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GaeltechVR: Measuring the Impact of an Immersive Virtual Environment to Promote Situated Identity in Irish Language Learning

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Abstract

This study investigates how a design-based research methodology is best suited to measuring the impact of a designed virtual reality experience to improve situated identity in Irish learners focusing on their attitudes, motivation, and confidence as Irish language learners. This paper describes the design of GaeltechVR: an immersive Irish language VR experience designed for the VIVE Pro. It also gives the results of a mixed-methods study to measure the impact in a local adult Irish language learner context. A questionnaire on situated attitudes and motivation to language learning (Ushioda & Dörnyei, 2009) was adapted for the Irish context to investigate a small scale sample of the local context's attitudes to Irish language learning. The participant's gameplay was recorded for analysis along with questionnaires on presence (Witmer & Singer, 1998), simulator sickness and an adapted questionnaire on their attitudes after the intervention.

Using best practice in design-based research experiments (Nelson, Ketelhut, Clarke, Bowman, & Dede, 2013) the study had two main goals: To investigate the usability of the design of GaeltechVR and to measure the impact of the intervention on attitudes, identity and motivation in the local Irish language learning context.

1.   Introduction

In an educational context, we view impact as a measure of the targeted changes in a learner due to the effect of educational interventions. Proof that virtual worlds are capable of educational influence to deliver an impact to their intended context is vital for the virtual world research community to demonstrate the value of virtual worlds for education. Measuring the impact of an educational intervention is a complex task. Firstly, impact involves defining what is it we "learn" when engaging with an immersive world. The major theories of learning or "grand theories" have been broadly defined by four major fields of inquiry: behaviorism (Skinner, 1967), cognitivism (Piaget, 1953), social constructivism (Vygotsky, 1962) and socio-cultural theory (Lave & Wenger, 1991). Decades of research into virtual worlds have evolved our perception of how virtual worlds affect learning. As our knowledge base and our virtual worlds have evolved in complexity our methodologies and worldviews have also changed thus changing how impact in these virtual environments is measured.

2.   Background

2.1. Impact In Learning: Situated Learning

Our worldview of impact in learning is influenced by sociocultural theory, also known as situated learning theory. Situated learning is immersion in a particular social situation over time to gain skillful knowledge along with the ability to engage in the norms and practices of a socio-cultural group known as a community of practice.

Language is developed over time by a language community, and these communities are formed through identity recognition. If the speaker is recognized, and understood by the listener they become part of a social group of speakers, as experience guides their development, they develop a personal identity alongside linguistic practices which articulates this identity (Eckert, 2006). Situated learning views an individual's activity as an act of participation in a system of practices that are constantly evolving (Cobb & Bowers, 2014). It views learning and its impact as a continual process of negotiation between the individual and the community of practice. The learner's self-identity changes to become part of the new community of practice. This theory views impact as a continual process-orientated system of constantly changing values. According to this worldview impact of an intervention is measured by investigating the social and emotional dimensions of an individual as well as traditional learning outcomes such as retention of learning outcomes. In order to measure this, work has been done to investigate motivational impacts such as the research of Zoltán Dörnyei.

2.2. Dörnyei's Theory Of Motivation

Dörnyei's motivational self-system is a process-orientated system of motivation (Dörnyei, 2003) interested in the short and long term identity changes in L2 language learners. L2 refers to the non-native second language of the speaker. Dörnyei's theory of motivation is drawn from the work of R.C. Gardner. Gardner was a social psychologist working in the bilingual context of Canada. He proposed that two main factors influence L2 performance: aptitude, and motivation in learning. He formulated these factors into his Attitude/Motivation Test Battery (ATMB) questionnaire (Gardner, 1985). Gardner believed that while language aptitude accounted for individual differences in language learning achievement, motivational factors can override the aptitude effect. This is usually observed when it is demanded in the social setting many people master an L2 regardless of their aptitude differences (Dörnyei, 1998). Dörnyei's model (Ushioda & Dörnyei, 2009) has three distinct categories:

1.   The ideal L2 self - the individual's imagined, ideal future self as a language speaker.

2. The ought to L2 self - associated with extrinsic motivation and includes the aspects an individual feels they need to meet the expectations. This includes factors such as family influence or promotional factors in learning the L2.

