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LEVERAGING IMMERSIVE TECHNOLOGIES TO SUPPORT BLENDED LEARNING POST COVID-19

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ABSTRACT

The Covid-19 pandemic caused a shift in teaching practice towards blended learning for many Higher Education institutions. This led to the rapid adoption of certain digital technologies within existing teaching structures as a means to meet student access needs and facilitate learning. Integration of these technologies caused numerous challenges for practitioners and often provided mixed results. This paper is an attempt to summarise and extend pre-Covid pedagogical research to leverage digital immersive technologies for blended teaching in the post-pandemic era. Focus is given towards the evolution of *Virtual Learning Environments* through elements of immersive audio-visual technologies, which are shown to be effective when coupled in a blended approach. It is both a review of these methodologies and a case study of the *I-Ulysses: Virtual Learning Environment* as a point of comparison for evaluating the review.

Keywords Audio-Visual Technologies · Blended Learning · Pedagogy · Virtual Learning Environments · Virtual Reality

1 Introduction

The following paper presents a review of the literature in the area of teaching pedagogy, specifically the use of audio-visual technologies, and a case study of the *I-Ulysses Virtual Learning Environment*, employing *Virtual Reality* (VR). In many respects, the Covid-19 pandemic has necessitated a new approach to learning and teaching, with a focus on dissemination through increasingly more technological formats. There is thus, a need for such a review. The pandemic has had two major implications for teachers in a wide variety of disciplines. *Panopto*, for example, or similar audio-recording technologies have been adapted by a number of higher-level institutions in the wake of the pandemic, as has the need for a blended learning model. Many of these adaptations have been circulating in teaching and learning discourses since before the pandemic; so it is in many respects serendipitous that practitioners in fields of technological education can leverage their expertise here. In fact, many such techniques are ubiquitous in fields like graphics, virtual reality, simulation, serious learning and game development, on account of the nature of those subjects [1, 2]. While embracing audio-visual technologies; it is also important to highlight cases were they may marginalise certain individuals, and so this is another objective of the review. For this reason, the paper looks in the Irish and UK context, at the deployment of the *I-Ulysses* project, which aimed to combine teaching practice, serious learning and methods for embodying and representing spatial and social tropes with a VLE.

2 A Comprehensive Review of Theory: UK and Ireland

The COVID-19 pandemic has profoundly disrupted education delivery, affecting 1.6 billion learners in more than 200 countries [3]. Before COVID, distance learning was an important element of modern education, with 35 percent of US students studying partially online in 2017 [4]. COVID forced a sudden transition from planned remote teaching to emergency remote teaching [5]. In the context of Ireland and the UK, this transition was seen as an acceptable compromise as, for example, Ireland has 91.9 percent internet access, and the UK has 94.9 percent. Issues that have emerged include inadequate online teaching infrastructure, the relative online-teaching inexperience of teachers, and the home environment [6]. This lack of professional training for instructors extends to a lack of technical support for content development [7]. A recent survey of lecturers in an Irish HE institute revealed that 77 percent of lecturers had little or no experience of teaching in an online environment, pre-COVID [8].

However, simply providing training for instructors in *Virtual Learning Environments*, providing better technical support, and hoping that students can create an appropriate environment for learning at home is not a coherent evidence-based pedagogic strategy. Before considering what improvements can be made in this new educational paradigm, even before researching how technology itself affects educational practice, there must be a deep understanding of educational practice itself. Research into pedagogic practice is fraught with problems, despite uniform opinion that educational research must always have the same focus: how to improve learning, and thereby how to improve teaching [9]. The difficulties exist because researching education is about researching a complex series of relationships to produce actionable information. There are profound issues in reaching an understanding of the complex relationship between the teacher and student, between the student and their peers, and especially the relationship between the student and their own mind.

In *Experience and Education*, John Dewey argued that education was of such social importance that it should always be an "arena of struggles, practical and theoretical", always changing and adapting, just as the students and the society they live in changes and develops over time [10](pp. 241-252). He urged all educators to strive towards continuous adjustment and improvement, acknowledging that educational policymakers had the difficult task of taking all these practical and theoretical struggles and creating a philosophy of education practice from them. *Critical Pedagogy* scholar Paulo Freire advocated for educational practice to be empowering, that learners should go from "the consciousness of the real' to 'the consciousness of the possible", by a learner perceiving possibilities beyond their limiting situation. Students' assignments and projects should be designed in opposition to what he called the banking concept of education, where knowledge was a gift bestowed without any acknowledgement that education is a process of inquiry [11]. While any activity can be educational, the quality of the experience must be judged by what is being learned, judged by how that activity helps the student to make sense of things, how it leads the student to ask further questions, how it engages the student with what is before them [9].

