback showed that learning a foreign language in VR has a potential future.

In their study, the authors Cheng, Yang and Andersen [13] adapted the game "Crystallize", for Japanese learning, to VR and conducted a formative user study to explore if VR could be used to design game mechanics around culturally relevant embodied physical interaction. The authors found the impact of the VR demo on learning inconclusive, suspecting that the users' interaction issues and that the cognitive overhead related to the adaption of the VR interface may have contributed to the less effective learning. However, it was observed a statistically significant increase in the participants' sense of cultural involvement.

Rakowski and Wojdynski [14] made a pilot study where was collected preliminary data regarding participants' attitudes towards high-immersive VR assisted language learning. In their experience with using an application, the learners were restricted to choosing a new language. The scenario was inside a moving taxi, and the users could see the surroundings in 360 degrees. Results showed that the learners' attitudes towards VR assisted language learning were positive and their engagement was high. Furthermore, the authors reported that it was felt more in the dynamic content and less in the static one regarding the cybersickness.

In the study of Yang et al. [15], the authors developed a three-dimensional animation VR English learning system where the learners could be able to study, practice and apply English to achieve communicative tasks by engaging and immersing themselves in a real-life simulated context. With the created system, the authors examined the effectiveness of the system and the sense of presence among the participants. Their results showed that the system actually contributed to significantly higher learning outcomes. Most participants were optimistic about the system regarding the spatial presence, involvement, and sense of realness. In this way, their goal of creating a sense of presence in the virtual world was achieved, and it led to an effective immersion experience for language acquisition among the students. The authors concluded their study by acknowledging that the VR-supported instruction is an appropriate pedagogical design for teaching communicative aspects of English, allowing the learners to be immersed and motivated in the learning tasks, leading to beneficial outcomes.

In sum, a lack of similar works in the area has been found, especially when it comes to fully immersive VR with gamification techniques for learning a second language. Besides the technological element, there has been a tendency for after experience immediate results, resulting in a knowledge gap regarding the retained knowledge after some time since the experience, comparing gamified VR with traditional methods. Overall, related work sustains the fact that learners are open-minded to learning with VR. This gave researchers opportunities to explore the best use of VR for education and the most adequate gaming techniques.

III. Methods

An empirical study with participants evaluated how being exposed to a gamified VR application for English learning impacts user satisfaction, the sense presence, the cybersickness, the quality of experience, and the user learning results.

A. Participants

This case study was made with 20 participants (16 males and 4 females), with ages between 20 and 51 years old ($M = 25,\ SD = 6.907$). The participants were invited through e-mail, and their participation was voluntary and confidential. Most of the participants had normal or corrected to normal vision. In general, the users informed that they had excellent knowledge about computers and a good understanding of VR systems.

B. Materials

1) Apparatus: For the experiment, a computer with an Intel Core i7-6700K @ 4.00GHz processor and NVIDIA GeForce 1080 graphic card was used to run the game in the Oculus Quest headset. The VR headset was used in Oculus Link

mode so that the application could run without frame rate loss throughout the experiment. The VR headset has a PenTile OLED display with 1440x1600 resolutions at 72Hz, positional tracking, and the Oculus Touch controllers are tracked via four wide-angle cameras in the front of the headset. These controllers were used to interact with the VR environment and track the player's hands inside the game. In addition, the Quest embedded speakers delivered the audio.

2) VirtualeaRn English Game: For the experiment, the VirtualeaRn game for English learning was developed in the Unity game engine (version 2020.1.6f1). The game has seven different scenarios, and all of the participants had to go through all the scenarios to end the game.

The first scenario is the game tutorial where the game mechanics are explained, how to interact with the user interface (UI) and how to use the controllers. Besides the UI and the haptic feedback, the controllers are used to interact with the boards of answers in the evaluation scenarios, such as in figure 1 where the user is holding the board with the virtual left hand. To validate the answer, the user needs to put it in the yellow grid box, also shown in figure 1.