3. The L2 learning experience - includes the situational and environmental aspects of the language learning process as well as one's subjective learning experience. This includes factors such as classroom experience or a specific teacher.

Language learning is context dependent and involves meaning-making to occur between the context of the individual and their self-identity (Kormos & Csizér, 2008). Dörynei's work, therefore, seeks to illuminate the factors involved in this meaning-making process and allow researchers to quantify an individual's state in this process, thus measuring the impact an educational intervention is having.

2.3. Irish Language context and virtual reality

In a virtual immersive setting, a user experiences presence in the virtual world when self-location and perceived actions are connected to a mediated spatial environment, and mental capacities are bound by the mediated location instead of reality (Cummings & Bailenson, 2016). When the virtual reality experience is accepted as a real place this allows the user to experience their new context. This, in turn, assigns new meaning to the user's interactions in the environment.

When they are recognized in this context in their role they take on a new identity. From a constructivist perspective language facilitates meaning-making (Piaget, 1953) (Vygotsky, 1962). According to the most recent census only 73803 Irish people reported that they spoke Irish daily outside the education system. This represents only 1.7 percent of the population (CSO, 2017). This situation creates a significant challenge for adult Irish language learners who do not have access to a community of practice. VR studies have begun to illustrate its potential for language learning in areas such as vocabulary retention (Vazquez, Xia, Aikawa, & Maes, 2018) and cultural awareness (Cheng, Yang, & Andersen, 2017). We seek to design the game from a situated perspective to give participants the ability to interact with native-speaking avatars to provide them with a community of practice.

2.4. Design-based research for impact

The design of virtual worlds for learning is second-order design (Salen & Zimmerman, 2004). This means that the designer does not have direct control over its players, but rather they build contexts that the player interacts with. The designer seeks to build an environment that the player can freely and intuitively interact with and learn from. Thus, multiple iterations of the design are essential to understand how the player interacts in the game. The virtual world contains the rules and structures that guide the participant through the world, and the designer builds these systems. A participant's understandings are developed through performance within these systems which instantiate theories of the world (Squire, 2006). This means that for the intended learning of an intervention to occur it is vital that the worldview of the virtual world can build upon the worldview and previous understanding of the participant. Virtual worlds must take the worldview and understanding of the specific target context group into account during the design phase. These virtual worlds must also assess their impact during the design phase to help foster design decisions that create a successful intervention. There is a growing consensus that impact must be assessed during the creation of designed context for learning (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012). Design-based research is the methodological toolkit that addresses these concerns in virtual world design for research. This methodology is relatively new, traced back to the work of Brown (1992) and Collins (1992), but it offers a flexible approach to educational research which is required for researchers authoring new environments to fulfill their learning agenda. Design-based research believes in continual refinement of a design

intervention (Barab & Squire, 2004). In a traditional research experiment a hypothesis is constructed and tested rigorously with experimentation. The results then align with a hypothesis, partially align or do not (Creswell, 2013). These results are then disseminated.

Design based research separates itself from traditional fields of science in two ways:

1. Design-based research accepts that educational contexts have too many variables to account for and instead it attempts to focus on understanding the messiness of real-world practice. Context is interwoven into the methodology and not treated as an isolated variable (Orngreen, 2015).

2. Context serves an important purpose under the methodology. The methodological design of interventions leads to localised small-scale experiments. The design is refined based on the measurable impact it's having. These localised results are then used to create generalisable theoretical claims based on the results (Nelson et al., 2013). The design seeks to focus on the exploration of a specific context. It examines how the virtual world has modified this context under specific design parameters. This leads to more applicable results. Which allows for a fuller account of the nature of the impact of the virtual world.

3. Methodology

3.1. Aims

GaeltechVR was developed with Unity3d for the HTC VIVE Pro, the most advanced current generation of head mounted displays (HMD). An HMD is a device worn on the head. It is used to evoke a sense of presence in the user. It ensures that the display is positioned right in front of the user's eyes in any direction they look.

In the first cycle of the study, there were two main objectives:

1. To ensure the design worked for its intended purpose through an investigation of the user's presence in the environment and any simulator sickness felt.

2. To improve the participant's attitude and motivation in their ability to become a fluent Irish language speaker as a result of the interaction with the virtual world.

