Rekindling Connections to Languages through Socio-Cultural Immersion Using Game-Based Learning and Virtual Reality: Cipher VR Case Study

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Abstract: Traditional language learning methods often fall short in engaging learners, especially in the context of indigenous languages like Irish. In this study we show how the language learning game Cipher VR combines digital game-based language learning with Virtual Reality (VR) to reconnect learners with indigenous languages, using the Irish language as a case study. Initially designed for English, Cipher has undergone several iterations to adapt to the Irish context, and is now completing its metamorphosis into a VR platform aimed at meeting the needs of less-resourced and endangered languages. This paper explores Cipher VR's development, emphasising the learner-centric design that merges educational aims, engaging gameplay and a culturally grounded approach to create an immersive and motivating learning experience.

Keywords: Game-based learning, Virtual reality, Indigenous language, Cultural heritage, second language acquisition

1. Introduction

Traditional language learning methods often fall short in engaging learners, especially in the context of indigenous languages like Irish. There are complex socio-cultural factors. The limited daily use of Irish outside educational settings, combined with outdated teaching methods and a lack of interactive resources, contribute to student disengagement. These issues are compounded by socio-cultural perceptions of Irish as less essential compared to global languages, influencing motivation negatively. Effective engagement requires easing these socio-cultural barriers and revitalising teaching approaches with relevant, dynamic content that connects learners with the culture of the language in a fun and engaging manner (Ward et al., 2019; Hickey and Stenson 2011).

This paper introduces an innovative approach to address this challenge. The original Cipher: Faoi Gheasa game (Xu et al. 2024), harnesses the power of game-based learning to learn languages. In Cipher VR, players immerse themselves in a magical world, engaging with language learning tasks enriched by fairytale and folklore elements, making the process both interactive and captivating. Cipher VR integrates VR to deepen immersion in indigenous culture, aiming to amplify socio-cultural contexts, bringing them to the forefront of language learning as means of enhancing learner motivation.

2. Background

2.1 The Irish Language: Socio-cultural Aspects

Irish belongs to the Celtic branch of the Indo-European languages. It has VSO (verb, subject, object) word order, case marking, a complex system of word-initial mutations and phonological harmonies, which means that is substantially different to English, the first language of many of the learners. Irish is taught as a compulsory subject in primary and secondary level education in Ireland. It is both the first language of the Republic of Ireland and also a minority language, while English is the dominant language.

The Irish language has been under pressure from English for many centuries. Over time as the status of Irish waned due to adverse economic and political factors, English was increasingly seen as the language of advancement. However, towards the end of the 19th century, scholars began to take an interest in the ancient

Irish tales and mythology which led to a renewed pride and interest in the Irish language (Gregory, 1904; Hyde, 1890; Ó Coileáin, 1986). Recent census data (Government of Ireland, 2017) reports that 1.76 million people can speak Irish, and approximately 74,000 use it on a daily basis outside the education system. Of these daily speakers, approximately one third are in native speaker regions (Gaeltachtaí), and two thirds are from outside of native speaker communities. Regardless of whether Irish is acquired as a first or second language, there is an urgent need for language learning support and for creative ways of increasing learners' contact with Irish on a regular basis (Dalton & Devitt, 2016).

Digital game-based language learning (DGBLL) has been shown to be an effective way of encouraging learner motivation and learner autonomy (Dixon et al 2022; Acquah & Katz 2020). Research has also shown that the enhanced immersion and interaction that VR offers is ideal for language learning and engagement (Çakır N 2024; Lan 2020). However, there is a significant lack of research on VR in Irish language learning, highlighting the need for further studies to understand its potential (Collins et al, 2019). The aim of Cipher VR is to harness VR features to provide an exciting and enjoyable digital game-based language experience which can transform learners' sometimes negative views of Irish as just a school subject. Through integrating ancient tales and mythology with modern technology in Cipher VR we hope to reinforce and renew pride and interest in the Irish language and its mythology. We believe that applying the philosophy of "reconnecting to the spirit of the language" (Napier and Whiskeyjack 2021) can help to increase learner engagement and motivation in the Irish context, and that this can be replicated in other endangered language scenarios.

2.2 Virtual Reality in Socio-cultural Context

Virtual Reality (VR) is an increasingly significant technology within the educational sector. One of the primary reasons VR has become popular is its ability to create interactive 3D models that help transform abstract concepts into tangible experiences, thereby enhancing comprehension (Christou, 2010). Virtual reality has been shown to be effective for various educational tasks, such as mathematics (Roussou et al. 2006) and language learning (Çakır, N. 2024; Lan, 2020).