This pedagogic engagement refers to a student's active involvement and participation in educational activities. While "Motivation" is the direction and intensity of one's activities [12], answering the question of "why am I doing this?" [13](p.11), 'Engagement' is the behavioural "intensity and emotional quality of a person's active involvement during a task" [14](p.147). Engagement entails students' reactions to, and interactions with, the learning material as it is embedded in the physical, instructional, and social environment, and has been studied actively for decades [14, 13, 15]. Motivation is an attitude that is much more general than Engagement, which must always be subject specific. Once an educational system creates an educational program, then measuring its success on an individual level requires an analysis of the following factors of engagement: Behavioural, Emotional, Cognitive, and Agentic. [16]; [17]; [18]. In addition, a socio-behavioural dimension should also be included, an examination of collaborative engagement in group-work [19]. Järvelä et al.'s study focused on how collaborative learning tasks were central for motivation, and how engagement is different when collaborating [20].

What happens when traditional teaching models, based on these psychological models, are mediated through remote learning? Does changing the method of delivery affect learning? If so, how exactly does changing the method of delivery affect how a student cohort learns? To begin to answer this, we need to examine *Constructivism*, a theory from the field of cognitive science and initially based on the work of Jean Piaget [21, 22]. *Constructivism* is fundamentally non-positivist, with an "epistemological view of knowledge acquisition that emphasises knowledge construction rather than knowledge transmission, where the learner is conceived as the one building and transforming knowledge" [23](p.6). The focus is on cognitive development and deep understanding, rather than learning skills. It must be emphasised that when *Constructivism* is applied to pedagogy, it is a psychological theory of learning and not a description of teaching. *Constructivism* describes how structures, language, activity, and meaning making come about, emphasising that the individual's construction of knowledge is stimulated by internal cognitive conflict as they strive to resolve mental disequilibrium. Learning is not the result of development; learning is development [24]. *Constructivism* describes how activity and meaning making interact [24].

An underlying assumption with this is that, while individuals change as they continue building on an ever-increasing foundation of knowledge, the cognitive process of learning continues to function in much the same way throughout their lives. How does this understanding of the psychology process of learning affect the design of post-COVID pedagogic practice? Rovai and Downey risk stating the obvious with "a well-designed online course offers an active-learning environment in which meaning is socially negotiated and students are actively engaged in the learning process" [25]. Unsurprisingly, the *VLE* has become a classroom with a reciprocal empathy between student and teacher, although there is emerging evidence that this new pedagogic setting leads to a reduction in engagement because of a lack of direct interaction, while simultaneously leading to an increase in engagement because of recordings made available for asynchronous learning [26].

In addition, Buckley et al. [26] observed that engagement was now individualised, and no longer a communal effort. This is a potentially dangerous development, as *Social Constructivism* views the origin of knowledge construction as being at the social intersection of people, the sharing, comparing, and debating between learners and mentors [27]. In contrast to Piaget's focus on individual constructions, the socio-cultural approach emphasises the socially and culturally situated context of cognition, the social origins of cognition, how an individual's appropriation of language is a mediating tool to construct meaning. Collective actions become the focus, where "learning occurs as people participate in shared endeavours with others, with all playing active, but often asymmetrical roles in sociocultural activity" [28](p.7). In addition, while asynchronous learning facilitates flexible learning and this is a positive development, the lack of direct contact between student and teacher has diluted the positive aspects of the student/teacher relationship [29].

Perhaps technology can compensate by facilitating the different ways that students learn best? Consider first that *Constructivism* defines 100 learners as 100 individuals who all learn differently, their cognitive processes profoundly affected by their individual knowledge and individual experiences, even though so many life-experiences are shared. Advocates of *Learning Styles* reduce complexity by positing that individual learners can be grouped into types, so that 100 learners can become 4 or 5 groups. Advocates suggest that curriculum design should be leveraging this in an advantageous way, insisting that their perspective is evidence-based and not simply the result of a desire to reduce complexity in the interests of efficiency. However, according to John Geake, "studies of educational effectiveness of applying any of these ideas in the classroom have failed to find any educational benefits" [30](p.1). Riener & Willingham go further and assert that there is no credible evidence that *Learning Styles* exist. They reason that it is individual ability, background, knowledge, and interest that overwhelmingly affect learning, and the focus on *Learning Styles* comes at the cost of attention to those factors [31].