3.2. Participants

The context of the participants was vital for the study as we measure the attitudes of current adult Irish language learners in a real context. In order to assess the impact in real context, information sheets were given to the Irish language classes organized by Oifig na Gaeilge TU Dublin. All participants of the study had to be partaking in the Irish language classes.

3.3. Questionnaires

Questionnaires were used as the main source of data. Questionnaires were chosen for this aspect of the study as they offer a measurable metric for comparison between the pre-test and post-test, and they are useful for asserting attitudes towards specific languages and the language learning process in different environments (Dörnyei & Csizér, 2012).

3.4. Pre-test

Before interacting with the virtual environment, a pre-test questionnaire was given to participants. This was to address an issue with current educational research studies where only 19% of technology in education studies contain a pre-test to post-test condition (Randolph, 2008).

The questionnaire was adapted into an Irish context from the motivation questionnaire used in a 2008-2009 comparative study by Zoltan Dörnyei utilizing his L2. Motivational Self System. Only minor adaptions were made changing the target language mentioned from English to Irish and changing the locations mentioned in the questionnaire to Ireland and the Gaeltacht (the native speaking areas of Ireland).

3.5. VR Lab

Once the questionnaire was completed, each participant was brought to the VR interaction lab. This lab has been specifically designed for VR research and offers a large space of 3.3m x 2.0m giving the participant free movement around the VR space and soundproof walls, so no audio distractions break the participant's presence during the experience (Witmer & Singer, 1998).

3.6. VR Training Exercise

Each participant put on a wireless VIVE Pro headset and engaged with a training

Figure 1 ViRAL Interaction Lab

exercise in a virtual world created by the research team. This was to teach the participants the basic control system of the virtual environment they were about to engage in. The researchers introduced the different systems and told the participants how to interact in the training world. Participants could only move onto the next virtual environment when they displayed a clear ability to be able to:

1. Physically move their bodies around 360 degrees, with a clear understanding they had 360-degree movement in the virtual world.

2. Pick up objects using the VIVE controllers.

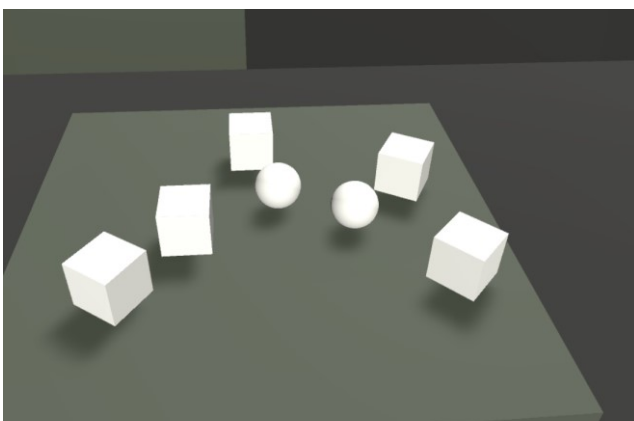3. Move around the space using the teleportation system
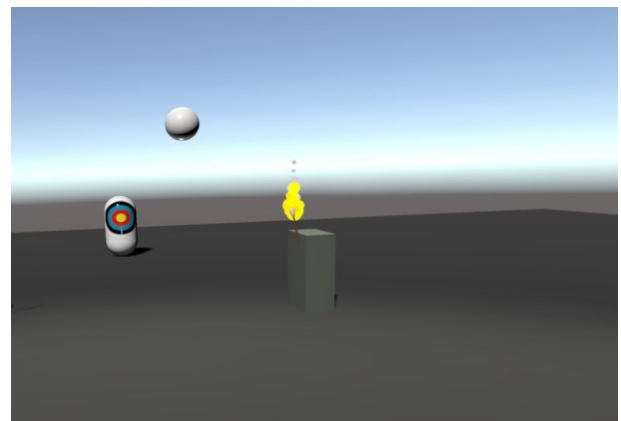