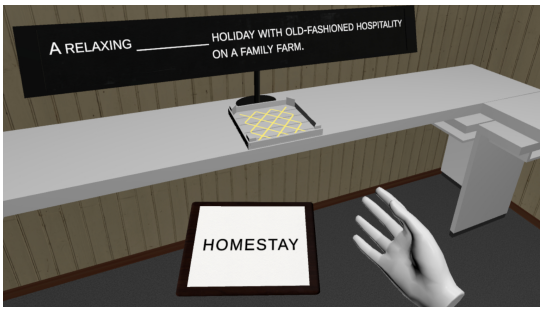

Fig. 1. Player holding the answer's board with the left controller.

Once the player have learned the game mechanics and is ready to continue, the game proceeds.

In the second scenario, shown in figure 2, the context of the game is presented by an avatar, on which the players understand that they are in an interview for the position of a travel consultant. To get the job they supposedly applied for, the users need to go through an evaluation to prove that they are the right fit. Once this scenario ends, the players go to the evaluation itself.

Fig. 2. The scenario of interview of the game VirtualeaRn.

The evaluation consists of three scenarios (the third, fourth and fifth), each with a different exercise. The exercises are from the book "English for international tourism" [16], which is for students of upper-intermediate and advanced levels. The first exercise, shown in figure 3, is the association of adjectives with nouns, the second is putting together a initially jumble phrase, and the third is to complete a phrase with one missing word.

Fig. 3. The first scenario of evaluation of the game VirtualeaRn.

All exercises have five challenges (items) and the theme of each one is also in the context of tourism. It is only possible to move forward in the challenges if the answers are all correct, meaning that the participants can check if their answer is correct or wrong, and if it is wrong, they need to change it until it is correct.

In these three evaluation scenarios, a television in front of the player displays a video with the interviewer avatar, as if the avatar was watching the player doing the exercises. In addition, at the beginning of each exercise, a video is played where the avatar explains the context and its objective.

Once the player has completed each challenge, a button to "Check answers" is displayed on the virtual TV. Depending on whether the answer is right or wrong, a video is played saying if the answers are correct or wrong, having different videos for each one. When the answer is correct, the video displayed also presents the right answer out loud so the player can listen to the words/phrases by the interviewer. Besides the video, a green indicator is also displayed (if the answer is correct) or a red indicator (if the answer is wrong) underneath the player's answer. This television also shows how long the players are in the game and the number of errors they make. A "Next game" or a "Next phrase" button appears if the answers are correct, depending on which part of the game the user is.

The sixth scenario starts once the player ends the evaluation. This scenario is divided into two since it depends on the player results from the previous scenarios. Suppose the player had more than a certain number of wrong answers. In that case, their sixth scenario is a negative speech from the initial avatar, but if the player had less than a certain number of wrong answers, the speech is positive. Finally. the users receive the information that they got the job they applied for.

Once this speech is over, the player goes to the seventh and final scenario, where it is possible to see the number of errors

made in the evaluations, the time it took to complete each one, and trophies related to these results, which can be observed in the wall in front of the users, represented in figure 4. Both the tutorial and final scenarios are in the participants' native language since they are not part of the evaluation. Therefore, it should be understandable for every player, independently of their English level of knowledge. Furthermore, in every scenario, participants could explore and walk freely within a tracked area (3 x 3 meters) in the VR environment, limited by the scenario itself.

Fig. 4. Wall of results in the final scenario.

C. Instruments and Dependent Variables

Besides the hardware and software used in this study, questionnaires were used to evaluate the considered dependent variables:

- *Sense of presence* - The validated Portuguese version of the Igroup Presence Questionnaire (IPQ) [17] was used, since it gives scores about the sense of presence and about the dimensions of spatial presence (the sense of being physically in the virtual environment), involvement (the attention devoted to the virtual environment) and experienced realism (the subjective realism of the virtual environment). It consists of fourteen likert scale items, where the answers are between one (totally disagree) and five (totally agree). Thus, the scores are between 0 and 5 points, with a higher value being better.
- *Cybersickness* - The Simulator Sickness Questionnaire (SSQ) [18] was used, which consists of sixteen items that give a cybersickness score (adverse symptoms to the experience), including its subscales: nausea, oculomotor discomfort and disorientation. The possible maximum in this questionnaire is 2437.88, and the minimum 0, and the higher the value is, the worse the symptoms are.
- *User satisfaction* - Results were acquired by the After-Scenario Questionnaire (ASQ) [19] using the system usability, which is built by the ease of task completion, time to complete and adequacy of support information and three additional items. It has also based on Likert scale answers and it is on a scale of seven, where one is "totally disagree" and seven is "totally agree". Therefore, the scores are between 0 and 7, with a higher value representing higher user satisfaction.
- *Quality of experience* - To get the evaluation of each participant towards the application, a Quality of Experience (QoE) questionnaire was developed by the investigators for this study, with five Likert scale affirmations. This questionnaire is composed by the evaluation towards the application, the sound, the scenario and the experience itself, having a global rating by the player. The scores are between 0 and 5, being the higher, the better.
- *English learning test results* - An English learning test was developed based on the same three exercises that were performed during the game, each with five items. The first and third exercises have a value of 7.5 each (1.5 values per correct item) and the second has a value of 5 (1 value per correct item) for a total of 20 values. The test is available in appendix A.