The use of digital technology in the preservation and revitalisation of indigenous languages has become increasingly popular (Galla, 2018). Research indicates that VR can aid in revitalisation by providing immersive and interactive environments (Minestrelli et al 2024). Additionally, VR games have been shown to enhance cultural awareness and heritage through immersive experiences (Shih et al., 2015). VR is particularly effective in engaging the young, who are crucial for the continuity of language. It not only bridges the geographical and temporal gaps between native speakers and learners in a virtual world but also boosts learners' confidence by providing a safe space for practice without fear of judgement (Lan, 2020). Moreover, VR allows learners to immerse themselves in the landscapes and cultural contexts of the languages, fostering a deeper connection and understanding (Outakoski et al. 2018).

By immersing learners in the rich folklore and mythology of their languages, VR creates a connection to the language's roots, thereby not only teaching the language but also rekindling or initiating a cultural bond. This approach aligns with the growing recognition of the importance of culturally grounded education methods in the preservation and revitalisation of indigenous languages globally (UNESCO 2023).

3. Methodology

Cipher VR is built on the existing screen-based Cipher game (Xu et al. 2024) and has been transformed using VR technology to immerse users in the folklore and mythology of the target language, focusing on their cultural and linguistic awareness. Through narrative-driven gameplay, learners encounter vocabulary embedded in tasks that mirror language use. The vocabulary of the stories has been cross-referenced with the primary school curriculum and the overlap has been enhanced wherever possible. Stories and myths reinforce many everyday words relating to familial relationships, food items and physical elements such as fire, water, rivers, lakes and seas, to name a few. This methodological approach ensures that language learning is contextual, meaningful, and tied to both cultural heritage and everyday life, enhancing the likelihood of retention and engagement.

3.1 VR Game Design

The game's environment, cloaked in mysterious shadows due to magical spells, is gradually illuminated as players reverse the spells, enhancing the immersive experience. Utilising the hand-tracking feature in VR, the

game offers intuitive interaction, allowing players to manipulate objects and solve puzzles naturally with their hands.

The game starts with the mystical "Well of Wisdom," where players encounter the enchanted book. The book reveals an enchanted word, and a clue to reversing the evil spell. Using the clue and the letter tiles, the player must physically re-arrange the letters to restore the word and to open the gateway to a magical world. Within this world, players work to dispel enchantments on hazel trees and other folklore-related objects, each time using the clues and the letter tiles. Successive tasks guide players through a narrative journey that culminates in the cooking and eating of the mythical Salmon of Knowledge, symbolising the acquisition of language and wisdom. Each task is designed to introduce vocabulary contextually, ensuring learning is meaningful and integrated with the cultural heritage of the language. Figure 1 illustrates the progression of the story flow within the game.

Figure 1: Screenshots of Cipher VR

3.2 Pedagogical Design

Motivation is a key element in language learning (Dornyei and Usioda, 2021). Cipher is designed to enhance the learning process by increasing student motivation, particularly in encouraging students to persevere when they have difficulties. It also shows them their progress through the game and celebrates their achievements each time they complete an element of the game.

Pedagogically, Cipher VR is grounded in the principles of experiential learning, where engagement with the language is embedded in culturally relevant narratives, and learners learn by doing, and by engaging as many of their senses as possible. The use of the latest VR technology creates a more positive progressive view of the language and increased motivation to participate in the game, thereby gaining valuable language input through the game. The game's design follows a scaffolded learning approach within the context of a folklore story.

3.3 Integration with Indigenous Cultural Landscapes

A significant component of Cipher VR's methodology is its emphasis on reconnecting learners with the environment and cultural heritage through folklore and mythology. The game's environment includes not only the mystical "Well of Wisdom" but also the factual River Boyne. This design reflects both mystical and real geographical and cultural landmarks, enhancing the authenticity of the learning experience. This approach provides not only language skills but also respect and connection to the cultural heritage.

3.4 Technical Development

The SortingGameManager script creates an interactive letter-sorting game that can automatically load and respond to player actions by managing different game objects and events. Figure 2 is a screenshot of the sorting game prefab and the script.

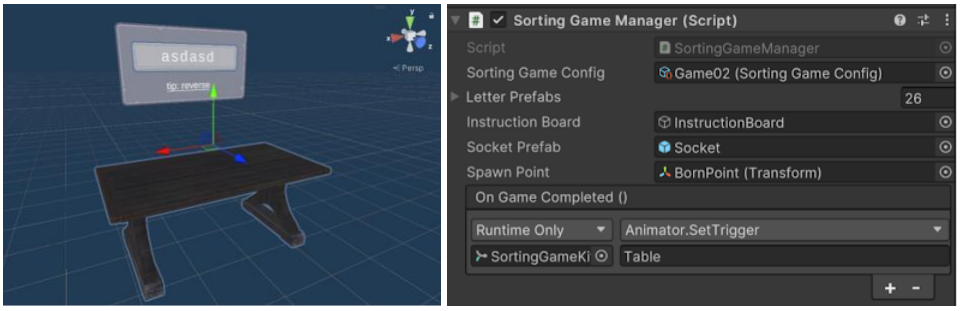

Figure 2: Sorting game prefab and script

The project utilises OpenXR and XR Interaction Toolkit to build the VR setup, using scripts such as XR Grab Interactable to achieve the actual grabbing effect of the player's hand with the letter card, as demonstrated in Figure 3.