Figure 3: Training world objects

Figure 2: Training world space

3.7. GaeltechVR Experience

After completing the basic training virtual world, the participants began the GaeltechVR experience. Each session lasted between 10- 20 minutes. Video of their time interacting with the virtual world was captured using Nvidia Shadowplay.
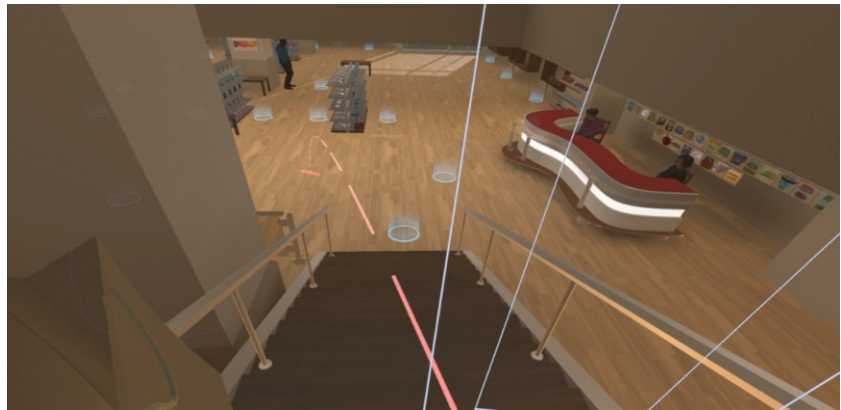

Figure 4: GaeltechVR Virtual world

3.8. Post-test Questionnaires

Once the experience was finished, participants completed a simulation sickness questionnaire (Bouchard, Robillard, Renaud, & Bernier, 2012), followed by a presence questionnaire (Witmer, Jerome, & Singer, 2005) reporting on their time interacting with the experience. These questionnaires were used to investigate if the design was working for its intended purpose. While self-report presence questionnaires have limitations (Slater, 2004) there is currently no ubiquitous measure of presence. It was also not the main focus of this investigation therefore it was deemed a suitable methodology for the researchers to utilise to give an indication of how immersive the design of GaeltechVR was for participants. Simulation sickness is a common concern for virtual reality environments, and this made it an important aspect to consider when exploring the impact the experience had on the participants. Finally participants

Figure 5: Methodology of DBR experiment

completed a post-test motivation questionnaire, this version of the questionnaire was modified to only include elements that were being investigated for change through interaction in the experience: Ideal Self and specific features of the L2 learning experience linguistic self-confidence, Irish anxiety, attitudes towards learning and integrativeness. Minor alterations were made to ask about their interactions in the virtual reality environment rather than the classroom environment in the Irish anxiety, attitudes towards learning and linguistic self-confidence scales. It also included open-ended questions designed to investigate the exploratory aspects of the research.
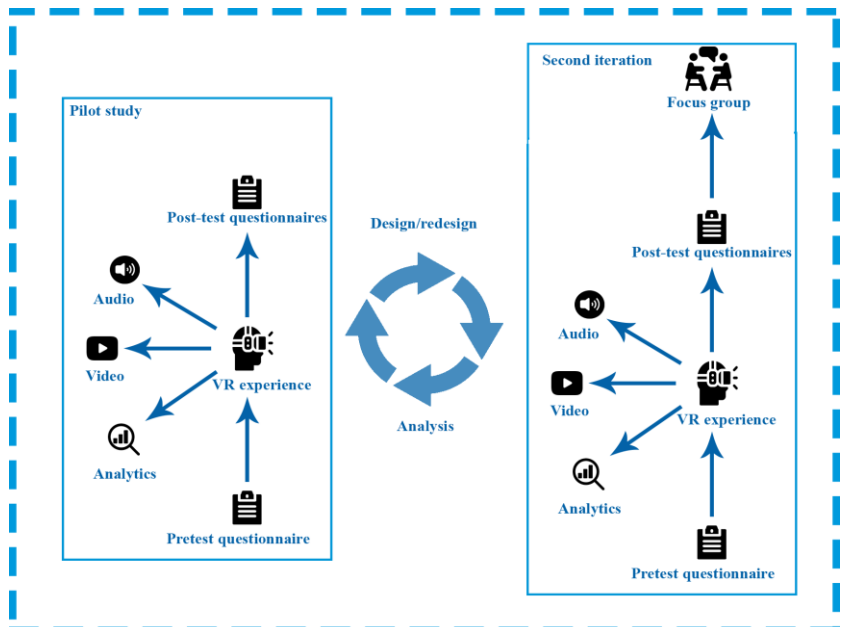
4. Design of GaeltechVR