While subject-specific ability obviously varies from individual to individual, according to *Learning Styles* theory an educator should be able to improve learning performance by matching instruction to a student's learning style. If learning styles is a neuromyth, then educators should simply continue to present information in the most appropriate manner for the content itself, taking into consideration the cohort's level of knowledge and the desired learning outcomes [32, 33]. The socio-cultural *Constructionist* approach suggests that the purpose of technological developments is to bridge the emotional distance created by distance learning. While social distancing has been necessary because of COVID, and distance learning will continue post-COVID, we must remain focused on using technology to facilitate learning and understanding. A learner's understanding is not brought about through the transmission of information; understanding is constructed with the information [34], constructed by the individual in a social context. So a question to be answered of this discourse is, given the necessity of the technological shift, can technologies help mediate learning materials to enhance student engagement, on an intellectual level by reflecting something innate about the content of the material? Furthermore, can technology leverage access to esoteric information, in a way that opens it up more whilst also creating greater social interaction; bridging the aforementioned dimensions and the teacher and learner in time of social distancing. This then brings us to the discussion of the *I-Ulysses: Virtual Learning Environment* and *Virtual Reality*.

3 I-Ulysses: a Retrospective Case Study

3.1 Psychoacoustics and Virtual Reality

In his work Acoustic Territories, Brandon LaBelle [35] focuses on sound culture and everyday spatial experience in urban settings. LaBelle is an installation artist and his work focuses on practical acoustical work and sound engineering in simulated spaces. A tentative connection between this work and James Joyce's classic *Ulysses* can be read in the way he discusses the flaneur and his analysis of Michel DeCerteau's theories of psycho-geography. LaBelle notes how, "leaving the house, the dynamics of sound and auditory experience open up towards a realm of greater public interaction conditioned by rhythms and the mobility of being on the go" (p.6). The locomotive urban experience that LaBelle describes in the informal public life of the 'Sidewalk chapter', with its unique set of acoustic and audio-spatial relations,

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maps the auditory experience of a city walker. It joins this experience to the social and public spheres of city life in a way that echoes Joyce's description of his main character Bloom's journey.

"...Opening the window of my apartment on a warm sunny day, the acoustical shape of the overall room is flooded with overall input, re-mixed by the passing of cars, the humdrum of voices, birds in the trees, and the breeze...leaving the apartment, I jump out into this mass of sonority, like a tumbleweed... the sidewalk seems to overwhelm or disregard the dichotomy of silence and noise with a general hubbub rising and falling through the day and night...pockets of intensity, zones of volume, shifting gradations of acoustical flow that makes the sidewalk a sort of sound membrane contoured by the noise of the street on one side and the buildings on the other...the sidewalk throbs with acoustic life, and the walker, I suggest, beats back..." [35] (p.88). Like Bloom, whose imagination actively reciprocates the city life, LaBelle notes that the city walker is not a passive receiver of audible cues, but also pre-empts and organises them, "beating back as a physical body" (ibid).

In 2011 the *I-Ulysses* project sought to represent the specifically aural features of Joyce's novel, in a format akin to LaBelle and DeCerteau's acoustic and psycho-geographical maps: specifically, as a video game experience, in which the user could experience the sounds of the novel, rendered in a realistic 3D spatial environment [36, 37, 38]. Similar projects had looked to represent the events in a format akin to a walking tour experience, but none had explored the use of *Virtual Reality* technologies to that end. At the time, the value of such a project was in use of smartphone technology, wherein a user could experience the game while walking around the actual setting of the book and an interplay of those elements was key to the experience, along with specific audio and aural cues. The format of the project took a similar format to the popular *Pokemon Go* 1(2014), but with more academic and serious learning trappings and predated the Nintendo game by a number of years.

Figure 1: Pokemon Go (all rights reserved)

At that time, creating a virtualised learning environment with a blend of real, virtual and augmented components was largely novel and experimental for typical teaching practice. However, with the onset of the Covid-19 pandemic, the need to create a virtual experience for a learning environment was pushed to the forefront to tackle obstacles of physical presence, raising the value of such a tool. Specifically, the integration of a psychologically realistic virtual environment, wherein spatial and audio cues could be presented and discussed in a social classroom setting, would be key and serve to create an immersive learning experience. This has vast implications also for the delivery of blended learning material and the curriculum as whole, which was an area the project explored comprehensively in respect of how the game could be used as a virtual classroom. What follows is a case study of such work, aiming to address issues raised in 2.