All the instruments were answered in pen and paper format as the participants' native language information, except the English learning test in English.

D. Procedure

The experiments were done in a controlled room. Once the participant entered the room, they would be asked to put the mobile phone in silence mode and sanitize their hands. At the same time, it was explained that all of the equipment used was previously sanitized. After that, it was told that the participant needed to sign a consent form before the experiment and fill the sociodemographic questionnaire and the first English learning test, which took on average 13:16 minutes per participant ($SD = 0.002$). Once the participant was done, it was explained that the experiment was in an interview context to the job of a travel consultant, that in the beginning, it would be explained how to work with the controllers, that it is possible to walk freely in the environment, and that the application would tell them when to take out the headset.

Once the participant was ready, the investigator would help them put on the headset, make sure that it would stay comfortable in their head, and give them the controllers. Once the participant had the controllers, they could start the experience (figure 5). The experience lasted an average of 15:09 minutes per participant ($SD = 0.003$). At the end of the experience, the investigator would take the controllers from the participant's hands to facilitate their action of taking out the headset.

After the headset was taken off, the participant would go to the next phase on which the remaining questionnaires were filled. This took on average 09:14 minutes per participant ($SD = 0.002$). At this point, the participants would again fill the English learning test, but with the questions in a different order. After that, they would fill the IPQ, SSQ, ASQ, and finally the QoE questionnaires.

Overall, each participation took in average 41:22 minutes ($SD = 0.007$). Once the participants left the room, the investigator would always sanitize the used equipment and put an anti-fog spray on the Oculus lenses, making the room and equipment ready for the next experience.

Fig. 5. Participant during the virtual reality experience.

E. Statistical Procedures

The SPSS 23 software was used to perform statistical analysis. An exact sign test was used to compare the before and after results of the English learning test. The Spearman's correlation was used to determine whether there was a correlation between all the dependent variables, namely the sense of presence, cybersickness, satisfaction, quality of experience, and the English learning test results.

IV. Results

Table I shows the descriptive statistics for each of the dependent variables.

Regarding the learning test results, the application showed influence in helping achieve better results after its use. Users scored lower ($M = 12.200,\ Mdn = 12.500$) before playing the VirtualeaRn game (pre test) and higher ($M = 18.425,\ Mdn = 20$) after playing the game (post test). An exact sign test was conducted to determine the VirtualeaRn game's effect on the English learning test results. Of the 20 participants recruited to the study, 18 participants had better results after playing the gamified VR application, and two performed the same before and after the game. There was a statistically significant median increase in the test results ($Mdn = 6.00$) after subjects were submitted to the gameplay of the VirtualeaRn VR application, $p < 0.0005$.