4.1. Task based language teaching

In order to simulate a situated learning environment, the research team incorporated task based language teaching (TBLT) methodology in its learning approach. It focuses on the use of authentic language asking participants to do meaningful tasks using the target language. The virtual world follows a modified version of the framework developed by Jane Willis (Willis, 1996). Willis identifies a number of purposes for TBLT which aligned with our goal of improving the participant's attitude and motivation in their ability to become a fluent Irish language speaker by interacting with the Irish language including:

1. To give learners experience of spontaneous interaction.

2. To engage learners in using language purposefully and co-operatively.

3. To make learners participate in a complete interaction, not just one-off sentences.

4. To develop learners' confidence that they can achieve communicative goals.

We argue that VR is ideally suited to TBLT as a participant is immersed in the virtual world created adding realism and new meaning to the actions for the participant. The participant is asked to complete a meaningful task by collecting the items required by the security guard in the shop. All language in the virtual world is in the target language, Irish. The context and the vocabulary chosen for the shop derived from the National Irish primary school curriculum themes (Rialtas na hÉireann, 1999). Every word was translated for accuracy using Tearma.ie, The National Terminology Database for Irish. The Irish speech synthesis system, abair.ie (Ní Chiaráin & Ní Chasaide, 2016) was used for the vocabulary, and a fluent Irish language voice actor was utilized as the security guard giving instructions to participants. The objective of the virtual world of GaeltechVR is to find specific objects in a shop. To begin, a participant has to approach a character in the shop. He lists out items for the participant to collect and put into their bag. When the participant finds each item they are searching for - they can approach the front desk of the shop, and the shopkeeper tells the participant if they collected all the items that were asked for. The experience ends when the participant picks up all the items they need and gives it to the shopkeeper.

4.2. Immersion

Immersion is usually defined as the technical, objective aspects of virtual environments (Jennett et al., 2008). Facilitating the immersive aspects of the experience was important as the designer has direct control over these aspects of the design. These decisions included:

1. Designing for the HTC VIVE Pro. Its features are currently the highest specifications for VR equipment. This includes an AMOLED display, 2880 x 1600 (615PPI) resolution, and a 90Hz refresh rate.

2. The use of the soundproof VR lab with suitable space for movement for participants.

3. The virtual world was designed and tested using an Alienware desktop with dual 1080ti graphics cards, 16gb RAM, and an i7 processor.

4.3. Presence

Presence is defined as the subjective experience of being in one place or environment, even when one is physically situated in another (Witmer & Singer, 1998). It is the core aim of VR technology.

These are subjective elements, but we can improve on these subjective elements with how we design the game.

1. Movement – We carefully designed the movement system within the VR virtual world as poor movement design leads to an increase in simulator sickness as it is believed to be caused by not being able to adapt to new transportation modes (Duzmanska, Strojny, & Strojny, 2018). In our design we implemented a teleportation system that allowed the participant to appear in specific spots around the world without the image moving separately to their eye tracking.

2. Liveable environment – The environment was designed to have multiple characters moving around the scene and music playing to give the impression of a real context in the virtual world.

3. Hands – The hand model was designed to grab and grip naturally mapping itself to the user's controller. The rubber hand illusion (Ehrsson, 2005) has shown it is possible to produce feelings of ownership and embodiment, which we designed into how our VR world's interaction system.

Figure 6: Hand Models and Bag

4. Audio – Each object gives its name in Irish as it's interacted with. Characters in the shop speak and give instructions to the participants and the music in the shop gives a shopping ambiance to the scene. All of audio in the experience has been spatialised, so the player has a sense of where audio is coming from in the environment.

4.4. Scaffolding and Identity

As we addressed earlier, there is a very limited group of native speakers in the Irish context. It is difficult to be recognized as performing a discourse (Gee, 2014). This is an essential part of language learning where an individual acts in the correct way in the target language and is recognised for it by the target community (Gee, 2015). This allows an individual to build an identity as a speaker of the target language. In turn this improves their L2 self in the target language. To help build towards this new identity the virtual world incorporates scaffolding. Scaffolding is a constructivist theory that explains social learning. Learners first succeed in performing a new function with the assistance of an experienced mentor and then internalize this function so that they can perform it unassisted (Ellis, 2000).