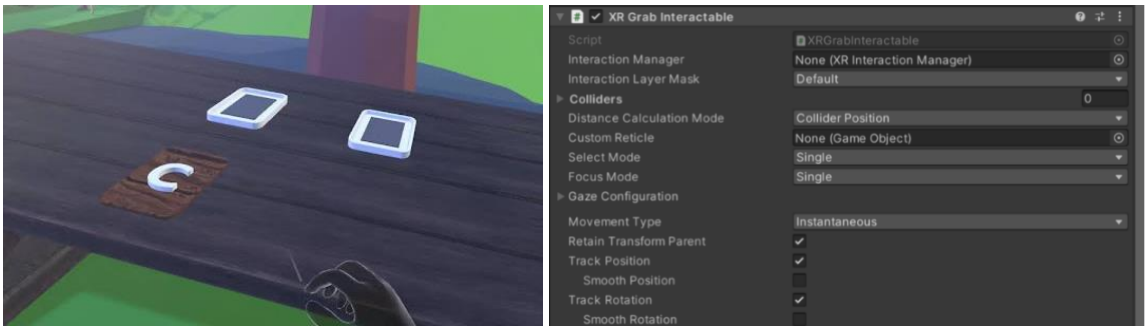

Figure 3: Hand-tracking implementation

4. Results and Discussion

In a small-scale pilot study of Cipher VR with 20 participants (school children), the initial questionnaire feedback was very positive regarding learning motivation, however the outcome regarding learning gains was not so clear. Detailed questionnaire results can be found in the Appendix. Users appreciated the integration of folklore and gamified elements in VR that made learning the language more enjoyable and engaging. Additional Verbal feedback from users include: “It’s really cool and I think it’s going to be incredibly useful for children in school” and “I like the way of combining folklore elements with language learning”. There is also room for improvement. While running the pilot study we could see the need for more explicit instructions, more stable controls, and clearer narrative connections to aid in the learning tasks. We intend to address these points by focusing on enhancing audiovisual feedback, refining interaction design, strengthening narrative integration, and simplifying the user interface to ensure that the game is both entertaining and effective in supporting language revitalisation in educational settings.

Future work includes standardised learning tests and detailed user studies to analyse the learning outcomes and engagement.

5. Conclusion

In this study, we aim to transcend conventional paradigms of language education by merging the immersive potential of VR with the dynamic engagement of game-based learning. This novel integration has the potential not only to facilitate the acquisition of language skills but also to deepen learners' connection to the cultural and historical contexts of the languages studied. By embedding the learning process within culturally rich narratives and landscapes, Cipher VR offers a promising avenue for both engaging with and preserving indigenous languages. The game’s modular design means that it is relatively easy to adapt it to a new language and learning context. This study contributes to the ongoing dialogue at the intersection of technology, pedagogy, and cultural preservation, and signals a new era in educational technology. As such, Cipher VR not only addresses the challenges facing language revitalisation but also provides a blueprint for future educational innovations in a globalised context, offering fresh insights and methodologies for engaging with the world’s linguistic and cultural heritage.

Acknowledgements

This research was supported by the Science Foundation Ireland Centre for Research Training in Digitally-Enhanced Reality (d-real) under Grant No. 18/CRT/6224. For the purpose of Open Access, the author has applied a CC BY public copyright licence to any Author Accepted Manuscript version arising from this submission.

References

Acquah, E.O. and Katz, H.T. (2020). Digital game-based L2 learning outcomes for primary through high-school students: A systematic literature review. Computers & Education, Volume 143.

Dixon, D.H., Dixon, T. and Jordan, E. (2022). Second language (L2) gains through digital game-based language learning (DGBLL): A meta-analysis. Language Learning & Technology, vol. 26, Issue 1, pp. 1–25.

Dörnyei, Zoltán, and Ema Ushioda. Teaching and researching motivation. Routledge, 2021.

Çakır, N. (2024). Virtual Reality Games in Foreign Language Education: A Systematic Review. Language Education and Technology, 4(1).