A Spearman's rank-order correlation was performed to assess the relationship between all the dependent variables. The twenty participants were considered. Analysis showed a statistically significant, strong positive correlation between presence and involvement, $r_s(18) = 0.851,\ p < 0.01$, between disorientation and oculomotor discomfort, $r_s(18) = 0.634,\ p < 0.01$, between cybersickness and nausea, $r_s(18) = 0.621,\ p < 0.01$, between cybersickness and oculomotor discomfort, $r_s(18) = 0.820,\ p < 0.01$, between cybersickness and disorientation, $r_s(18) = 0.894,\ p < 0.01$, between scenario and user satisfaction, $r_s(18) = 0.663,\ p < 0.01$, between scenario and application, $r_s(18) = 0.665,\ p < 0.01$, between quality of experience and user satisfaction, $r_s(18) = 0.684,\ p < 0.01$, between quality of experience and application, $r_s(18) = 0.856,\ p < 0.01$, and between quality of experience and scenario, $r_s(18) = 0.878,\ p < 0.01$. Analysis also showed a statistically significant positive correlation between presence and spatial presence, $r_s(18) = 0.472,\ p < 0.05$, between nausea and presence, $r_s(18) = -0.468,\ p < 0.05$, between oculomotor discomfort and nausea, $r_s(18) = 0.527,\ p < 0.05$, between application and experienced realism, $r_s(18) = 0.506,\ p < 0.05$, between application and user satisfaction, $r_s(18) = 0.479,\ p < 0.05$, between experience and disorientation, $r_s(18) = -0.542,\ p < 0.05$, between experience and cybersickness, $r_s(18) = -0.467,\ p < 0.05$, between experience and user satisfaction, $r_s(18) = 0.535,\ p < 0.05$, between quality of experience and sound, $r_s(18) = .519, p < 0.05$, and between quality of experience and experience, $r_s(18) = 0.546,\ p < 0.05$. Regarding the correlation between the remaining variables, there was no statistically significant correlation. More information are presented below in table II.

V. Discussion

Results of the study show a vast difference between the user learning results from before to after playing the VirtualeaRn game. These outcomes suggest that the use of gamified VR is beneficial to the learning of a foreign / second language, which can corroborate the primary outcome of the systematic review of Pinto et al. [10], where it was found that most of the studies that were made had a positive outcome regarding the learning of a foreign language. As opposed to the results of the study of Cheng, Yang and Andersen [13], the observed interaction issues did not anecdotally affect the learning process. Despite the issues with interacting with the UI of the game, mostly from users that never had experienced VR beforehand, those issues were surpassed with the tutorial or with the continuous attempts of learning during the game itself. Therefore, this possible cognitive overhead related to the adaptation to the VR interface did not affect the language's learning outcomes.

The results from the exact sign test show that, from the 20 participants, at least half of the participants had an increase of 6 or more values on the English learning test after playing the VirtualeaRn game and that none of the participants registered a decrease in the learning results. In addition, at least half of the learners had the maximum score in the post-test. These results support the suggestion that the use of gamified VR helps learn a second language.

When it comes to the sense of presence variable, high results could be expected because of the immersive VR environment. However, only somewhat positive values were found towards the use of the application. This outcome can be explained by the Quest embedded speakers delivering the audio, and even though the experience was made in a controlled environment, there is always some possible outside noise. However, at least half of the participants had a good sense of presence during the experience. Some reported being fully involved by the VR environment, forgetting the place where they physically were. One of the users claimed that "the virtual world was really well represented and it makes the player fully involved in the task and forgetting the real world". These results are similar to the results of the study of Yang et al. [15] where it was found that the participants were optimistic about the

TABLE I
DESCRIPTIVE STATISTICS FOR THE DEPENDENT VARIABLES

Dependent Variable	M	SD	Mdn	Min	Max
Pre English Learning Test	12.2	4.443	12.5	3	20
Post English Learning Test	18.425	2.129	20	14	20
Presence	3.76	0.430	3.68	3.14	4.53
Spatial Presence	4.33	0.379	4.33	3.50	5.00
Involvement	3.81	0.986	4.13	2.00	5.00
Experienced Realism	3.14	0.714	3.00	1.50	4.25
Cybersickness	113.06	360.897	0.00	0.00	1626.97
Nausea	6.20	23.424	0.00	0.00	104.94
Oculomotor Discomfort	8.72	27.305	0.00	0.00	121.28
Disorientation	15.31	46.746	0.00	0.00	208.80
User Satisfaction	6.508	0.790	6.75	4	7
Quality of Experience	4.75	0.326	4.813	3.75	5

TABLE II
SPEARMAN'S CORRELATION BETWEEN DEPENDENT VARIABLES (*. CORRELATION IS SIGNIFICANT AT THE 0.05 LEVEL (2-TAILED); **. CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED)).