Figure 7: Scaffolding using text and imagery

Virtual worlds can act as the experienced mentor and allow participants to progress at their own pace and get information when they need it (Gee, 2006). The system of the virtual world does this through feedback. In GaeltechVR scaffolding is incorporated in a number of ways:

1. When a participant picks up an item, the word is said in Irish.

2. The security guard's dialogue says everything the participant needs in the shop.

3. There is an inventory system so the player can keep track of what they have collected.

4. The participant is told at the front counter when they've retrieved everything needed in the shop. This is further enforced with a clapping animation that tells them they have succeeded. There is a head shake animation, and they are told to keep looking if they don't have all the required items.

5. Results

As this is a DBR experiment in its first phase of design, we were interested in a localised study with an authentic context group. Our aim was not to make inferences about a population from a sample but to examine the specific context through our localised results to make generalisable claims about our design. Our pre-test motivation questionnaire was marked on a five point Likert scale. The participants were aged between 24-59 and there was an even distribution of ages. The participants were also predominately female 83%.

Our intervention's main intention was to create a positive change in the learner's ideal self as an Irish language learner. Table 1 display the results of the scales involved with the Pre-Test questionnaire only. These are scales that give an indication of the extrinsic motivational factors involved for the context group, for example, the influence their family has on their motivation to learn Irish. These factors give us a detailed impression of the context group; however they are not expected to be influenced by the intervention and not the intention of the intervention, therefore, no post-test scales were incorporated in our post-test questionnaire. Table 2 and Table 3 show the results of the main scales being investigated in the experiment. The scales included for the pre-test to post-test measure were: Ideal L2 Self, Irish Anxiety, Integrativeness, and Linguistic Self-Confidence. These scales are the intrinsic influences and the L2 learning environment as discussed earlier in our discussion about Dörnyei's theory of motivation.

Table 1: Motivational Self-System Pre-Test Only Results

Scale	Ought to L2 Self	Family Influence	Promotion	Prevention
Median	4.2	2.83	4.1	4.3
Mode	4.2	2.33	4.33	4.25

Table 2: Motivational Self-System Pre-Test Results

Scale	Ideal L2 Self	Irish Anxiety	Integrativeness	Linguistic Self Confidence
Median	4.1	1.8	4.1	4.3
Mode	4.0	1.17	4.67	4

Table 3: Motivational Self-System Post-Test Results

Scale	Ideal L2 Self	Irish Anxiety	Integrativeness	Linguistic Self Confidence
Median	4.2	2.83	4.1	4.3
Mode	4.2	2.33	4.33	4.25

The context's ideal L2 self results in the pre-test were high with a mode of 4.2. In the post-test result, there was a slight reduction of .2 in the mode with learner's ideal L2 self reducing to 4. This demonstrates the opposite of the intended effect of the intervention.

There was also a minor reduction in the linguistic self-confidence of the context group from the pre-test mode of 4.25 to 4 in the post-test.

The intervention had a positive effect on the level of Irish anxiety among the group. The level of Irish anxiety was found to be quite high in the pre-test with a mode of 2.3 and a median of 2.8. In the post-test, there was a decrease in the anxiety scale with the mode dropping to 1.17 and the median lowering to 1.8. This was a full 1 point scale reduction in the case of the median.

The ought to L2 self investigates the extrinsic motivations involved with the target language. The learner's pre-test ought to L2 self was low with a mode of 1.29. This corresponded with low modes in all the extrinsic motivation scales in the pre-test: promotion, prevention, and family influence, which had low modes of 2.5, 1.25, and 1.80 respectively.

The integrativeness score had a rise in the post-test of .34 to 4.67. Integrativeness is a measure first constructed by Gardner (Gardner, 1985). His research into the field demonstrated that a person's beliefs about the target language community influence their motivation for the target language. Dörnyei agreed with this. However, he saw with the advent of globalisation, language communities do not always exist in fixed locations. Instead of focusing on the fixed space of a target language community Dörnyei's integrativeness scale is interested in investigating the perceived beliefs of the individual to a target language group, real or imaginary (Ushioda & Dörnyei, 2009).