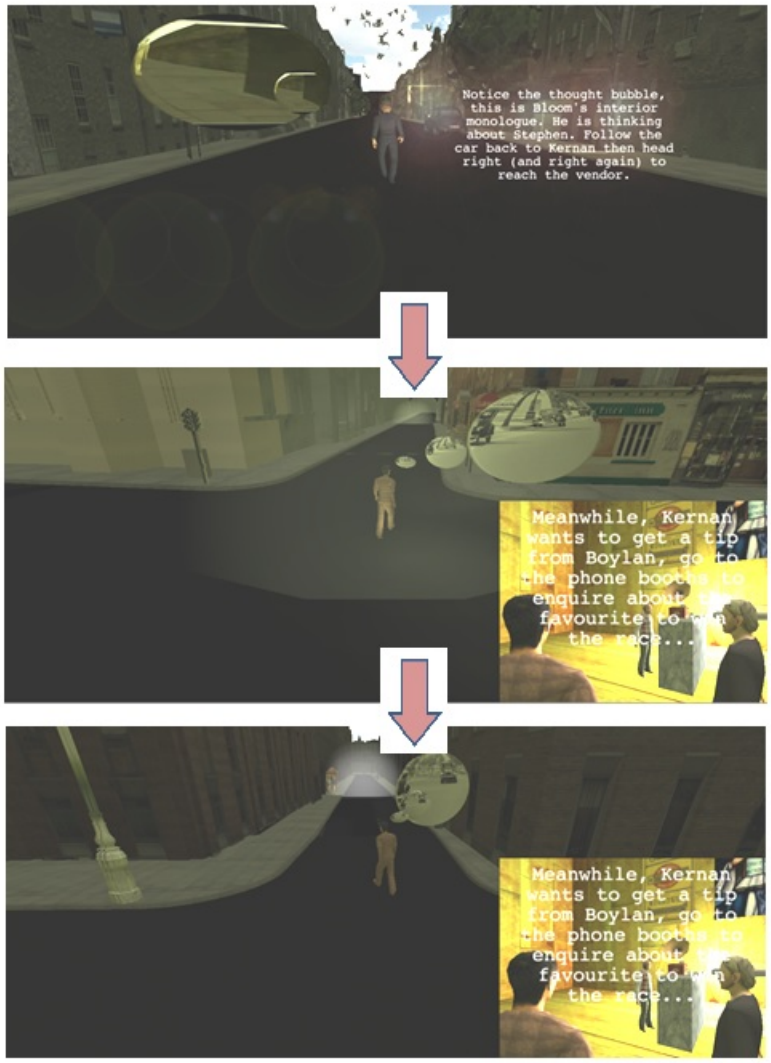

Figure 2: I-Ulysses:: the Game

3.2 Methodologies: Blended Learning

The central objective of this section is to show how the *I-Ulysses* educational model could be used in practice. This section utilises examples of teaching techniques and Randy Garrison's discussion of the operational and instructional tenets of the COI [39, 40] to discuss what blended learning is, what the *Community of Inquiry* (COI) is and how it serves as a practical framework for implementing a blended learning that addresses the issues in 2. Blended learning is a term that describes both a specific learning model in education and a model for developing ICT learning resources for classroom settings. This blended learning methodology is employed in an enhanced, interactive learning setting. Blended learning, like digital humanities, uses both teaching and humanities computing methodologies. Randy Garrison notes the popularity of the emerging blended learning methodology by outlining that it is an approach and design that merges the best of traditional and web-based learning experience to create and sustain vital communities of inquiry that many higher level institutions are quickly positioning themselves to harness for its transformational potentials [41].

The blended learning model is accompanied by an implementation framework known as the *Community of Inquiry* paradigm. The paradigm is used as a method to blend learning resources and materials together into an integrated, practical learning setting. Blending learning represents a unified framework, that merges the public and private worlds in a framework that avoids the confusion of separation into theory and practice [41]. The *Community of Inquiry* (COI) is a tripartite model divided into three categories, or presences of the learning and teaching method (Figure 3 & Table 1).

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These are the social presence, the teaching presence and the learning/cognitive presence. The COI serves as a means to practically implement the social and cognitive aspects of education studies in a blended learning context. Because the mediation and modality of a learning material represents a further dimension of its understanding, this has lent value to the use of ICT in classroom environments and in this case, the *I-Ulysses* project.