	Post English Learning Test	Spatial Presence	Involvement	Experienced Realism	Presence	Nausea	Oculomotor Discomfort	Disorientation	Cybersickeness	User Satisfaction	Application	Sound	Scenario	Experience
Spatial Presence	-0.184													
Involvement	-0.008	0.254												
Experienced Realism	0.112	0.161	-0.024											
Presence	-0.018	**0.472***	**0.851****	0.405										
Nausea	-0.9312	-0.092	-0.396	-0.122	**-0.468***									
Oculomotor Discomfort	-0.066	-0.357	-0.030	0.051	-0.161	**0.527***								
Disorientation	-0.126	-0.364	-0.269	0.287	-0.245	0.348	**0.634****							
Cybersickeness	-0.056	-0.349	-0.271	0.127	-0.339	**0.621****	**0.820****	**0.894****						
User Satisfaction	0.382	0.214	0.275	0.226	0.315	-0.331	-0.091	-0.245	-0.240					
Application	-0.120	0.334	0.125	**0.506***	0.291	-0.106	0.014	0.110	0.041	**0.479***				
Sound	-0.181	-0.183	0.222	0.126	0.218	-0.385	-0.003	-0.144	-0.296	0.369	0.324			
Scenario	-0.060	0.162	0.195	0.402	0.311	-0.050	0.062	0.118	0.073	**0.663****	**0.665****	0.402		
Experience	0.147	0.198	0.365	0.199	0.436	-0.397	-0.334	**-0.542***	**-0.467***	**0.535***	0.395	0.286	0.388	
Quality of Experience	-0.006	0.255	0.283	0.443	0.422	-0.348	-0.081	-0.029	-0.111	**0.684****	**0.856****	**0.519***	**0.878****	**0.546***

system regarding the sense of presence, which led to a practical immersive experience for language acquisition.

Regarding the cybersickness variable, the results show that only a few users were sensible to cybersickness symptoms. In this case, the higher the values the higher cybersickness it was felt. Even though a considerable part of the participants did not feel cybersickness during the application, some of them reported nausea, "heavy" head and general discomfort after the experience. This outcome can be explained by the fact that it was the first time in VR for some of the participants. Another possible cause is the fact that it is possible to walk and at the same time to read the text presented in the virtual environment, which can cause some dragging in the image, something that does not happen in reality. Rakowski and Wojdynski [14] on their study reported that, on their experiment, more cybersickness was felt by the participants when more dynamic content is presented and less in a static one, which is in line with this study results. However, from both studies, it can be assumed that cybersickness is still a fragile variable that highly depends on technology, interaction methods, and

people. Therefore, further work should be done to allow for a more accurate discussion.

High score were found related to the user satisfaction results, meaning that the participants were delighted with the experience. In the box of suggestions, the users expressed their delight regarding the experience and the application with some observations, such as: "Amazing experience!", "This is a good way of learning, it would make sense if it was used in school", "I think that the environments were really good and the exercises really helped, in the sense of interactivity, to understand certain things in English better", and "Very intuitive game and easy to play". The authors also observed noticeable enthusiasm from the users during the gameplay. After taking the headset, it was common to see the users smiling and reporting that it was incredible to play the VirtualeaRn game. These results can corroborate Tazouti, Boulaknadel and Fakhri's [11] good results related to the satisfaction variable. However, you must note that our study does not compare VR learning to traditional learning.

Regarding the quality of experience variable results, the obtained outcomes from the questionnaire were tremendously positive. The users showed their appreciation towards the application, sound, scenario and experience, demonstrating a positive quality of experience. For example, some of the participants reported that "The scenario was appealing and the methods of interaction were suitable. The world itself was realistic enough for me", "the virtual world is really well done, and it keeps us locked inside it", "I really liked the physics of the objects", "the world looked really well build and with sense", and "the music was really relaxing".

Concerning the results of Spearman's correlation, which are presented in detail in table II, some interesting results were found. Analysis showed a statistically significant, strong positive correlation between the variable of quality of experience and global satisfaction, meaning that when the quality of the experience was high, the user satisfaction was also high, and vice versa. Besides, it is also noticeable that the "application", the sub-scale of quality of experience, showed a statistically significant positive correlation with "experienced realism", a subscale of presence. It is possible to take from this result that when the experienced realism felt by the user was high, their evaluation of quality towards the application was also high. Therefore, we can hypothesize that the higher the felt experienced realism, the higher their propensity to appreciate the application.