The simulator sickness questionnaire was measured on a 7 point scale, and it reflected little to no sickness among the participants, as demonstrated in Table 4 with mean of .1481 in nausea and .1667 in oculo motor issues.

Table 4: Simulator Sickness Results

Scale	Mean
Nausea	0.1481
Oculo Motor Issues	0.1667

The presence questionnaire was measured on a 7-point likert scale. Participants rated each scale with a mean in the range between 5-6 which indicated a high degree of presence felt. Only one scale fell below this range the Sounds scale which was given a mean of 4.8 as shown in Table 5.

Table 5: Presence Results

Scale	Mean
Possiblity to act	5.3
Possibility to examine	5.6
Self-evaluation of performance	5.4
Sounds	4.8
Haptic	5.4
Quality Of Interface	5.3

6.   Discussion

Our intervention did not confirm the design's effectiveness at improving the target context's ideal L2 self; however we believe this may be due to the possibility that the questionnaires are demonstrating a lack of awareness among the participants in their L2 language ability rather than

representing their motivation and confidence to interact with the L2 community. Larger scale studies for adult Irish language learners have found that a lack of native Irish speakers makes learners question their authority in language ownership (Nic Fhlannchadha & Hickey, 2018). This creates a situation whereby Irish language speakers have a passive positive motivation for the language rather than a proactive motivation to become fluent speakers (Ó Laoire, 2007). They feel positively inclined towards the language as this data also demonstrates but they do not proactively believe in their ability to become fluent speakers.

The context group voluntarily attend Irish language classes in order to improve their Irish language ability and volunteered for this study with no incentive, which reflects the high pre-test ideal L2 self. After engaging in the VR experience their ideal L2 self lowered. This may be due to the opportunity afforded to them to engage in a task based activity in Irish with native speaking avatars giving them instructions in the target language. We believe participants observed their actual L2 ability through their competency in recognising the words and their ability to achieve the task. This, in turn, may have effected their ideal L2 self. They may have realised their actual competency was further from a fluent speaker than they originally believed. This theory is further backed up by their linguistic self-confidence mode reducing between the pre-test and the post-test. The data shows that there was very little external motivation for the context group to learn Irish. The participants have very little interactions with Irish in their daily life and no social need to attain the language as their low ought to L2 self mode of 1.29 demonstrates. The participants had a relatively high level of anxiety around Irish but also state they are highly confident of their linguistic skills in Irish in the pre-test. In self-reporting attitude surveys such as this it is common to see conflicting attitudes in how an individual perceives their own sense of self. The self is irrational in nature and is based on the continual renegotiation of one's beliefs and attitudes (Gee, 2004). This offers further evidence towards our theory as it demonstrates a lack of interaction between the context group and native Irish speakers as they display anxiety towards the L2. The large reduction in anxiety in the post-test reveals that participants did not feel the same anxiety in their interactions in the virtual world interacting with native speaking avatars that they felt in the real world. This finding is consistent with other research into virtual reality, which finds a reduction in anxiety for participants interacting with virtual reality environments (Gorini & Riva, 2008). The social pressure and stigma of making mistakes do not exist in a virtual world, and so it gives the participant the opportunity to experiment in the target language.

We believe the rise in the integrativeness scale offers evidence that participants saw the virtual world as a believable reality; their attitudes to the Irish language community improved as a result of their interaction with the native speaking avatars.

The simulator sickness result offers evidence that the design of movement in GaeltechVR, combined with the use of the short tasks, along with using the HTC VIVE Pro in the ViRAL lab space led to experience without the issue of simulator sickness.

The high values in the presence questionnaire offer further evidence that the design was effective in creating a believable virtual context for the participants.

The open-ended questions were thematically coded and were used for triangulation purposes. Participants found the experience to be highly immersive when asked about the issues with the environment; one participant noted: "Remembering not to physically move around! I haven't used VR before so I got absorbed and initially forgot that I wasn't really in the room I was seeing."

This gives further evidence that participants felt present in GaeltechVR - a key aim of the design. Another participant noted: "…due to the immersiveness of it, it really transforms you out of current situation into a new one."

Many participants noted the native speaker used in the environment. When asked if the experience was beneficial, a participant commented: "Yes. I think if I used experience this often I will

speak Irish like a native speaker." Another participant noted: "Yes, more fun and interesting hearing how the words are pronounced by different people and dialects."