Christou, C., 2010. Virtual reality in education. In Affective, interactive and cognitive methods for e-learning design: creating an optimal education experience (pp. 228-243). IGI Global.

Collins, N., Vaughan, B., and Cullen, C. (2019). GaeltechVR: Measuring the Impact of an Immersive Virtual Environment to Promote Situated Identity in Irish Language Learning. Journal of Virtual Worlds Research, 12(3).

Dalton, G., and Devitt, A. (2016). Irish in a 3D World: Engaging Primary School Children. Language Learning & Technology, 20(1), 21–33.

Galla, C.K., (2018). Digital realities of Indigenous language revitalization: A look at Hawaiian language technology in the modern world. Language and Literacy, 20(3), pp.100-120.

Government of Ireland (2017) Census 2016 Summary Results - Part 1. Central Statistics Office. www.cso.ie/en/census

Gregory, Lady Agusta. (1904). Irish Myths and Legends.

Hickey, T. and Stenson, N. (2011). Irish orthography: what do teachers and learners need to know about it, and why?. Language, Culture and Curriculum, 24(1), pp.23-46.

Holt, S. (2023). Virtual reality, augmented reality and mixed reality: For astronaut mental health; and space tourism, education and outreach. Acta Astronautica, 203, pp.436-446.

Hyde, D. (1890). Beside the Fire: A Collection of Irish Gaelic Folkstories. London: Nutt. https://cartlann.org/dicilimt/2020/12/A-Collection-of-Irish-Gaelic-Folk-Stories-by-Douglas-Hyde-1.pdf

Lan, Y.J., (2020). Immersion into virtual reality for language learning. In Psychology of learning and motivation (Vol. 72, pp. 1-26). Academic Press.

Minestrelli, C., Power, M., Kamara, A. and Zachariadou, D. (2024). 'Virtual Reconnections': Using VR storytelling to reconnect to Indigenous cultural Artefacts. Transmotion, 9(1&2), pp.179-204.

Napier, K. and Whiskeyjack, L. (2021). wahkotowin: Reconnecting to the Spirit of nêhiyawêwin (Cree Language). Engaged Scholar Journal, 7(1), pp.1-24.

Ó Coileáin, A. (Ed.) (1986). The Irish Language in a Changing Society: Shaping the Future. Baile Átha Cliath: Bord na Gaeilge

Outakoski, H., Cocq, C. and Steggo, P., (2018). Strengthening Indigenous languages in the digital age: social media–supported learning in Sápmi. Media International Australia, 169(1), pp.21-31.

Roussou, M., Oliver, M. and Slater, M., 2006. The virtual playground: an educational virtual reality environment for evaluating interactivity and conceptual learning. Virtual reality, 10, pp.227-240.

UNESCO, (2023). UNESCO Framework for Culture and Arts Education. Available from: https://www.unesco.org/sites/default/files/medias/fichiers/2024/02/WCCAE_UNESCO%20Framework_EN_0.pdf [accessed 1 May 2024].

Xu, L., Thomson, J., Uí Dhonnchadha, E., and Monica, W. (2024). Learner-Oriented Game Design: The Evolution of Cipher. In 2024 IEEE Gaming, Entertainment, and Media Conference (GEM) (pp. 1-6). IEEE.

Ward, M., Mozgovoy, M. and Purgina, M. (2019). Can WordBricks make learning Irish more engaging for students?. International Journal of Game-Based Learning (IJGBL), 9(2), pp.20-39.

Appendix: Questionnaire Results

Table 1: Proportion of participants' ratings

Question	Satisfaction (n = 20) positive (percentage)
Did you like the VR game?	20 (100%)
What do you think about learning Irish through the VR game?	20 (100%)
How would you compare learning or reading Irish through the VR game to normal	20 (100%)

Question	Satisfaction (n = 20) positive (percentage)
classroom teaching?	
Do you think you learned anything while playing the VR game?	14 (70%)
Did you find the VR game easy to play?	19 (95%)
Would you recommend this VR game to your friends?	20 (100%)
Do you feel motivated to learn Irish through the VR game?	17 (85%)
Do you think the VR game makes learning Irish more interesting?	20 (100%)
Do you think the VR game makes the Irish folklore story more interesting?	18 (90%)
Do you think the VR game brings the Irish folklore story to life?	18 (90%)
Would you like to learn Irish through more folklore stories like this in VR?	19 (95%)
Do you think the visual part of the VR game helps you understand the language better?	18 (90%)
Do you think the visual part of the (VR) game helps you pay better attention to the language challenge?	17 (85%)

Note: User satisfaction is measured by combining responses of 4 (positive) and 5 (very positive) on a 5-point Likert scale, while the remainder consists of responses of 1 (very negative), 2 (negative), and 3 (neutral).