The subscale "experience", of quality of experience also showed a statistically significant negative correlation with "Disorientation", sub-scale of cybersickness, and "Cybersickness" itself. Contrariwise, the values presented in this correlation are negative. When the value reported was high, the other variable had a low value, suggesting that the participants liked the experience, even more, when they did not feel any disorientation cybersickness. A similar situation happened between the subscale "nausea", of the variable cybersickness, and the variable "presence", where a statistically significant negative correlation was also found. The presented values are negative, meaning that when the result of nausea was high, low values for presence were found, and vice versa, suggesting that when the nausea was felt, the felt presence was low.

VI. Conclusion

This paper describes a gamified VR application that was developed targeting the learning of English as a second language. The game is contextualized in a job interview for the position of travel consultant in a travel company. To finish the game and see the final results, the user must face the challenges presented in English and get all of them right, having an opportunity to fail and understand where the mistakes are and fix it for them right after.

This study had as objective the understanding of the impact of being exposed to a gamified VR application for English learning on the user satisfaction, the sense of presence, the cybersickness, quality of experience and the user learning results, using the VirtualeaRn game as a case study.

According to our analysis, we can conclude that the use of the game is enjoyable by the players, that the game is reasonably immersive, and that it supports the learning of a foreign language, which was found in the growth of scores between a pre and post-experiment English learning test.

In general, the outcomes are promising and provide enough information to assume the potential and the efficacy of using a gamified VR application in this field of education. In this way, further work can complement new levels and new scenarios with even more diversified aspects of the English language. It can also be complemented with the use of headphones to enhance the immersion of the game. Furthermore, a better tutorial can be developed with a more extensive UI to improve the interaction by the players with the UI of the game. In addition, limitations due to the COVID pandemic were noticeable in the sample size, which can be expanded in future work with the complement of further evaluations to understand if this learning through the game is also noticeable in a long-term condition and compared to a traditional learning method.

In conclusion, this research contributes to understanding the potential of the gamification of VR technology in education and supporting the fact that the VirtualeaRn VR game effectively teaches a second language, reinforcing the potential of the technology to support this area beneficially.

Appendix A
English Learning Test

- Exercise A – MATCH: Each group of three adjectives can be used to describe one of the nouns below. Match each noun with one set of adjectives.
  - *Groups of three adjectives: Low-rise, Spacious, Well-appointed; Spectacular, Soaring, Majestic; Secluded, Safe, Sheltered; Relaxed, Carefree, Welcoming; Quaint, Old-World, Charming.*
  - *Nouns: Beach; Hotels; Village; Atmosphere; Mountains.*
- Exercise B – ARRANGE THE PHRASE: Below there is jumbled questions. Put them in the right order.

  - *details? if the you I mind do check*
  - *sharing mind twin you a would bedroom?*
  - *me you is? can what tell fax your number*
  - *for I necessary shall the make arrangements you?*
  - *you in mind filling would this form me? for*
- Exercise C – THE MISSING WORDS: There are words below. Fill in the gaps with the correct word.
  - *Phrase: A relaxing (gap) holiday with old-fashioned hospitality on a family farm.*
    - *Words: Winter Sports; Special Interest; Homestay; Cruise; Safari; Adventure; Package Tour; Weekend Break.*
  - *Phrase: A month's (gap) holiday lost in the amazon rain forest.*
    - *Words: Business; Paris; Adventure; Commerce; Cuisine; Sit Back And Relax; Locomotion; Self-Catering.*
  - *Phrase: A fortnight's (gap) holiday for the family in a rented Swiss chalet.*
    - *Words: Business; Weekend Break; Special Interest; Cruise; Safari; Package Tour; Self-Catering; Adventure.*
  - *Phrase: A(n) (gap) in Amsterdam to visit the Rijksmuseum and be back in time for work on Monday.*
    - *Words: Air Travel; Eco-Tourism; Honeymoon; Vacation; Business; Weekend Break; Transport; Accommodation.*
  - *Phrase: A(n) (gap) holiday skiing on the slopes of the Pyrenees.*
    - *Words: Locomotion; Excursion; Hiking; Special Interest; Water sports; Package tour; Winter sports; Safari.*

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REFERENCES

[1] Roshan Ali Teevno. Challenges in teaching and learning of english at secondary level class x. *International Journal of Human Resource Studies*, 1(2):27, 2011.