This further backs up evidence that GaeltechVR was giving learners the experience of interacting with Irish in a context they perceived to be real. On the issue of Irish anxiety, the participants noted: "Yes. It is much more fun interacting. You feel frustrated if you get it wrong so you want to try again to "win" instead of giving up;" "This was absolutely enjoyable. I felt no learning pressure, no time pressure and my brain was really forced to work on what I have already learnt."

The simulation effects, as noted earlier seems to boost the confidence and remove the pressure participants felt of making mistakes in the L2.

The participants noted some areas where improvement is needed in terms of the immersive aspects of the design. One participant noted several areas where the virtual world didn't meet reality: "The items didn't appear in the bag either - I was disappointed with that. Also, it's not realistic to put a massive table in a small bag. Maybe an interaction with the person giving instructions in a more natural way and for a more genuine reason."

Feedback was another area that participants commented on the need for improvements with one participant noting: "Maybe a clue at counter – e.g. You have 4 items correct."

This is commenting on the scaffolding in the game; in future iterations, there will be even more feedback to guide participants as they progress. Finally, the size of the area and number of items were an issue for many participants. The shop contained over 90 items and some participants found it challenging to navigate the area of the virtual environment to find the item they needed even when comprehension was not the issue. Other participants noted the shortness of the experience and the lack of challenge for them with comments such as "The experience was very short -but I could see the benefits" "Would have liked a second challenge."

The quantitative and qualitative feedback from this experiment will be used to design the second iteration of the experience.

7. Future Work

In order to improve the feedback and scaffolding elements of the world, future iterations will incorporate levels. Each level will be designed to improve the situated design of the experience, for example, a smaller number of items in each level. Once a participant finds the objects they need - they will be able to progress. This will reduce the item count in the main area and allow the design of each area thematically to suit the items located in it. It will also allow for increased challenge as the participants progress. Full sentences and riddles can be used in order to challenge more able participants as they progress through the virtual world improving their flow state (Csikszentmihalyi, 1990) as they engage with the world. In the first iteration of GaeltechVR there was not a significant change in the L2 ideal self of participants. We believe that the length of the intervention may have affected this. Future iterations will test over a longer period of time and give participants more opportunities to engage with the environment. This will also be done to remove the novelty element of trying new technology. For many participants this was their first time engaging with VR, and the novelty factor may have affected the results. The renegotiation of one's language identity is also a long term perpetually occurring complex process. In order to capture this process its valuable to have longitudinal data. Future iterations will also seek to further iterate on the design choices which lead to participants feeling present without any simulator sickness by making the virtual world reflect the expectations of the participants.

8. Conclusion

This paper gives a full account of the first stage of a design-based research experiment focusing on using a virtual reality design intervention to improve the Irish language identity, attitudes, and motivations of adult Irish language learners. We explored the value of DBR as a methodology, specifically examining its importance for the exploration of impact in virtual worlds. We explored the complexities of impact on learning and how we have defined the impact of our goal through this intervention. We explored the context group and our targeted intervention with a detailed account of our design decisions and the rationale. The methodology of the experiment was then detailed. This was followed by a detailed discussion of the results.

While the intervention did not confirm the design's effectiveness at improving the target context's ideal L2 self, this iteration proved invaluable for the future progress of the design of GaeltechVR.

In terms of the design of the virtual environment, participants felt present in the virtual world and experienced little to no simulation sickness. Two positive outcomes for the design choices of the intervention.

This first iteration has led to several design decisions moving forward:

1. The introduction of levels to the design in order to promote scaffolding opportunities.

2. A further focus on creating a more situated experience in the design of the context.

We found these design decisions valuable for exploring the impact of this environment in a local context, and this paper has sought to give a guide to researchers undertaking a design based research approach to explore the impact of an intervention. While this approach does not offer large scale global results it gives a much fuller account of the impact of a design intervention.

Finally, we found that by expanding our viewpoint of educational impact and investigating the social and emotional factors involved in a learner's behavior from a socio-cultural perspective, we found participants had a significant decrease in Irish language anxiety after engaging with the virtual environment, and the participants valued being able to interact with the target language using avatars with native speaker dialects.

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