Garrison states that, "blended learning is more than enhanced lectures. It represents the transformation of how we approach teaching and learning. It is a complete redesign of the educational environment and the learning experience" [41] (p.6). Blended learning represents a potential model for implementing ICT in teaching practice. The COI seeks to implement an instrumental framework for that blended learning, where the use of ICT is innovative and not substitutive, focusing on how specific ICT tools can provide new understanding in participatory learning settings. The value of such paradigms in the context of the Covid-19 pandemic and specifically, in the case of *I-Ulysses*, is in being able to map a virtual environment and fold this into a virtual, online curriculum, delivered in a virtual, or partially virtualised, classroom.

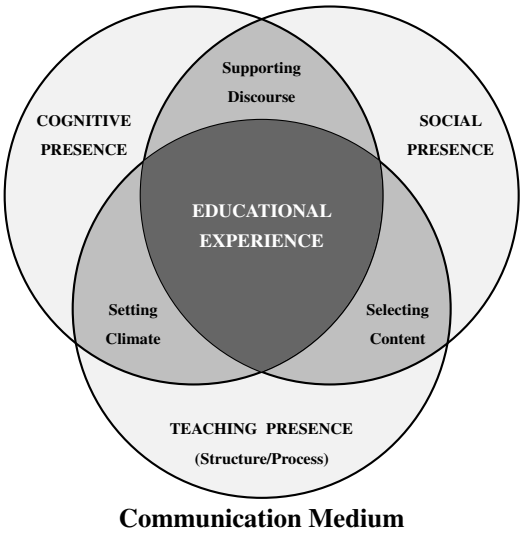

Figure 3: The community of inquiry Paradigm [41]

ELEMENTS	CATEGORIES	INDICATORS
Social Presence	Affective Expression	Emoticons
	Open Communication	Risk-free expression
	Group Cohesion	Encourage collaboration
Cognitive Presence	Triggering Event	Sense of puzzlement
	Exploration	Information Exchange
	Integration	Connecting ideas
	Resolution	Apply new ideas
Teaching Presence	Design & Organisation	Setting curriculum & methods
	Facilitating Discourse	Sharing personal meaning
	Direct Instruction	Focusing discussion

Table 1: The COI [41]

Blended learning is a participatory learning model that combines educational theory, curriculum and humanities computing. The blended learning model's ICT-invested approach is similar to the analytical and 'synthetic' models of Patrick Svenson, Susan Hockey, Matthew Kirshenbaum and Willard McCarty [42, 43, 44]. Their *Digital Humanities* philosophy employs ICT in an instrumental humanities framework. The philosophy underpinning blended learning involves a similarly holistic and instrumental dimension. The research of academics working in education theory and

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digital humanities is transferred between the fields, whilst also yielding new research models for working with digital practice-based scenarios.

Garrison also notes that one of the main areas where blended learning enables new understanding is in distance learning, or providing remote classroom environments where tutors are encouraged to thoughtfully integrate face-to-face and online learning and fundamentally rethink course design to optimise student engagement [41]. Garrison concludes that this crossover with distance learning is not the only benefit that ICT can afford the classroom, but that it is central in a learning format in which, verbal, visual and aural information is communicated and disseminated electronically. As Garrison notes, "Blended learning recognises the strengths of verbal and text-based communication and creates a unique fusion of synchronous and asynchronous, direct and mediated modes of communication" (p.6). The *I-Ulysses* project uses specific curriculum testing scenarios developed by Garrison [39, 40].

3.3 Critical Paradigms: the Arranger and the Blended Learning Model

In this section several aspects of the blended learning methodology will be related to the specific methodology employed in the *I-Ulysses* project. Aspects of Joyce's work shall be discussed and the COI will be used as a model to examine and interrogate the methodology employed in the project, with reference to Section 2. The concept of the *Arranger*[45], an idea from Joyce studies, will be noted as an analogue to a number of the aforementioned concepts, and will be discussed after the tenets of the COI are established.

The first tenet of the COI is the social presence. The social aspects of online learning represent a significant dimension of the COI and the blended learning methodology. As discussed before, Garrison notes that one of the central capabilities that ICT learning enables is the creation of remote classrooms and distance learning. Joyce studies has undergone a dramatic shift towards online media in recent years, as Joyce social and academic networking has a significant online presence. With the ability to communicate and share information directly, manuscript studies and archival research are now being conducted in a predominantly electronic format, evidenced by the *James Joyce Collection of the University at Buffalo*, which holds most of the archive materials relating to Joyce, moving all of its materials online. The movement of manuscript work into an online setting has had an important effect for Literary studies, namely that the academic discussion of the original work has also shifted online in response. Many of Joyce's larger works are read in reading groups and in a reading group the social presence is a key factor. In terms of the virtual classroom setting, there is a natural fit for reading literature together in groups and connecting that setting to a literary online community.