[2] S Erdem and OF Tutkun. Problems in english language teaching according to secondary school students. *TOJET: The Turkish Online Journal of Educational Technology,(Special Issue for INTE 2016)*, pages 268–275, 2016.

[3] Tzu-Yu Tai and Howard Hao-Jan Chen. The impact of immersive virtual reality on efl learners' listening comprehension. *Journal of Educational Computing Research*, page 0735633121994291, 2021.

[4] Bruno Peixoto, Darque Pinto, Aliane Krassmann, Miguel Melo, Luciana Cabral, and Maximino Bessa. Using virtual reality tools for teaching foreign languages. In *World Conference on Information Systems and Technologies*, pages 581–588. Springer, 2019.

[5] Philippe Fuchs, Guillaume Moreau, and Pascal Guitton. *Virtual reality: concepts and technologies*. CRC Press, 2011.

[6] Jingjing Hu. Gamification in learning and education: Enjoy learning like gaming: By sangkyun kim, kibong song, barbara lockee, and john burton. pp 159. pp 138. cham, switzerland: Springer international publishing ag. 2018.£ 55.16,(hbk). isbn 978-3-319-47282-9 (hbk), 2020.

[7] Zhipeng Liang, Keping Zhou, and Kaixin Gao. Development of virtual reality serious game for underground rock-related hazards safety training. *IEEE Access*, 7:118639–118649, 2019.

[8] 50+ new playstation vr games coming this year and into early 2018, Oct 2017.

[9] Tassio de Souza Silva, Edwin Carlo Ribeiro Marinho, Giordano Ribeiro Eulalio Cabral, and Kiev Santos da Gama. Motivational impact of virtual reality on game-based learning: Comparative study of immersive and non-immersive approaches. In *2017 19th Symposium on Virtual and Augmented Reality (SVR)*, pages 155–158. IEEE, 2017.

[10] Rafael Darque Pinto, Bruno Peixoto, Miguel Melo, Luciana Cabral, and Maximino Bessa. Foreign language learning gamification using virtual reality—a systematic review of empirical research. *Education Sciences*, 11(5):222, 2021.

[11] Yassine Tazouti, Siham Boulaknadel, and Youssef Fakhri. Imaleg: A serious game for amazigh language learning. *International Journal of Emerging Technologies in Learning (IJET)*, 14(18):28–38, 2019.

[12] Sarah Garcia, Ronald Kauer, Denis Laesker, Jason Nguyen, and Marvin Andujar. A virtual reality experience for learning languages. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, pages 1–4, 2019.

[13] Alan Cheng, Lei Yang, and Erik Andersen. Teaching language and culture with a virtual reality game. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, pages 541–549, 2017.

[14] Regina Kaplan-Rakowski and Tomasz Wojdynski. Students' attitudes toward high-immersion virtual reality assisted language learning. *Future-Proof CALL: language learning as exploration and encounters–short Papers from EUROCALL*, pages 124–129, 2018.

[15] Fang-Chuan Ou Yang, Fang-Ying Riva Lo, Jun Chen Hsieh, and Wen-Chi Vivian Wu. Facilitating communicative ability of efl learners via high-immersion virtual reality. *Journal of Educational Technology & Society*, 23(1):30–49, 2020.

[16] Miriam Jacob, Peter Strutt, et al. *English for international tourism*. Pearson Education Limited, 1997.

[17] Jacinto Vasconcelos-Raposo, Maximino Bessa, Miguel Melo, Luis Barbosa, Rui Rodrigues, Carla Maria Teixeira, Luciana Cabral, and António Augusto Sousa. Adaptation and validation of the igroup presence questionnaire (ipq) in a portuguese sample. *Presence*, 25(3):191–203, 2016.

[18] Robert S Kennedy, Norman E Lane, Kevin S Berbaum, and Michael G Lilienthal. Simulator sickness questionnaire: An enhanced method for quantifying simulator sickness. *The international journal of aviation psychology*, 3(3):203–220, 1993.

[19] James R Lewis. Ibm computer usability satisfaction questionnaires: psychometric evaluation and instructions for use. *International Journal of Human-Computer Interaction*, 7(1):57–78, 1995.