The second tenet of the COI is the cognitive presence. Joyce encourages a reader to conceptualise and deconstruct meaning in a self-reflexive and recursive fashion. Joyce's works have an open-meaning structure, with the possibility of a variety of different, hypertextual interpretations. Each interpretation can be organised into a hierarchy of individual associations and meanings. Joyce's interior monologue technique portrays an individual's inner thoughts and embeds them within the wider array of collected experiences. With the use of ICT it is possible to sustain a network of meaning in a way that does not privilege one reading. It is possible to organise and structure these meanings within a hypertextual framework that can propagate new understanding. An online classroom is also reflective of collective experience and verbal communication in a wider, electronically-enabled setting. With digital media tools it becomes possible to explore the visual and aural dimensions of Joyce's work and to connect them to *Ulysses* hypertextual structure. This gives the class the added benefit of seeing the techniques used in practice, while connecting them to the higher networks of meaning from the book; fulfilling the cognitive tenet of the COI.

The final tenet of COI is the teaching presence. The *I-Ulysses* project provides a learning guide to *Ulysses* that is interactive and can be studied as part of a Joyce course, or English curriculum, that complements audio-visual resources and references and supports the effort of the teacher in the classroom. In the *I-Ulysses* environment, when the user interacts with the environment they do so in a manner that takes them through the physical space of Dublin virtually, while simultaneously exploring the threads of *Ulysses'* narrative in the environment. This has the added benefit for the tutor that when they focus in on a specific aspect of the text and environment, they do not disrupt the overall flow of the environment for the students. In this way the *I-Ulysses* project preserves the instructional and operational frameworks of the blended learning model, while making the experience of using the environment a participatory experience.

The many threads of meaning in *Ulysses* correspond to nodes or juncture points of meaning; Joyce provides a topographical overview of Dublin whilst conveying a complex arrangement of events through the presence of an *Arranger* [46]. In the *I-Ulysses* project, the teaching presence of the COI mediates the *Arranger* presence and the teacher in the classroom has the objective of conceptualising the *Arranger* for the class, using illustrative scenarios from the environment. Examples of these scenarios will be noted shortly and the areas of intersection between the blended learning methodology, the COI and the *I-Ulysses* project are shown below in table 2.

As part of the project, the author undertook an *Enterprise Ireland* sponsored feasibility study in 2014 to assess the value of spinning the project out into a commercial start-up. During this process some valuable resources were developed

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Tenet of COI	Description	Implementation in *i-Ulysses*
Social Presence	Use of social media, reading groups and classroom setting	Offering the possibility for a wider engagement with *Ulysses* in a virtual format, involving several participants and complementing reading the book aloud in a classroom/reading group setting
Cognitive Presence	Developing curriculum that encourage formation in a recursive manner, with respect to the structural and cognitive aspects of learning, use of ICT to facilitate this bridge of meaning	Use of links in the environment, drawing the user's attention to use the *interior monologue* of meaning technique, the multi-linear structure of the novel and connections between key events and characters
Teaching Presence	The role of the teacher in facilitating meaningful learning interactions	Equating the teaching presence/designer of the environment with the*arranger* of the text, the layered level design of the environment mirroring *Ulysses*' multi-linear storyline

Table 2: I-Ulysses COI Framework Overlap

to assist in developing the marketing and distribution platforms of the environment. Some of the content developed for the feasibility is of direct relevance to this section, particularly areas of resource management in an e-learning curriculum, which Garrison points out as being a topic of the blended learning framework [41]. One of these resources was a promotional *Facebook* page that linked to a survey about the project. The page is used here as an example of an e-learning resource that could be useful to a tutor using the environment in an educational context. In its current format the page shows images and videos from the environment, but could be expanded into a more diverse range of formats, including maps, reading materials, interviews with scholars, other linked data images, music and recordings of the book being read. Focus groups, interviews, surveys and seminars were also organised, via this platform and a survey was hosted there, using the *Survey Monkey* platform.

Figure 4: Promotional Materials

The tutor would draw student's attention towards Joyce's use of the interior monologue technique to focus on the experience of different characters by going inside their stream of consciousness. The tutor would discuss each of these presences and have the students read through the book, as characters from the novel. After they played through relevant segments of the environment they could later go online, consult the relevant section of the website and discuss what

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they had learned in class that day. Each of the relevant presences in the text would refer to a specific waypoint in the environment and break down the significant themes and tabs in the interior monologue section.

The class could look up the relevant headings in the interior monologue tab, which the tutor or students in the class could regularly update. The involvement of the group in this manner creates a learning community, which can tap into already vast online resources devoted to Joyce. This functionality complements features from the environment; for example, embedded in the environment is a recording of *The Croppy Boy*, a representation of a gramophone, footage of the *Royal Ascot Cup* and images of *Gentleman Jim Corbett* from Patrick Dignam's interior monologue, forming a multi-media resource. Each *Waypoint* from the environment refers to a specific theme or technique from the book and the imagery and sound effects can support the structure of set learning themes in a way that complements the environments key screens. Obviously, the capacity for exploring the physical locations noted in a virtualised environment, is of value to those who cannot physically attend those locations, but also the network of information hosted in such a format adds considerable value to the VLE.

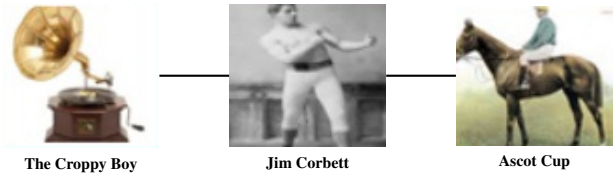

Figure 5: Story Nodes

Key aspects of the character, such as their motives, what the specific character was thinking and giving clues as to why they may think in a particular way draws attention to the different character's points of view and uses multi-linear storytelling techniques. Examples of such story nodes can be seen in Figures 5 & 6. The key to Joyce's use of the monologue is the joining together of different characters' points of view. By hosting these elements in a network that the student can easily visualise as part of the key screen, it makes the format of the book easier to understand and creates a cognitive link between the space of the environment and the themes of the book.

In *Ulysses*, the *Arranger* [46] gives hints and clues as to its presence: subtle alterations in Joyce's use of the style that he developed, the interior monologue and examples of this were noted in the use of the pigeon sound and the operation of the record machine. The *Arranger* is an analogue for Joyce, the designer and architect of *Ulysses*, connecting ideas and motifs together in a hyperlinked order. The techniques that Joyce employed naturally lend themselves to an electronic learning context. The presence of the *Arranger* organises the narrative into different strands and builds the story around an assumption that the reader will follow the narrative pattern, trying to learn more about *Ulysses* by solving its puzzles.

The designer of the environment is comparable with the novelist, as they are trying to visualise the narrative through connecting sound and spatial geometry in a way that illuminate its presence as the narrative architect of the text. With use of game development tools the separation of the different narrative strands through use of context-sensitive thought bubbles and multiple views through the same space meaningfully enhance participatory engagement with *Ulysses*. The ability to provide imagery, music, dialogue and hyper-linked content can facilitate the *Community of Inquiry* paradigm of the blended learning methodology. For example, maps and illustrations can be linked with the environment (Figure 7) and it becomes possible to provide actual examples of Joyce's use of sound effects and his use of technological tropes as storytelling devices.

Specific examples of relative technology, such as the trams, the gramophone and phone conversations are provided in a spatial setting, facilitated through use of the game. Key points where this technology fits into and complements the other techniques, such as the use of the interior monologue and switching between characters, can be structured in a way that complements the experience of reading the novel. With the addition of the virtual format, the user gets to see the relevant scenarios unfolding in real-time as they play them, while not having to worry about physical location. Thus, linking back to the discussion in Section 2, the *Arranger* becomes an excellent analogue for both Joyce, the architect of the VLE and the teaching presence: mediating and interlineating those presences into a workflow, complementing the social dimensions of participatory learning with a VLE.

4 Conclusions

This paper sought to provide a review of the literature in the area of teaching pedagogy, specifically the use of audio-visual technologies and VR, contrasted through a case study providing a retrospective analysis of the *I-Ulysses Virtual Learning Environment*. As argued, the Covid-19 pandemic has necessitated a new approach to learning and teaching materials, with a focus on dissemination through increasingly technologically-focused formats. There had thus been a

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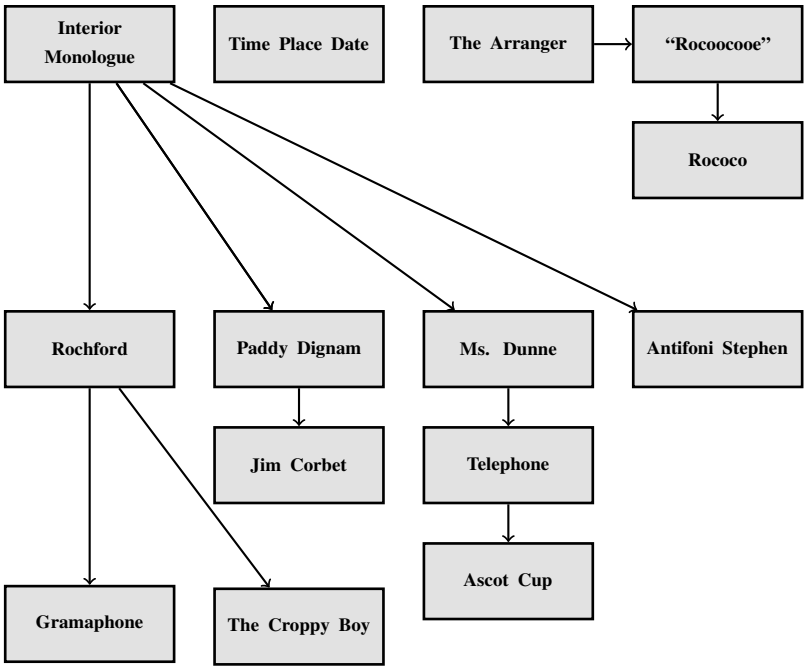

Figure 6: The Arranger

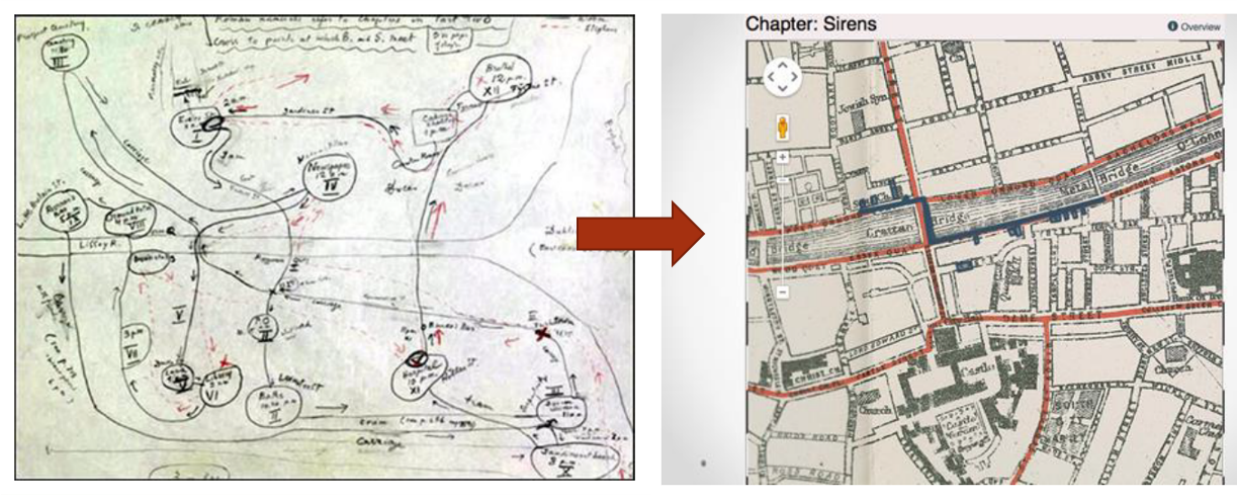

Figure 7: Maps and Illustrations [47]

need for more environments like *I-Ulysses*, which both consolidate blended learning frameworks and offer the potential for virtual environments, where access to location may be a concern, but also the teaching, social and engagement of participatory learning are enhanced. The intention in Section 2 was to set up the issues with such a technological delivery of a VLE and to suggest possible solutions and a template going forward, using the *I-Ulysses* project as a formative example, with integrative case studies focusing on its employment within a blended learning framework. As noted, the *I-Ulysses* environment has a distinct learning focus and combines this learning faculty with potentials offered by interactive game development media and the mediating presences of the blended learning COI. The *I-Ulysses* environment creates an immersive, interactive experience that can be a model for equivalent platforms in the post-Covid era.

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